Appendix E

Noise Modeling Data

Long-Term Noise Measurement Summary

KEY: Orange cells are for input.
Grey cells are intermediate calculations performed by the model.
Green cells are data to present in a written analysis (output).

Measurement Site: south side of Capitol Building nearest N and 12 th street.
Measurement Date: 6/4/2019 through 6/5/2019
Project Name: Capitol Annex

Hour of Day (military time)	Sound Level Leq (dBA)	Sound Power =10*Log(dBA/10)	Computation of CNEL: Period of 24-Hour Day (1=included, 0=not)			Sound Power Breakdown by Period of Day		
			Day	Evening	Night	Day	Evening	Night
0:00	48.6	72,444	0	0	1	0	0	72,444
1:00	47.7	58,884	0	0	1	0	0	58,884
2:00	47.9	61,660	0	0	1	0	0	61,660
3:00	48.9	77,625	0	0	1	0	0	77,625
4:00	50.4	109,648	0	0	1	0	0	109,648
5:00	50.0	100,000	0	0	1	0	0	100,000
6:00	52.3	169,824	0	0	1	0	0	169,824
7:00	60.3	1,071,519	1	0	0	1,071,519	0	0
8:00	55.2	331,131	1	0	0	331,131	0	0
9:00	52.2	165,959	1	0	0	165,959	0	0
10:00	53.9	245,471	1	0	0	245,471	0	0
11:00	53.2	208,930	1	0	0	208,930	0	0
12:00	51.9	154,882	1	0	0	154,882	0	0
13:00	51.0	125,893	1	0	0	125,893	0	0
14:00	50.7	117,490	1	0	0	117,490	0	0
15:00	51.3	134,896	1	0	0	134,896	0	0
16:00	53.2	208,930	1	0	0	208,930	0	0
17:00	51.2	131,826	1	0	0	131,826	0	0
18:00	50.4	109,648	1	0	0	109,648	0	0
19:00	49.2	83,176	0	1	0	0	83,176	0
20:00	49.4	87,096	0	1	0	0	87,096	0
21:00	49.9	97,724	0	1	0	0	97,724	0
22:00	52.1	162,181	0	0	1	0	0	162,181
23:00	50.3	107,152	0	0	1	0	0	107,152

	Day	Evening	Night
Sum of Sound Power during Period wo/penalty	3,006,573	267,996	919,417
Log Factor for CNEL Penalty (i.e., 10*log(x))	1	3	10
Sound Power during Period with penalty	3,006,573	803,989	9,194,173

Total Daily Sound Power, with penalties	13,004,735
Hours per Day	24
Average Hourly Sound Power, with penalties	541,864
CNEL	57.3

Ldn computation on next page.

Computation of Ldn

Period of 24-Hour Day (1=included, 0=not)		Sound Power Breakdown by Period of Day	
Day	Night	Day	Night
0	1	0	72,444
0	1	0	58,884
0	1	0	61,660
0	1	0	77,625
0	1	0	109,648
0	1	0	100,000
0	1	0	169,824
1	0	1,071,519	0
1	0	331,131	0
1	0	165,959	0
1	0	245,471	0
1	0	208,930	0
1	0	154,882	0
1	0	125,893	0
1	0	117,490	0
1	0	134,896	0
1	0	208,930	0
1	0	131,826	0
1	0	109,648	0
1	0	83,176	0
1	0	87,096	0
1	0	97,724	0
0	1	0	162,181
0	1	0	107,152

	Day	Night
Sum of Sound Power during Period wo/penalty	3,274,569	919,417
Log Factor for Penalty (i.e., 10*log(x))	1	10
Sound Power during Period with penalty	3,274,569	9,194,173

Total Daily Sound Power, with penalties	12,468,742
Hours per Day	24
Average Hourly Sound Power, with penalties	519,531
Ldn	57.2

Notes:

Computation of the CNEL based on 1-hour Leq measurements for each hour of a day are based on equation 2-27 on pg. 2-57 of Caltrans 2009.

Computation of the Ldn based on 1-hour Leq measurements for each hour of a day are based on equation 2-26 on pg. 2-56 of Caltrans 2009.

Log factors for the Ldn and CNEL penalties are provided in Table 2-12 on pg. 2-52 of Caltrans 2009.

Source:

California Deaprtment of Transportation (Caltrans), Divisiong of Environmental Analysis. 2009 (November). *2009 Technical Noise Supplement* . Sacramento, CA. Available: <http://www.dot.ca.gov/hq/env/noise/>. Accessed September 24, 2010.

Site Preparation

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
Threshold	1,333	50.0
Residence 1	25	93.6
Residence 2	50	85.6

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Dump Truck	84	0.4
Hydra Break Ram	90	0.1
Front End Loader	80	0.4
Grapple (on Backhoe)	85	0.2
Shears (on backhoe)	85	0.2

Ground Type	Soft
Source Height	8
Receiver Height	5
Ground Factor[2]	0.63

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Dump Truck	80.0
Hydra Break Ram	80.0
Front End Loader	76.0
Grapple (on Backhoe)	78.0
Shears (on backhoe)	78.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
85.6

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Site Preparation

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
Threshold	2,618	50.0
Residence 1	25	100.9
Residence 2	50	93.0

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Dump Truck	84	1
Hydra Break Ram	90	1
Front End Loader	80	1
Grapple (on Backhoe)	85	1
Shears (on backhoe)	85	1

Ground Type	Soft
Source Height	8
Receiver Height	5
Ground Factor[2]	0.63

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Dump Truck	84.0
Hydra Break Ram	90.0
Front End Loader	80.0
Grapple (on Backhoe)	85.0
Shears (on backhoe)	85.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
93.0

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Night Cable Crossing Equipment

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
Threshold	990	55.0
jesse	200	71.6
senator	350	65.2
LOB/Caltrans	100	79.5
Thayer Apt.	500	61.1

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Excavator	85	0.4
Grader	85	0.4
Dump Truck	84	0.4
Front End Loader	80	0.4
Scraper	85	0.5

Ground Type	soft
Source Height	8
Receiver Height	5
Ground Factor[2]	0.63

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Excavator	81.0
Grader	81.0
Dump Truck	80.0
Front End Loader	76.0
Scraper	82.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
87

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Night Cable Crossing Equipment

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
Threshold	350	70.0
Jesse	200	75.3
Senator	350	68.9
LOB/Caltrans	100	83.2
Thayer Apt.	500	64.8

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Excavator	85	1
Grader	85	1
Dump Truck	84	1
Front End Loader	80	1
Scraper	85	1

Ground Type	soft
Source Height	8
Receiver Height	5
Ground Factor[2]	0.63

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Excavator	85.0
Grader	85.0
Dump Truck	84.0
Front End Loader	80.0
Scraper	85.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
91

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Day Cable Crossing Equipment (no helicopter)

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
Threshold	1,236	50.0
Residence 1	600	56.4
Residence 2	100	76.9

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Crane	85	0.16
Pneumatic Tools	85	0.5
Pickup Truck	55	0.4
Auger Drill Rig	85	0.2
Concrete Pump Truck	82	0.2
Welder / Torch	73	0.5

Ground Type	soft
Source Height	8
Receiver Height	5
Ground Factor[2]	0.63

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Crane	77.0
Pneumatic Tools	82.0
Pickup Truck	51.0
Auger Drill Rig	78.0
Concrete Pump Truck	75.0
Welder / Torch	70.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
84.8

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Day Cable Crossing Equipment (no helicopter)

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
Threshold	908	50.0
Hyatt	200	65.6
		#NUM!

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Flat Bed Truck	84	0.4
Pickup Truck	55	0.4
Front End Loader	80	0.4

Ground Type	soft
Source Height	8
Receiver Height	5
Ground Factor[2]	0.63

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Flat Bed Truck	80.0
Pickup Truck	51.0
Front End Loader	76.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
81.5

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Day Cable Crossing Equipment (no helicopter)

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
Threshold	2,074	50.0
Residence 1	100	82.5
Residence 2	100	82.5

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Crane	85	1
Pneumatic Tools	85	1
Pickup Truck	55	1
Auger Drill Rig	85	1
Concrete Pump Truck	82	1
Welder / Torch	73	1

Ground Type	soft
Source Height	8
Receiver Height	5
Ground Factor[2]	0.63

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Crane	85.0
Pneumatic Tools	85.0
Pickup Truck	55.0
Auger Drill Rig	85.0
Concrete Pump Truck	82.0
Welder / Torch	73.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
90.4

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Day Cable Crossing Equipment (no helicopter)

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
Threshold	1,310	50.0
Hyatt	200	69.6
		#NUM!

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Flat Bed Truck	84	1
Pickup Truck	55	1
Front End Loader	80	1

Ground Type	soft
Source Height	8
Receiver Height	5
Ground Factor[2]	0.63

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Flat Bed Truck	84.0
Pickup Truck	55.0
Front End Loader	80.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
85.5

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Day Cable Crossing Equipment (no helicopter)

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
Threshold	1,402	50.0
Hyatt	200	70.3
Thayer	500	59.9

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Concrete Mixer Truck	85	1
Drum Mixer	80	1
Pickup Truck	55	1

Ground Type	soft
Source Height	8
Receiver Height	5
Ground Factor[2]	0.63

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Concrete Mixer Truck	85.0
Drum Mixer	80.0
Pickup Truck	55.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
86.2

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Day Cable Crossing Equipment (no helicopter)

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
Threshold	908	50.0
Hyatt	200	65.6
Thayer	500	55.1

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Flat Bed Truck	84	0.4
Pickup Truck	55	0.4
Front End Loader	80	0.4

Ground Type	soft
Source Height	8
Receiver Height	5
Ground Factor[2]	0.63

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Flat Bed Truck	80.0
Pickup Truck	51.0
Front End Loader	76.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
81.5

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Attenuation Calculations for Stationary Noise Sources

ASCENT ENVIRONMENTAL

KEY: Orange cells are for input.

Grey cells are intermediate calculations performed by the model.

Green cells are data to present in a written analysis (output).

STEP 1: Identify the noise source and enter the reference noise level (dBA and distance).

STEP 2: Select the ground type (hard or soft), and enter the source and receiver heights.

STEP 3: Select the distance to the receiver.

Noise Source/ID	Reference Noise Level			Attenuation Characteristics				Attenuated Noise Level at Receptor		
	noise level (dBA)	@	distance (ft)	Ground Type (soft/hard)	Source Height (ft)	Receiver Height (ft)	Ground Factor	noise level (dBA)	@	distance (ft)
Helicopter	68.0	@	492	soft	6	5	0.65	94.3	@	50
chipper	99.0	@	3	soft	6	5	0.65	67.7	@	50
blasting (night lmax)	94.0	@	50	soft	6	5	0.65	65.0	@	620
helicopter (night leq)	68.0	@	492.00	soft	6	5	0.65	45.1	@	3600
blasting (day lmax)	94.0	@	50	soft	6	5	0.65	70.1	@	400
helicopter (day leq)	68.0	@	492	soft	6	5	0.65	55.0	@	1520
Blasting (SF Res)	94.0	@	50	soft	6	5	0.65	79.6	@	175
blasting	94.0	@	50	soft	6	5	0.65	86.0	@	100
							0.66			
							0.66			
							0.66			
							0.66			
							0.66			
							0.66			

Notes:

Estimates of attenuated noise levels do not account for reductions from intervening barriers, including walls, trees, vegetation, or structures of any type.

Computation of the attenuated noise level is based on the equation presented on pg. 12-3 and 12-4 of FTA 2006.

Computation of the ground factor is based on the equation presentd in Figure 6-23 on pg. 6-23 of FTA 2006, where the distance of the reference noise leve can be adjusted and the usage factor is not applied (i.e., the usage factor is equal to 1).

Sources:

Federal Transit Association (FTA). 2006 (May). Transit Noise and Vibration Impact Assessment. FTA-VA-90-1003-06. Washington, D.C. Available: <http://www.fta.dot.gov/documents/FTA_Noise_and_Vibration_Manual.pdf>. Accessed: September 24, 2010.

Equipment Description	Acoustical Usage Factor (%)	Spec 721.560 Lmax @ 50ft (dBA slow)	Actual Measured Lmax @ 50ft (dBA slow)	No. of Actual Data Samples (count)	Spec 721.560 LmaxCalc	Spec 721.560 Leq	Distance	Actual Measured LmaxCalc	Actual Measured Leq
Auger Drill Rig	20	85	84	36	79.0	72.0	100	78.0	71.0
Backhoe	40	80	78	372	74.0	70.0	100	72.0	68.0
Bar Bender	20	80	na	0	74.0	67.0	100		
Blasting	na	94	na	0	88.0		100		
Boring Jack Power Unit	50	80	83	1	74.0	71.0	100	77.0	74.0
Chain Saw	20	85	84	46	79.0	72.0	100	78.0	71.0
Clam Shovel (dropping)	20	93	87	4	87.0	80.0	100	81.0	74.0
Compactor (ground)	20	80	83	57	74.0	67.0	100	77.0	70.0
Compressor (air)	40	80	78	18	74.0	70.0	100	72.0	68.0
Concrete Batch Plant	15	83	na	0	77.0	68.7	100		
Concrete Mixer Truck	40	85	79	40	79.0	75.0	100	73.0	69.0
Concrete Pump Truck	20	82	81	30	76.0	69.0	100	75.0	68.0
Concrete Saw	20	90	90	55	84.0	77.0	100	84.0	77.0
Crane	16	85	81	405	79.0	71.0	100	75.0	67.0
Dozer	40	85	82	55	79.0	75.0	100	76.0	72.0
Drill Rig Truck	20	84	79	22	78.0	71.0	100	73.0	66.0
Drum Mixer	50	80	80	1	74.0	71.0	100	74.0	71.0
Dump Truck	40	84	76	31	78.0	74.0	100	70.0	66.0
Excavator	40	85	81	170	79.0	75.0	100	75.0	71.0
Flat Bed Truck	40	84	74	4	78.0	74.0	100	68.0	64.0
Front End Loader	40	80	79	96	74.0	70.0	100	73.0	69.0
Generator	50	82	81	19	76.0	73.0	100	75.0	72.0
Generator (<25KVA, VMS si	50	70	73	74	64.0	61.0	100	67.0	64.0
Gradall	40	85	83	70	79.0	75.0	100	77.0	73.0
Grader	40	85	na	0	79.0	75.0	100		
Grapple (on Backhoe)	40	85	87	1	79.0	75.0	100	81.0	77.0
Horizontal Boring Hydr. Jac	25	80	82	6	74.0	68.0	100	76.0	70.0
Hydra Break Ram	10	90	na	0	84.0	74.0	100		
Impact Pile Driver	20	95	101	11	89.0	82.0	100	95.0	88.0
Jackhammer	20	85	89	133	79.0	72.0	100	83.0	76.0
Man Lift	20	85	75	23	79.0	72.0	100	69.0	62.0
Mounted Impact Hammer (	20	90	90	212	84.0	77.0	100	84.0	77.0
Pavement Scarafier	20	85	90	2	79.0	72.0	100	84.0	77.0
Paver	50	85	77	9	79.0	76.0	100	71.0	68.0
Pickup Truck	40	55	75	1	49.0	45.0	100	69.0	65.0
Pneumatic Tools	50	85	85	90	79.0	76.0	100	79.0	76.0
Pumps	50	77	81	17	71.0	68.0	100	75.0	72.0
Refrigerator Unit	100	82	73	3	76.0	76.0	100	67.0	67.0
Rivit Buster/chipping gun	20	85	79	19	79.0	72.0	100	73.0	66.0
Rock Drill	20	85	81	3	79.0	72.0	100	75.0	68.0
Roller	20	85	80	16	79.0	72.0	100	74.0	67.0
Sand Blasting (Single Nozzle	20	85	96	9	79.0	72.0	100	90.0	83.0
Scraper	40	85	84	12	79.0	75.0	100	78.0	74.0
Shears (on backhoe)	40	85	96	5	79.0	75.0	100	90.0	86.0
Slurry Plant	100	78	78	1	72.0	72.0	100	72.0	72.0
Slurry Trenching Machine	50	82	80	75	76.0	73.0	100	74.0	71.0
Soil Mix Drill Rig	50	80	na	0	74.0	71.0	100		
Tractor	40	84	na	0	78.0	74.0	100		
Vacuum Excavator (Vac-tru	40	85	85	149	79.0	75.0	100	79.0	75.0
Vacuum Street Sweeper	10	80	82	19	74.0	64.0	100	76.0	66.0
Ventilation Fan	100	85	79	13	79.0	79.0	100	73.0	73.0
Vibrating Hopper	50	85	87	1	79.0	76.0	100	81.0	78.0
Vibratory Concrete Mixer	20	80	80	1	74.0	67.0	100	74.0	67.0
Vibratory Pile Driver	20	95	101	44	89.0	82.0	100	95.0	88.0
Warning Horn	5	85	83	12	79.0	66.0	100	77.0	64.0
Welder / Torch	40	73	74	5	67.0	63.0	100	68.0	64.0
chipper		75							

Source:
FHWA Roadway Construction Noise Model, January 2006. Table 9.1
U.S. Department of Transportation
CA/T Construction Spec. 721.560

Distance Propagation Calculations for Stationary Sources of Ground Vibration

KEY:
- Orange cells are for input.
- Grey cells are intermediate calculations performed by the model.
- Green cells are data to present in a written analysis (output).

STEP 1: Determine units in which to perform calculation.

— If vibration decibels (VdB), then use Table A and proceed to Steps 2A and 3A.

— If peak particle velocity (PPV), then use Table B and proceed to Steps 2B and 3B.

STEP 2A: Identify the vibration source and enter the reference vibration level (VdB) and distance.

STEP 3A: Select the distance to the receiver.

Table A. Propagation of vibration decibels (VdB) with distance

Noise Source/ID	Reference Noise Level vibration level (VdB)	@	distance (ft)	Attenuated Noise Level at Receptor vibration level (VdB)	@	distance (ft)
caisson drilling	87	@	25	72.0	@	79

STEP 2B: Identify the vibration source and enter the reference peak particle velocity (PPV) and distance.

STEP 3B: Select the distance to the receiver.

Table B. Propagation of peak particle velocity (PPV) with distance

Noise Source/ID	Reference Noise Level vibration level (PPV)	@	distance (ft)	Attenuated Noise Level at Receptor vibration level (PPV)	@	distance (ft)
caisson drilling	0.089	@	25	0.191	@	15
caisson drilling	0.089	@	25	0.079	@	27

Notes:

Computation of propagated vibration levels is based on the equations presented on pg. 12-11 of FTA 2006. Estimates of attenuated vibration levels do not account for reductions from intervening underground barriers or other underground structures of any type, or changes in soil type.

Sources:

Federal Transit Association (FTA). 2006 (May). Transit Noise and Vibration Impact Assessment. FTA-VA-90-1003-06. Washington, D.C. Available: <http://www.fta.dot.gov/documents/FTA_Noise_and_Vibration_Manual.pdf>. Accessed: September 24, 2010.