4.12 NOISE AND VIBRATION

4.12.1 INTRODUCTION

Subsequent noise and vibration analysis has been prepared to incorporate additional field noise and vibration measurements, soil testing, updated modeling assumptions, updated land use information, preliminary engineering details, and design changes. Therefore, this section provides updated information on noise and vibration impacts for the entire project and then discusses specific design changes. The conclusions are supported by noise and vibration studies as noted in the text and bibliography.

4.12.2 ENVIRONMENTAL SETTING

A field survey of the land uses along the alignment was conducted to update locations of noise and vibration sensitive land uses. This new information was used in the quantification of noise and vibration impacts.

4.12.3 REGULATORY SETTING

The noise and vibration criteria were previously discussed in the FEIR. However, the FTA has published additional guidance for addressing transit noise and vibration (Federal Transit Administration, 2006). This recent guidance document was used in this analysis. The criteria for a general assessment of noise and vibration impacts have not changed. However, the vibration impact criteria for detailed analysis did change and is being applied to this SEIR.

4.12.4 PROJECT IMPACTS AND MITIGATION MEASURES

14.12.4.1 Line Segment (Warm Springs to Tunnel)

NOISE IMPACT

Subsequent noise analysis has been prepared to incorporate additional field noise measurement results, updated modeling, land use changes, preliminary engineering details, and design changes. The noise impacts have been compared to FTA noise criteria. A total of 132 ground level residences from Warm Springs to the tunnel entrance would be exposed to levels in excess of the FTA Criteria without mitigation (Wilson Ihrig & Associates Inc. [WIA], 2006a). This is based on the FEIR approved project. The SEIR options are discussed later in this chapter.

The number of residences impacted is higher than identified in the FEIR due to the increase in noise levels associated with concrete slab track, when compared to ballasted track, included into the noise analysis for places where floating slab track is the recommended vibration mitigation, the more detailed profile information (track elevation), which affects the noise reduction effectiveness provided by the existing sound walls, the addition of new residential development since preparation of the FEIR, and the updated number of multi-family residence units that would be exposed to BART train noise.

Table 4.12-1 identifies the noise impacts by station number and location. The type of land use is also identified. The existing ambient noise level, predicted noise level, increase in level, impact types, and recommended mitigation are provided.

TABLE 4.12-1:

Projected Baseline Cumulative Noise Levels for Line Portion

CIVIL STATION	RECEIVER LOCATION ADDRESS (# and TYPE)	TRACK DIR	SPEED (MPH)	DISTANCE FROM NEAR	TRACK TYPE	EXISTING AMBIENT LDN	PREDICTED CUMULATIVE NOISE LEVELS WITH MITIGATION			
							TOTAL LDN (dBA)	LEVEL INCREASE (dBA)	IMP. TYPE	RECOM MIT.
180+60 to 182+00	Park Homes at Mayfield Warm Springs Blvd (1 Multi-family)	NB	67	132	FST	57	63	5.7	MI	(1)
182+50	Spinnaker Point Apartments (1 Multi-family)	NB	67	38	FST	57	63	6.2	MI	(1)
189+50 to 191+00	Spinnaker Point Apartments (2 Multi-family)	NB	67	42	FST	59	64	4.9	MI	(1)
246+00 to 247+00	Berryessa St (1 Single-family)	SB	67	230	AG	59	63	3.9	MI	(2)
247+00 to 248+50	Berryessa St (2 Single-family)	SB	67	255	AG	59	63	3.7	MI	(2)
248+50 to 250+50	Berryessa St (3 Single-family)	SB	67	280	AG	59	63	3.6	MI	(2)
330+00 to 332+50	Parc Metropolitan Condos (1 Multi-family)	SB	67	340	FST	60	62	2.4	MI	(9)
332+50 to 336+00	Parc Metropolitan Condos (4 Multi-family)	SB	67	94	FST	60	63	3.2	MI	(9)
413+50	North Star PL (1 Single-family)	NB	67	95	AG	58	64	5.7	MI	(1)
417+00	Country Brook Apt's, Canal Wy (1 Multi-family)	NB	67	150	AG	58	63	4.9	MI	(1)
424+00	1897 Flickinger Ave (1 Single-family)	NB	67	55	AG	56	62	6.4	MI	(1)
424+50	1891Flickinger Ave (1 Single-family)	NB	67	57	AG	56	62	6.3	MI	(1)
424+50 to 426+50	Flickinger Ave (3 Single-family)	NB	67	53	AG	56	62	6.1	MI	(1)

CIVIL STATION	RECEIVER LOCATION ADDRESS (# and TYPE)	TRACK DIR	SPEED (MPH)	DISTANCE FROM NEAR	TRACK TYPE	EXISTING AMBIENT LDN	PREDICTED CUMULATIVE NOISE LEVELS WITH MITIGATION			
							TOTAL LDN (dBA)	LEVEL INCREASE (dBA)	IMP. TYPE	RECOM MIT.
427+00	1861Flickinger Ave (1 Single-family)	NB	67	67	AG	56	62	6.4	MI	(1)
427+50	Flickinger Ave (1 Single-family)	NB	67	65	AG	56	62	6.5	MI	(1)
427+50 to 437+50	Flickinger Ave (18 Single-family)	NB	67	50	AG	56	62	6.5	MI	(1)
438+50 to 439+50	Flickinger Ave (2 Single-family)	NB	67	65	AG	56	62	5.6	MI	(1)
449+50 to 450+00	Silvertree Dr (1 Single-family)	NB	67	50	FST	58	63	5.3	MI	(3),(8)
450+00 to 451+00	Silvertree Dr (2 Single-family)	NB	67	70	FST	58	63	5.4	MI	(3),(8)
451+50	Silvertree Dr (1 Single-family)	NB	67	63	FST	58	63	5.4	MI	(3),(8)
462+50 to 464+00	Gordy Dr (3 Single-family)	SB	67	72	FST	56	62	6.3	MI	(8)
464+00 to 465+00	Gordy Dr (2 Single-family)	SB	67	80	FST	56	62	5.7	MI	(8)
471+00 to 473+00	Gordy Dr (5 Single-family)	NB	67	48	FST	56	62	6.1	MI	(8)
473+00	Gordy Dr (1 Single-family)	NB	67	32	FST	56	63	6.6	MI	(8)
471+50 to 478+50	Rue Avati (11 Single-family)	NB	67	43	FST	56	62	6.1	MI	(8)
478+00 to 480+00	Rue Avati (3 Single-family)	SB	67	75	FST	56	62	6.1	MI	(8)
476+50 to 478+50	Tersini Ct (4 Single-family)	SB	67	44	FST	56	62	6.5	MI	(8)
480+00	Prelude Dr (1 Single-family)	SB	67	55	FST	56	61	5.4	MI	(8)
480+50 to 484+00	Prelude Dr (7 Single-family)	SB	67	37	FST	56	62	6.2	MI	(8)
496+00 to 497+00	Briar Creek (2 Single-family)	SB	67	33	FST	57	63	6.0	MI	(4)
497+30	Briar Creek (1 Single-family)	SB	67	60	FST	57	63	6.0	MI	(4)
499+50 to 500+50	Rose Briar Wy (2 Single-family)	NB	67	43	FST	57	63	5.9	MI	(1), (8)
500+50	Rose Briar Wy (1 Single-family)	NB	67	53	FST	57	63	5.5	MI	(1), (8)

CIVIL STATION	RECEIVER LOCATION ADDRESS (# and TYPE)	TRACK DIR	SPEED (MPH)	DISTANCE FROM NEAR	TRACK TYPE	EXISTING AMBIENT LDN	PREDICTED CUMULATIVE NOISE LEVELS WITH MITIGATION			
							TOTAL LDN (dBA)	INCREASE LEVEL (dBA)	IMP. TYPE	RECOM MIT.
500+70 to 502+00	Rose Briar Wy (2 Single-family)	NB	67	53	FST	57	63	5.5	MI	(1), (8)
501 + 90	Rose Briar Wy (1 Single-Family)	NB	67	35	FST	57	63	6.1	MI	(1), (8)
502+30	Rose Briar Wy (1 Single-family)	NB	67	53	FST	57	63	5.5	MI	(1), (8)
502+50 to 507+00	Rose Briar Wy (9 Single-family)	NB	67	47	FST	57	63	5.9	MI	(1), (8)
503+35	Rose Briar Wy (1 Single-family)	NB	67	33	FST	57	63	5.8	MI	(1), (8)
498+00 to 499+30	Royal Crest Dr (2 Single-family)	SB	67	37	FST	57	63	6.1	MI	(2), (8)
499+30 to 500+00	Royal Crest Dr (2 Single-family)	SB	67	37	FST	57	63	5.6	MI	(2), (8)
500+00 to 501+70	Royal Crest Dr (4 Single-family)	SB	67	37	FST	57	63	5.6	MI	(2), (8)
501+80	Royal Crest Dr (1 Single-family)	SB	67	37	FST	57	63	5.8	MI	(2), (8)
502+20 to 503+50	Royal Crest Dr (3 Single-family)	SB	67	35	FST	57	63	5.8	MI	(2), (8)
504+00	Valley Crest Dr (1 Single-family)	SB	67	25	FST	57	63	6.1	MI	(2), (8)
505+50 to 507+30	Aschauer Ct (5 Single-family)	SB	67	43	FST	57	63	5.9	MI	(2), (8)
510+00 to 511+50	Taida St, Berryessa Villa (2 Multi-family)	NB	67	66	FST	57	63	6.1	MI	(1)
511+50 to 513+00	Taida St, Berryessa Villa (2 Multi-family)	NB	67	90	FST	57	63	5.6	MI	(1)
513+50 to 515+00	Winston Ct, Berryessa Villa (1 Multi-family)	NB	67	50	FST	60	64	4.4	MI	(5)
516+00 to 516+50	Heavenly Bamboo Ct, Regency Park (1 Multi-family)	NB	67	30	FST	60	65	4.6	MI	(5)
517+00	Fern Pine Ct (1 Multi-family)	NB	67	28	FST	60	64	4.1	MI	(5)
518+50	Fern Pine Ct (1 Multi-family)	NB	67	25	FST	60	64	4.4	MI	(5)
518+50	Fern Pine Ct (1 Multi-family)	NB	67	140	FST	60	64	3.7	MI	(6)

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
MI Moderate Impact
FST Floating Slab Track on Embankment or At-Grade
NI No Impact as defined by Federal Transit Administration.

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) Top of retaining wall on Embankment, north side of BART track (13 ft from track centerline)
(6) Bridge sound wall, north side of BART track (10 ft from track centerline)
(7) Bridge sound wall, south side of BART track (10 ft from track centerline)
(8) Sound Absorptive Material
(9) UPRR at-grade sound wall, south of UPRR track (16 feet from track centerline)

Source: WIA, Inc. 2006a

The UPRR yard lead track relocation would result in an increase of about 1 dBA in the existing ambient noise for approximately 70 residences located on the west side of the alignment. However, the increase in noise levels due to both the UPRR relocation and SVRT Projects are expected to be at a level that is either Moderate Impact or No Impact depending on the receptor. Therefore, no noise mitigation is required. Two exceptions were found for six single-family residences located on Berryessa Street and two multi-family buildings located at the Parc Metropoiltan Condominium complex for which the increase due to both Projects is expected to result in Severe Impact and therefore noise mitigation is needed. In terms of the benefits of implementing a grade separation, the existing area of impact due to UPRR trains and warning horns at the Dixon Landing crossing includes residences at the Spinnaker Apartments and at the Mobile Home Park. Eliminating warning horns from trains, would limit the area of impact to be within the UPRR right-of-way.

The SVRT Project also impacts residences with second or higher floors. This is a result of the existing sound walls and other features that provide noise mitigation only for ground floors. A total of 425 residential units in 281 buildings on the second or higher floor are projected to be impacted.

NOISE MITIGATION

Sound walls are the recommended noise mitigation for residences impacted by the BART operations north of the tunnel. Table 4.12-2 indicates the location of recommended sound walls. The approximate length of sound walls needed is 9,100 linear feet. The sound walls range in length from 150 to 1,730 feet long. 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 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 4.12-1a through 4.12-1u.

see Table 4.12-2 >>

TABLE 4.12-2:

Recommended Baseline Noise Mitigation for Line Portion

CIVIL STATION BEGIN	CIVIL STATION END	SIDE OF TRACK	HEIGHT(feet)	LENGTH (feet)
180+50	184+00	S2	7	350
188+50	192+20	S2	8	370
246+50	250+60	S1	4	410
330+00	337+50	S1	12 (*)	750
412+50	423+00	S2	6	1050
423+00	440+30	S2	7	1730
447+50	452+30	S2	10	480
470+00	475+00	S1	12	500
495+00	506+00	S1	10 (**)	1100
499+40	506+00	S2	10 (**)	660
506+00	508+00	S1	8 (**)	200
506+00	507+50	S2	10 (**)	150
507+50	512+00	S2	9	450
512+00	515+50	S2	8	350
515+50	521+00	S2	4	550

S1- Southbound Track
S2- Northbound Track
(*) Sound Wall part of UPRR Relocation Project
(**) Absorptive Sound Wall

Source: WIA, Inc. 2006a

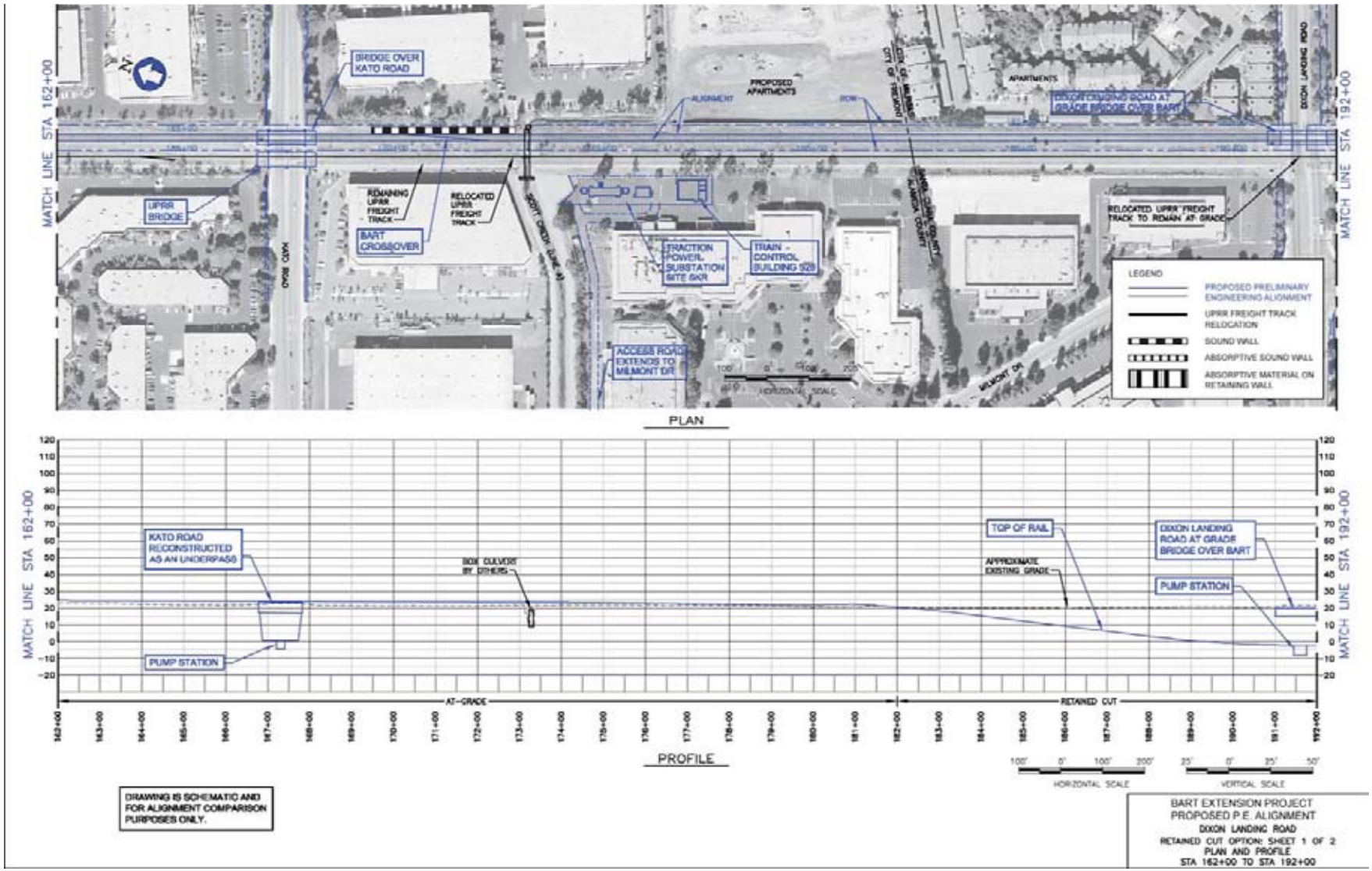

Figure 4.12-1a Noise Mitigation for Line Portion

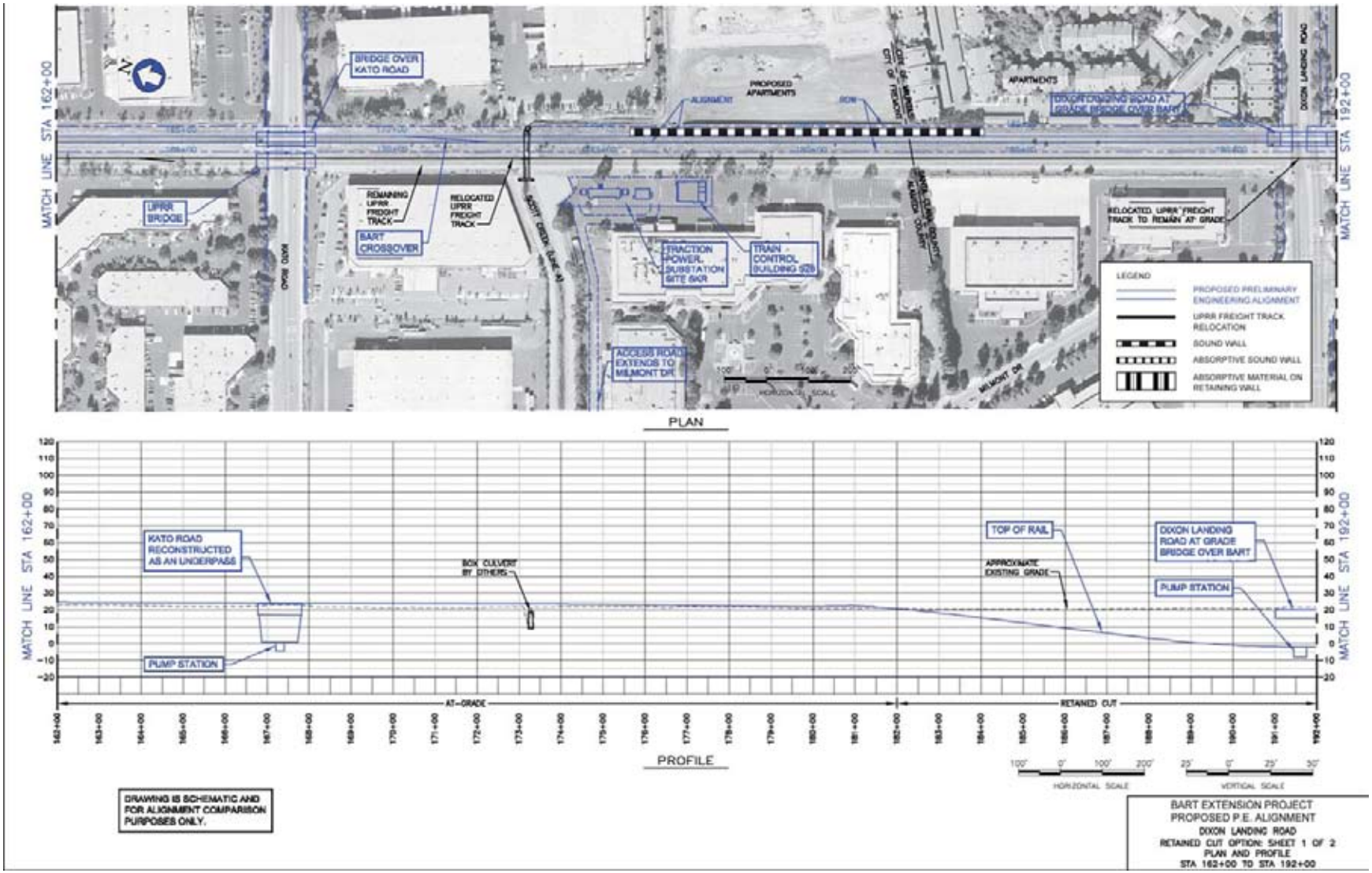

Figure 4.12-1b Noise Mitigation for Line Portion

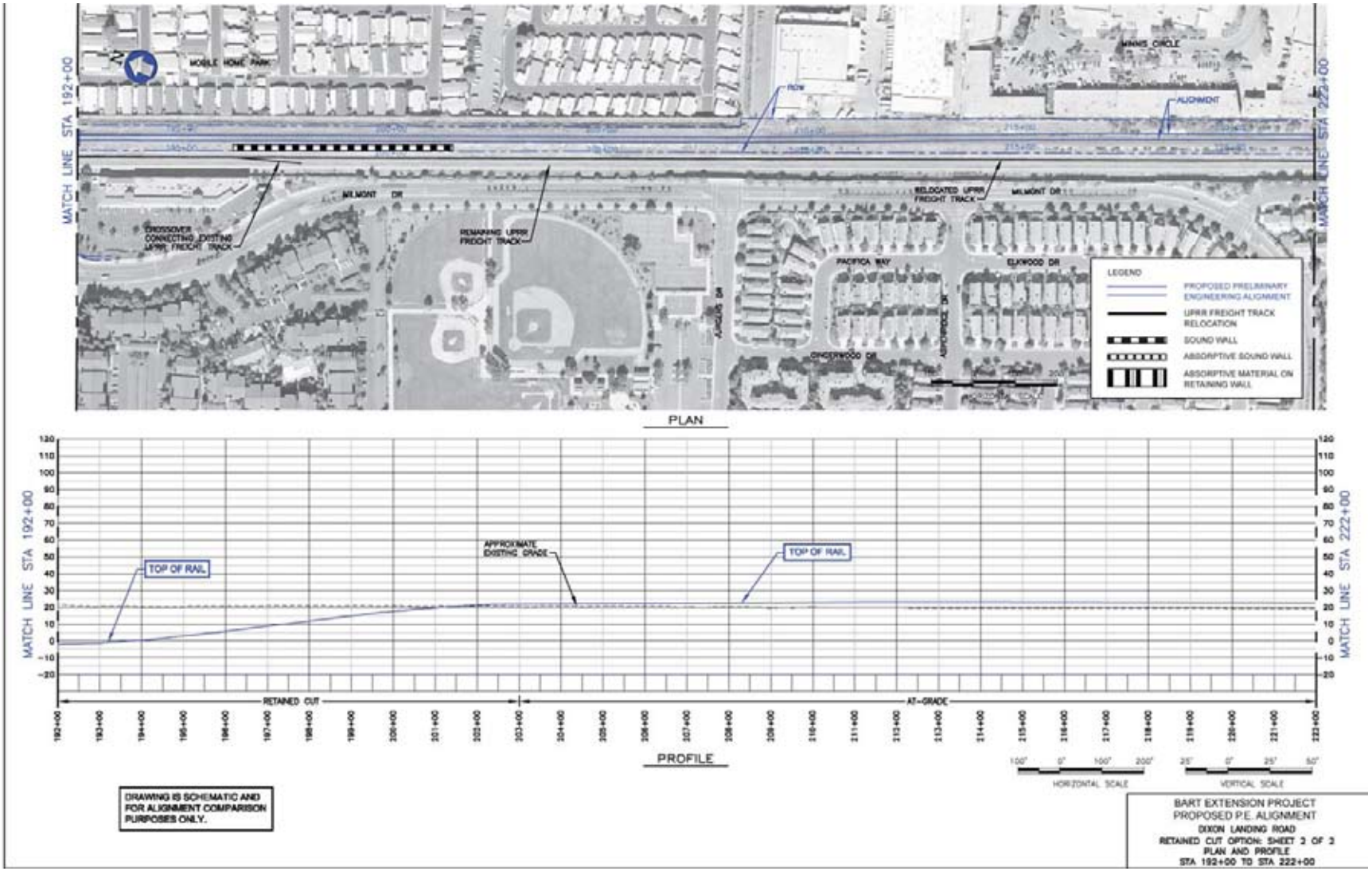

Figure 4.12-1c Noise Mitigation for Line Portion

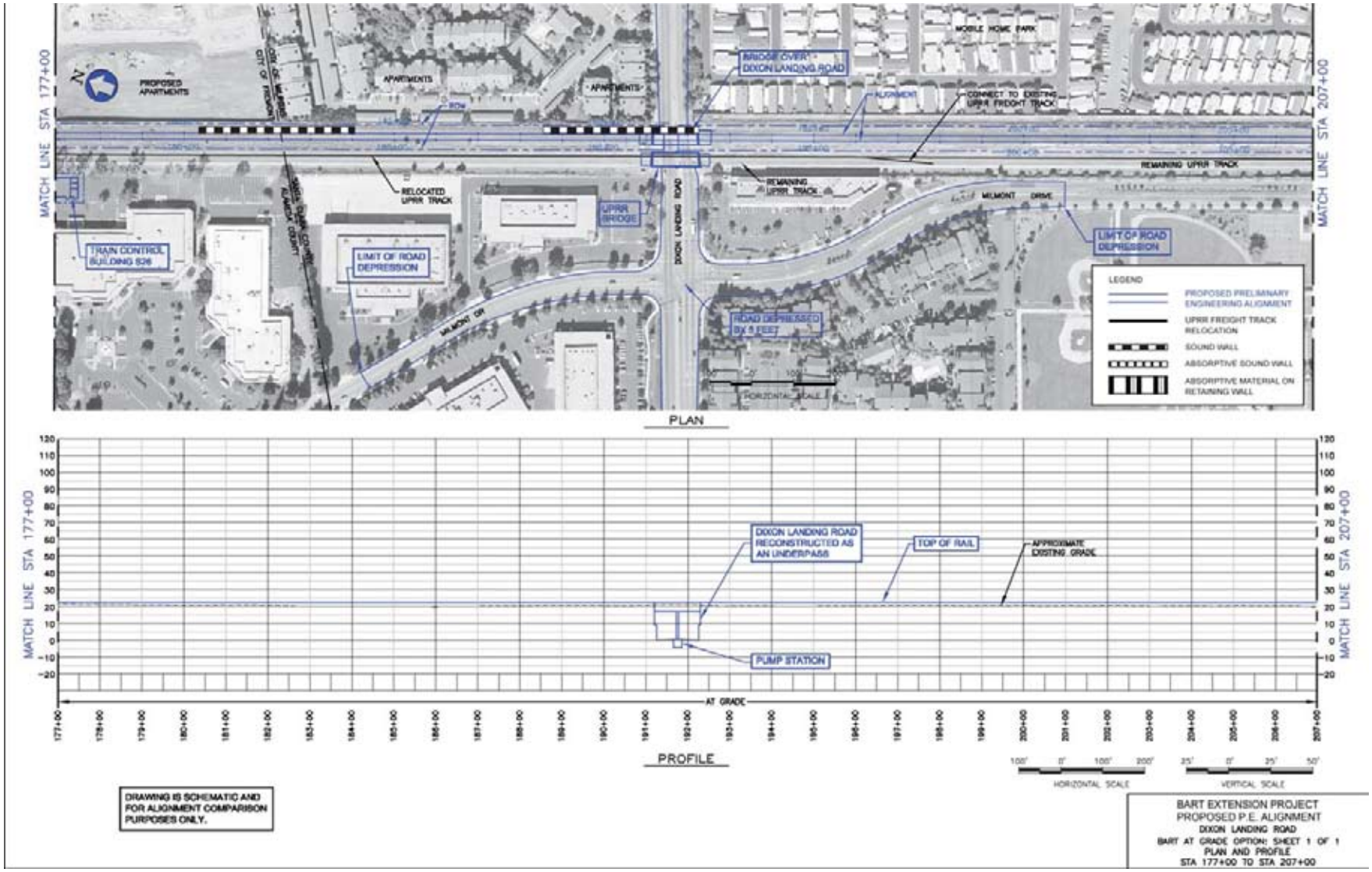

Figure 4.12-1d Noise Mitigation for Line Portion

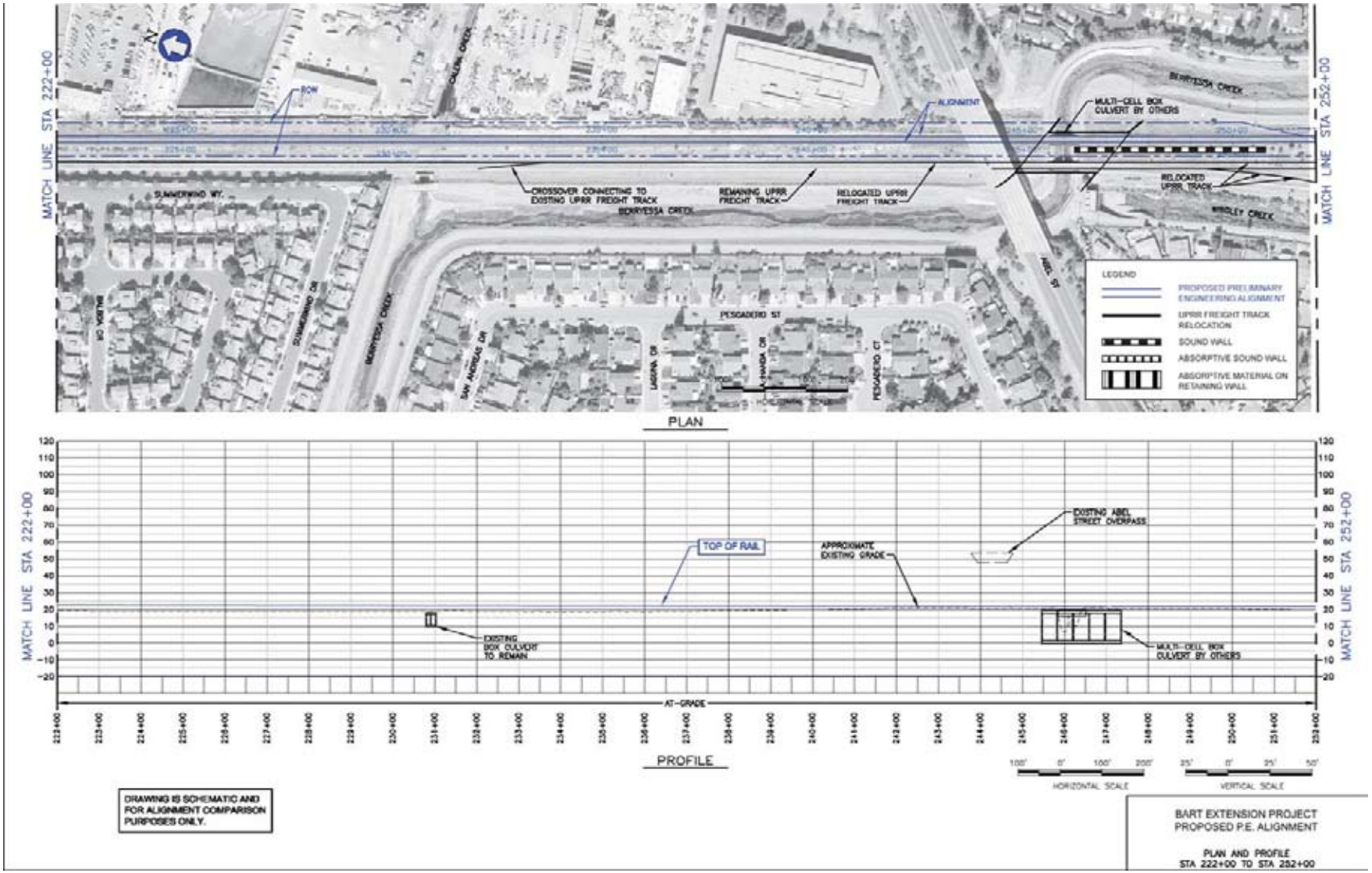

Figure 4.12-1e Noise Mitigation for Line Portion

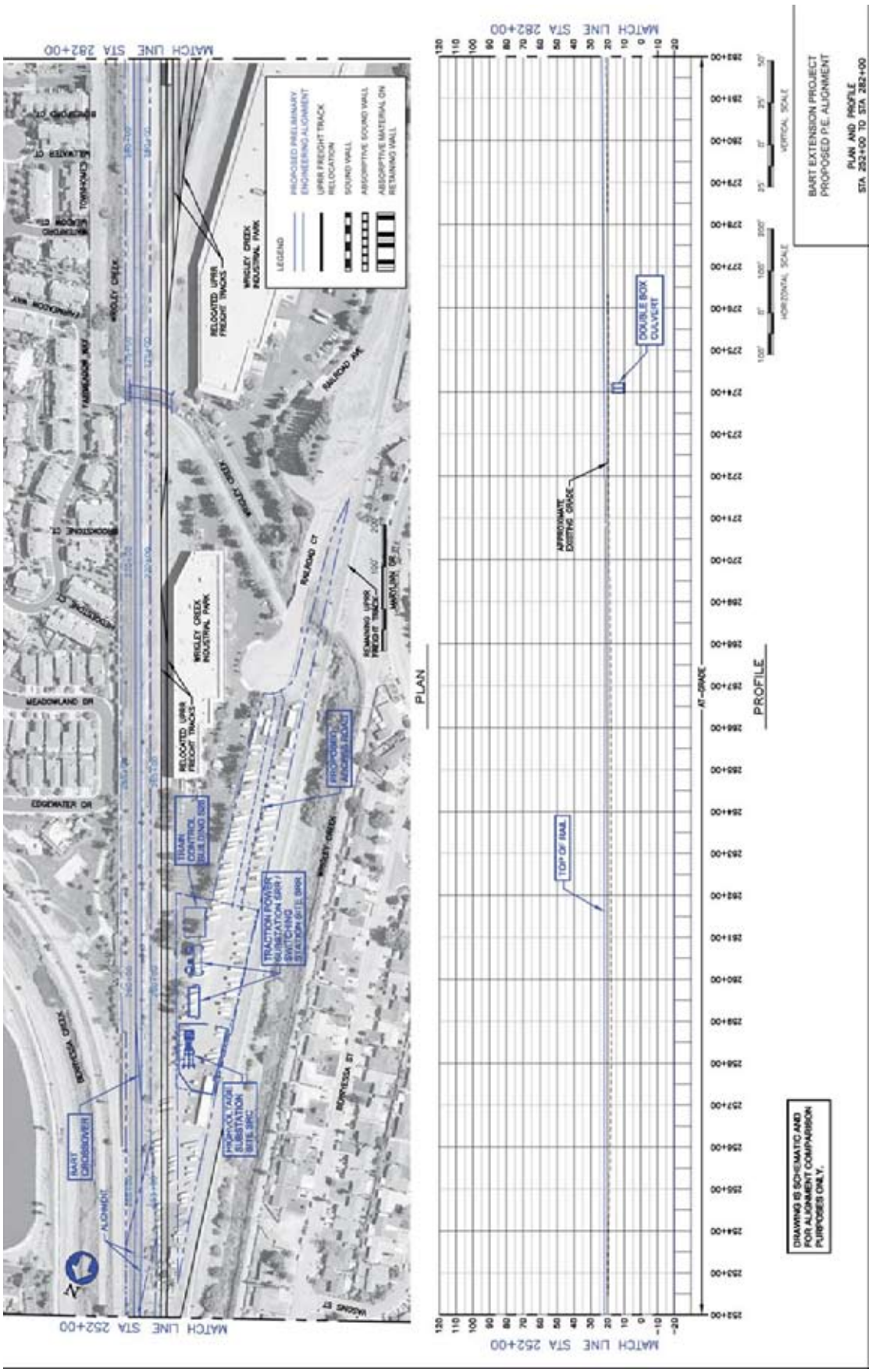

Figure 4.12-1f Noise Mitigation for Line Portion

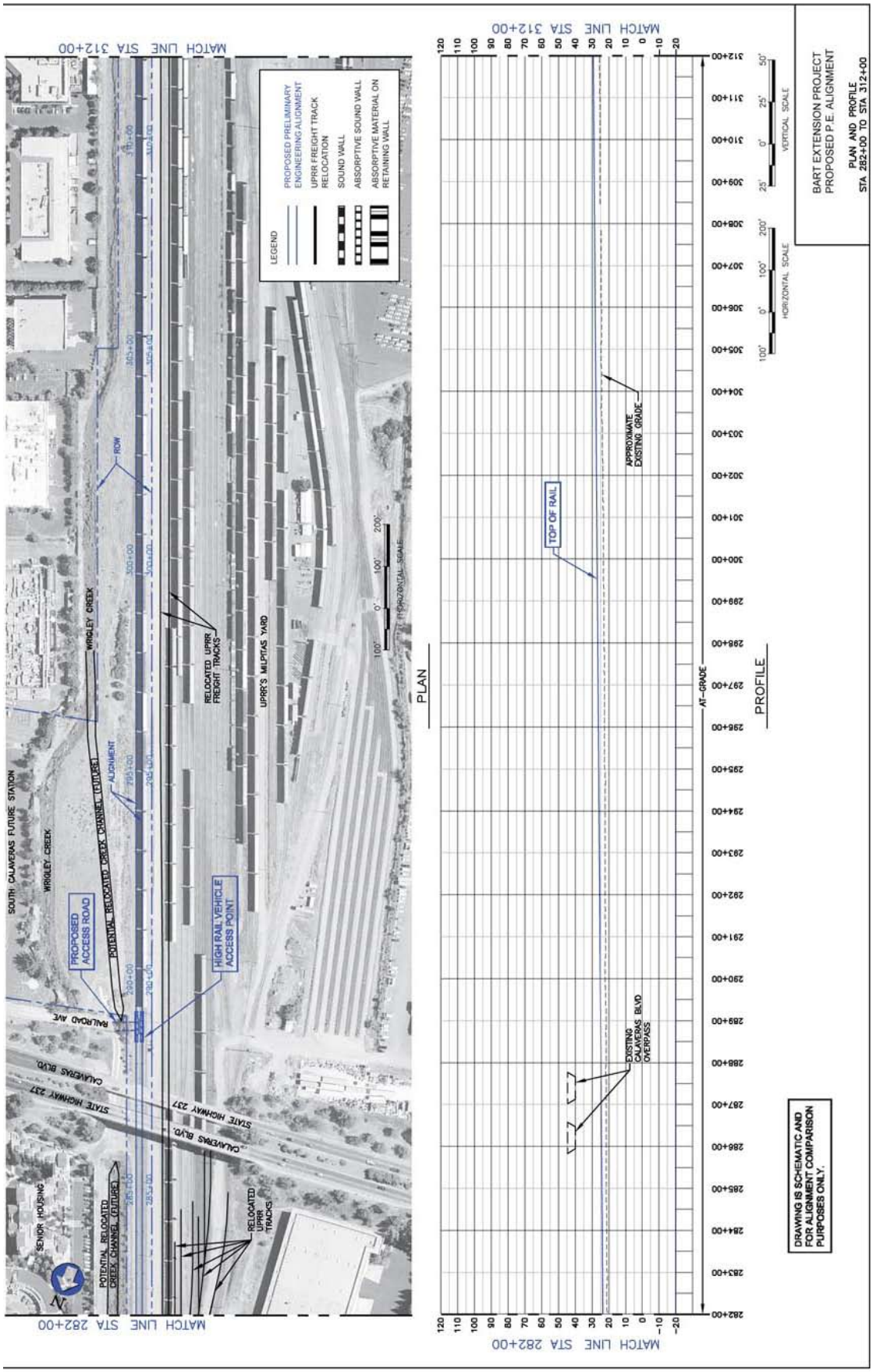

Figure 4.12-1g Noise Mitigation for Line Portion

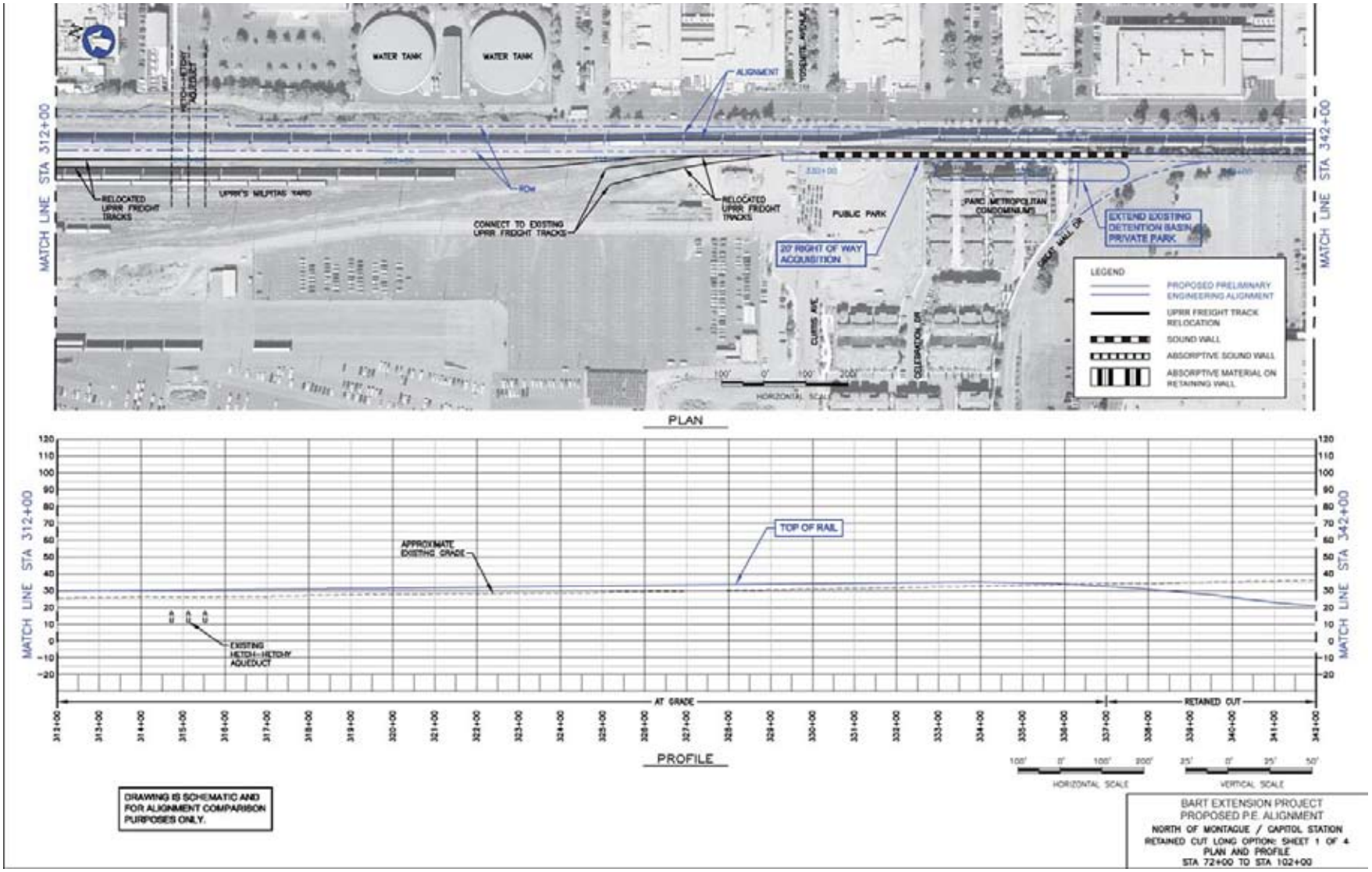

Figure 4.12-1h Noise Mitigation for Line Portion

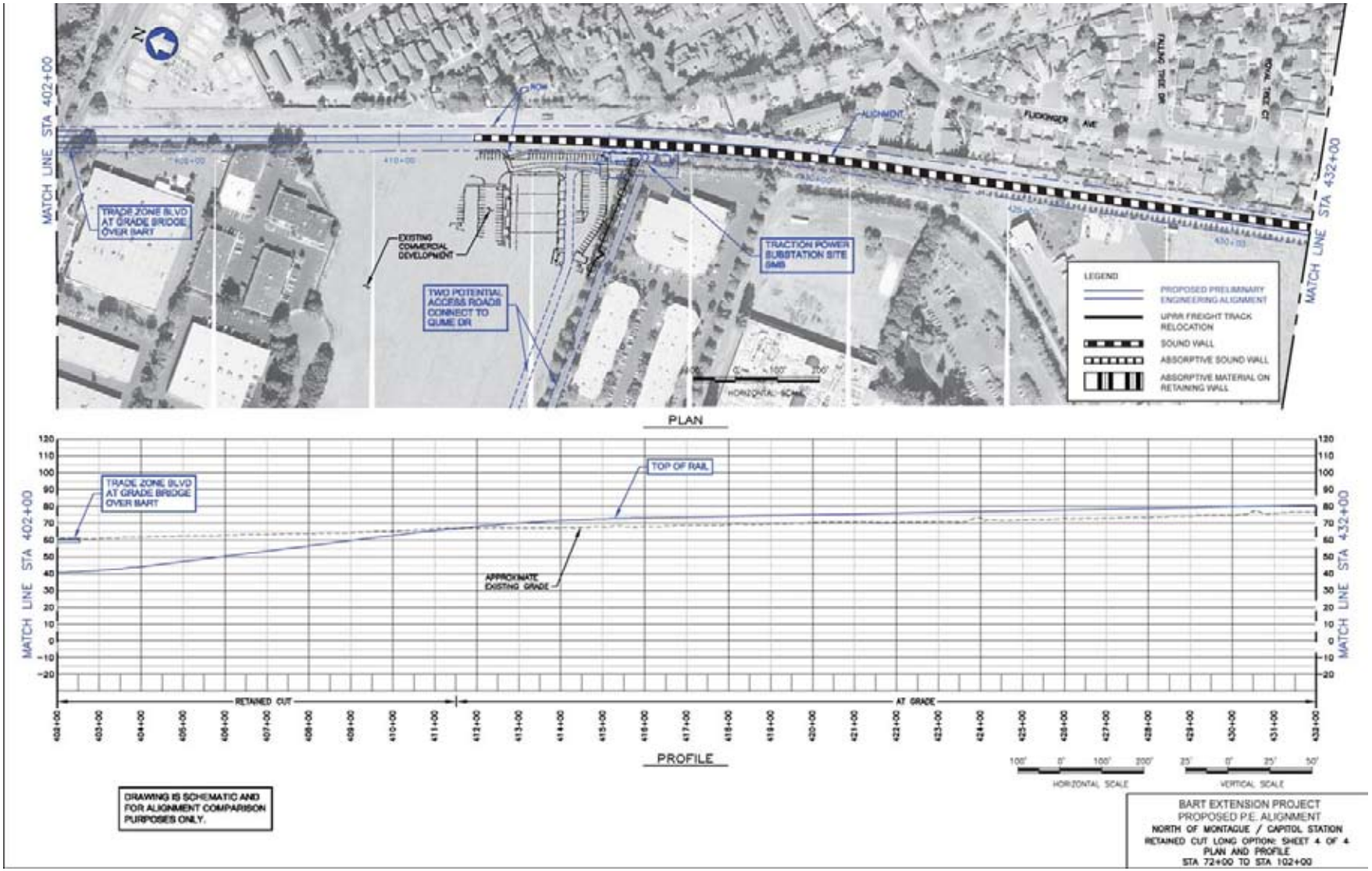

Figure 4.12-1i Noise Mitigation for Line Portion

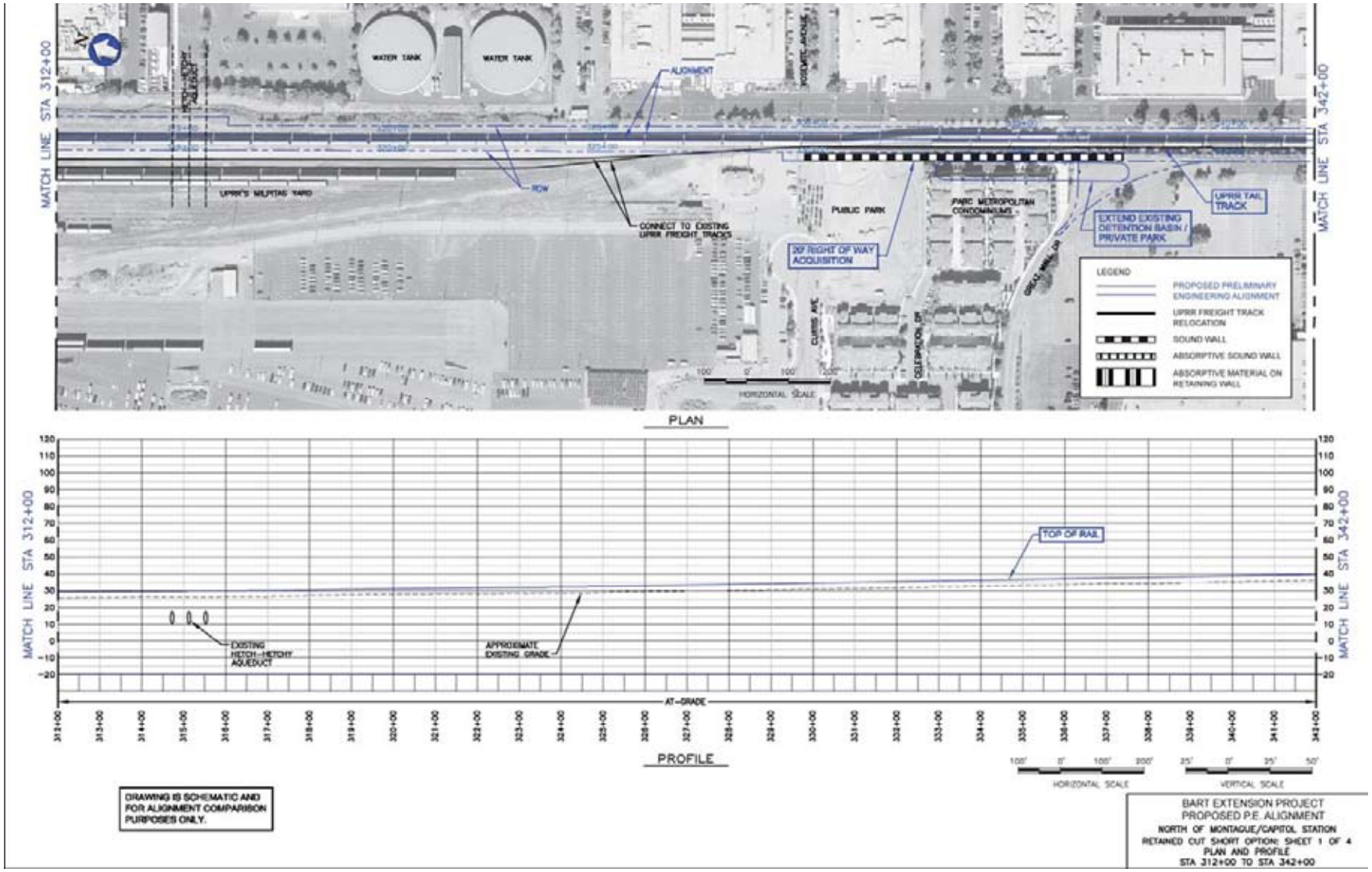

Figure 4.12-1j Noise Mitigation for Line Portion

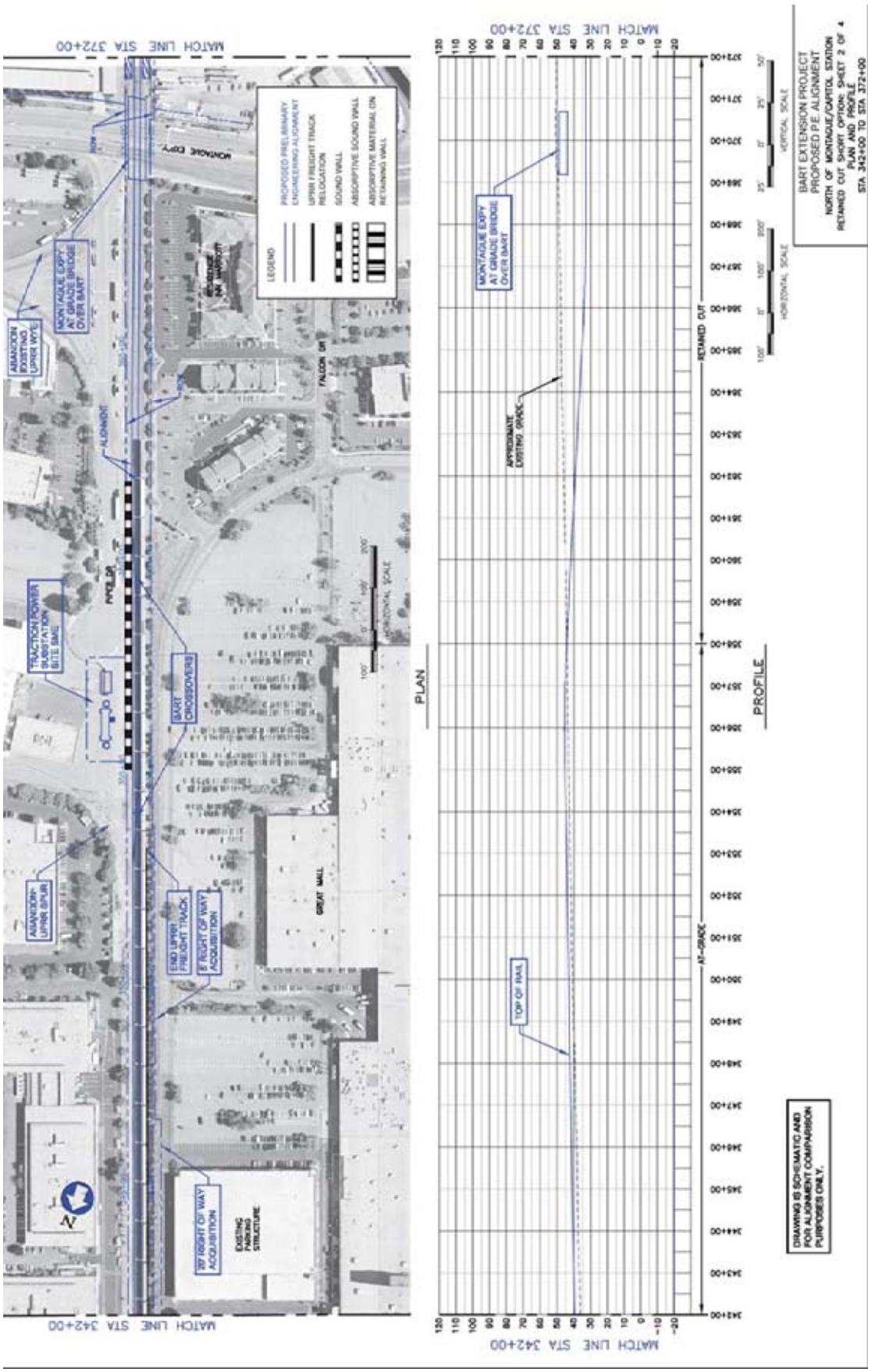

Figure 4.12-1k Noise Mitigation for Line Portion

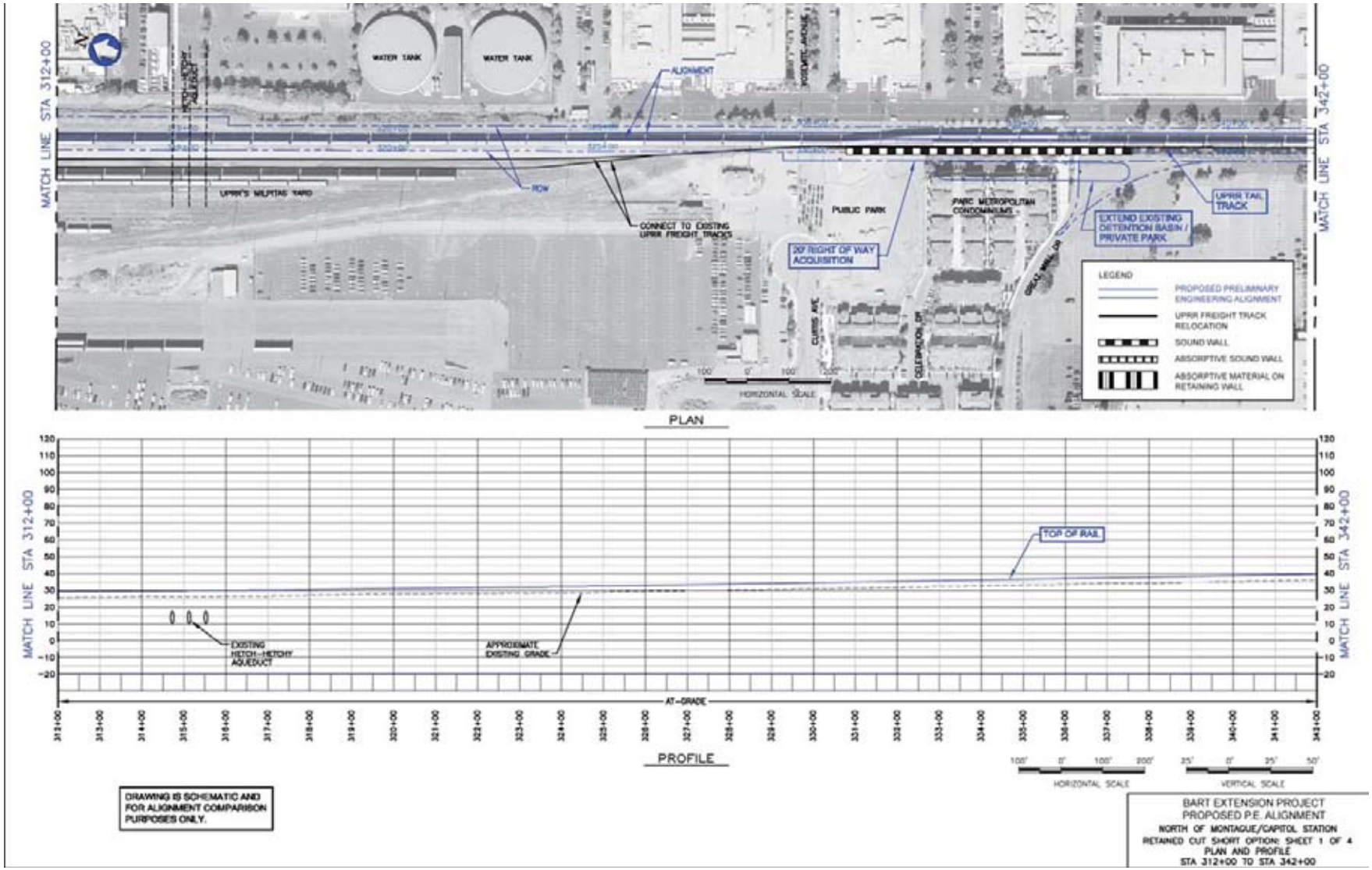

Figure 4.12-11 Noise Mitigation for Line Portion

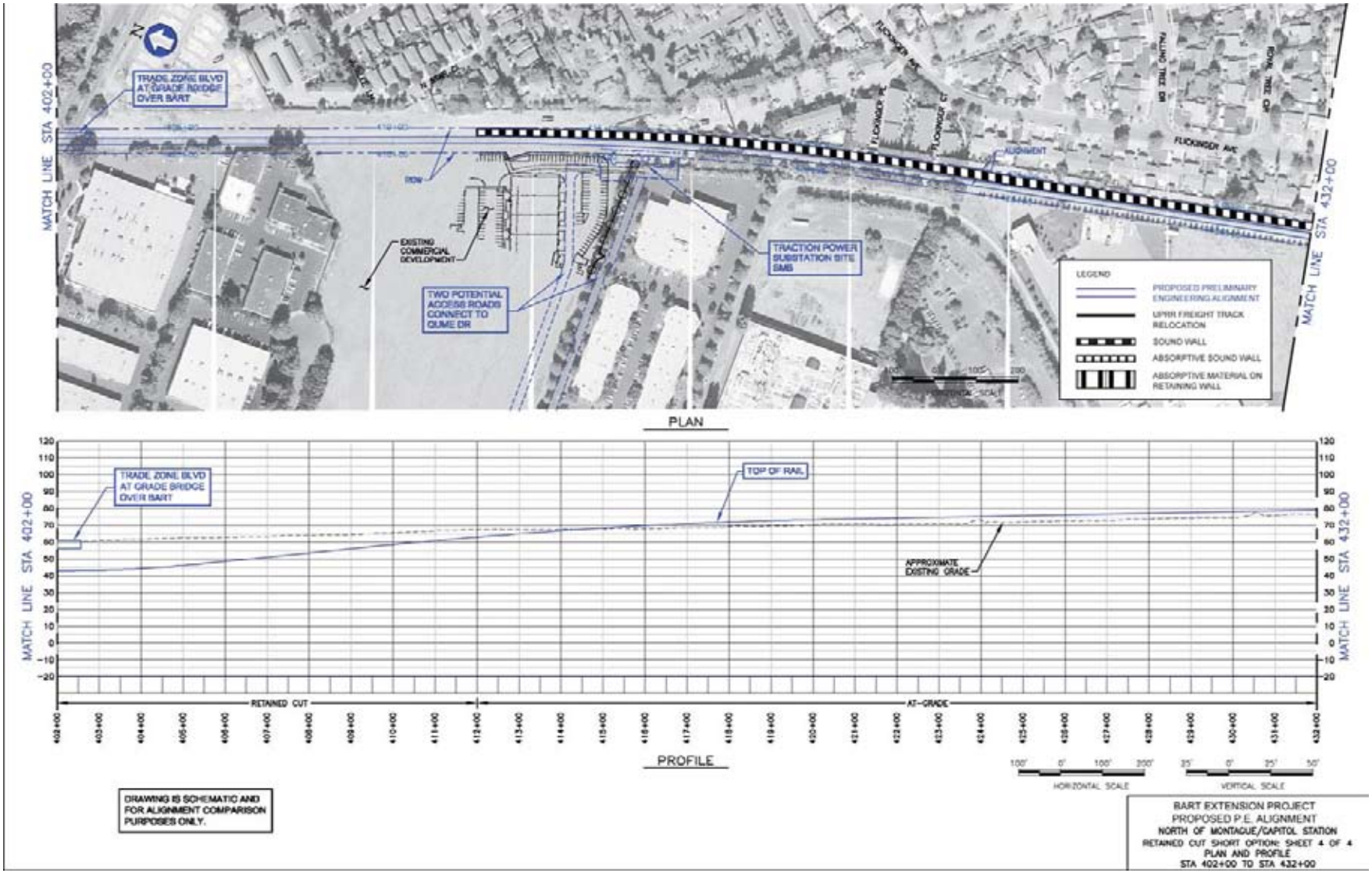

Figure 4.12-1m Noise Mitigation for Line Portion

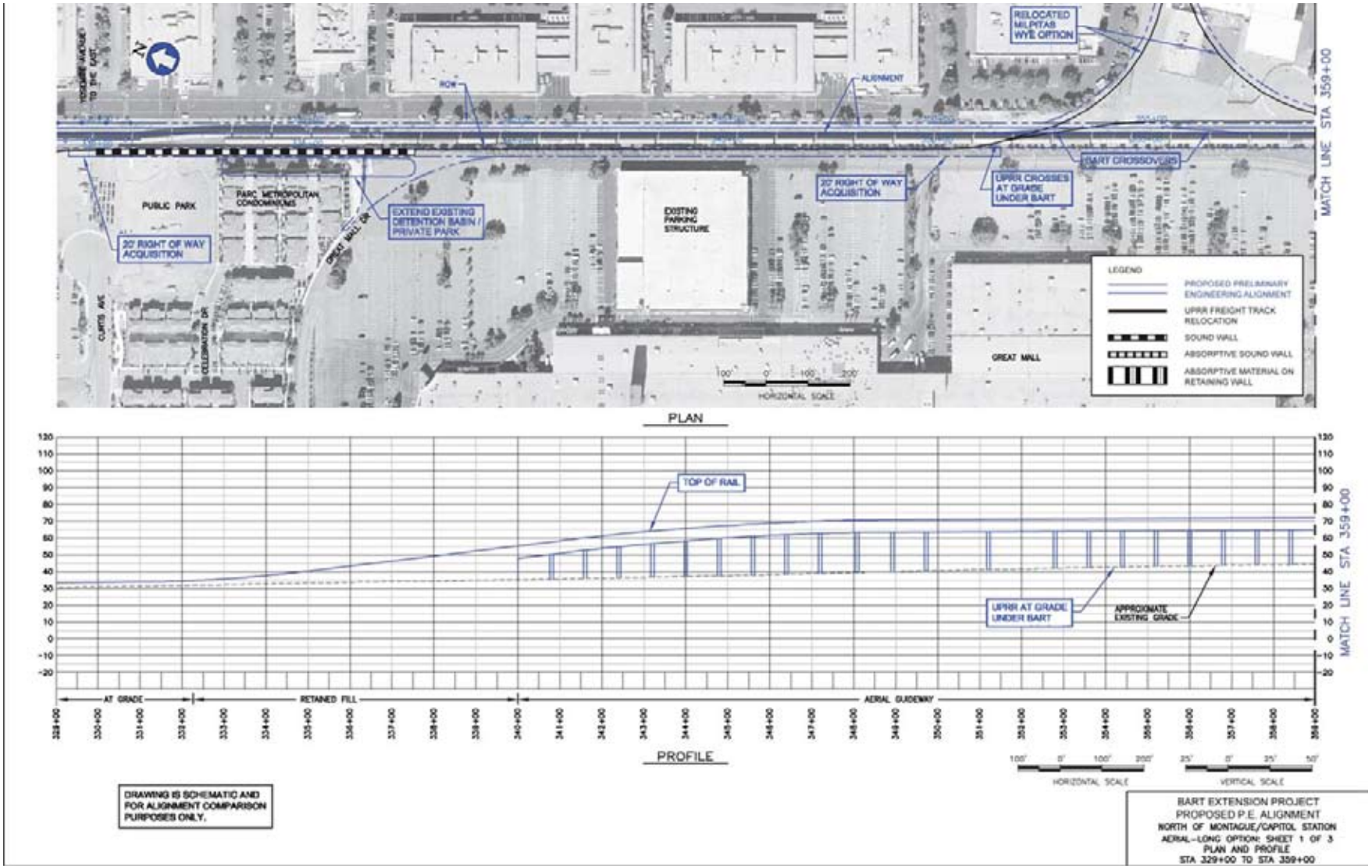

Figure 4.12-1n Noise Mitigation for Line Portion

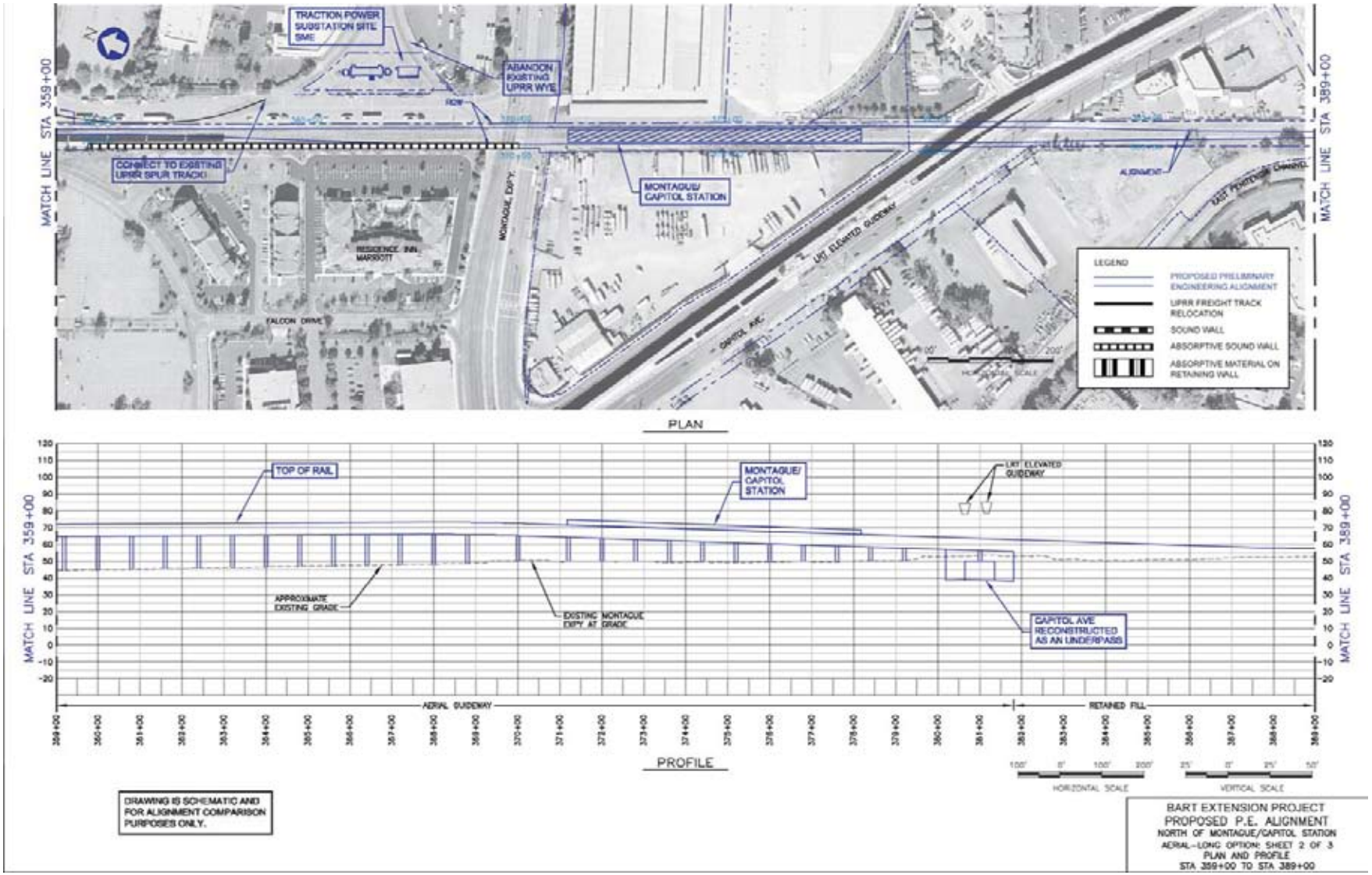

Figure 4.12-1o Noise Mitigation for Line Portion

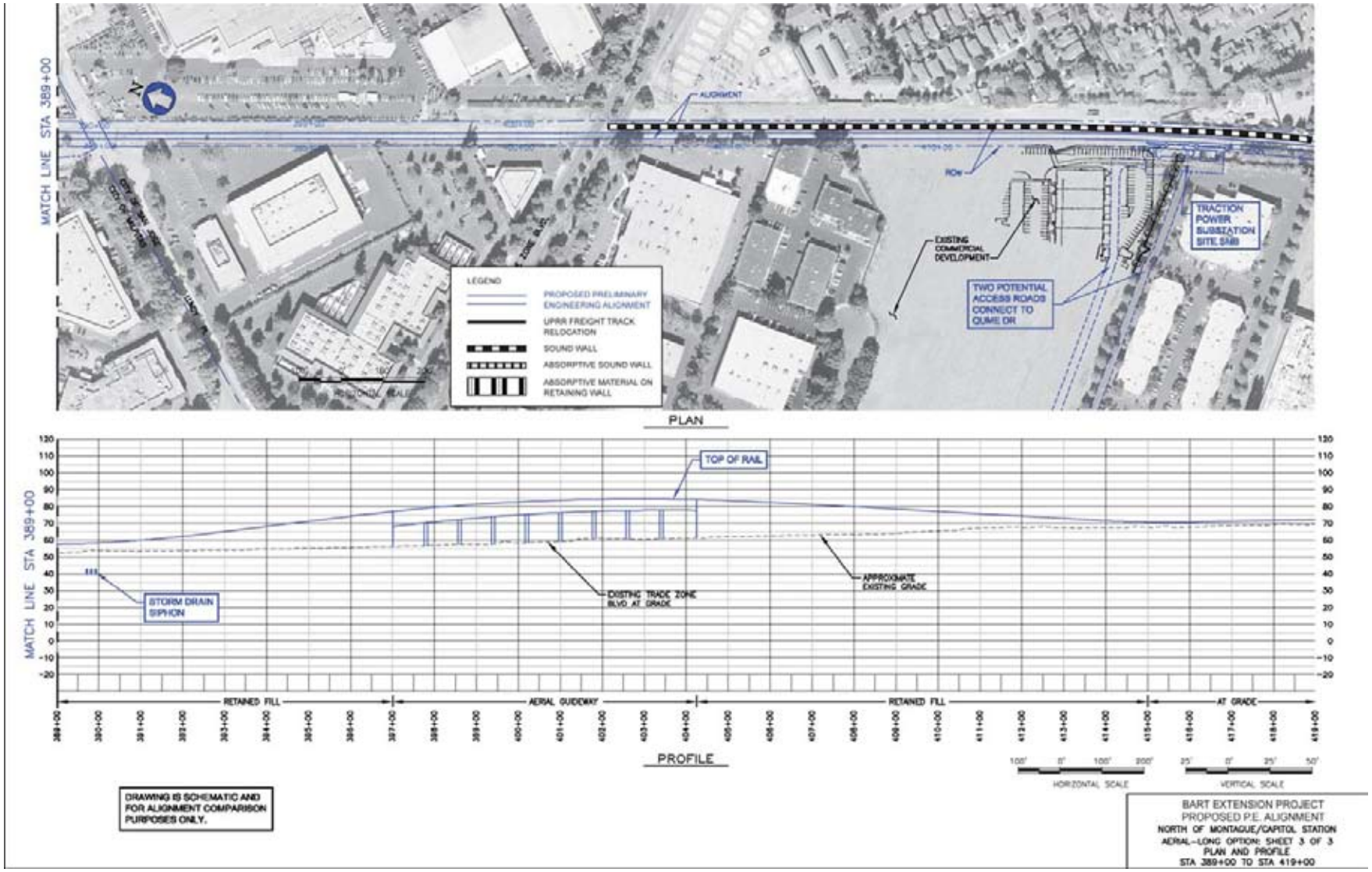

Figure 4.12-1p Noise Mitigation for Line Portion

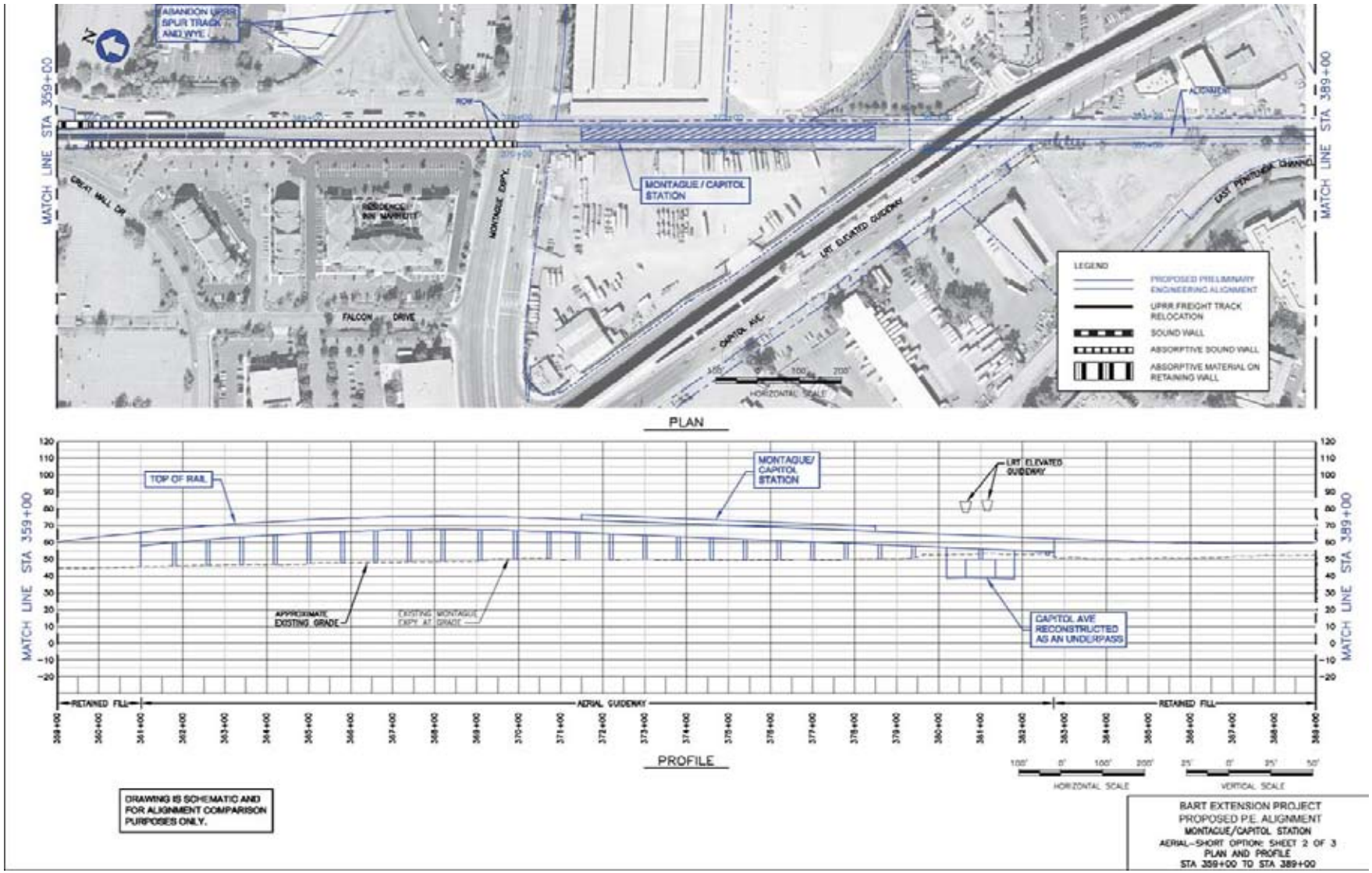

Figure 4.12-1q Noise Mitigation for Line Portion

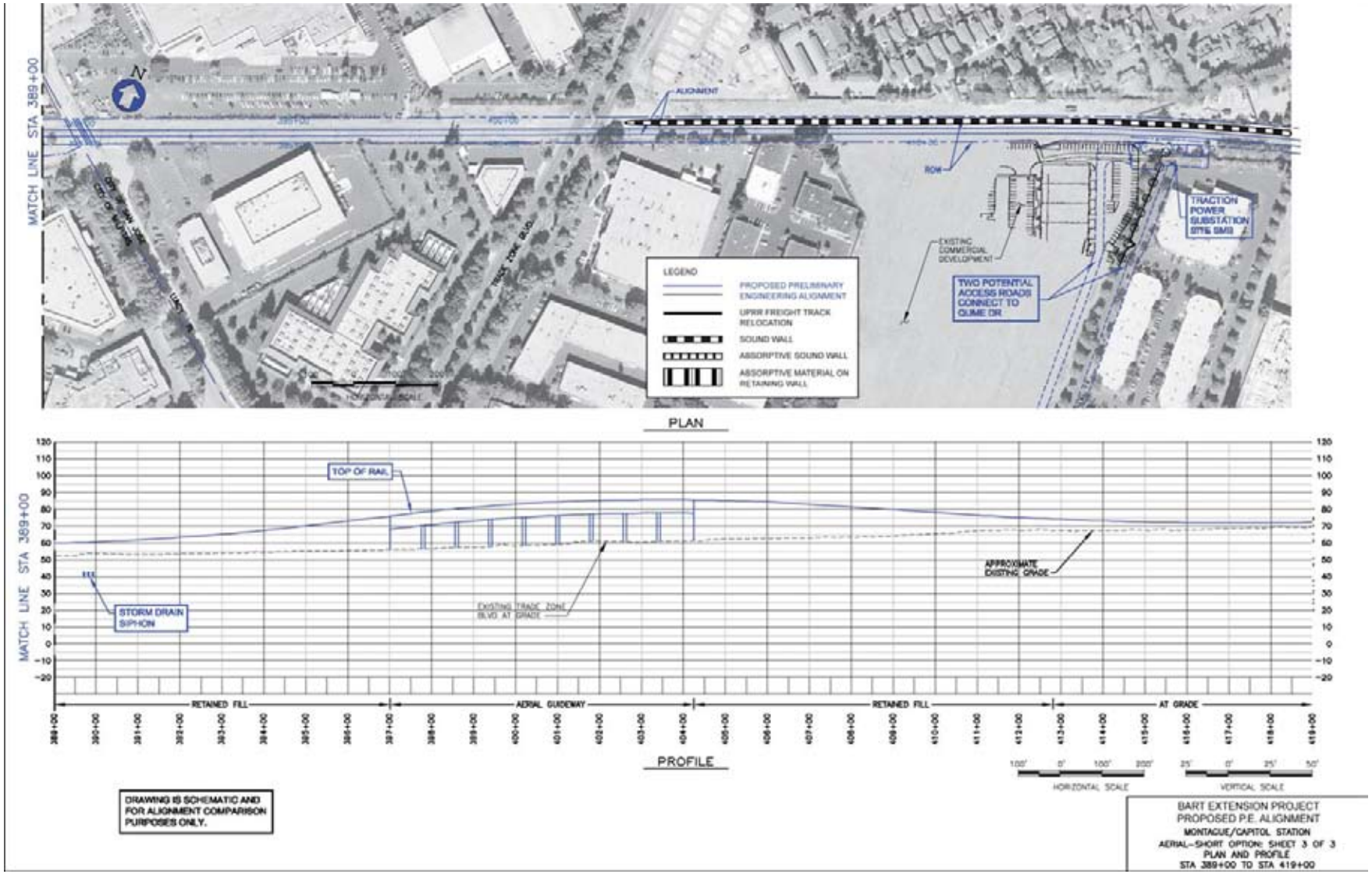

Figure 4.12-1r Noise Mitigation for Line Portion

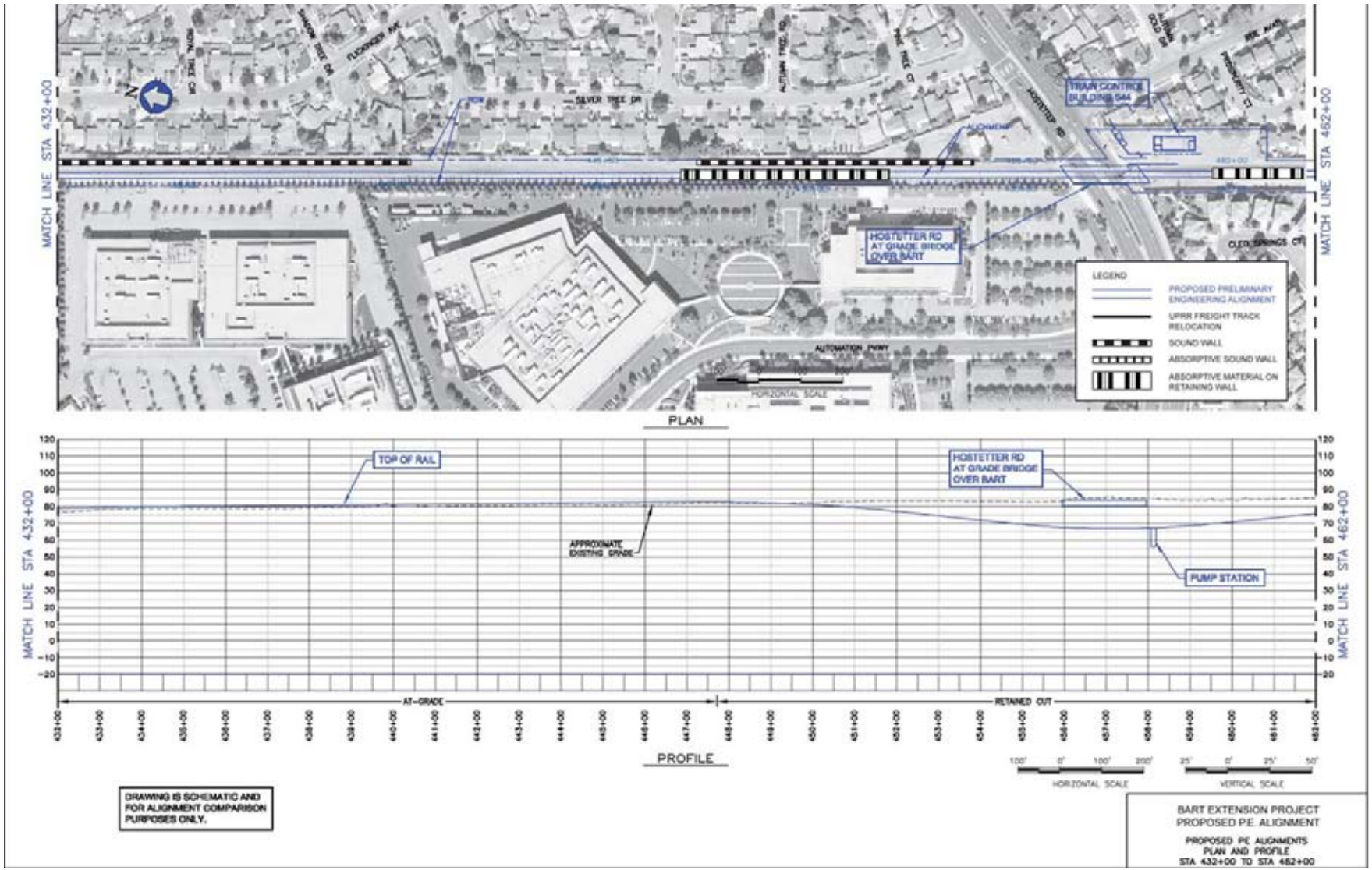

Figure 4.12-1s Noise Mitigation for Line Portion

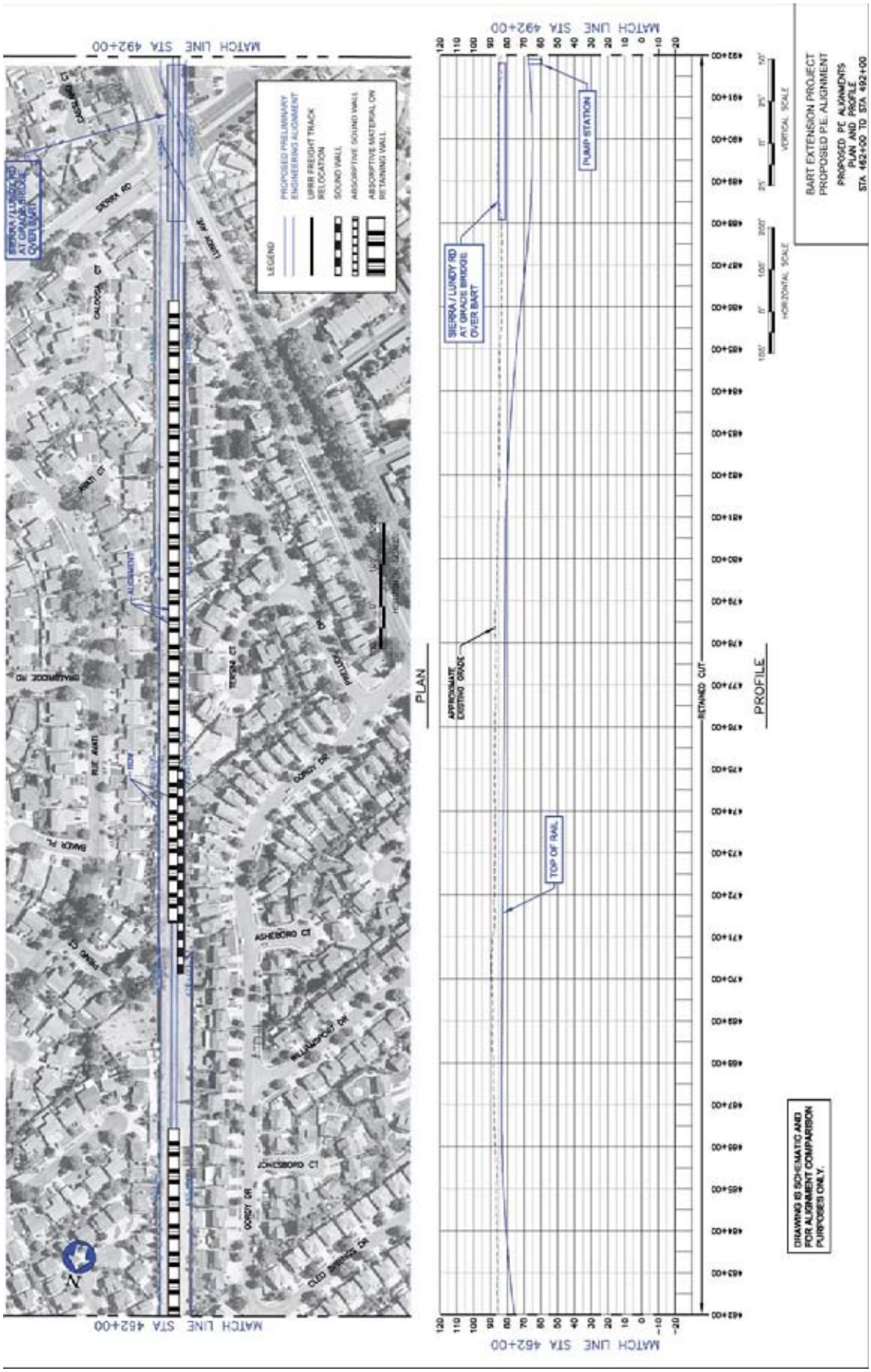

Figure 4.12-1t Noise Mitigation for Line Portion

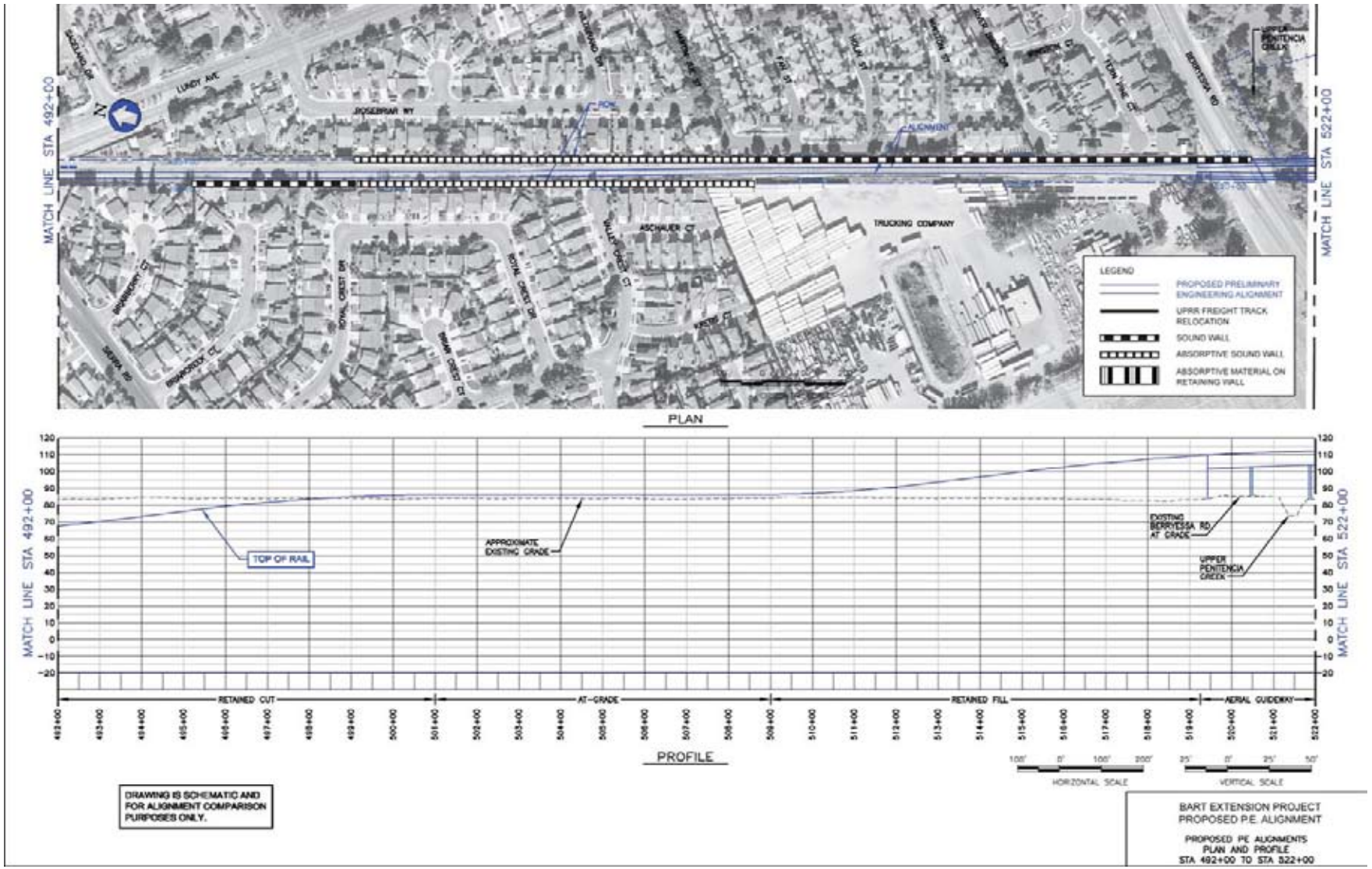

Figure 4.12-1u Noise Mitigation for Line Portion

Residences located on the second floor or higher would potentially remain impacted even with the recommended sound wall mitigation, which are considered to be the maximum feasible height. A total of approximately 425 residences (counting single-family and individual units in multi-family) in 281 buildings would remain exposed to noise in excess of the FTA Criteria. These numbers represent an estimate of the number of multi-story residences affected. These residences would be considered for improved building insulation as additional mitigation where necessary. A more detailed analysis will be conducted during final design for residences with residual noise impacts to determinate the noise attenuation provided by the existing windows and exterior walls of residences and assess the potential for upgrades required to achieve an interior noise level of 45 Ldn.

Besides the recommended sound walls and retro-fitting multi-story residences with improved exterior sound isolation, sound absorptive material on the trackway structure is needed for areas where the SVRT alignment runs in an open cut and/or sound wall mitigation is recommended on both sides of the track and the corridor is narrow (50 feet or less). Potential degradation of the projected acoustical performance (as much as 2 dBA) of either the project retaining walls or sound walls, could be eliminated by installing sound absorptive material on the inside face of the walls. Otherwise, degradation could result in noise levels for the SVRT in excess of the FTA criteria. Table 4.12-3 provides the extent of recommended sound absorptive material. A total of 2,850 linear feet of sound absorptive material on retaining walls is proposed in addition to the absorptive sound wall specified in Table 4.12-2. The locations of sound wall and sound absorptive materials on retained walls and sound walls is also depicted on Figures 4.12-1a through 4.12-1u.

TABLE 4.12-3:

Locations for Sound Absorptive Material for Line Portion

CIVIL STATION	SIDE OF TRACK	LENGTH (feet)
448+00 to 453+00	S1 & S2	500
460+80 to 467+00	S1 & S2	700
471 to 487+50	S1 & S2	1,650

Source: WIA, Inc. 2006a

VIBRATION IMPACT

Subsequent vibration analysis has been pre-pared to incorporate additional field vibration measurement, soils testing, modeling and land use updates, preliminary engineering details, and design changes. The vibration impacts have been compared to the more recent FTA criteria published in May 2006 and subsequent to the FEIR. For residential land uses, the FTA criterion for groundborne vibration is 72 VdB re 10^{-6} in/sec. For buildings that are primarily used for offices, the FTA criterion for groundborne vibration is 84 VdB re 10^{-6} in/sec. Except for special cases, the FTA does not recognize commercial or industrial land uses as sensitive receptors and therefore has no vibration criteria for these land uses. Special cases include concert halls, recording studios, theaters, etc and the maximum allowed vibration levels depend upon the use. There are no such special case uses adjacent to the Line Portion. 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 Line Portion.

Table 4.12-4 summarizes the line segment vibration analysis results. The table includes the number

of residential impacts by civil station and receiver location. There are no other types of land use impacts expected along the line segment. A total of 172 single family and 40 multi-family buildings/171 residences would be impacted without mitigation. This is based on the FEIR approved project. The SEIR options are discussed later in this chapter.

TABLE 4.12-4:

Baseline Groundborne Vibration Levels for Line Portion

CIVIL STATION	RECEIVER LOCATION	TRACK DIR	SPEED (MPH)	DISTANCE TO NEAR TRACK CL (feet)	DEPTH TO TOP OF RAIL (feet)	TRACK TYPE	FTA DETAILED CRITERIA	MAX 1/3 OCTAVE BAND W/O MITIGATION	# IMPACTS W/OUT MITIGATION	PRELIM. MITIGATION	MAX 1/3 OCTAVE BAND WITH MITIGATION	# IMPACTS WITH MITIGATION
168+00 to 170+00	Castilleja Subdivision	NB	67	58	—	AG	72	77	8	TDA	71	0
170+00 to 172+40	Castilleja Subdivision	NB	67	58	—	AG	72	77	8	TDA	71	0
172+60	Warm Springs Village	NB	67	83	—	AG	72	74	1	TDA	68	0
173+50 to 175+60	Warm Springs Village	NB	67	92	—	AG	72	73	7	TDA	67	0
176+00	Warm Springs Village	NB	67	96	—	AG	72	73	1	TDA	67	0
180+60 to 182+00	Park Homes at Mayfield	NB	67	132	—	AG	72	73	7	TDA	71	0
182+50	Spinnaker Point Apartments	NB	67	38	—	AG	72	77	6	FST	67	0
184+00	Spinnaker Point Apartments	NB	67	75	—	AG	72	74	4	TDA	72	0
189+50 to 191+00	Spinnaker Point Apartments	NB	67	42	—	AG	72	75	10	FST	65	0
192+50 to 194+20	Friendly Village Mobile Homes	NB	67	49	—	AG	72	73	4	TDA	71	0
194+20 to 196+20	Friendly Village Mobile Homes	NB	67	49	—	AG	72	73	5	TDA	71	0
196+20 to 198+50	Friendly Village Mobile Homes	NB	67	49	—	AG	72	73	5	TDA	71	0
198+50 to 200+50	Friendly Village Mobile Homes	NB	67	49	—	AG	72	78	5	TDA	72	0

CIVIL STATION	RECEIVER LOCATION	TRACK DIR	SPEED (MPH)	DISTANCE TO NEAR TRACK CL (feet)	DEPTH TO TOP OF RAIL (feet)	TRACK TYPE	FTA DETAILED CRITERIA	MAX 1/3 OCTAVE BAND W/O MITIGATION	# IMPACTS W/OUT MITIGATION	PRELIM. MITIGATION	MAX 1/3 OCTAVE BAND WITH MITIGATION	# IMPACTS WITH MITIGATION
201+50	Friendly Village Mobile Homes	NB	67	49	—	AG	72	78	1	TDA	72	0
202+50 to 207+00	Milpitas Mobilodge, N Milpitas Blvd	NB	67	49	—	AG	72	78	11	TDA	72	0
207+50 to 208+00	Milpitas Mobilodge, N Milpitas Blvd	NB	67	52	—	AG	72	7	1	TDA	71	0
265+00	Edgewater Dr	NB	67	90	—	AG	72	73	1	TDA	71	0
266+00	Meadow-land Dr	NB	67	92	—	AG	72	72**	1	TDA	70	0
267+50	Meadow-land Dr	NB	67	70	—	AG	72	76	1	FST	65	0
268+20	Hedgstone Ct	NB	67	90	—	AG	72	74	1	TDA	71	0
269+00	Hedgstone Ct	NB	67	40		AG	72	82	3	FST	63	0
270+00 to 271+00	Brookstone Ct	NB	67	65	—	AG	72	79	3	FST	65	0
271+00 to 273+50	FairMeadow Wy	NB	67	44	—	AG	72	80	10	FST	65	0
273+50 to 275+50	FairMeadow Wy	NB	67	134		AG	72	73	6	TDA	71	0
276+00 to 278+00	FairMeadow Wy	NB	67	104	—	AG	72	75	4	FST	63	0
278+00 to 280+50	Millwater Ct	NB	67	104		AG	72	75	6	FST	63	0
281+00	Terrace Gardens Senior Housing	NB	67	100	—	AG	72	79	10	FST	73	2
283+00 to 286+00	Terrace Gardens Senior Housing	NB	67	143	—	AG	72	73	22	FST	67	0

CIVIL STATION	RECEIVER LOCATION	TRACK DIR	SPEED (MPH)	DISTANCE TO NEAR TRACK CL (feet)	DEPTH TO TOP OF RAIL (feet)	TRACK TYPE	FTA DETAILED CRITERIA	MAX 1/3 OCTAVE BAND W/O MITIGATION	# IMPACTS W/OUT MITIGATION	PRELIM. MITIGATION	MAX 1/3 OCTAVE BAND WITH MITIGATION	# IMPACTS WITH MITIGATION
332+50 to 336+00	Parc Metropolitan Condos	SB	67	94	—	AG	72	79	32	FST	62	0
419+00 to 420+50	BrookTree Square #5, Flickinger Wy	NB	67	47	—	AG	72	72**	10	TDA	70	0
420+50 to 423+00	BrookTree Square #'s 4,3,2,1, Flickinger Pl & Flickinger Ct	NB	67	46	—	AG	72	72**	16	TDA	70	0
424+00	1897 Flickinger Ave	NB	67	55	—	AG	72	77	1	TDA	70	0
424+50	1891 Flickinger Ave	NB	67	47	—	AG	72	76	1	TDA	70	0
424+90 to 425+90	Flickinger Ave	NB	67	66	—	AG	72	76	2	TDA	69	0
426+15	Flickinger Ave	NB	67	53	—	AG	72	77	1	TDA	70	0
427+00	1861 Flickinger Ave	NB	67	67	—	AG	72	76	1	TDA	69	0
427+50	Flickinger Ave	NB	67	66	—	AG	72	76	1	TDA	69	0
428+00	Flickinger Ave	NB	67	49	—	AG	72	76	1	TDA	70	0
428+20 to 437+50	Flickinger Ave	NB	67	50	—	AG	72	74	17	TDA	67	0
438+50 to 439+50	Flickinger Ave	NB	67	65	—	AG	72	76	2	TDA	69	0
441+00 to 449+50	Silvertree Dr	NB	67	54	—	AG	72	77	15	TDA	70	0
449+50 to 450+00	Silvertree Dr	NB	67	50	—	AG	72	79	1	FST	63	0
450+00 to 451+00	Silvertree Dr	NB	67	70	—	AG	72	74	2	TDA	70	0
473+30	Gordy Dr	SB	67	30	5	RC	72	76	1	FST	61	0

CIVIL STATION	RECEIVER LOCATION	TRACK DIR	SPEED (MPH)	DISTANCE TO NEAR TRACK CL (feet)	DEPTH TO TOP OF RAIL (feet)	TRACK TYPE	FTA DETAILED CRITERIA	MAX 1/3 OCTAVE BAND W/O MITIGATION	# IMPACTS W/OUT MITIGATION	PRELIM. MITIGATION	MAX 1/3 OCTAVE BAND WITH MITIGATION	# IMPACTS WITH MITIGATION
460+50 to 462+50	Prosperity Ct	NB	67	40	11	RC	72	73	3	FST	68	0
462+50 to 464+00	Prosperity Ct	NB	67	53	5	RC	72	75	2	FST	70	0
464+50	Prosperity Ct	NB	67	53	4	RC	72	75	1	FST	70	0
476+50 to 478+50	Tersini Ct	SB	67	40	5	RC	72	75	4	FST	62	0
480+00	Prelude Dr	SB	67	55	5	RC	72	72**	1	FST	63	0
480+50 to 484+00	Prelude Dr	SB	67	37	5	RC	72	75	7	FST	65	0
484+00 to 485+50	Prelude Dr	SB	67	37	9	RC	72	74	3	FST	66	0
494+30	Briar Berry Ct	SB	67	37	10	RC	72	73	1	FST	63	0
496+00 to 497+00	Briar Creek	SB	67	33	---	AG	72	74	2	TDA	70	0
497+30	Briar Creek	SB	67	60	---	AG	72	72**	1	TDA	69	0
497+50 to 499+50	Rose Briar Wy	NB	67	40	---	AG	72	75	4	TDA	70	0
499+50 to 500+50	Rose Briar Wy	NB	67	43	---	AG	72	81	2	FST	64	0
500+50	Rose Briar Wy	NB	67	53	---	AG	72	77	1	FST	64	0
500+70 to 502+00	Rose Briar Wy	NB	67	53	---	AG	72	81	2	FST	65	0
501+90	Rose Briar Wy	NB	67	35	---	AG	72	84	1	FST	65	0
502+30	Rose Briar Wy	NB	67	53	---	AG	72	77	1	FST	64	0
502+50 to 507+00	Rose Briar Wy	NB	67	47	---	AG	72	80	9	FST	63	0
503+35	Rose Briar Wy	NB	67	33	---	AG	72	85	1	FST	66	0
498+00 to 499+30	Royal Crest Dr	SB	65	37	---	AG	72	76	2	TDA	70	0
499+30 to 500+00	Royal Crest Dr	SB	65	37	---	AG	72	79	2	FST	63	0
500+00 to 501+70	Royal Crest Dr	SB	60	37	---	AG	72	74	4	TDA	69	0

CIVIL STATION	RECEIVER LOCATION	TRACK DIR	SPEED (MPH)	DISTANCE TO NEAR TRACK CL (feet)	DEPTH TO TOP OF RAIL (feet)	TRACK TYPE	FTA DETAILED CRITERIA	MAX 1/3 OCTAVE BAND W/O MITIGATION	# IMPACTS W/OUT MITIGATION	PRELIM. MITIGATION	MAX 1/3 OCTAVE BAND WITH MITIGATION	# IMPACTS WITH MITIGATION
501+80	Royal Crest Dr	NB	67	51*	–	AG	72	79	1	FST	63	0
502+20 to 503+50	Royal Crest Dr	SB	60	35	–	AG	72	82	3	FST	63	0
504+00	Valley Crest Dr	SB	50	25	–	AG	72	85	1	FST	66	0
505+50 to 507+30	Aschauer Ct	SB	50	43	–	AG	72	78	5	TDA	72	0
507+00 to 508+00	Rose Briar Wy	NB	65	45	–	AG	72	81	2	FST	64	0
507+50 to 509+50	Taida St, Berryessa Villa	NB	65	87	–	AG	72	76	4	TDA	72	0
510+00 to 511+50	Taida St, Berryessa Villa	NB	65	66	–	AG	72	79	6	FST	61	0
511+50 to 513+00	Taida St, Berryessa Villa	NB	60	90	–	AG	72	77	4	FST	57	0
513+50 to 515+00	Winston Ct, Berryessa Villa	NB	65	50	–	EM	72	76	4	FST	70	0
516+00 to 516+50	Heavenly Bamboo Ct, Regency Park	NB	50	30	–	EM	72	75	1	FST	70	0
517+00	Fern Pine Ct	NB	50	28	–	EM	72	75	1	FST	71	0
518+50	Fern Pine Ct	NB	50	25	–	EM	72	76	1	FST	71	0

Vibration dominated from trains on far track at indicated receptors

***72 < Max 1/3 Octave Band < 72.5*

KEY:

NB = North Bound
SB = South Bound
AG = At-Grade ballasted track
RC = Retained Cut
EM = Embankment with ballasted track
AR = Aerial structure
TDA = Tire Derived Aggregate under ballasted track
FST = 8 Hz Floating Slab Track

Source: WIA, Inc., 2006b

VIBRATION MITIGATION

Table 4.12-5 summarizes the vibration mitigation recommended to achieve the FTA criteria. The locations of vibration mitigation are depicted on Figures 4.12-2a through 4.12-2p. The mitigation recommendations do not include ballast mat as a mitigation approach for the Line Portion. Ballast mat is mainly effective at frequencies above 25-30 Hz. Where vibration is dominated by lower frequencies, such as the case along the corridor, 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. After mitigation, only two impacts remain. This is at station 281+00 (Terrace Gardens Senior Housing) where the FTA criteria are exceeded by 1 VdB.

TABLE 4.12-5:

Baseline Vibration Mitigation for Line Portion

CIVIL STATION	MITIGATION
167+00 to 175+00	Tire Derived Aggregate(1)
175+00 to 177+00	Tire Derived Aggregate(1)
179+60 to 181+50	
183+60 to 185+00	
192+00 to 209+00	
181+50 to 183+60	8 Hz Floating Slab
188+50 to 192+00	
264+00 to 266+30	Tire Derived Aggregate(1)
266+30 to 287+00	8 Hz Floating Slab
331+50 to 337+25	8 Hz Floating Slab
418+00 to 448+00	Tire Derived Aggregate(1)
448+00 to 452+00	8 Hz Floating Slab
459+50 to 466+50	
472+30 to 474+30	
475+50 to 486+50	
493+30 to 506+00	
506+00 to 519+50(2)	8 Hz Floating Slab

(1) Tire derived aggregate or comparable mitigation will be implemented.
(2) North end of bridge structure over Berryessa Road

Source: WIA, Inc. 2006b

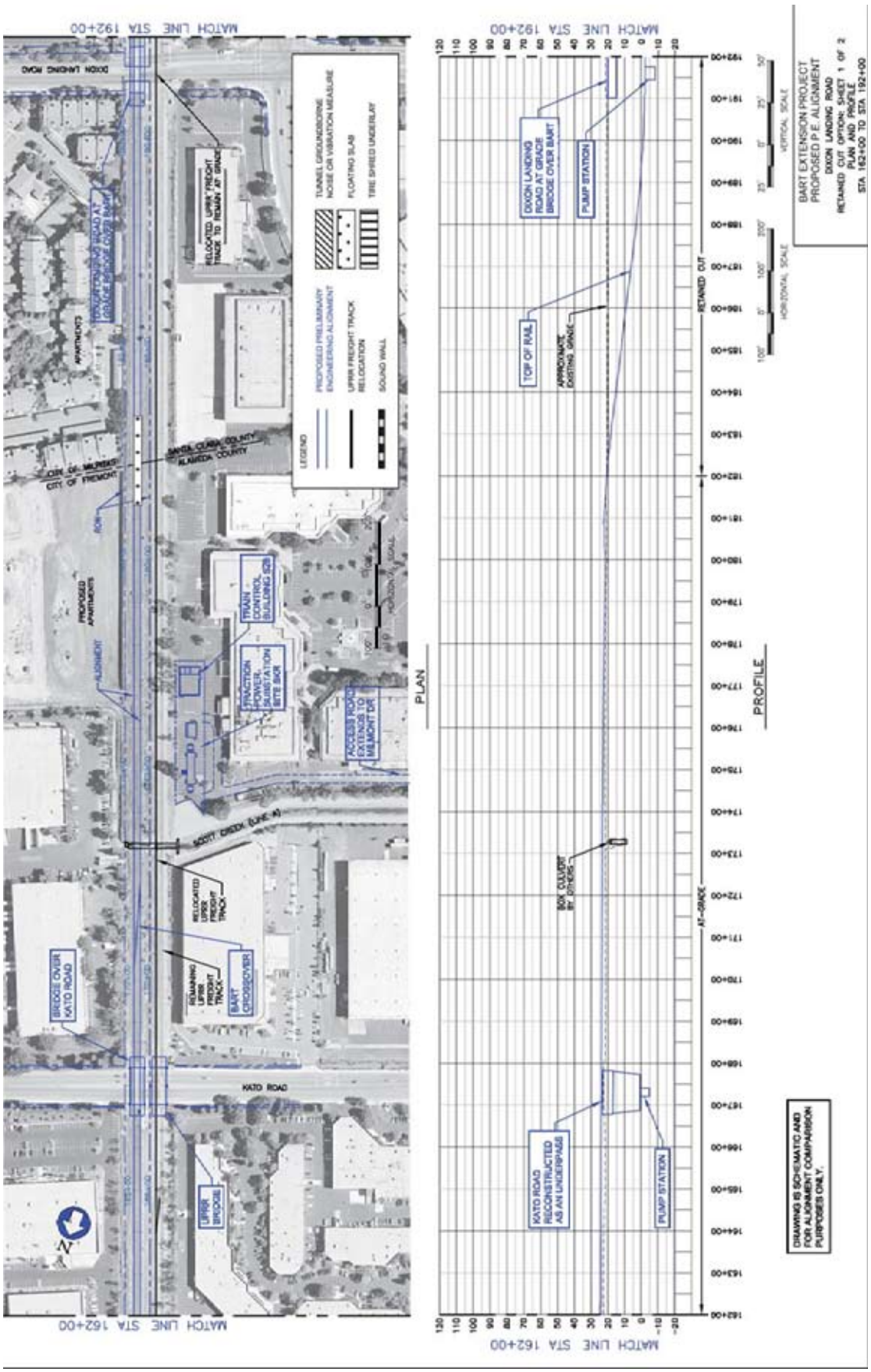

Figure 4.12-2a Vibration Mitigation for Line Portion

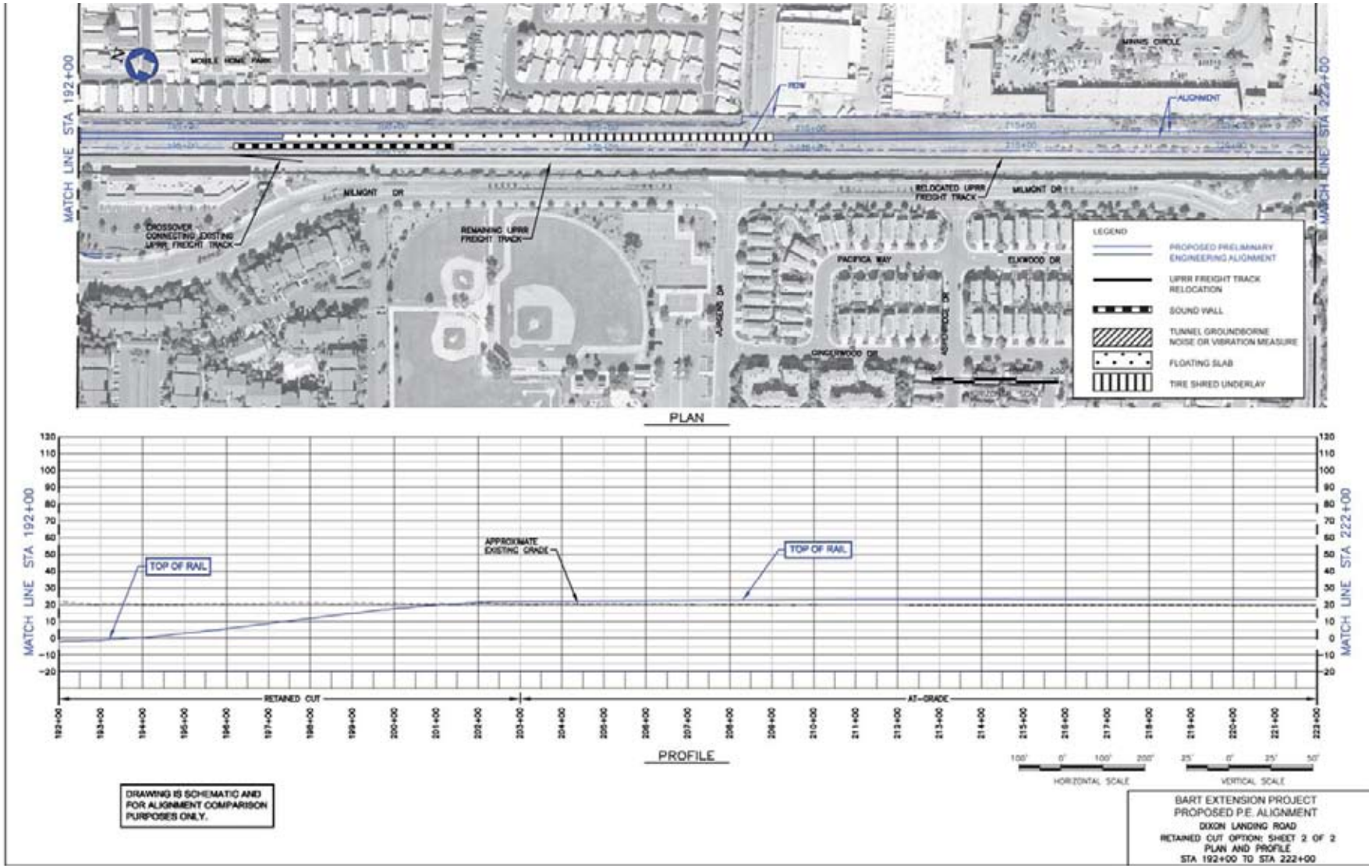

Figure 4.12-2b Vibration Mitigation for Line Portion

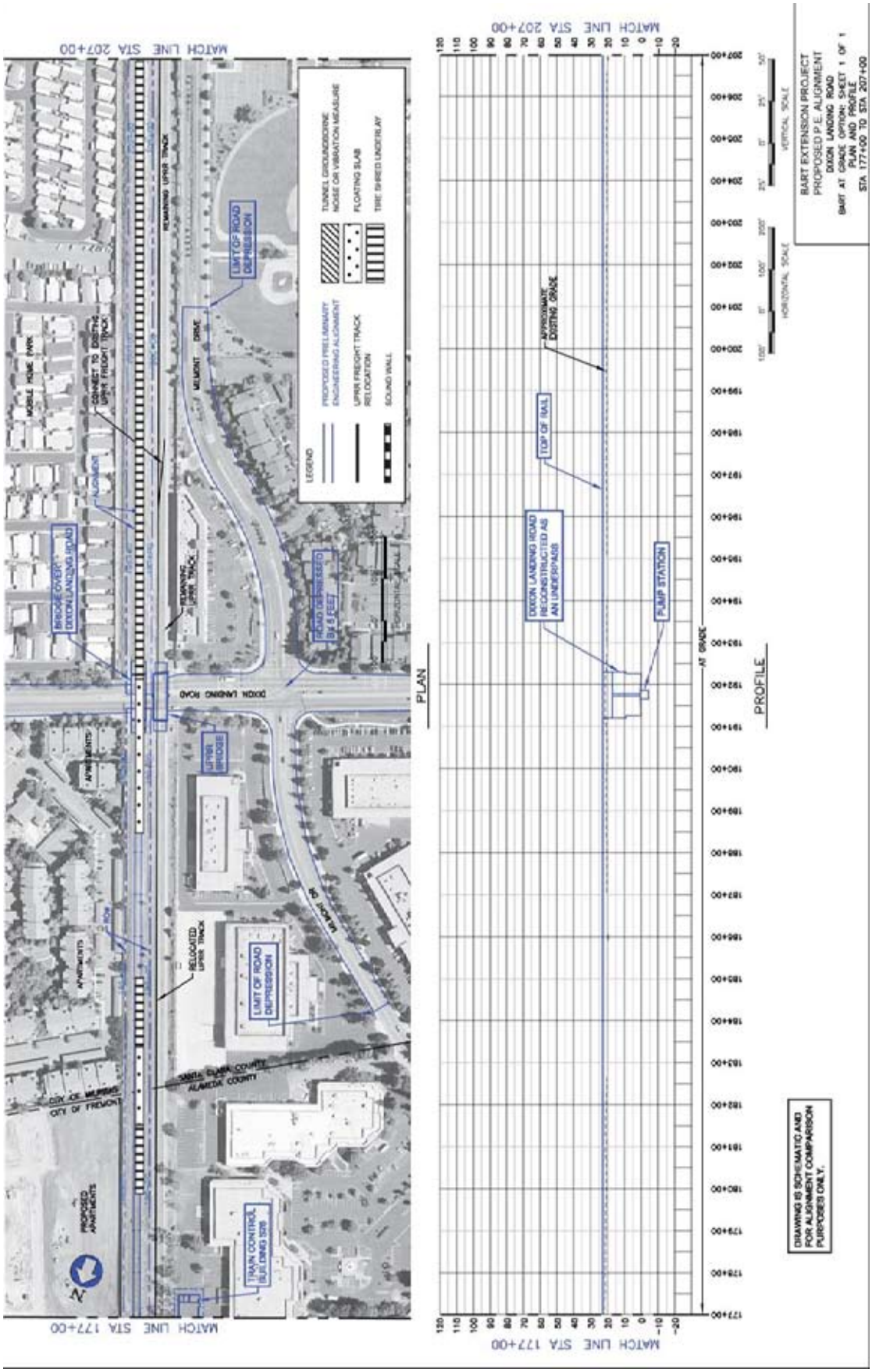

Figure 4.12-2c Vibration Mitigation for Line Portion

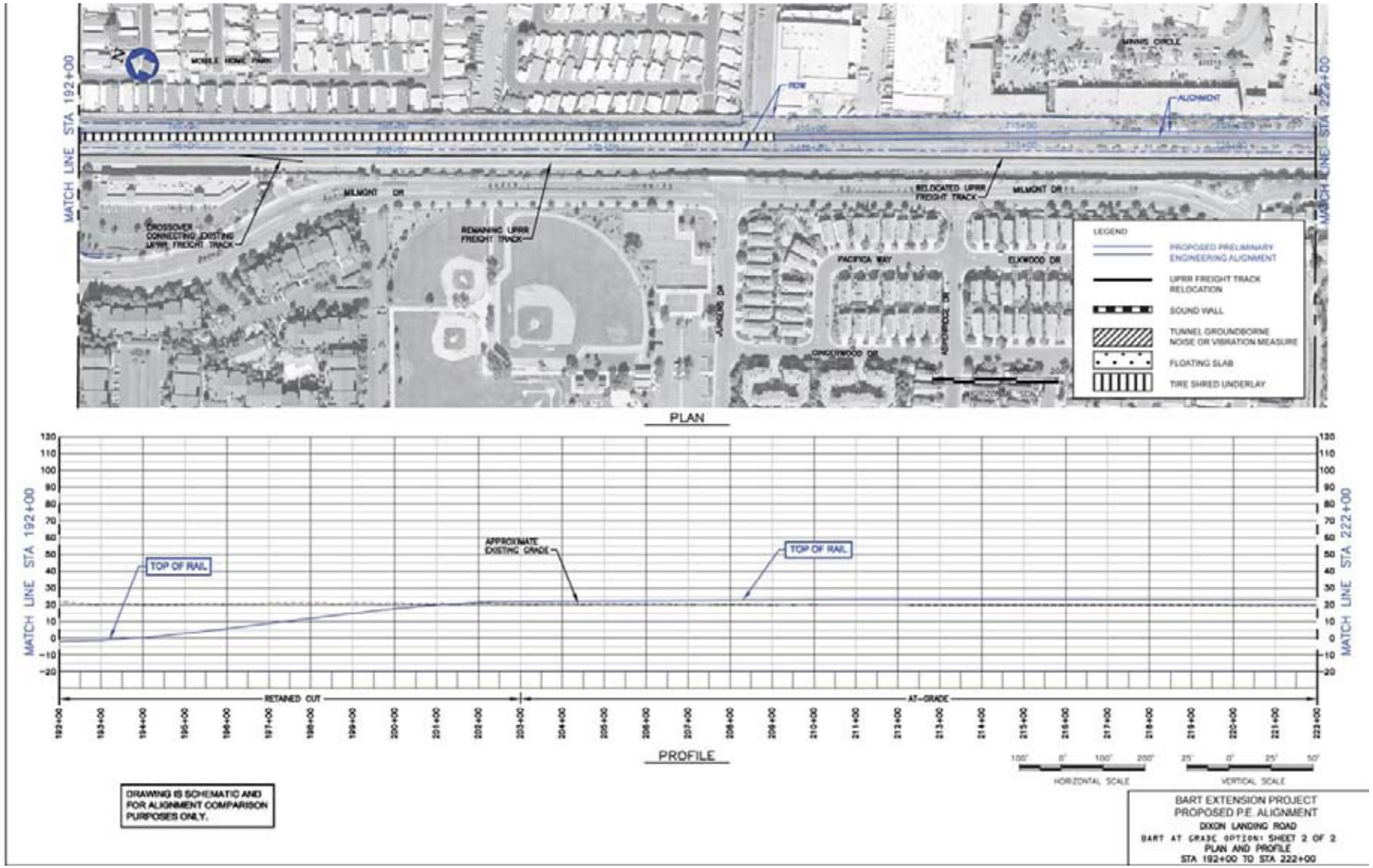

Figure 4.12-2d Vibration Mitigation for Line Portion

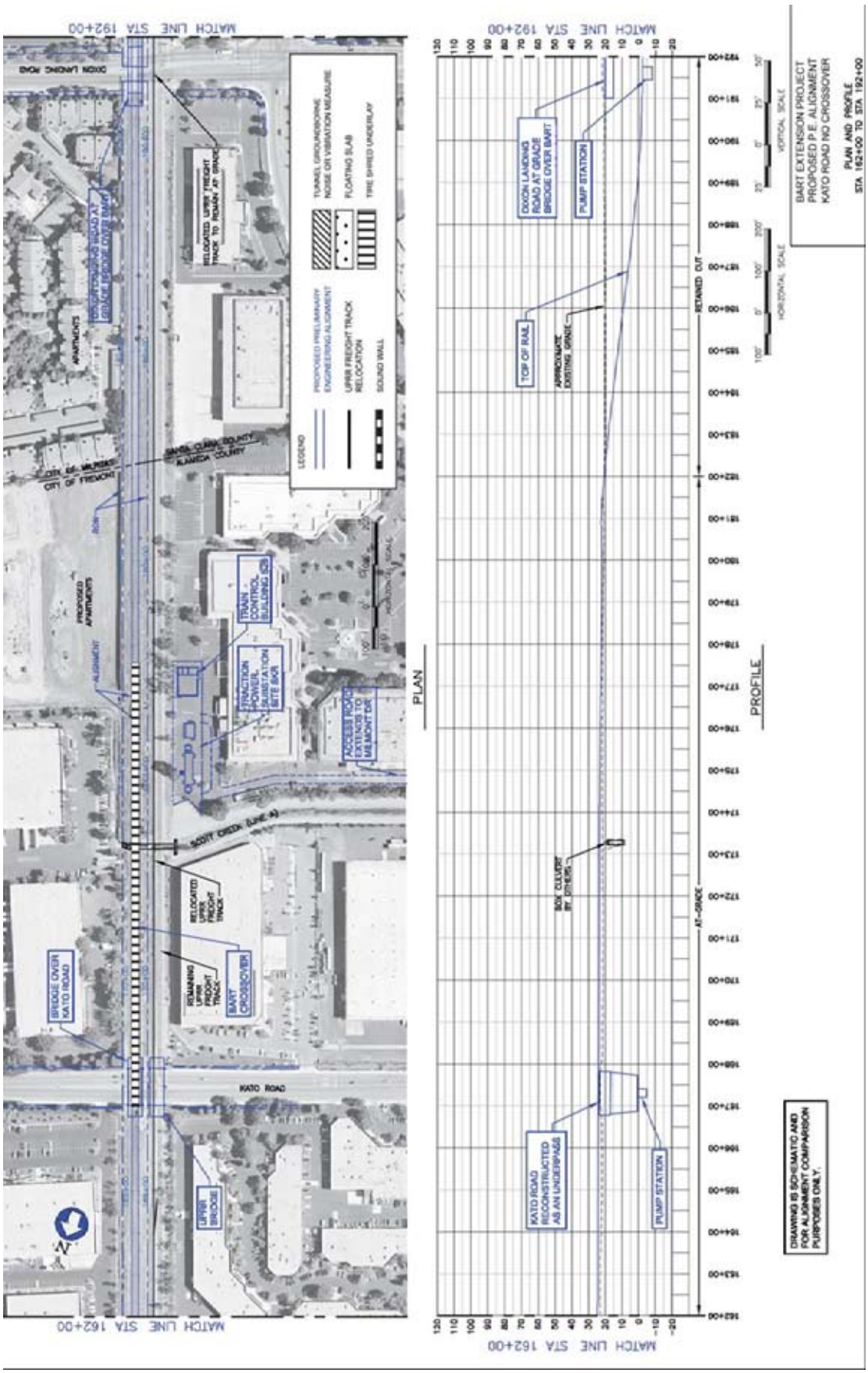

Figure 4.12-2e Vibration Mitigation for Line Portion

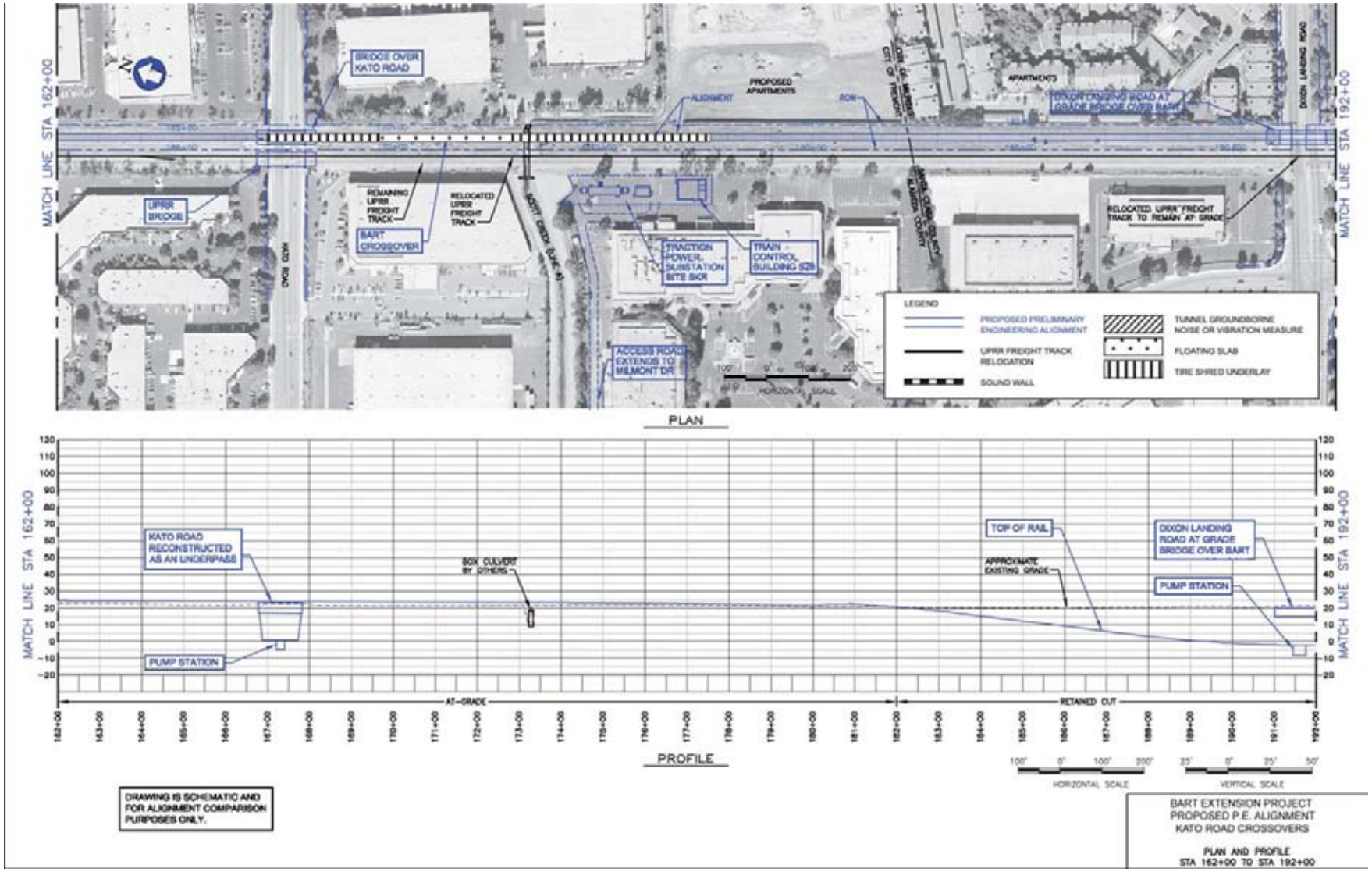

Figure 4.12-2f Vibration Mitigation for Line Portion

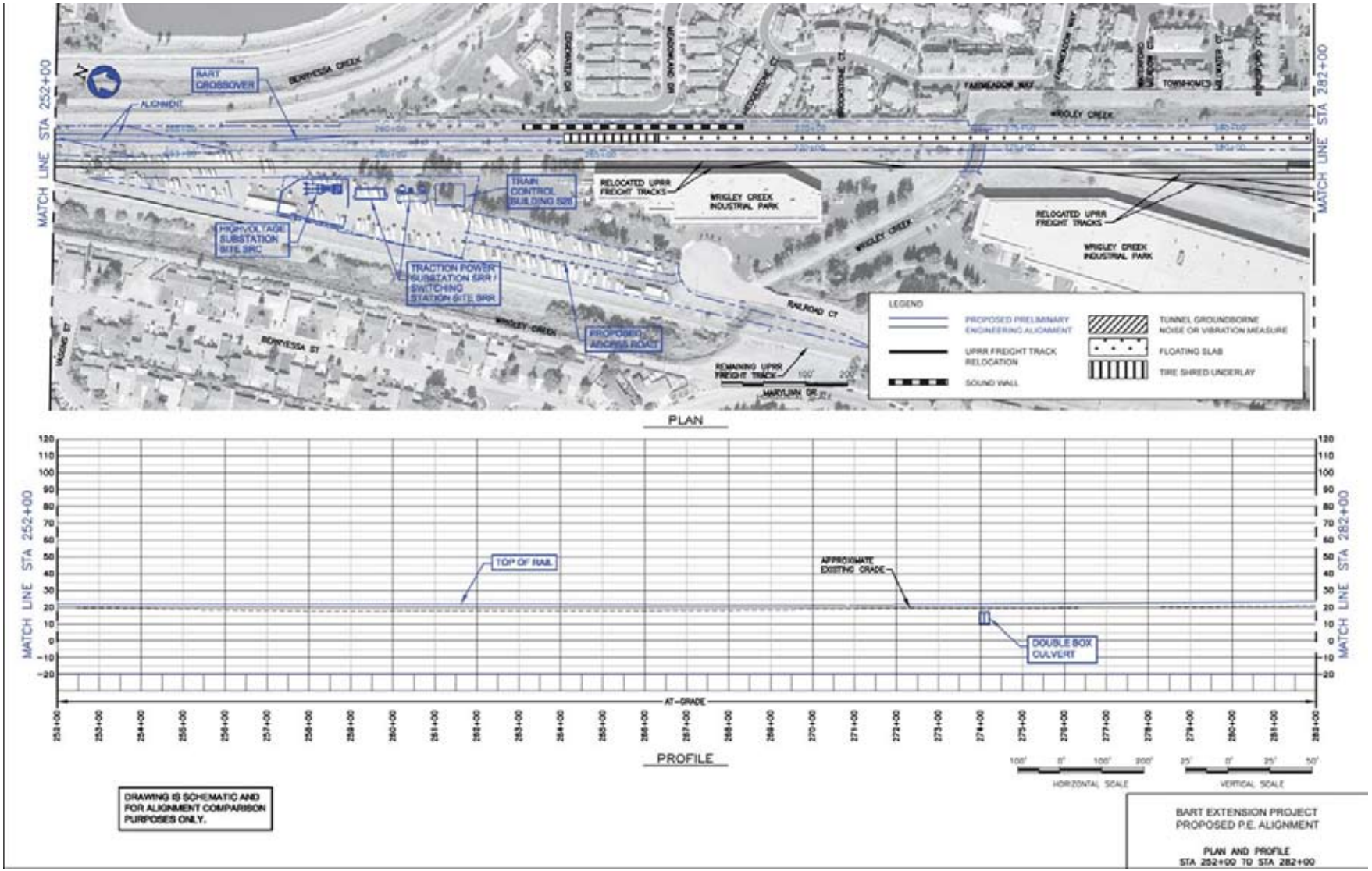

Figure 4.12-2g Vibration Mitigation for Line Portion

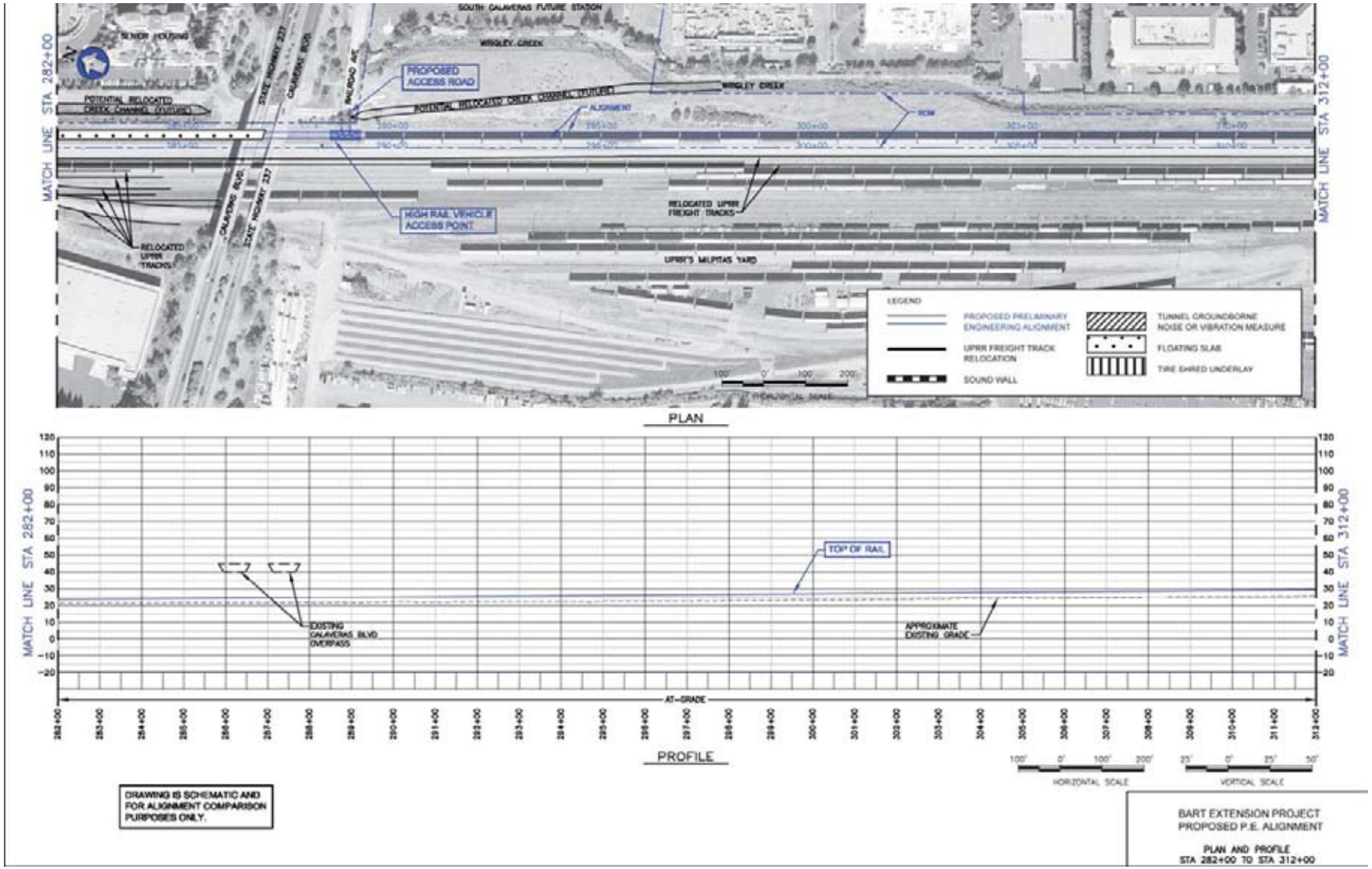

Figure 4.12-2h Vibration Mitigation for Line Portion

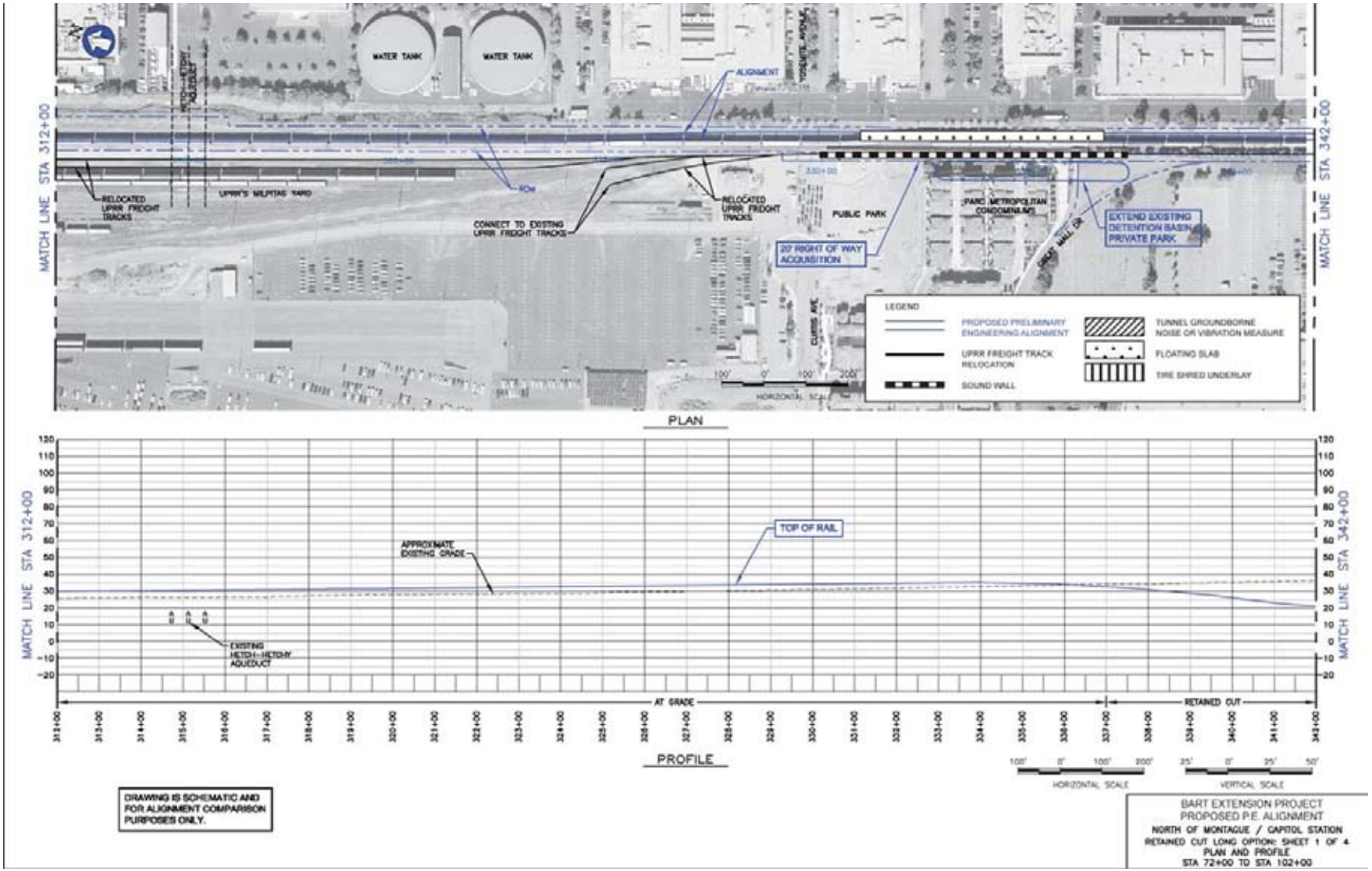

Figure 4.12-2i Vibration Mitigation for Line Portion

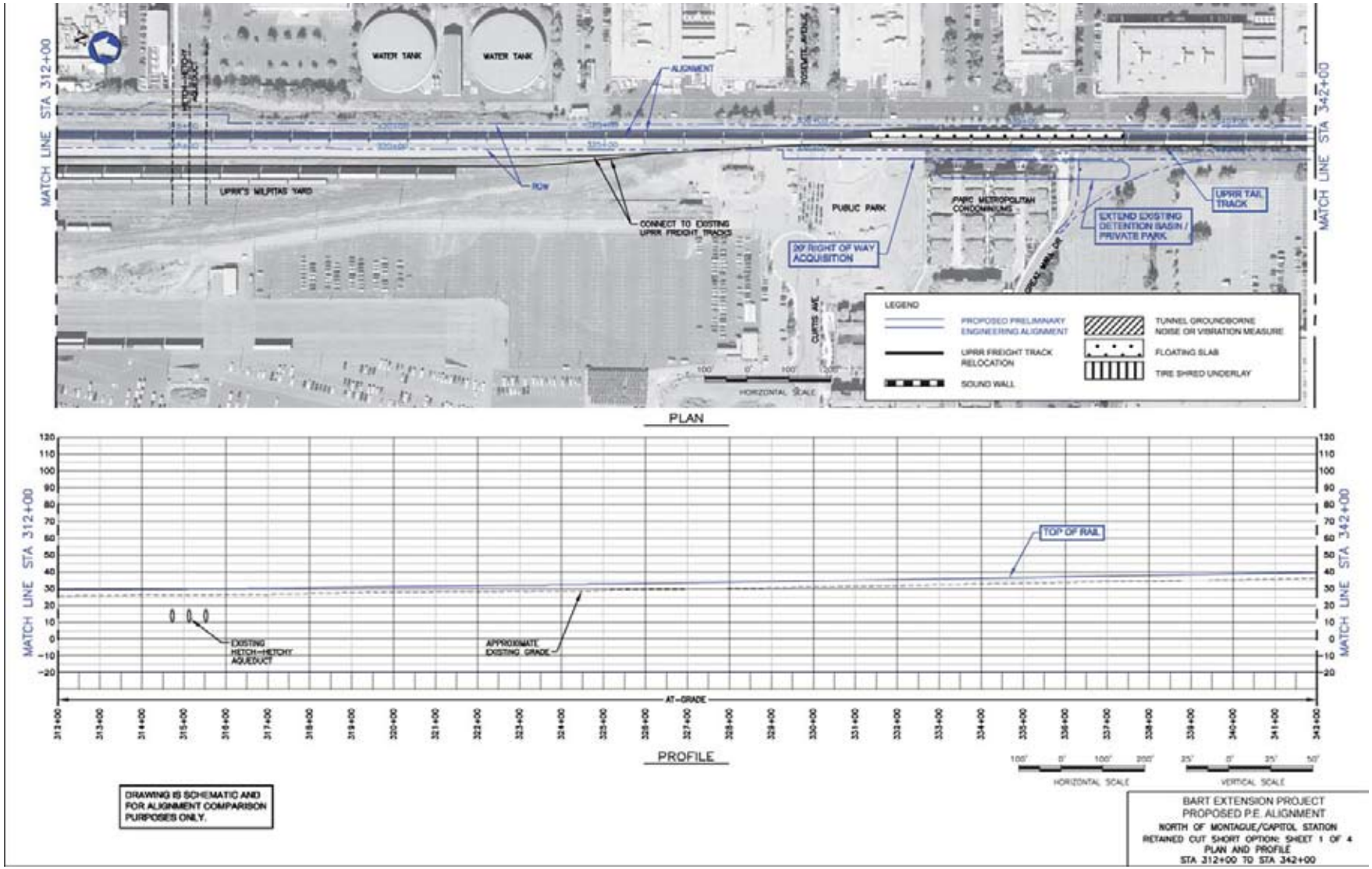

Figure 4.12-2j Vibration Mitigation for Line Portion

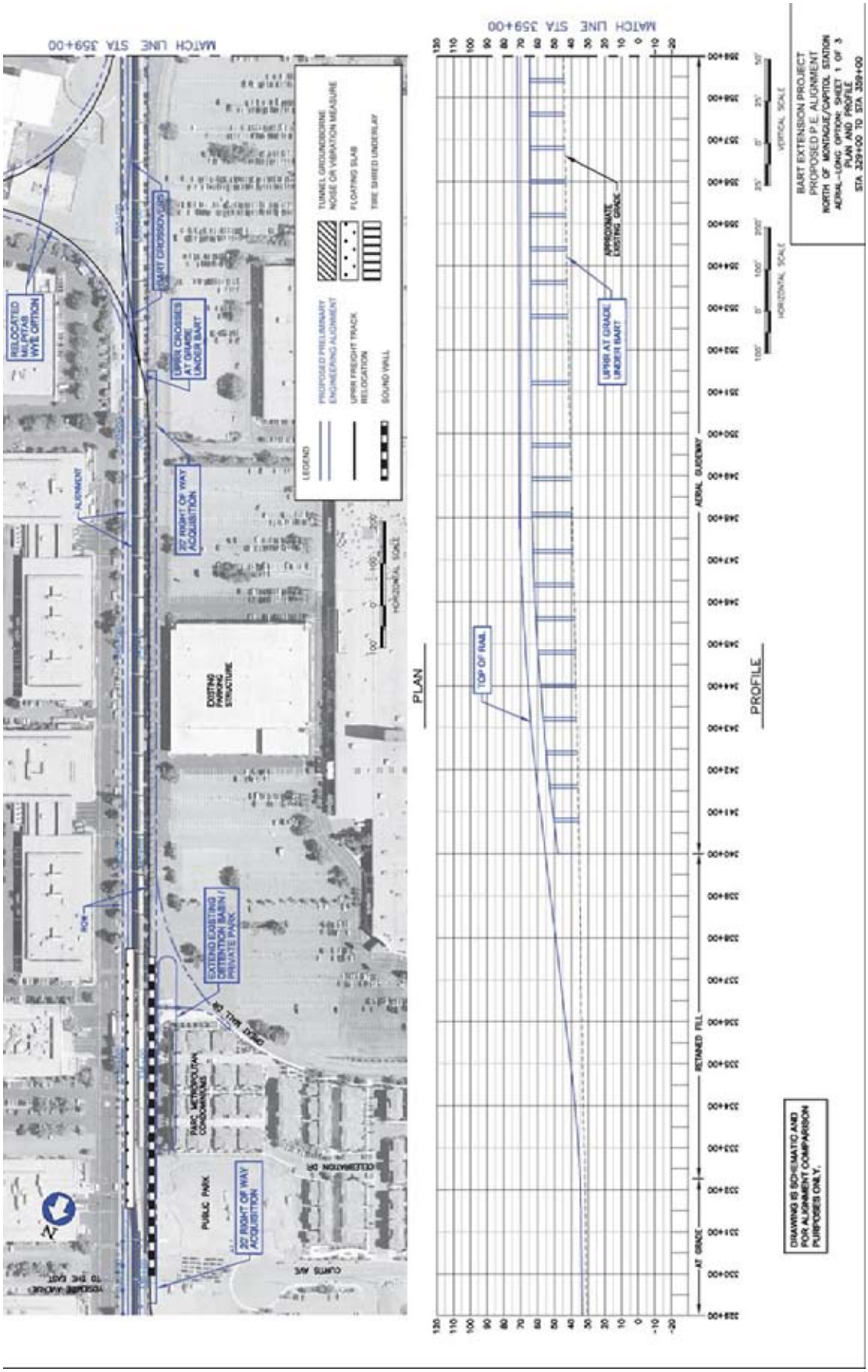

Figure 4.12-2k Vibration Mitigation for Line Portion

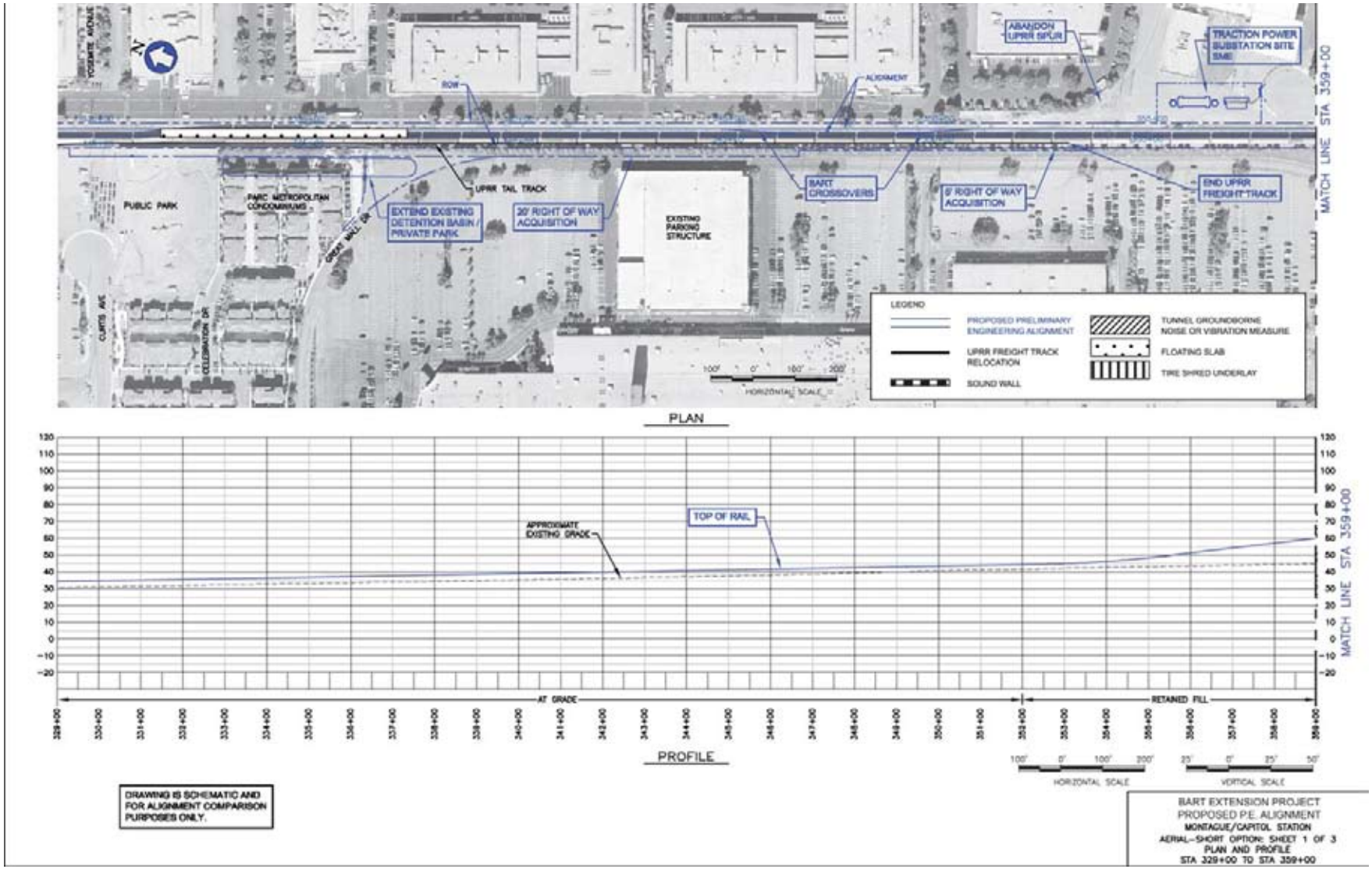

Figure 4.12-2l Vibration Mitigation for Line Portion

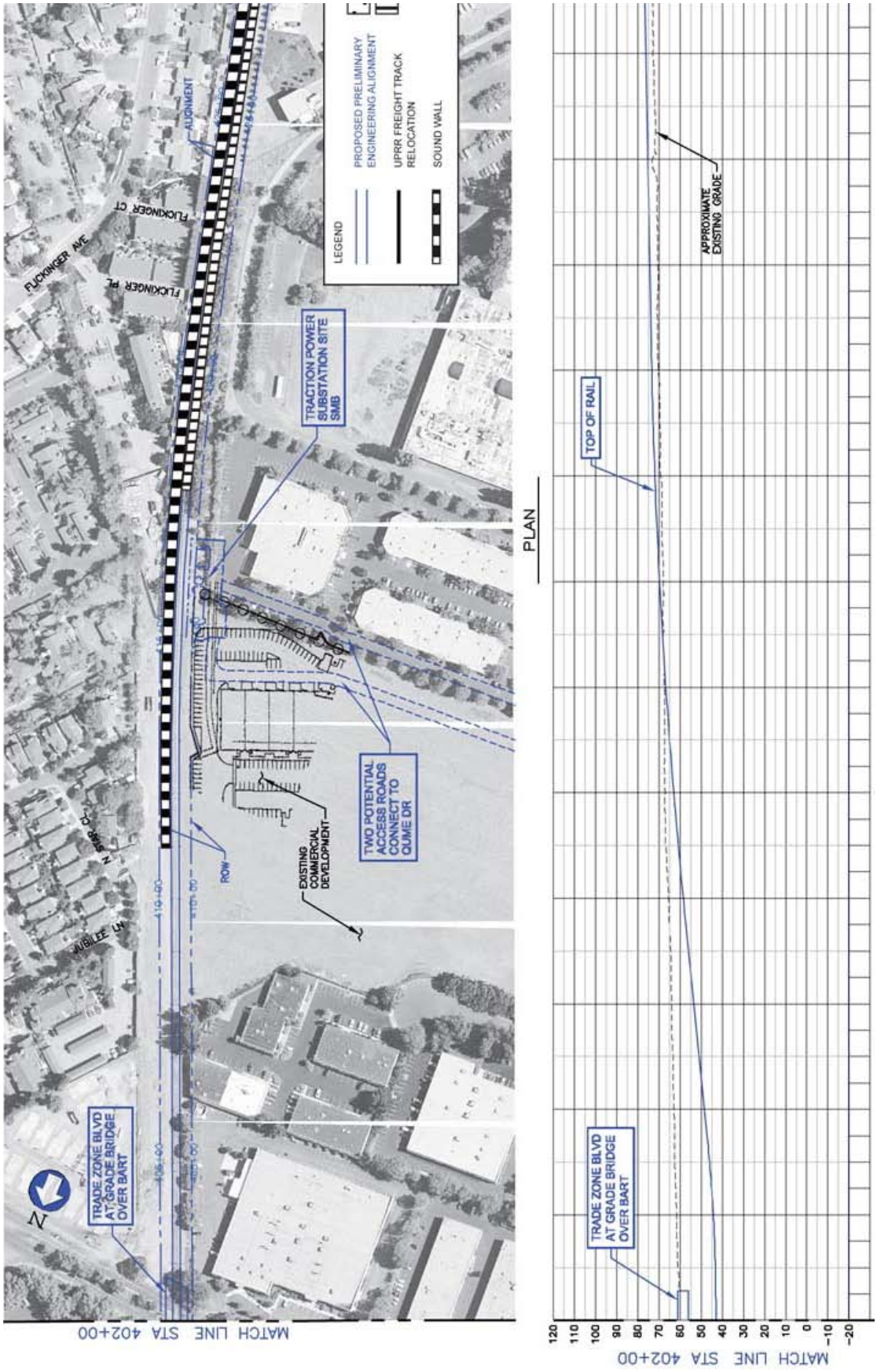

Figure 4.12-2m Vibration Mitigation for Line Portion

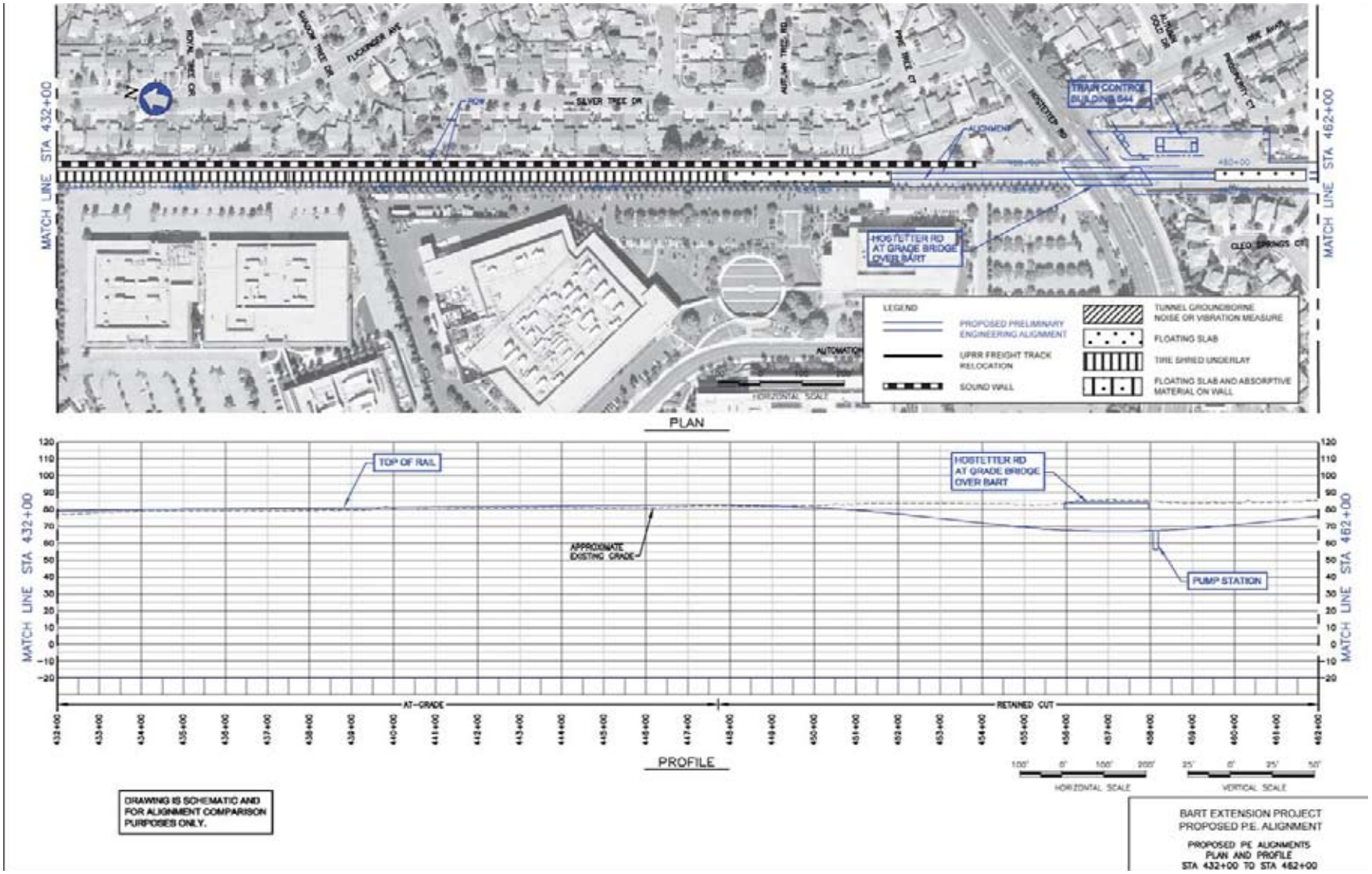

Figure 4.12-2n Vibration Mitigation for Line Portion

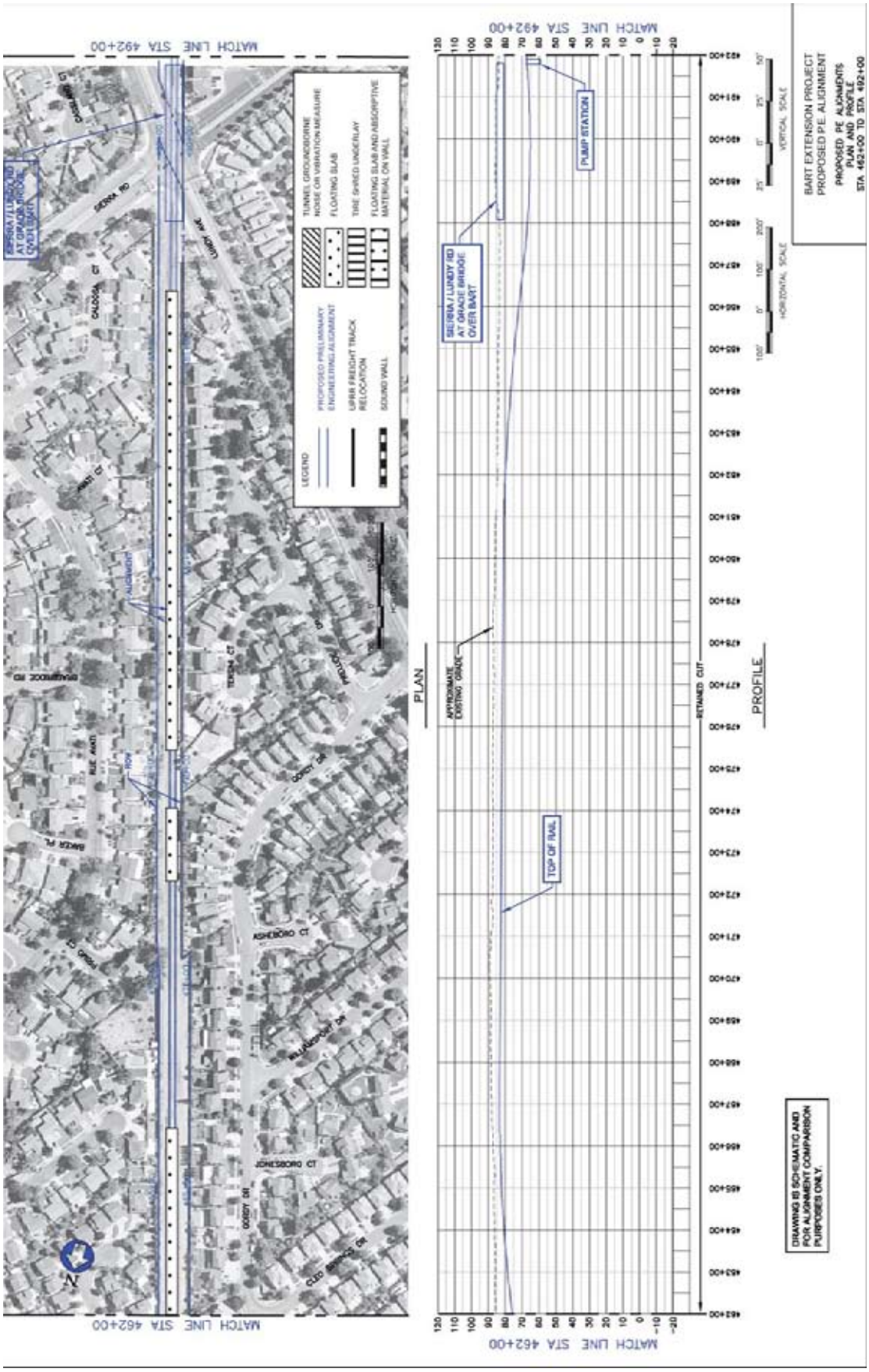

Figure 4.12-2o Vibration Mitigation for Line Portion

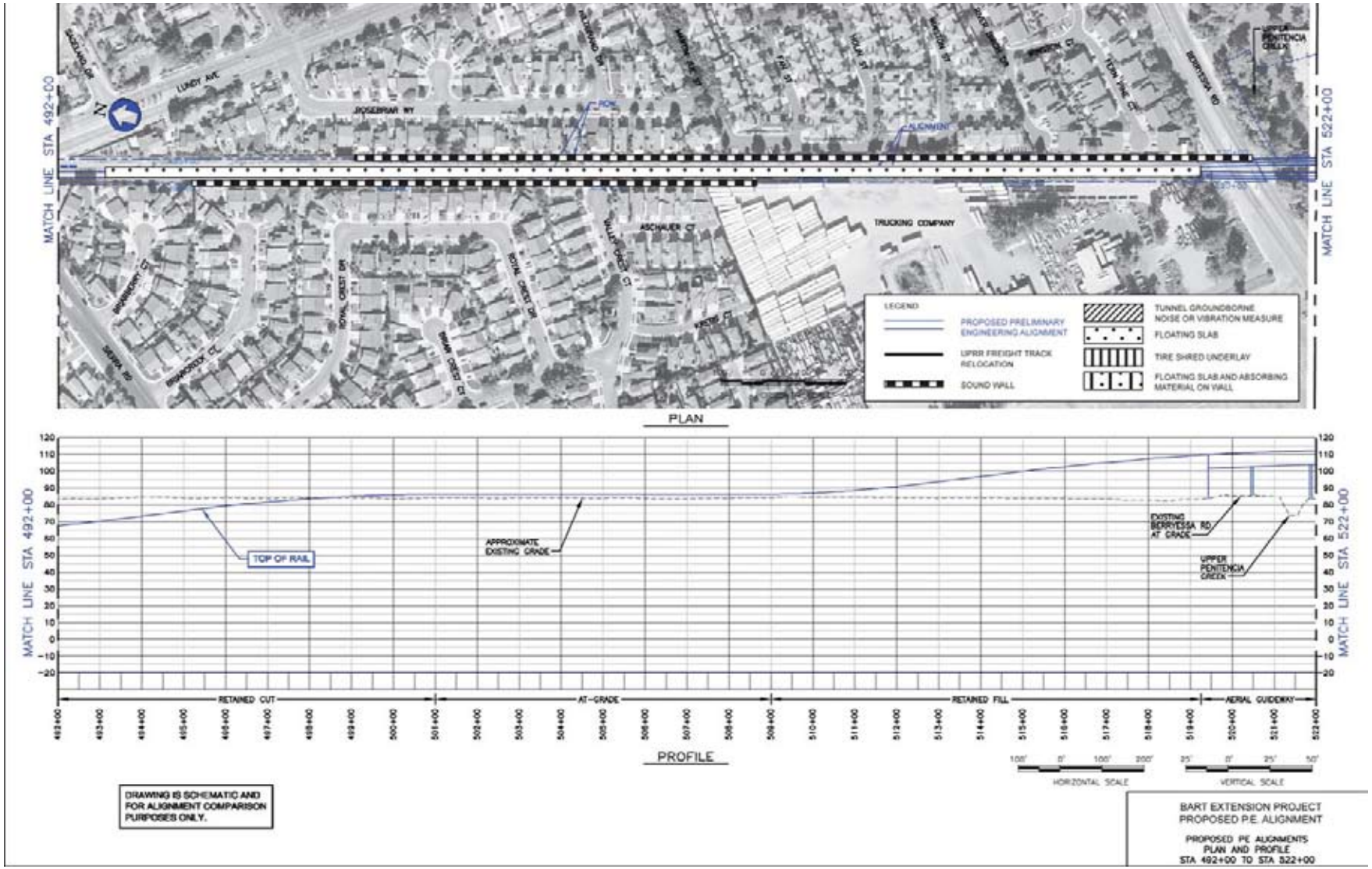

Figure 4.12-2p Vibration Mitigation for Line Portion

4.12.4.2 Tunnel Segment

GROUNDBORNE NOISE AND VIBRATION IMPACTS

Subsequent tunnel portion groundborne noise and vibration analysis has been prepared to incorporate additional field measurement, soils testing, more detailed modeling, land use updates, preliminary engineering design details, and certain design changes. The new modeling assumptions included a shallower tunnel depth and higher vehicle speeds, both of which increase the level of impact. The impacts have been compared to the FTA criteria previously described in the FEIR. The analysis shows that 133 residences and other sensitive uses would be impacted by groundborne noise under the FTA criteria. These impacts are identified by station number and addressed as shown in Table 4.12-6. No vibration impacts for the tunnel portion were identified based on the FTA Criteria.

TABLE 4.12-6:

Baseline Groundborne Noise Impacts for Tunnel Portion

CIVIL STATION	RECEIVER LOCATION	HORIZONTAL DISTANCE TO NEAR TRACK CL (feet)	RAIL DEPTH (feet)	FTA GBN CRITERIA (dBA)	MAX PROJECTED GBN w/OUT MITIGATION (dBA)	# OF RECEPTORS	MAX PROJECTED GBN LEVEL WITH HRDF MITIGATION (dBA	MAX PROJECTED GBN WITH RSF MITIGATION (dBA)
619	1226 East Santa Clara	75	54	35	39	1	34	-
622	Next to 1183 East Santa Clara	60	56	35	41	1	35	-
623	16 S 24th	115	56	35	36	1	31	-
623	20 N 24th	90	56	35	38	1	32	-
629	1072 East Santa Clara	25	64	35	39	4	33	-
630	1049 East Santa Clara	75	55	35	38	1	33	-
631	1047 East Santa Clara	70	67	35	39	1	33	-
631	1044 East Santa Clara	30	67	35	43	1	38	32
632	1026-32 East Santa Clara	35	69	35	44	8	38	32
635	968 A,B,C East Santa Clara	25	74	35	42	3	35	-
640	892 East Santa Clara	25	84	35	42	4	36	30
646	802 East Santa Clara	55	85	35	40	1	35	-
649	748 East Santa Clara	40	81	35	42	4	36	30
649	725 East Santa Clara	35	81	35	36	1	31	-
652	700 Block East Santa Clara	35	78	35	44	1	37	31

CIVIL STATION	RECEIVER LOCATION	HORIZONTAL DISTANCE TO NEAR TRACK CL (feet)	RAIL DEPTH (feet)	FTA GBN CRITERIA (dBA)	MAX PROJECTED GBN w/OUT MITIGATION (dBA)	# OF RECEPTORS	MAX PROJECTED GBN LEVEL WITH HRDF MITIGATION (dBA	MAX PROJECTED GBN WITH RSF MITI-GATION (dBA)
651	716 East Santa Clara	50	79	35	41	4	35	-
663	525 East Santa Clara	35	68	35	43	2	36	30
669	11 S 10th	30	65	35	48	4	40	34
674	390 East Santa Clara	30	62	35	47	4	40	34
693	111 East Santa Clara (at X-over)	58	50	35	38	4	32	-
694	19 N 3rd (at X-over)	30	50	35	40	4	33	-
698	42 East Santa Clara (at X-over)	85	51	35	39	4	32	-
706	141 West Santa Clara	30	52	35	39	4	32	-
748	754 Bush	0	55	35	37	20	30	-
748	754 Bush Building 5	0	55	35	40	8	34	-
750	5101 Wilson	0	55	35	40	20	34	-
750	51 Wilson	35	56	35	37	1	31	-
751	49 Wilson	0	56	35	40	1	34	-
752	34 Sunol	0	58	35	40	1	34	-
753	30 Sunol	0	57	35	40	1	34	-
753	24 Sunol	0	57	35	40	1	34	-
752	20 Sunol	0	58	35	40	1	34	-
754	33 Sunol	0	59	35	40	1	34	-
754	27 Sunol	0	59	35	40	1	34	-
779	489 Stockton	10	64	35	43	1	38	32
780	493 Stockton	10	66	35	43	1	38	32
781	711 Pershing	70	67	35	40	1	36	30
783	549 Stockton	30	68	35	43	1	38	31
784	713 Harding	80	69	35	40	1	35	-
786	597 Stockton	35	71	35	42	1	37	31
786	599 Stockton	35	71	35	42	1	37	31

CIVIL STATION	RECEIVER LOCATION	HORIZONTAL DISTANCE TO NEAR TRACK CL (feet)	RAIL DEPTH (feet)	FTA GBN CRITERIA (dBA)	MAX PROJECTED GBN w/OUT MITIGATION (dBA)	# OF RECEPTORS	MAX PROJECTED GBN LEVEL WITH HRDF MITIGATION (dBA	MAX PROJECTED GBN WITH RSF MITI-GATION (dBA)
787	733 Schiele	170	72	35	36	1	31	-
789	625 Stockton	35	70	35	42	1	37	31
789	635 Stockton	45	70	35	42	1	37	31
790	641 Stockton	45	69	35	42	1	37	30
790	649 Stockton	55	69	35	41	1	36	31
800	702 Asbury	30	63	35	43	1	38	32
803	779 Stockton	50	61	35	42	1	37	31

KEY:
GBN = Groundborne noise
HRDF = Highly resilient direct fixation fasteners or equivalent measure
RSF = Rail suspension fastener or equivalent measure
X-Over = Crossover (special track switches)

Source: WIA, Inc. 2006c

GROUNDBORNE NOISE AND VIBRATION MITIGATION

Table 4.12-6 also presents the predicted groundborne noise levels for each impacted location before mitigation, and the mitigated groundborne noise levels for mitigation strategies. The mitigation strategies include highly resilient direct fixation rail fasteners (HRDF) and rail suspension fasteners (RSF). The locations for these mitigations are shown in Figures 4.12-3a through 4.12-3g. These mitigation measures reduce groundborne noise impacts to achieve the FTA noise criteria and include approximately 5,500 linear feet of HRDF and 10,500 linear feet of RSF.

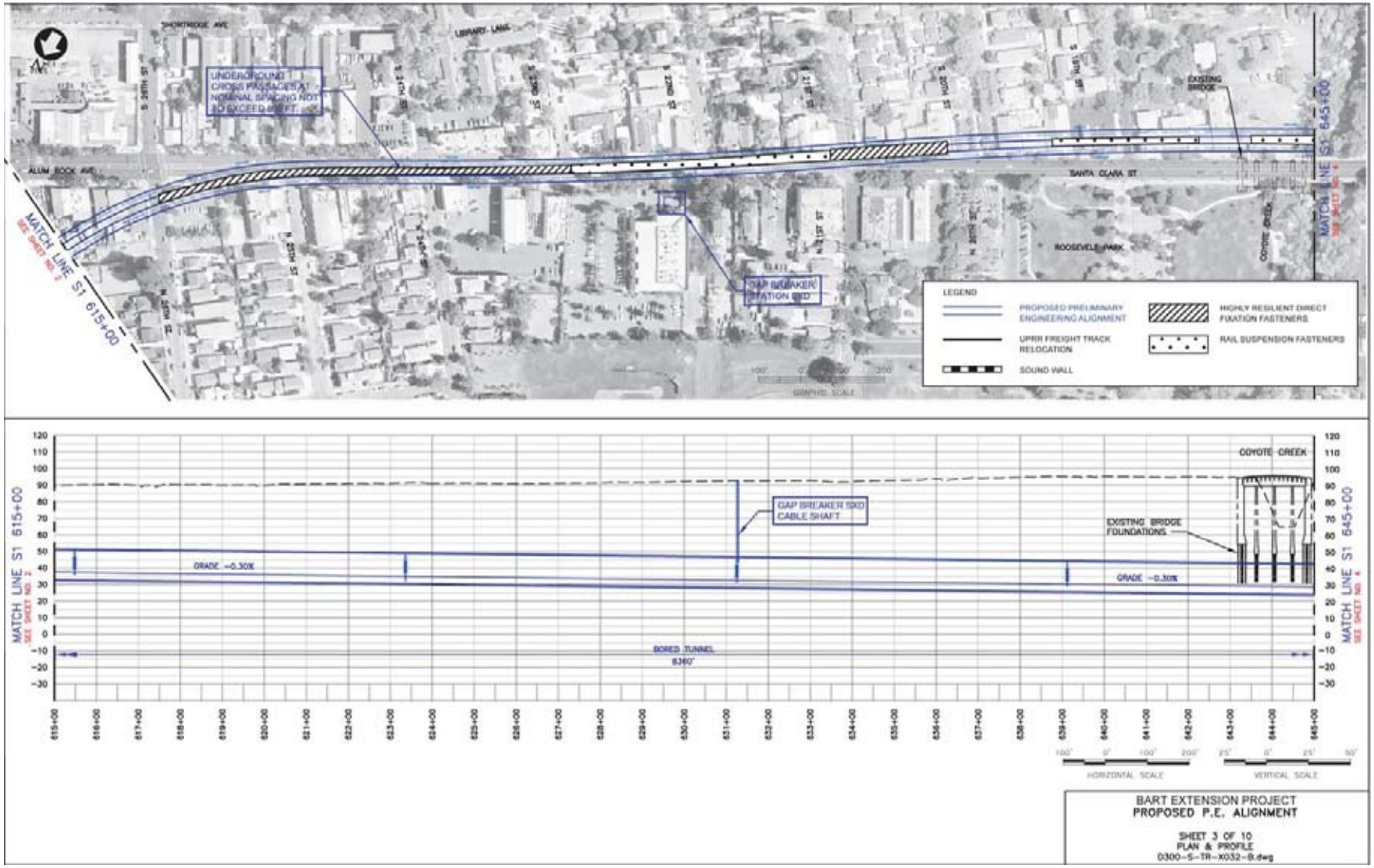

Figure 4.12-3a Noise and Vibration Mitigation for Tunnel Portion

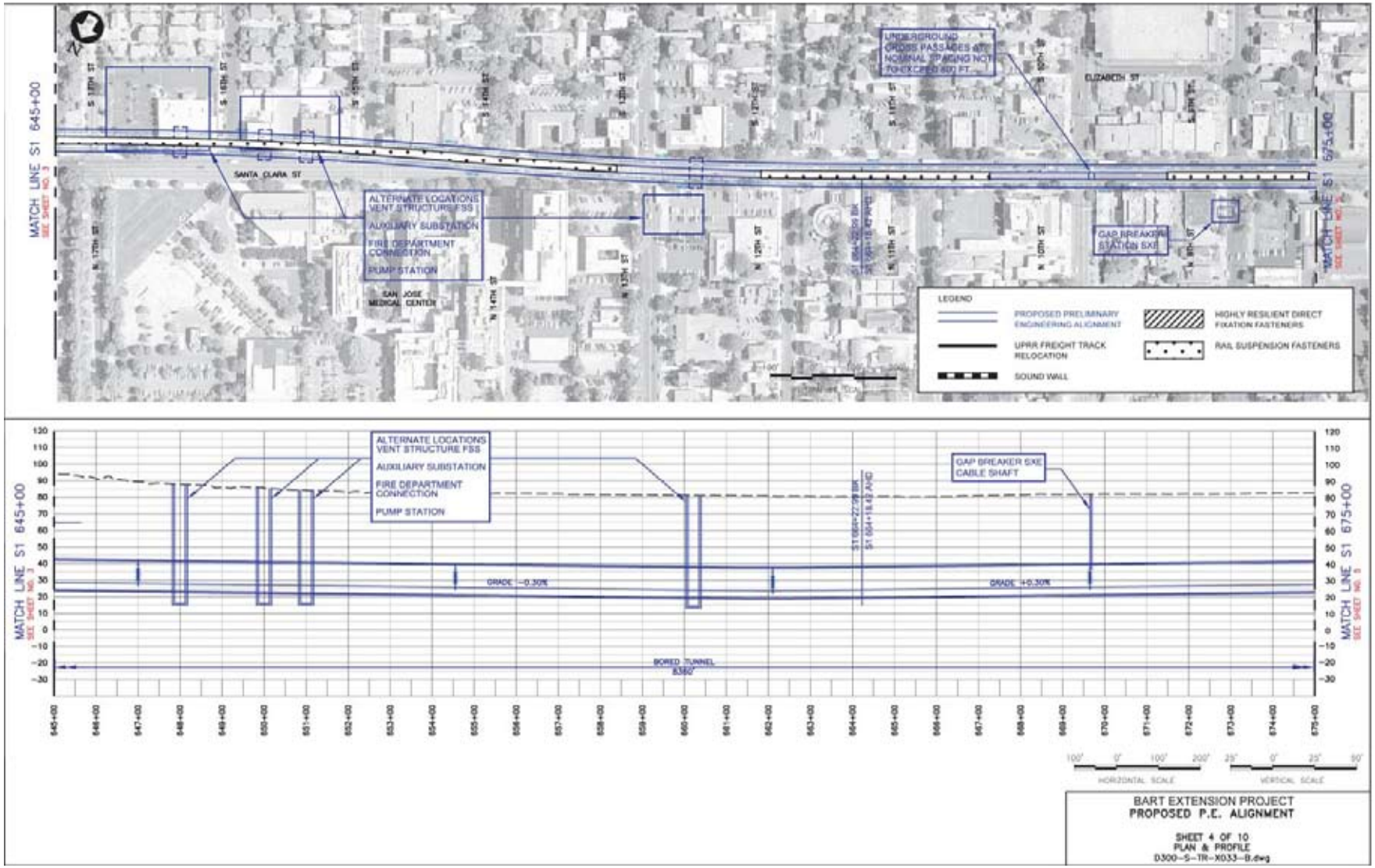

Figure 4.12-3b Noise and Vibration Mitigation for Tunnel Portion

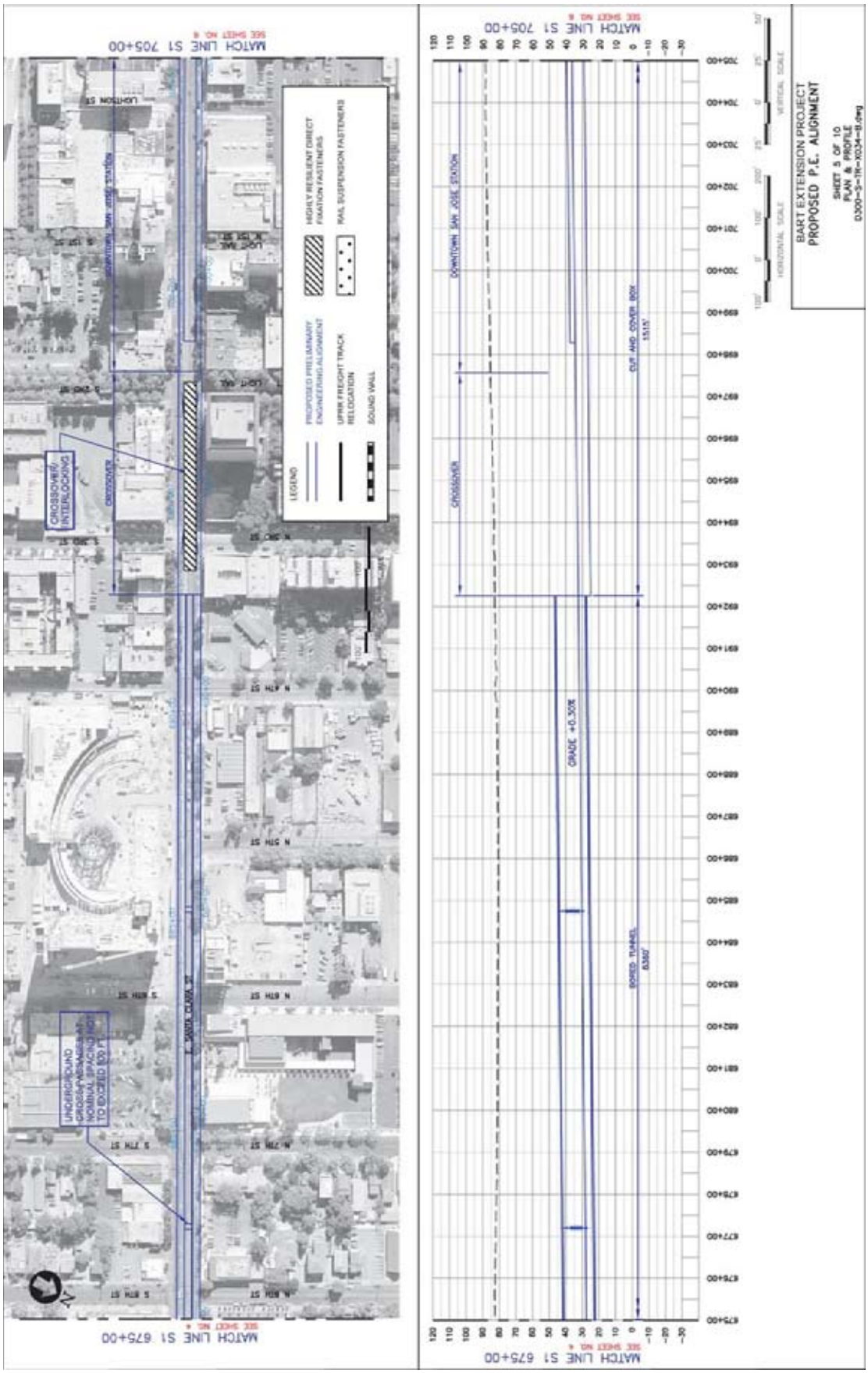

Figure 4.12-3c Noise and Vibration Mitigation for Tunnel Portion

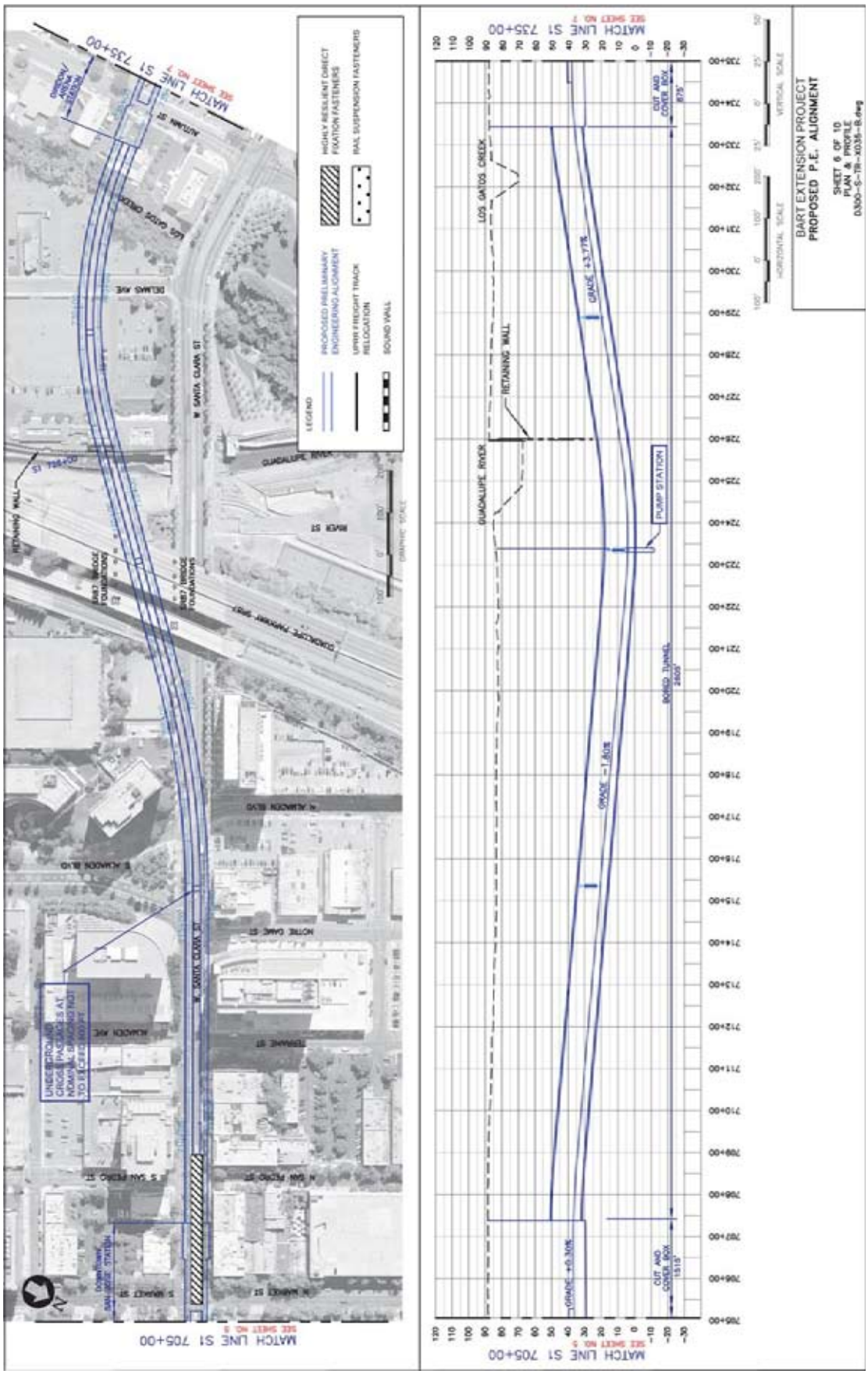

Figure 4.12-3d Noise and Vibration Mitigation for Tunnel Portion

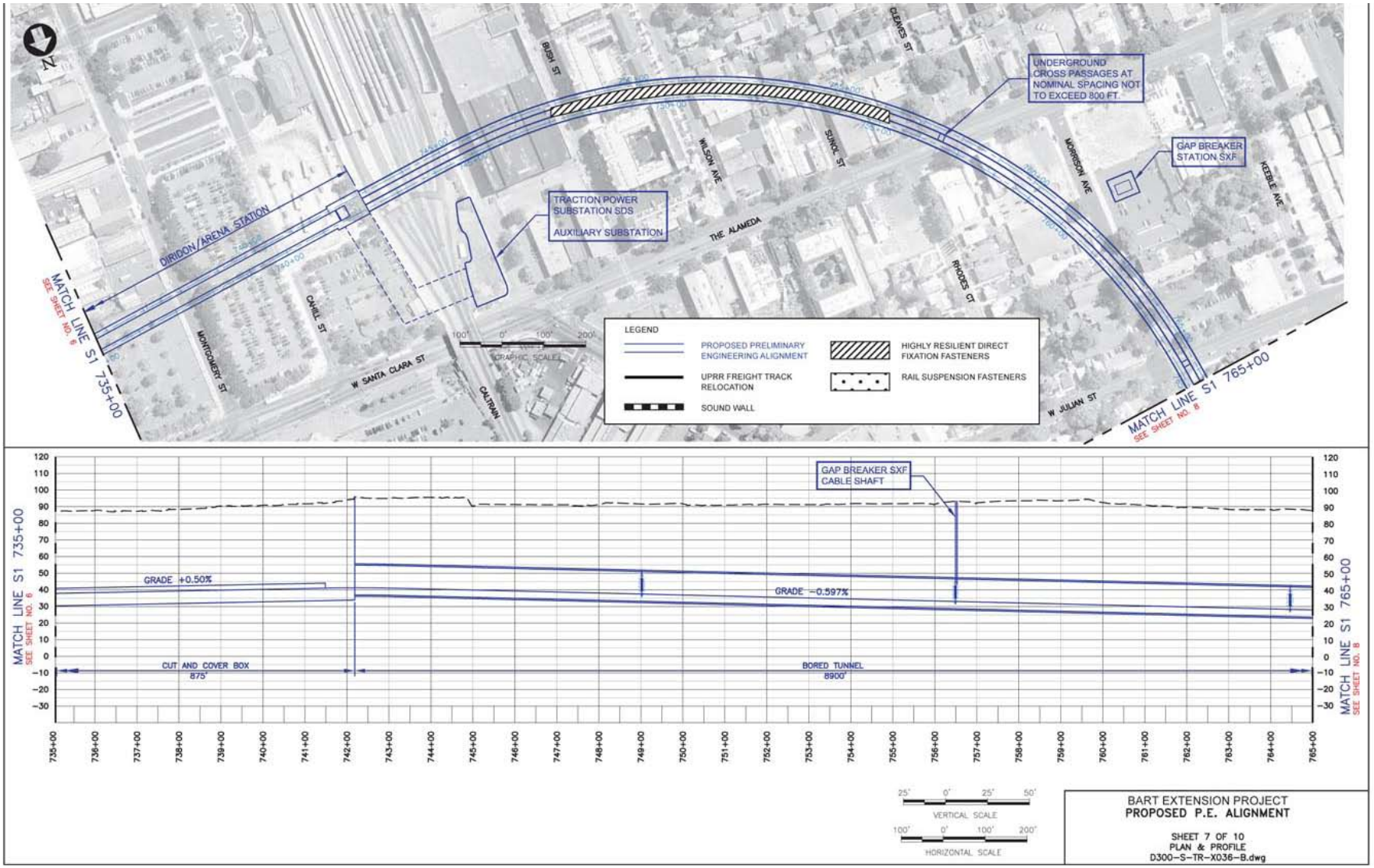

Figure 4.12-3e Noise and Vibration Mitigation for Tunnel Portion

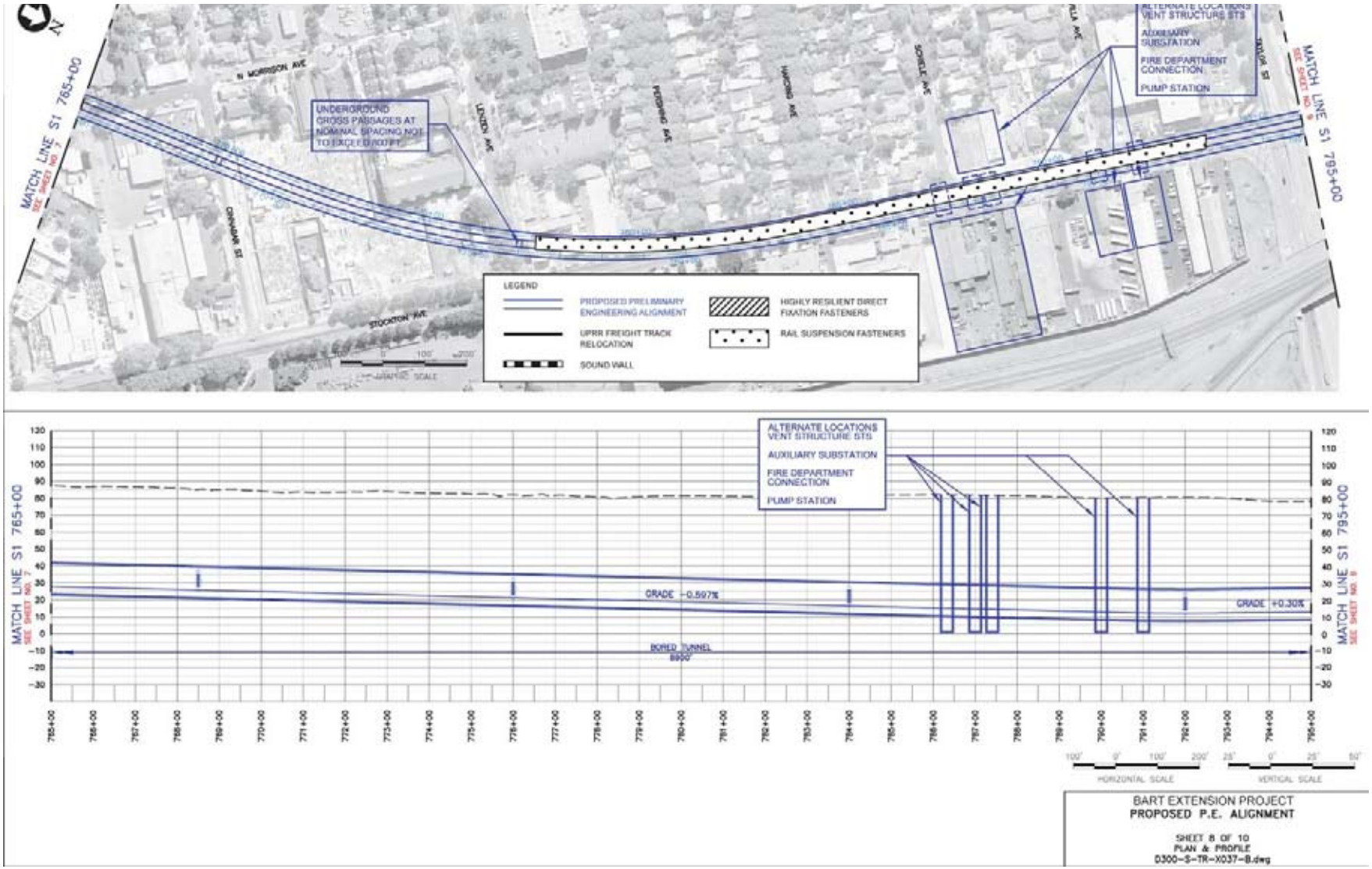

Figure 4.12-3f Noise and Vibration Mitigation for Tunnel Portion

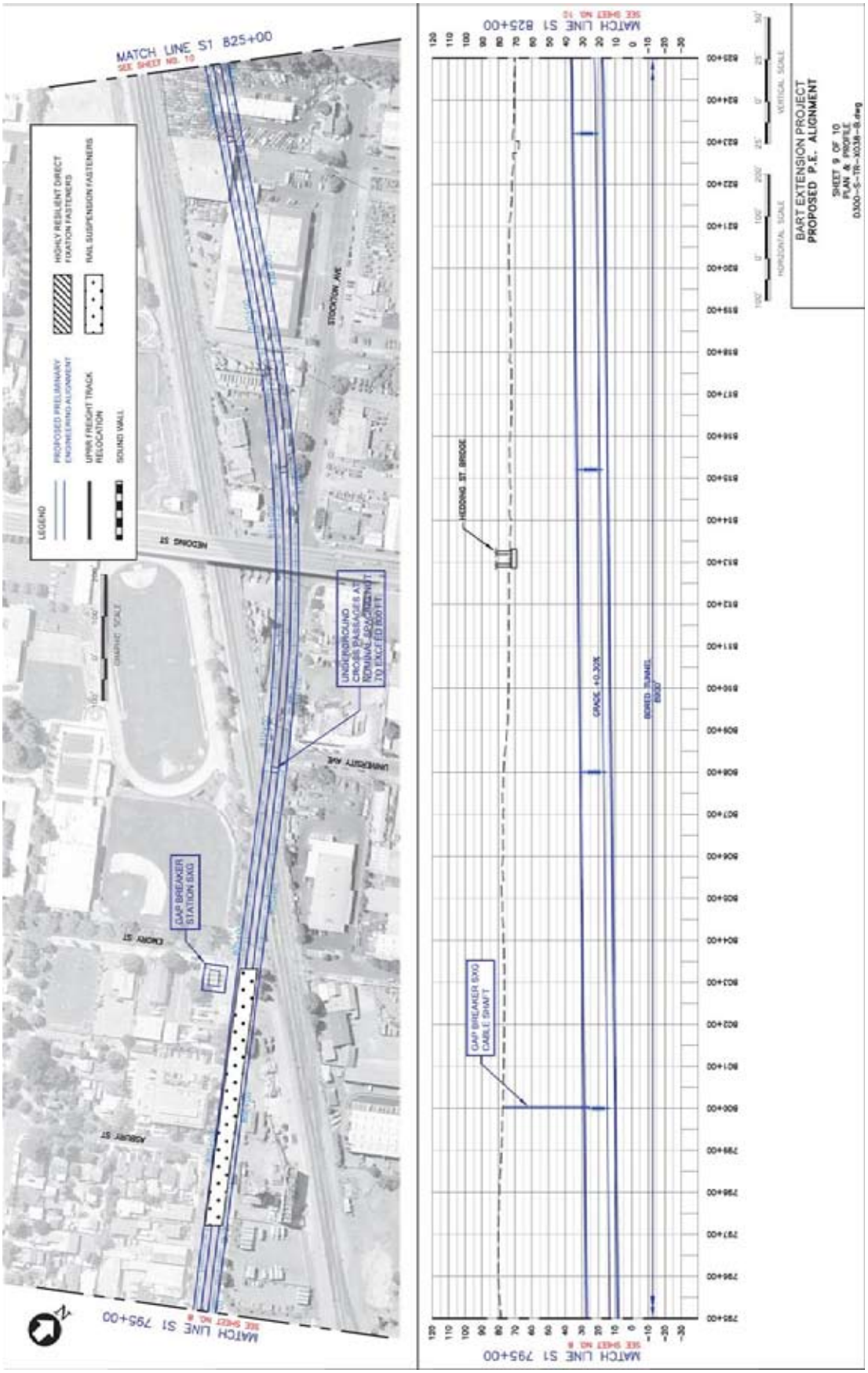

Figure 4.12-3g Noise and Vibration Mitigation for Tunnel Portion

4.12.4.3 Design Changes

Design Change 1. Mission Boulevard/East Warren Avenue Alignment.

Noise

The FEIR did not identify a noise impact based on FTA Criteria at this location from the adopted Project's At-Grade alignment. This was primarily a result of the surrounding industrial land uses that are not noise-sensitive. Additional noise analysis was prepared to address Aerial and Aerial East Options (WIA, 2006a). Surrounding land uses are still industrial and similar to the approved At-Grade alignment, both the Aerial and Aerial East Option do not result in noise impacts.

Vibration

There are no vibration impacts at this location (WIA, 2006b).

Design Change 4. Crossover Tracks near Kato Road.

Noise

The FEIR did not identify crossover tracks near Kato Road. Single crossovers are now proposed both north and south of Kato Road. The crossover south of Kato Road is expected to increase ambient noise levels over nearby residences by approximately 3 dBA. North of Kato Road there are no noise-sensitive land uses and therefore, no additional noise impacts have been identified. South of Kato Road, two new residential projects have been approved by the City of Fremont east of the SVRT alignment. This includes the Castilleja Condominiums and Warm Springs Village. Subsequent noise analysis was prepared to address noise impacts from the new project design and land use change (WIA, 2006a).

Table 4.12-7 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 impacted 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 impacts are associated with the noise from the crossover. To mitigate outdoor severe noise impacts 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 visual impacts. In addition, nine residences would have noise impacts 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 noise impacts 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.

Vibration

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 impacted homes in each area was then estimated by projecting the distance from the alignment where there would be no impact. Two types of vibration mitigation were evaluated: Tire Derived Aggregate Underlayment (TDA) and Floating Slab Track (FST).

Table 4.12-8 summarizes the vibration assessment results with respect to the FTA Criteria. A total of 29 residences would be impacted without mitigation.

As indicated in Table 4.12-8, FST is recommended to reduce train generated vibration for a portion of the proposed Castilleja Condominiums and TDA is recommended 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.

TABLE 4.12-7:

Noise Impact from Crossover Tracks near Kato Road

CIVIL STATION	RECEIVER LOCATION ADDRESS (# and TYPE)	TRACK DIR	SPEED (MPH)	DISTANCE FROM NEAR	TRACK TYPE	EXISTING AMBIENT LDN	PREDICTED CUMULATIVE NOISE LEVELS WITH MITIGATION			
							TOTAL LDN (dBA)	LEVEL INCREASE (dBA)	IMP. TYPE	RECOM MIT.
168+00 to 170+00	Castilleja Condos (4 Single-family)	NB	67	58	FST	61	65	4.0	MI	
170+00 to 172+40	Castilleja Subdivision (4 Single-family)	NB	67 XO	58	FST	61	68	6.8	SI	(1)
172+60	Warm Springs Village (1 Single-family)	NB	67 XO	96	FST	58	63	5.3	MI	
173+50 to 175+60	Warm Springs Village (7 Single-family)	NB	67	92	AG	58	61	2.6	MI	
176+00	Warm Springs Village (1 Single-family)	NB	67	96	AG	57	60	3.1	MI	

KEY:

NB Northbound
SB Southbound
XO Cross-over switch with frog
AG At-Grade Ballast and Tie Track
FST Floating Slab Track on Embankment or At-Grade
NI No Impact as defined by Federal Transit Administration.
MI Moderate Impact
SI Significant Impact defined by FTA.

MITIGATION

(1) A sound wall on the northbound side of BART track, 13 feet from track centerline, 8 feet above the top of rail and extending 330 feet from station 169+50 to 172+80 would partially mitigate ground level receptors.

Source: WIA, Inc. 2006a

TABLE 4.12-8:

Groundborne Vibration from the Crossover near Kato Road

CIVIL STATION	RECEIVER LOCATION	TRACK DIR	SPEED (MPH)	DISTANCE TO NEAR TRACK CL (feet)	TRACK TYPE	FTA DETAILED CRITERIA	MAX 1/3 OCTAVE BAND W/O MITIGATION	# IMPACTS W/OUT MITIGATION	PRELIM. MITIGATION	MAX 1/3 OCTAVE BAND WITH MITIGATION	# IMPACTS WITH MITIGATION
168+00 to 170+00	Castilleja Subdivision	NB	67	58	AG	72	77	8	TDA	71	0
170+00 to 172+40	Castilleja Subdivision	NB	67	58	AG XO	72	86	8	TDA	69	0
172+60	Warm Springs Village	NB	67	96*	AG XO	72	76	1	TDA	68	0
173+50 to 175+60	Warm Springs Village	NB	67	92	AG	72	73	7	TDA	67	0
176+00	Warm Springs Village	NB	67	96	AG	72	73	1	TDA	67	0

**Crossover frog on far track (SB)*

KEY:

NB = North Bound
SB = South Bound
AG = At-Grade ballasted track
XO = Crossover
TDA = Tire Derived Aggregate under ballasted track
FST = 8 Hz Floating Slab Track

Source: WIA, Inc., 2006b

TABLE 4.12-9:

Vibration Mitigation for Crossover near Kato Road

CIVIL STATION	MITIGATION
167+00 to 169+79(1)	Tire Derived Aggregate
169+79(1) to 172+80(1)	8 Hz Floating Slab
172+80(1) to 177+00	Tire Derived Aggregate

(1) Extents of proposed crossover

Source: WIA, Inc. 2006b

Design Change 8. Dixon Landing Road Alignment.

Noise

The Retained Cut and the At-Grade Options are being considered at this location. The impacts from the Retained Cut Option are provided in Table 4.12-10. Table 4.12-1 previously provided the At-Grade Option noise impacts. The Retained Cut Option results in fewer impacts because the alignment is depressed at Dixon Landing Road. Two multi-family buildings (Park Homes at Mayfield and Spinnaker Point Apartments) with approximately 14 residence

units would experience cumulative noise levels in excess of the FTA Criteria. The mitigation necessary to reduce this impact is a sound wall as identified in Table 4.12-11. Residual noise impacts would occur to the second and higher floor levels as the sound wall would not benefit these floors. Approximately 57 residences in nine buildings would require additional noise insulation.

The At-grade Dixon Landing Road design requires Dixon Landing Road to be reconstructed as an underpass so BART vehicles and trains are grade separated. This is an additional benefit as it would eliminate the need for train engineers to sound horns at Dixon Landing Road as they are required to do for at-grade crossings.

Vibration

Table 4.12-12 provides the Retained Cut Option groundborne vibration impacts. Vibration impacts are projected to occur at the Spinnaker Point Apartments (one building and an estimated six residential units) and at Friendly Village and Mobilodge of Milpitas (18 mobile homes located further south). This compares to At-Grade Option impacts at the Park Homes at Mayfield (seven attached residences), at Spinnaker Point (four buildings and an estimated 20 residences) and 32 mobile homes. These impacts would be mitigated floating slab and tire derived aggregate as identified in Table 4.12-13.

TABLE 4.12-10:

Noise Impact for Retained Cut Option at Dixon Landing Road

CIVIL STATION	RECEIVER LOCATION ADDRESS (# and TYPE)	TRACK DIR	SPEED (MPH)	DISTANCE FROM NEAR	TRACK TYPE	EXISTING AMBIENT LDN	PREDICTED CUMULATIVE NOISE LEVELS WITH MITIGATION			
							TOTAL LDN (dBA)	LEVEL INCREASE (dBA)	IMP. TYPE	RECOM MIT.
176+50 to 180+00	Park Homes at Mayfield (3 Multi-family)	NB	67	157	AG	57	61	4.8	MI	
180+60 to 182+00	Park Homes at Mayfield (1 Multi-family)	NB	67	132	AG	57	63	5.5	MI	(1)
182+50	Spinnaker Point Apartments (1 Multi-family)	NB	67	38	RC	57	63	6.0	MI	(3)
184+00	Spinnaker Point Apartments (1 Multi-family)	NB	67	75	RC	57	60	2.9	MI	
184+50 to 186+00	Spinnaker Point Apartments (1 Multi-family)	NB	67	95	RC	57	59	2.2	NI	
186+00 to 188+00	Spinnaker Point Apartments (1 Multi-family)	NB	67	95	RC	57	59	2.1	NI	
189+50 to 191+00	Spinnaker Point Apartments (2 Multi-family)	NB	67	42	RC	59	62	2.8	MI	
198+00 to 199+00	Mill Creek Apartment (2 Multi-family)	SB	67	210	RC	63	64	0.7	NI	
192+50 to 194+20	Friendly Village Mobile Homes (4 Single-family)	NB	67	49	RC	59	61	2.5	MI	

CIVIL STATION	RECEIVER LOCATION ADDRESS (# and TYPE)	TRACK DIR	SPEED (MPH)	DISTANCE FROM NEAR	TRACK TYPE	EXISTING AMBIENT LDN	PREDICTED CUMULATIVE NOISE LEVELS WITH MITIGATION			
							TOTAL LDN (dBA)	LEVEL INCREASE (dBA)	IMP. TYPE	RECOM MIT.
194+20 to 196+20	Friendly Village Mobile Homes (5 Single-family)	NB	67	49	RC	57	60	3.5	MI	
196+20 to 198+50	Friendly Village Mobile Homes (5 Single-family)	NB	67	49	RC	57	60	3.5	MI	
198+50 to 200+50	Friendly Village Mobile Homes (5 Single-family)	NB	67	49	RC	57	61	3.5	MI	
201+50	Friendly Village Mobile Homes (1 Single-family)	NB	67	49	RC	57	61	3.5	MI	
202+50 to 207+00	Milpitas Mobilodge, N Milpitas Blvd (11 Single-family)	NB	67	49	AG	57	60	3.0	MI	
207+50 to 208+00	Milpitas Mobilodge, N Milpitas Blvd (1 Single-family)	NB	67	52	AG	57	60	2.9	MI	
208+00 to 209+00	Jurgens Drive (1 Single-family)	SB	67	185	AG	63	64	1.1	NI	
209+00 to 213+00	Pacifica Way (8 Single-family)	SB	67	185	AG	63	64	1.4	NI	

Noise levels predicted for ground level receptors

KEY:

NB Northbound
SB Southbound
XO Cross-over switch with frog
EM Embankment Ballast and Tie Track
AG At-Grade Ballast and Tie Track
RC Retained Open Cut
FST Floating Slab Track on Embankment or At-Grade
NI No Impact as defined by Federal Transit Administration.
MI Moderate Impact

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) Top of retaining wall on Embankment, north side of BART track (13 ft from track centerline)
(6) Bridge sound wall, north side of BART track (10 ft from track centerline)
(7) Bridge sound wall, south side of BART track (10 ft from track centerline)
(8) Sound Absorptive Material
(9) UPRR at-grade sound wall, south of UPRR track (16 feet from track centerline)

Source: WIA, Inc. 2006a

TABLE 4.12-11:

Noise Mitigation for Retained Cut Option at Dixon Landing Road

CIVIL STATION		DIRECTION	DISTANCE FROM TRACK CL TO SOUND WALL (feet)	SIDE OF TRACK	RECOMMENDED SOUND WALL HEIGHT ABOVE TOP OF RAIL (feet)	LENGTH (feet)
BEGIN	END					
180+50	184+00	NB	10	S2	8	350

Source: WIA, Inc. 2006b

TABLE 4.12-12:

Groundborne Vibration for Retained Cut Option at Dixon Landing Road

CIVIL STATION	RECEIVER LOCATION	TRACK DIR	SPEED (MPH)	DISTANCE TO NEAR TRACK CL (feet)	DEPTH TO TOP OF RAIL (feet)	TRACK TYPE	FTA DETAILED CRITERIA	MAX 1/3 OCTAVE BAND W/O MITIGATION	# IMPACTS W/OUT MITIGATION	PRELIM. MITIGATION	MAX 1/3 OCTAVE BAND WITH MITIGATION	# IMPACTS WITH MITIGATION
182+50	Spinnaker Point Apartments	NB	67	38	1	RC	72	75	6	FST	67	0
198+50 to 200+50	Friendly Village Mobile Homes	NB	67	49	4	RC	72	75	5	FST	63	0
201+50	Friendly Village Mobile Homes	NB	67	49	1	RC	72	75	1	FST	63	0
202+50 to 204+20	Milpitas Mobilodge, N Milpitas Blvd	NB	67	49	—	AG	72	78	4	TDA	72	0
204+20 to 207+00	Milpitas Mobilodge, N Milpitas Blvd	NB	67	49	—	AG	72	78	7	TDA	72	0
207+50 to 208+00	Milpitas Mobilodge, N Milpitas Blvd	NB	67	52	—	AG	72	77	1	TDA	71	0

KEY:
NB = North Bound
AG = At-Grade ballasted track
RC = Retained Open Cut
TDA = Tire Derived Aggregate under ballasted track
FST = 8 Hz Floating Slab Track

Source: WIA, Inc. 2006b

TABLE 4.12-13:

Vibration Mitigation for Retained Cut Option at Dixon Landing Road

CIVIL STATION	MITIGATION
181+50 to 183+60	8 Hz Floating Slab (1)
197+50 to 204+20	8 Hz Floating Slab (1)
204+20 to 209+00	Tire Derived Aggregate (1)

(1) 8Hz floating slab or tire derived aggregate or a comparable mitigation.

Source: WIA, Inc. 2006b

Design Change 10. Crossover Tracks Between Berryessa Creek and Railroad Court.

Noise

In the FEIR, a crossover track was located near Railroad Court (STA 267) and less than 50 feet from a residence to the east. The design change moves the crossover to the north (STA 258) and approximately 245 feet to the closest residence. Therefore, this design change reduces noise impacts such that they will be less than significant.

Vibration

As described for noise above, the design change reduces vibration impact by relocating the crossover 245 feet from the closest residence.

Design Change 14. Curtis Avenue to Trade Zone Boulevard.

Noise

Four options (Retained Cut Long, Aerial Long, Retained Cut Short, and Aerial Short) are being considered in the SEIR at this location. To make a valid comparison of the options, the option lengths have been normalized to the same length. The northern end has been defined by the northern end of the Retained Cut Short Option. Similarly, the southern end has been defined by the southern end of the Aerial Short Option. Table 4.12-14 presents a summary of the number of impacted land uses for each of the four options. The greatest number of impacts occurs for the Aerial Options, whereas the Retain Cut Options results in the least number of impacts.

TABLE 4.12-14:

Noise Impact Comparison between Alignment Options

ALIGNMENT OPTIONS	SINGLE-FAMILY RESIDENCES	MULTI-FAMILY RESIDENCES		TOTAL BUILDINGS	TOTAL INDIVIDUAL UNITS
		NUM OF BUILDINGS	NUM OF UNITS		
Long Retained Cut – Baseline	1	5	18	6	19
Long Aerial	18	11	50	29	68
Short Retained Cut	1	5	18	6	19
Short Aerial	13	11	57	24	70

Source: WIA, Inc. 2006a

Table 4.12-15 presents a summary of the noise mitigation required for each of the four options. The aerial options have similar lengths of sound wall necessary to mitigate impacts. The Retained Cut Long Option has the least amount of sound wall required among the four options.

Residences located on the second floor or higher would potentially remain impacted even with the recommended sound wall mitigation, which are considered to be the maximum feasible height. Each structures exterior walls, windows and doors will be assessed to determine the ability of the existing building facades to provide sufficient attenuation of airborne noise to achieve an interior noise level of Ldn 45 or less. Thus, interior noise level would be in accordance with the local noise criteria.

TABLE 4.12-15:

Noise Mitigation for Aerial and Retained Cut Options

APP. CIVIL STATION/ SIDE OF TRACK	LONG RETAINED CUT–BASELINE		LONG AERIAL		SHORT RETAINED CUT		SHORT AERIAL	
	HEIGHT (feet)	LENGTH (feet)	HEIGHT (feet)	LENGTH (feet)	HEIGHT (feet)	LENGTH (feet)	HEIGHT (feet)	LENGTH (feet)
330+00 to 337+50 / S1	12	750	12	750	12	750	12	750
359+50 to 370+00 /S1	—	—	4	1,050	—	—	4	970
402+80 to 412+00 /S2	—	—	4	920	—	—	4	920
412+00 to 416+00 / S2	6	400	5	400	7	400	5	400
TOTAL length of mitigation		1,150		3,120		1,850		3,040

S1- southbound, S2- northbound

Source: WIA, Inc. 2006a

Vibration

A summary of the results of the groundborne vibration impact analyses for the four options is presented in Table 4.12-16. The vibration impact analysis concluded that approximately 32 multi-family residences within four buildings would be impacted by vibration levels in excess of the FTA criteria regardless of the design option selected. The impact is to the Parc Metropolitan Condominiums on the west side of the track.

Floating slab track with a design frequency of 8 Hz is the recommended vibration mitigation for the residences impacted for all of the design options. The approximate length of mitigation needed varies slightly depending upon the option selected due to differences in the track structure at the south end of the Parc Metropolitan Condominium property. The comparison in Table 4.12-17 indicates that the long retained cut option requires the least mitigation while the aerial long option requires the most. In all cases, floating slab track is the recommended mitigation.

Design Change 15. Crossover Tracks North of Montague Expressway. The noise and vibration impacts from the crossover tracks north of Montague Expressway were considered in the discussion of Design Change #14 Curtis Avenue to Trade Zone Boulevard above.

Design Change 16. Electrical Facilities North of Montague Expressway. With the retained cut and aerial long options, a traction power substation would be located in an industrial area that was previously analyzed in the FEIR (STA 366+50). The retained cut and aerial short options locate the substation farther to the north (STA 356+00) also in

an industrial area east of the railroad tracks. Neither the long or short options result in a noise or vibration impact because of a lack of sensitive uses in the area (WIA, 2006d).

TABLE 4.12-16:

Noise Impact for Aerial and Retained Cut Options

ALIGNMENT OPTIONS	SINGLE-FAMILY RESIDENCES	MULTI-FAMILY RESIDENCES		TOTAL BUILDINGS	TOTAL INDIVIDUAL UNITS
		NUM OF BUILDINGS	NUM OF UNITS		
Long Retained Cut – Baseline	0	4	32	4	32
Long Aerial	0	4	32	4	32
Short Retained Cut	0	4	32	4	32
Short Aerial	0	4	32	4	32

Source: WIA, Inc. 2006b

TABLE 4.12-17:

Vibration Mitigation for Aerial and Retained Cut Options

ALIGNMENT OPTIONS	TYPE	CIVIL STATION	LENGTH (feet)
Long Retained Cut–Baseline	FST	331+50 to 337+25	575
Long Aerial	FST	331+50 to 337+80	630
Short Retained Cut	FST	331+50 to 337+40	590
Short Aerial	FST	331+50 to 337+40	590

FST= 8 Hz Floating Slab track

Source: WIA, Inc. 2006b

Design Change 17. Montague/Capitol Station. 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 Montague/Capital 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 cause noise exposure at the Residence Inn that is higher than is currently 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 was included in the FEIR at the south end of the station parking lot. The required height of the wall will be reevaluated after the station layout has been finalized. If the station layout is substantially different than assumed for the FEIR analysis, a different height wall may be appropriate. In any case, the wall will be designed to ensure that the noise impact criteria used in the FEIR will be achieved (ATS Consulting, 2005 and 2006a).

Design Change 18. Depth of Retained Cut South of East Penitencia Channel. The noise and vibration impacts from the depth of retained cut south of East Penitencia Channel were considered in the discussion of Design Change #14 Curtis Avenue to Trade Zone Boulevard above.

Design Change 19. Electrical Facilities South of Trade Zone Boulevard. While the location has not changed, subsequent noise analysis has concluded that sound barrier may be needed at the location depending on Final Design. The sound barrier would be no higher than 8 feet (WIA, 2006d).

Design Change 20. Depth of Retained Cut Hostetter Road to Sierra Road/Lundy Avenue. As stated in the Project description, the depth of the retained cut at this location is less than approved in the FEIR. The existing sound wall and retained cut would reduce noise levels from BART operations. However, noise reflections within the retained cut could result in potential noise impacts for 14 residences on the east side and 23 residences on the west side. Therefore, as shown in Table 4.12-3, sound absorptive material is recommended at this location to reduce noise to acceptable levels (WIA, 2006a).

Design Change 22. Electrical and Communication Facilities near Berryessa Road. By relocating the traction power substation from north of Berryessa Road to south of Berryessa Road and adjacent to the Berryessa Station noise impacts are reduced. The FEIR substation location was near existing residential uses on both side of the trackway. The proposed location has industrial uses to the east and the existing flea market to the west. No noise or vibration impacts would result from this design change (WIA, 2006d).

Design Change 23. Berryessa Station. The closest existing noise sensitive land uses are residential units to the east of the existing railroad tracks. These residences are at least 300 feet from the station platform and therefore would not be exposed to adverse noise impacts from the station activities (ATS Consulting, 2005 and 2006b).

Design Change 24. Crossover Tracks and Pocket Track near Berryessa and Mabury Road. No noise or vibration impacts were previously identified in the FEIR with the three crossover tracks and a pocket track located on the aerial guideway from the Berryessa Station to south of Mabury Road. This design change eliminates the crossover track south of Mabury Road and has minor shifts in the location of the crossover tracks and pocket track. These changes are in a commercial/ industrial area and no new noise or vibration impacts would occur.

Design Change 25. Electrical and Communication Facilities near Mabury Road. No noise or vibration impacts were identified in the FEIR with the high voltage substation located in an industrial area north of Mabury Road and east of the SVRT alignment. Relocating the substation to the south of Mabury Road in an industrial area would similarly not result in a noise or vibration impact.

Design Change 27. Maintenance of Way Siding Track. The maintenance of way siding track would be located in an industrial area and near U.S. 101. Since no noise or vibration sensitive land uses

are located in the area, no significant impacts would result from this design change.

Design Change 31. Gap Breaker Station near Marburg Way. This location is in an industrial area above the tunnel alignment and east of U.S. 101 that is the dominant noise source in the area. Gap breaker stations only operate during maintenance and repair periods or during an emergency to isolate electrified third rail sections. They are not a substantial noise source. Therefore, this design change would not result in new noise impacts. No vibration impacts would result from these electrical facilities.

Design Change 32. US 101 Alignment. This design change shifts the tunnel alignment further to the east of U.S. 101 into an industrial area and further to the south as the alignment approaches Santa Clara Street. This change results in the tunnel passing beneath fewer residences near Santa Clara Street. No groundborne noise impacts occurred previously nor will occur with this design change. Similarly, no vibration impacts would occur with this design change (WIA, 2006c).

Design Change 33. Alum Rock Station. The Alum Rock Station will be underground with parking and potential future transit facilities located above ground. Five Wounds Church and school are located southeast of the site and there is a mixed residential/commercial area to the east. Major existing noise sources include traffic on the U.S. 101, Julian Street, and Santa Clara Street. The primary station activity that could cause intrusive noise at the church and school is the bus stop at the southeast corner of the station site. The existing 6-foot high property line wall would be sufficient to avoid adverse noise impacts at the church and school buildings from the buses using the bus stop. The residential uses to the east are shielded by the commercial buildings located between 27th and 28th streets. Because of the existing noise levels, station noise would not result in a noise impact (ATS Consulting, 2005 and 2006b). In addition, the vent shafts are not near any noise-sensitive land uses and would not result in a noise impacts (WIA, 2006d).

Design Change 34. Gap Breaker Station near 22nd Street. This location is in a commercial area. Gap breaker stations only operate during maintenance and repair periods or during an emergency to isolate electrified third rail sections. They are also not a substantial noise source. Therefore, this design change would not result in new noise impacts. No vibration impacts would result from these electrical facilities.

Design Change 36. Ventilation Structure West of Coyote Creek. None of the four alternate locations for a ventilation structure west of Coyote Creek is anticipated to result in an adverse noise impact. However, the design will include provisions for a 7-foot long sound attenuator inline between the fan and surface at each of the 4 alternate locations to ensure compliance with the FTA Criteria (WIA, 2006d).

Design Change 37. Gap Breaker Station near 9th Street. This location is underground, in a commercial area. Gap breaker stations only operate during maintenance and repair periods or during an emergency to isolate electrified third rail sections. They are also not a substantial noise source. Therefore, this design change would not result in new noise impacts. No vibration impacts would result from these electrical facilities.

Design Change 39. Downtown San Jose Crossover. The Downtown San Jose Crossover is located in a commercial area. This design change would not result in a new noise impact. This change would also not result in a vibration impact.

Design Change 40. Downtown San Jose Station. The Downtown San Jose Station is underground and would not result in any adverse noise impacts (ATS Consulting, 2005 and 2006a). In addition, the vent shafts are not near any noise-sensitive land uses and would not result in an adverse noise impact (WIA, 2006d).

Design Change 42. Diridon/Arena Station and Alignment. The Diridon/Arena Station is located in an urban area characterized by commercial use (including the HP Pavilion events center), transportation facilities (railroad, transit center, and Highway 87), and aircraft overflights to and from Norman Y. Mineta International Airport (SJIA). No adverse noise impacts would result from this station due to the high background noise levels (ATS Consulting, 2005 and 2006a). In addition, the vent shafts are not near any noise-sensitive land uses and would not result in an adverse noise impact (WIA, 2006d).

Design Change 43. Traction Power Substation near Diridon/Arena Station. Residential uses are located to the southwest of this traction power substation. Noise levels are projected to exceed the criteria and therefore mitigation is required. An 8-foot high sound wall will reduce noise impacts to acceptable levels (WIA, 2006d).

Design Change 44. Gap Breaker Station near Morrison Avenue. This gap breaker would be located in an existing parking lot. Gap breaker stations only operate during maintenance and repair periods or during an emergency to isolate electrified third rail sections. They are also not a substantial noise source. Therefore, this design change would not result in new noise impacts. No vibration impacts would result from these electrical facilities.

Design Change 45. Ventilation Structure near Stockton Avenue. There are five alternate locations for a ventilation structure near Stockton Avenue. The alternative location on the northwest corner of Stockton and Schiele avenues is adjacent to residential land uses. Noise impacts would occur if not mitigated. Mitigation at this location will include a 10-foot long sound attenuator inline between the fan and surface and potentially a sound barrier to reduce the noise to below the criteria. The four other alternate locations also require mitigation including a 7-foot long sound attenuator and potentially a sound barrier to reduce the noise to below the criteria (WIA, 2006d).

Design Change 46. Gap Breaker Station near Emory Street. This gap breaker would be located in an existing parking lot. Gap breaker stations only operate during maintenance and repair periods or during an emergency to isolate electrified third rail sections. They are also not a substantial noise source. Therefore, this design change would not result in new noise impacts. No vibration impacts would result from these electrical facilities.

Design Change 47. Tunnel Alignment near Hedding Street. This alignment change shifts the tunnel under industrial land uses to the east of FEIR alignment with the west tunnel portal also shifted further to the north. There are no noise or vibration sensitive land uses located in this area. No noise or vibration impacts were previously identified in this area and this design change results in similar conclusions.

Design Change 49. Depth of Tunnel Bores. The impacts from this design change are addressed in the previous noise and groundborne noise and vibration impact and mitigation discussions.

Design Change 50. Crossover Tracks near the West Tunnel Portal. The crossover track is located in the yard with industrial uses to the south, east and north. Across the railroad tracks to the west are residential uses. While noise and vibration levels increase at crossover locations, existing noise and vibration levels in the area are dominated by passenger movements on the mainline and aircraft operations from SJIA. Therefore, this design change would not result in a significant impact.

Design Change 51. Yard and Shops Facility. There are a number of noise generating activities associated with the yard including transfer track train movements, train movements on storage tracks, hi-rail vehicles moving trains, carwash, cleaning/blow-down facility, outdoor maintenance, noise from maintenance shops, use of audible warnings, vehicle turntable and vehicular traffic into and out of the facility. However, the nearest noise-sensitive land use is a motel across the existing railroad tracks to the

west. The conclusion of the yard and shops facility noise analysis was that noise will be similar to, but substantially less than, the noise from various types of existing train equipment operating on the mainline tracks today (ATS Consulting, 2006b and 2006c).

Design Change 52. Santa Clara Station. The Santa Clara Station site is located in an area surrounded with rail and commercial land uses. The nearest noise-sensitive land use is a motel across the existing railroad tracks to the west and over 300 feet from the station. Because of the high background noise from the railroad activities and airport and the distance separation, station activities would not result in noise impacts (ATA Consulting, 2005 and 2006a).

CONCLUSION

Noise impacts to the first floor of residences can be mitigated with sound walls and sound absorptive material on retaining walls. The second floor and higher floors of impacted areas can be mitigated with additional sound insulation.

Vibration impacts can be mitigated with tire derived aggregate and floating slab or equivalent measures except for two residences at the Terrace Gardens Senior Housing complex. Vibration impacts would exceed the FTA criteria by 1 VdB even with mitigation.