



APPENDIX 12

Noise and Vibration

12-1: Construction Assumptions Used in Noise Analysis

12-2: ARC FEIS Chapter 5.2 Construction-Related Impact to Land Use, Zoning and Public Policy

12-3: ARC FEIS Appendix 5.7 Noise and Vibration

12-4: TBM Vibration Table (Excerpt from ARC FEIS Chapter 5.7)

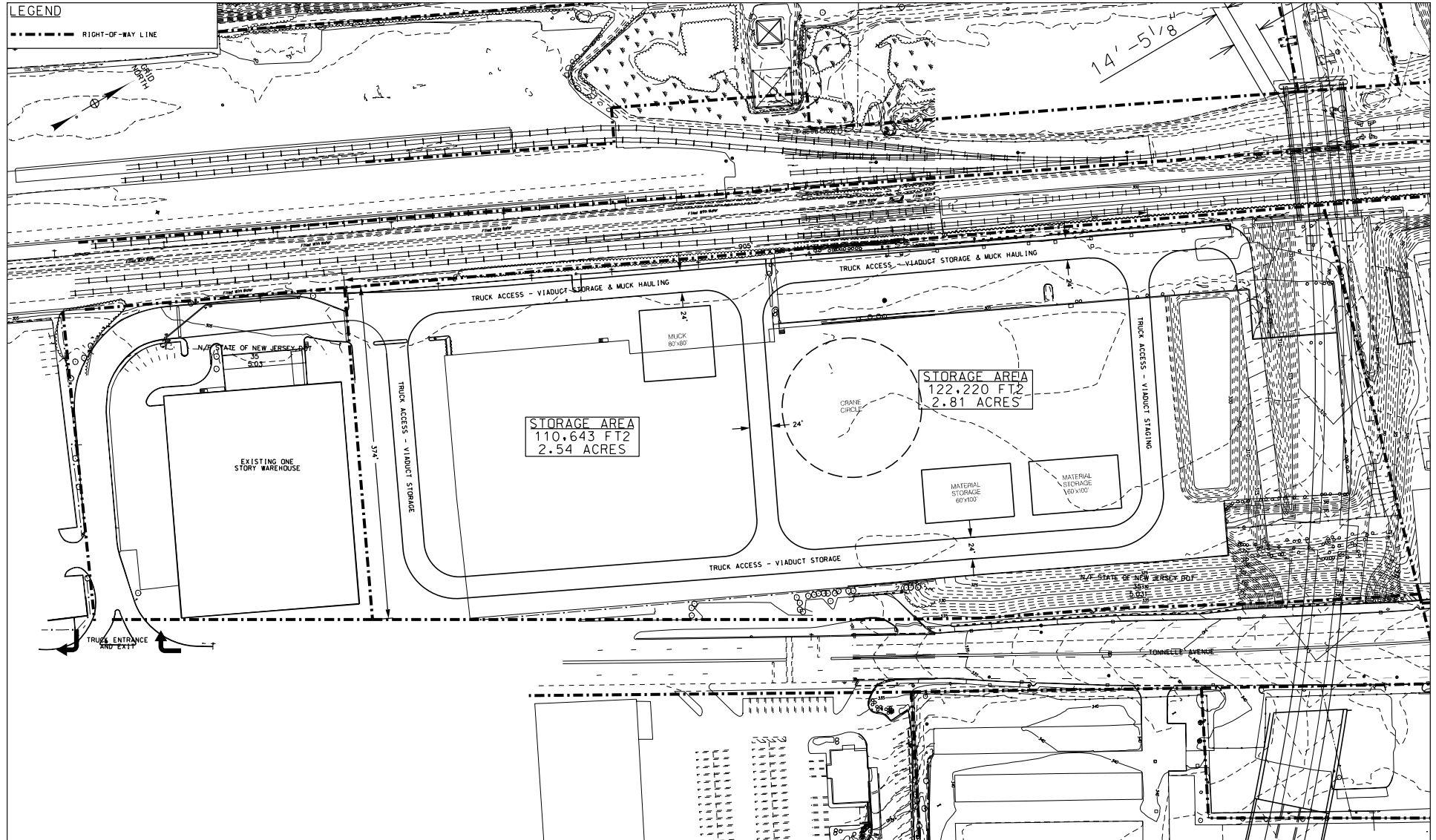


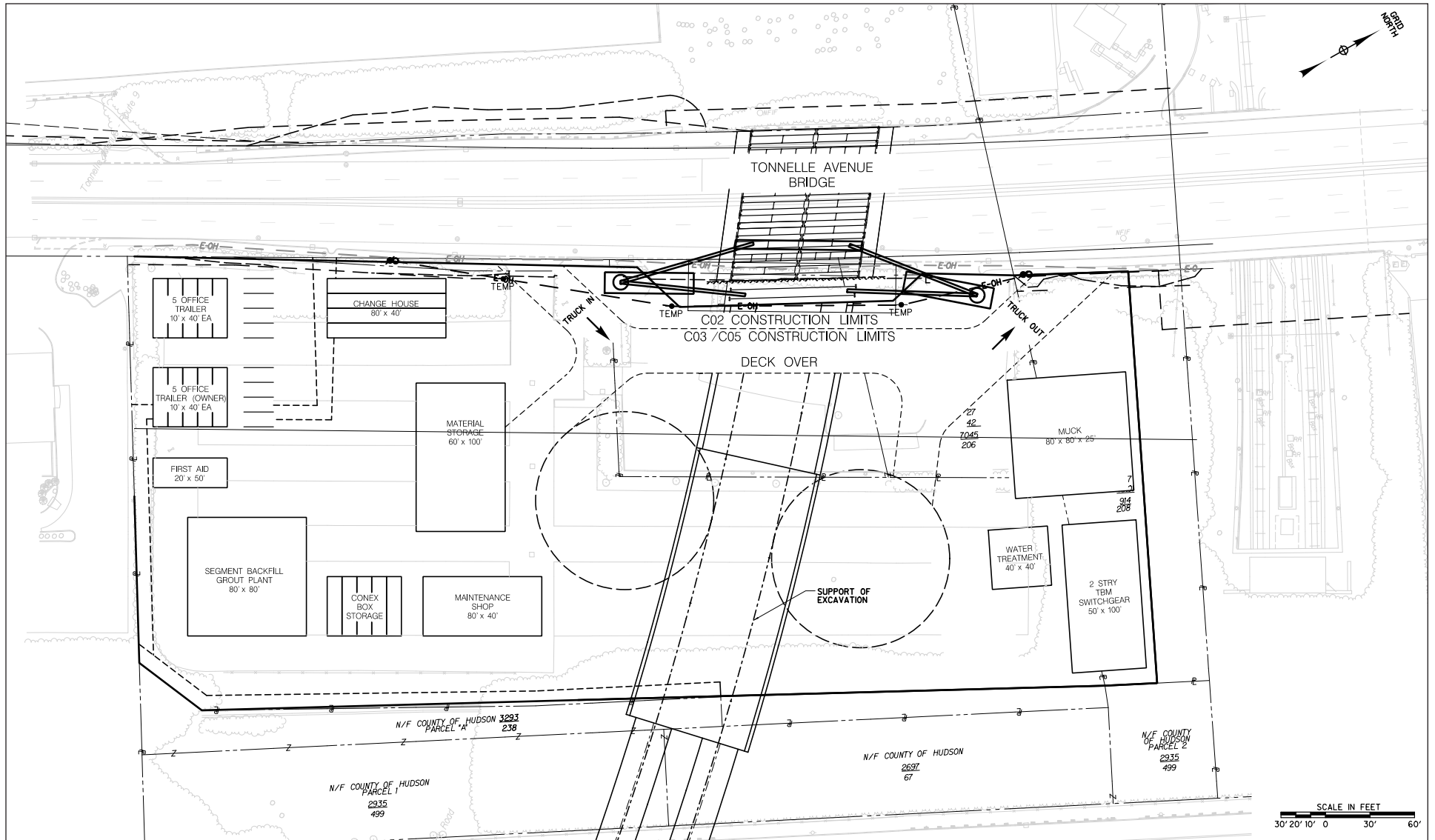
FINAL ENVIRONMENTAL IMPACT STATEMENT AND FINAL SECTION 4(f) EVALUATION

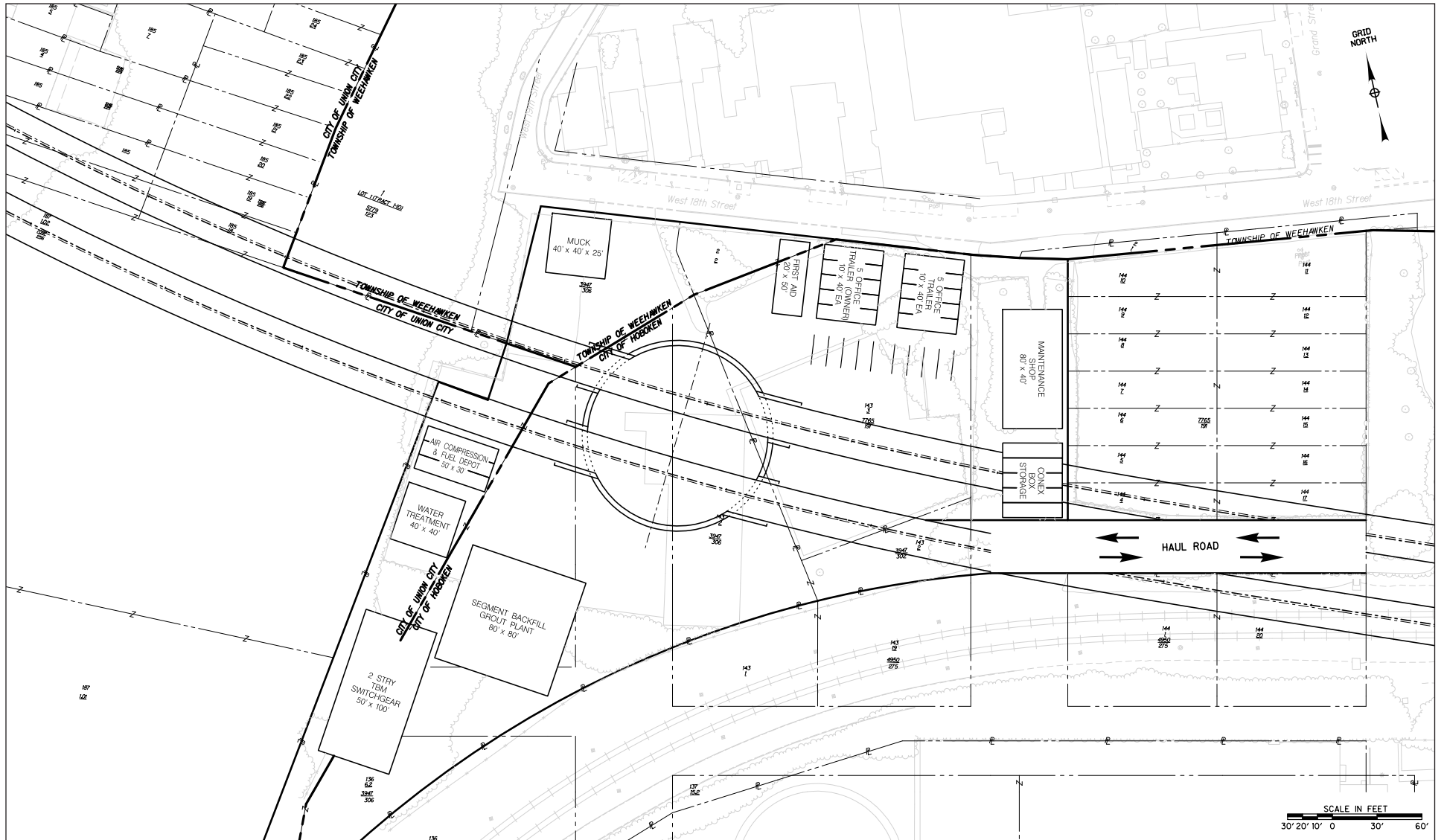
APPENDIX 12-1

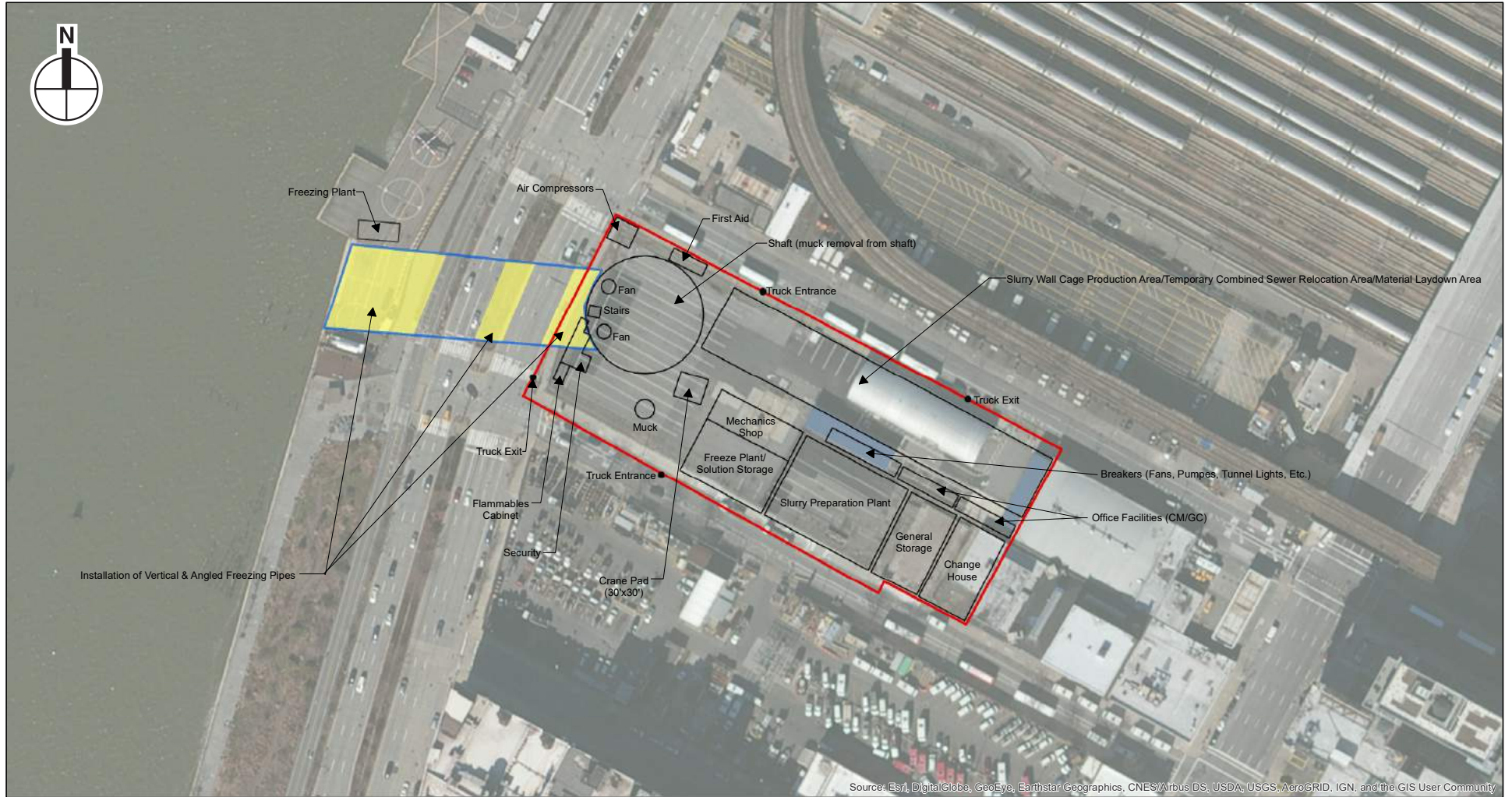
Construction Assumptions Used in Noise Analysis

Conceptual Site Layout





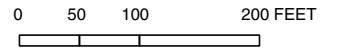




Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Limit of Construction

 Frozen Ground



New Tunnel Construction Equipment Noise

Hudson Tunnel - Construction Noise - 2021

Staging Area / Construction Site	MAJOR CONSTRUCTION CONTRACTS	Approximate Duration (in months)	QTY	DAILY USAGE (Percentage equipment is in use during a typical 8-hour workday. Example: 75% daily use equals 75% of an 8-hour workday or 6 hours)	dBA at 50ft	Acoustical Use Factor (1 hour)	Working Shifts
	DESIGN-BUILD CONTRACTS						
Palisades Tunnels							
	Advance Design - Palisades Tunnels & Crosspassages						
Tonnelle Avenue Staging Area	Site Preparation & Set Up	1					7AM-3PM
	Construction Equipment						
	Front End Loaders		2	80%	80	40%	7AM-3PM
	Backhoes		2	70%	80	40%	7AM-3PM
	Cranes		1	80%	83	16%	7AM-3PM
	Cherry Pickers		2	70%	83	20%	7AM-3PM
	Excavators/Bulldozers		2	90%	85	40%	7AM-3PM
	Graders		1	80%	85	40%	7AM-3PM
	Compressors (total: electric and/or diesel)		2	90%	80	40%	7AM-3PM
Tonnelle Avenue Staging Area	C & C Support Of Excavation Of Tonnelle Portal & Starter Tunnels	9					7AM-11PM
	Construction Equipment						
	Crawler Mounted Drill Rig		2	80%	80	20%	7AM-11PM
	Vibratory Pile Hammerw/ppack		2	90%	95	20%	7AM-11PM
	Front End Loaders		2	80%	80	40%	7AM-11PM
	Backhoes		2	70%	80	40%	7AM-11PM
	Cranes		1	80%	83	16%	7AM-11PM
	Cherry Pickers		2	80%	83	20%	7AM-11PM
	Excavators/Bulldozers		1	95%	85	40%	7AM-11PM
	Compressors (total: electric and/or diesel)		2	90%	80	40%	7AM-11PM
Tonnelle Avenue Staging Area	TBM Mining of Palisades Tunnels and Hudson Tunnels	23					24 hours
	Construction Equipment						
	Front End Loaders		2	80%	80	40%	24 hours
	Cranes		2	80%	83	16%	24 hours
	Cherry Pickers		2	80%	83	20%	24 hours
	Forklifts		2	80%	84	20%	24 hours
	Compressors (total: electric and/or diesel)		4	90%	80	40%	24 hours
	Fans		2	100%	63	100%	24 hours
	Tunnel Boring Machine		2	60%	0	0%	24 hours
	Locomotives (Battery or Diesel Powered)		4	30%	0	50%	24 hours
	Cranes (Rough Terrain)		2	80%	83	16%	24 hours
	Grout Plant		2	70%	85	15%	24 hours
	Vertical conveyor or scroll dump for muck cars (500 hp each)		2	70%	62	50%	24 hours
	Surface transfer conveyor to muck bin (600 ton / hr)		1	70%	62	50%	24 hours
	shaft dewatering pumps to treatment plant (100 hp each)		2	100%	62	50%	24 hours
	surface water treatment plant		1	100%	62	50%	24 hours
	Dump Truck		2	80%	84	40%	24 hours

Hudson Tunnel - Construction Noise - 2021

Staging Area / Construction Site	MAJOR CONSTRUCTION CONTRACTS	Approximate Duration (in months)	QTY	DAILY USAGE (Percentage equipment is in use during a typical 8-hour workday. Example: 75% daily use equals 75% of an 8-hour workday or 6 hours)	dBA at 50ft	Acoustical Use Factor (1 hour)	Working Shifts
Hoboken Staging Area	TBM Mining of Hudson Tunnels	12					24 hours
	Construction Equipment						
	<i>Cranes</i>		2	80%	83	16%	24 hours
	<i>Forklifts</i>		2	80%	64	20%	24 hours
	<i>Fans</i>		2	100%	63	100%	24 hours
	<i>Tunnel Boring Machine</i>		2	60%	0	0%	24 hours
	<i>Locomotives (Battery or Diesel Powered)</i>		4	30%	0	50%	24 hours
	<i>Grout Plant</i>		2	70%	60	15%	24 hours
	<i>Dump Truck</i>		2	80%	84	40%	7AM-10PM
Hoboken Staging Area	Cross Passage Construction (Rock 22 d - 3 crews+ Soil 77d 2 crews)	10					7AM-11PM
	Construction Equipment						
	<i>Front End Loaders</i>		2	70%	80	40%	7AM-11PM
	<i>Backhoes</i>		1	70%	80	40%	7AM-11PM
	<i>Cranes</i>		1	70%	83	16%	7AM-11PM
	<i>Cherry Pickers</i>		2	80%	83	20%	7AM-11PM
	<i>Compressors (total: electric and/or diesel)</i>		2	90%	55	40%	7AM-11PM
	<i>Freeze Plant</i>		1	90%	80	50%	7AM-11PM
	<i>tunnel locomotives</i>		4	70%	0	50%	7AM-11PM
	Hoboken Shaft Ready To Receive Palisades TBM						
	Manhattan Tunnels - 12th Ave Shaft, SEM Tunnels & 30th Street SEM						
	Advance Design - 12th Ave Shaft, SEM Tunnels & 30th Street SEM						
12th Avenue Staging Area	Site Preparation & Set Up	1					7AM-3PM
	Construction Equipment						
	<i>Front End Loaders</i>		2	70%	80	40%	7AM-3PM
	<i>Backhoes</i>		2	80%	80	40%	7AM-3PM
	<i>Cranes</i>		1	80%	83	16%	7AM-3PM
	<i>Cherry Pickers</i>		2	80%	83	20%	7AM-3PM
	<i>Excavators/Bulldozers</i>		2	90%	85	40%	7AM-3PM
	<i>Graders</i>		1	80%	85	40%	7AM-3PM
	<i>Compressors (total: electric and/or diesel)</i>		2	90%	80	40%	7AM-3PM

Hudson Tunnel - Construction Noise - 2021

Staging Area / Construction Site	MAJOR CONSTRUCTION CONTRACTS	Approximate Duration (in months)	QTY	DAILY USAGE (Percentage equipment is in use during a typical 8-hour workday. Example: 75% daily use equals 75% of an 8-hour workday or 6 hours)	dBA at 50ft	Acoustical Use Factor (1 hour)	Working Shifts
12th Avenue Staging Area	12th Ave Shaft & SEM Construction	21					7AM-11PM
	Construction Equipment						
	Front End Loaders		2	80%	80	40%	7AM-11PM
	Backhoes		2	70%	80	40%	7AM-11PM
	Cranes		2	80%	83	16%	7AM-11PM
	Cherry Pickers		2	80%	83	20%	7AM-11PM
	Excavators/Bulldozers		1	70%	85	40%	7AM-11PM
	Compressors (total: electric and/or diesel)		2	90%	80	40%	7AM-11PM
	Slurry Plant		1	70%	82	100%	7AM-11PM
	Man Lift (Shaft Elevator)		1	60%	85	20%	7AM-11PM
	Freeze Plant		1	100%	80	50%	7AM-11PM
	Crawler Mounted Drill Rig		2	90%	80	20%	7AM-11PM
30th Street / 12th Avenue Staging Area	SEM OPTION - 30th Street	23					7AM-11PM
	Construction Equipment						
	Front End Loaders		2	80%	80	40%	7AM-11PM
	Backhoes		2	90%	80	40%	7AM-11PM
	Cranes		1	80%	83	16%	7AM-11PM
	Cherry Pickers		2	80%	83	20%	7AM-11PM
	Excavators/Bulldozers		1	80%	85	40%	7AM-11PM
	Compressors (total: electric and/or diesel)		2	90%	80	40%	7AM-11PM
30th Street / 12th Avenue Staging Area	Cut & Cover OPTION - 30th Street	37					7AM-11PM
	Construction Equipment						
	Front End Loaders		2	80%	80	40%	7AM-11PM
	Backhoes		2	90%	80	40%	7AM-11PM
	Cranes		1	80%	83	16%	7AM-11PM
	Cherry Pickers		2	80%	83	20%	7AM-11PM
	Excavators/Bulldozers		1	80%	85	40%	7AM-11PM
	Compressors (total: electric and/or diesel)		2	90%	80	40%	7AM-11PM
	impact hanner		2	90%	101	20%	7AM-11PM

Hudson Tunnel - Construction Noise - 2021

Staging Area / Construction Site	MAJOR CONSTRUCTION CONTRACTS	Approximate Duration (in months)	QTY	DAILY USAGE (Percentage equipment is in use during a typical 8-hour workday. Example: 75% daily use equals 75% of an 8-hour workday or 6 hours)	dBA at 50ft	Acoustical Use Factor (1 hour)	Working Shifts
Tunnel Internal Conc., Fan Plant Structures & Fit Out (NJ Portal, Hoboken Shaft & 12 Th Ave. Shaft)							
12th Avenue Staging Area	Invert Concrete, Construct Fan Plant Structures(Below Grade & Above Grade) & Fit Out - 12th Avenue	39					7AM-11PM
	Construction Equipment						
	Front End Loaders		1	70%	80	40%	7AM-11PM
	Backhoes		1	80%	80	40%	7AM-11PM
	Cranes		1	80%	83	16%	7AM-11PM
	Cherry Pickers		1	90%	83	20%	7AM-11PM
	Compressors (total: electric and/or diesel)		2	90%	80	40%	7AM-11PM
	Concrete Pumps		1	90%	82	50%	7AM-11PM
Tonnelle Ave Staging Area	Invert Concrete (Below Grade & Above Grade) & Fit Out - Palisades Tunnel	7					7AM-11PM
	Construction Equipment						
	Front End Loaders		1	70%	80	40%	7AM-11PM
	Backhoes		1	80%	80	40%	7AM-11PM
	Cranes		1	80%	83	16%	7AM-11PM
	Cherry Pickers		1	90%	83	20%	7AM-11PM
	Compressors (total: electric and/or diesel)		2	90%	80	40%	7AM-11PM
	Concrete Pumps		1	90%	82	50%	7AM-11PM
Hoboken Staging Area	Invert Concrete, Construct Fan Plant Structures(Below Grade & Above Grade) & Fit Out / MEP - Hudson Tunnel	10					7AM-11PM
	Construction Equipment						
	Front End Loaders		1	70%	80	40%	7AM-11PM
	Backhoes		1	80%	80	40%	7AM-11PM
	Cranes		1	80%	83	16%	7AM-11PM
	Cherry Pickers		1	90%	83	20%	7AM-11PM
	Compressors (total: electric and/or diesel)		2	90%	55	40%	7AM-11PM
	Concrete Pumps		1	90%	72	50%	7AM-11PM

Hudson Tunnel - Construction Noise - 2021

Staging Area / Construction Site	MAJOR CONSTRUCTION CONTRACTS	Approximate Duration (in months)	QTY	DAILY USAGE (Percentage equipment is in use during a typical 8-hour workday. Example: 75% daily use equals 75% of an 8-hour workday or 6 hours)	dBA at 50ft	Acoustical Use Factor (1 hour)	Working Shifts
NJ Surface - Embankments, Viaducts & Bridge							
	Advance Design						
along NJ alignment & 2001 Tonnel Avenue	Site Preparation & Set Up	2					
	Construction Equipment						
	Crawler Mounted Drill Rig		2	80%	80	20%	11PM-7AM
	Crawler Crane 100T		2	70%	83	16%	11PM-7AM
	35-45 TON GROVE CRANE		2	80%	83	16%	11PM-7AM
	CONC PUMP		1	90%	82	50%	11PM-7AM
	BHOE -CAT 3.00CY		2	70%	80	40%	11PM-7AM
	CAT D6 TRACTOR		2	80%	85	40%	11PM-7AM
	4000 GALLON WATER TRUCK		1	80%	84	20%	11PM-7AM
	CAT LOADER		1	90%	80	40%	11PM-7AM
	PORTABLE LIGHT PLANT		4	70%	82	50%	11PM-7AM
	6 INCH SUBMERSIBLE PUMP		4	80%	77	50%	11PM-7AM
	WALK BEHIND ROLLER		2	70%	85	20%	11PM-7AM
	CAT MOTOR GRADER		1	80%	85	40%	11PM-7AM
	84" ROLLER		1	90%	85	20%	11PM-7AM
	Liebherr LRB 16 Piling Rig		1	60%	101	20%	11PM-7AM
along NJ alignment	Meadowlands Viaduct	39					
	Construction Equipment						
	Crawler Mounted Drill Rig		2	80%	80	20%	11PM-7AM
	Crawler Crane 100T		2	70%	83	16%	11PM-7AM
	35-45 TON GROVE CRANE		2	80%	83	16%	11PM-7AM
	CONC PUMP		1	90%	82	50%	11PM-7AM
	BHOE -CAT 3.00CY		2	70%	80	40%	11PM-7AM
	CAT D6 TRACTOR		2	80%	85	40%	11PM-7AM
	4000 GALLON WATER TRUCK		1	80%	84	20%	11PM-7AM
	CAT LOADER		1	90%	80	40%	11PM-7AM
	PORTABLE LIGHT PLANT		4	70%	82	50%	11PM-7AM
	6 INCH SUBMERSIBLE PUMP		4	80%	77	50%	11PM-7AM
	WALK BEHIND ROLLER		2	70%	85	20%	11PM-7AM
	CAT MOTOR GRADER		1	80%	85	40%	11PM-7AM
	84" ROLLER		1	90%	85	20%	11PM-7AM
	Liebherr LRB 16 Piling Rig		1	60%	101	20%	11PM-7AM

Hudson Tunnel - Construction Noise - 2021

Staging Area / Construction Site	MAJOR CONSTRUCTION CONTRACTS	Approximate Duration (in months)	QTY	DAILY USAGE (Percentage equipment is in use during a typical 8-hour workday. Example: 75% daily use equals 75% of an 8-hour workday or 6 hours)	dBA at 50ft	Acoustical Use Factor (1 hour)	Working Shifts
along NJ alignment	Embankment Construction	6					
	Construction Equipment						
	Crawler Mounted Drill Rig		2	80%	80	20%	11PM-7AM
	Crawler Crane 100T		2	70%	83	16%	11PM-7AM
	35-45 TON GROVE CRANE		2	80%	83	16%	11PM-7AM
	CONC PUMP		1	90%	82	50%	11PM-7AM
	BHOE -CAT 3.00CY		2	70%	80	40%	11PM-7AM
	CAT D6 TRACTOR		2	80%	85	40%	11PM-7AM
	4000 GALLON WATER TRUCK		1	80%	84	20%	11PM-7AM
	CAT LOADER		1	90%	80	40%	11PM-7AM
	PORTABLE LIGHT PLANT		4	70%	82	50%	11PM-7AM
	6 INCH SUBMERSIBLE PUMP		4	80%	77	50%	11PM-7AM
	WALK BEHIND ROLLER		2	70%	85	20%	11PM-7AM
	CAT MOTOR GRADER		1	80%	85	40%	11PM-7AM
	84" ROLLER		1	90%	85	20%	11PM-7AM
	Liebherr LRB 16 Piling Rig		1	60%	101	20%	11PM-7AM
2001 Tonnelle Avenue	Bridge Crossing Conrail & NYS& W	35					
	Construction Equipment						
	Crawler Mounted Drill Rig		2	80%	80	20%	11PM-7AM
	Crawler Crane 100T		2	70%	83	16%	11PM-7AM
	35-45 TON GROVE CRANE		2	80%	83	16%	11PM-7AM
	CONC PUMP		1	90%	82	50%	11PM-7AM
	BHOE -CAT 3.00CY		2	70%	80	40%	11PM-7AM
	CAT D6 TRACTOR		2	80%	85	40%	11PM-7AM
	4000 GALLON WATER TRUCK		1	80%	84	20%	11PM-7AM
	CAT LOADER		1	90%	80	40%	11PM-7AM
	PORTABLE LIGHT PLANT		4	70%	82	50%	11PM-7AM
	6 INCH SUBMERSIBLE PUMP		4	80%	77	50%	11PM-7AM
	WALK BEHIND ROLLER		2	70%	85	20%	11PM-7AM
	CAT MOTOR GRADER		1	80%	85	40%	11PM-7AM
	84" ROLLER		1	90%	85	20%	11PM-7AM
	Liebherr LRB 16 Piling Rig		1	60%	101	20%	11PM-7AM

Hudson Tunnel - Construction Noise - 2021

Staging Area / Construction Site	MAJOR CONSTRUCTION CONTRACTS	Approximate Duration (in months)	QTY	DAILY USAGE (Percentage equipment is in use during a typical 8-hour workday. Example: 75% daily use equals 75% of an 8-hour workday or 6 hours)	dBA at 50ft	Acoustical Use Factor (1 hour)	Working Shifts
Tonnelle Avenue Underpass							
Tonnelle Avenue Staging Area	Site Preparation & Set Up	24					7AM-3PM
	Construction Equipment						
	Crawler Mounted Drill Rig		1	80%	80	20%	7AM-3PM
	Vibratory Pile Hammerw/ppack		1	90%	95	20%	7AM-3PM
	Crawler Crane 100T		1	80%	83	16%	7AM-3PM
	35-45 TON GROVE CRANE		2	80%	83	16%	7AM-3PM
	CONC PUMP		1	70%	82	50%	7AM-3PM
	BHOE -CAT 3.00CY		1	80%	80	40%	7AM-3PM
	CAT D6 TRACTOR		1	80%	85	40%	7AM-3PM
	4000 GALLON WATER TRUCK		1	80%	84	20%	7AM-3PM
	CAT LOADER		1	90%	80	40%	7AM-3PM
	PORTABLE LIGHT PLANT		2	70%	82	50%	7AM-3PM
	6 INCH SUBMERSIBLE PUMP		4	90%	77	50%	7AM-3PM
	WALK BEHIND ROLLER		1	70%	85	20%	7AM-3PM
	CAT MOTOR GRADER		1	80%	85	40%	7AM-3PM
	84" ROLLER		1	80%	85	20%	7AM-3PM
Tonnelle Avenue Staging Area	Tonnelle Avenue Underpass	24					7AM-11PM
	Construction Equipment						
	Crawler Mounted Drill Rig		1	80%	80	20%	7AM-11PM
	Vibratory Pile Hammerw/ppack		1	90%	95	20%	7AM-11PM
	Crawler Crane 100T		1	80%	83	16%	7AM-11PM
	35-45 TON GROVE CRANE		2	80%	83	16%	7AM-11PM
	CONC PUMP		1	70%	82	50%	7AM-11PM
	BHOE -CAT 3.00CY		1	80%	80	40%	7AM-11PM
	CAT D6 TRACTOR		1	80%	85	40%	7AM-11PM
	4000 GALLON WATER TRUCK		1	80%	84	20%	7AM-11PM
	CAT LOADER		1	90%	80	40%	7AM-11PM
	PORTABLE LIGHT PLANT		2	70%	82	50%	7AM-11PM
	6 INCH SUBMERSIBLE PUMP		4	90%	77	50%	7AM-11PM
	WALK BEHIND ROLLER		1	70%	85	20%	7AM-11PM
	CAT MOTOR GRADER		1	80%	85	40%	7AM-11PM
	84" ROLLER		1	80%	85	20%	7AM-11PM

Hudson Tunnel - Construction Noise - 2021

Staging Area / Construction Site	MAJOR CONSTRUCTION CONTRACTS	Approximate Duration (in months)	QTY	DAILY USAGE (Percentage equipment is in use during a typical 8-hour workday. Example: 75% daily use equals 75% of an 8-hour workday or 6 hours)	dBA at 50ft	Acoustical Use Factor (1 hour)	Working Shifts
Trackwork & RR Systems (Tunnels)- Tonnelle Ave To East Side Of Tenth Avenue							
simultaneous work at: Tonnelle Avenue, Hoboken, and 12th Avenue staging areas	Trackwork - DF Track (Starting from 12th Ave To East of Tenth Ave., Palisades, Hoboken)	16					7AM-11PM
	Construction Equipment						
	Speed Swing Pettibone		1	70%	80	40%	7AM-11PM
	Locomotive Crane, 40 Ton American		1	80%	0	16%	7AM-11PM
	Crew Truck		4	80%	55	40%	7AM-11PM
	35-45 TON GROVE CRANE		2	70%	83	16%	7AM-11PM
	PORTABLE LIGHT PLANT		2	80%	70	50%	7AM-11PM
	CONC PUMP		1	70%	82	50%	7AM-11PM
	100 HP Vent Fan		1	90%	63	100%	7AM-11PM
simultaneous work at: Tonnelle Avenue, Hoboken, and 12th Avenue staging areas	Signals & Comm (C09-4100)	23					7AM-11PM
	Construction Equipment						
	Utility Crew Truck-Hi Rail 6 men		4	80%	55	40%	7AM-11PM
	PORTABLE LIGHT PLANT		2	70%	70	50%	7AM-11PM
	35-45 TON GROVE CRANE		2	70%	83	16%	7AM-11PM
	100 HP Vent Fan		1	90%	63	100%	7AM-11PM
simultaneous work at: Tonnelle Avenue, Hoboken, and 12th Avenue staging areas	OCS Structures & Wire	8					7AM-11PM
	Construction Equipment						
	Catenary Maint. Car (MTW-100)- 2nd wire Train		1	80%	0	50%	7AM-11PM
	PORTABLE LIGHT PLANT		2	70%	70	50%	7AM-11PM
	Utility Crew Truck-Hi Rail 6 men		2	80%	55	40%	7AM-11PM
	100 HP Vent Fan		1	90%	63	100%	7AM-11PM
simultaneous work at: Tonnelle Avenue, Hoboken, and 12th Avenue staging areas	TPSS	21					7AM-11PM
	Construction Equipment						
	Utility Crew Truck-Hi Rail 6 men		4	80%	55	40%	7AM-11PM
	35-45 TON GROVE CRANE		2	80%	83	16%	7AM-11PM
	BHOE -CAT 3.00CY		1	80%	80	40%	7AM-11PM
	CAT D6 TRACTOR		1	90%	85	40%	7AM-11PM
	4000 GALLON WATER TRUCK		1	70%	84	20%	7AM-11PM
	CAT LOADER		1	80%	80	40%	7AM-11PM
	PORTABLE LIGHT PLANT		2	70%	70	50%	7AM-11PM
	6 INCH SUBMERSIBLE PUMP		1	90%	77	50%	7AM-11PM
	WALK BEHIND ROLLER		1	70%	85	20%	7AM-11PM

Hudson Tunnel - Construction Noise - 2021

Staging Area / Construction Site	MAJOR CONSTRUCTION CONTRACTS	Approximate Duration (in months)	QTY	DAILY USAGE (Percentage equipment is in use during a typical 8-hour workday. Example: 75% daily use equals 75% of an 8-hour workday or 6 hours)	dBA at 50ft	Acoustical Use Factor (1 hour)	Working Shifts
Trackwork & RR Systems (Surface) - Allied To Tonnelle Avenue Portal							
along NJ surface alignment	Trackwork - Surface	19					7AM-11PM
	Construction Equipment						
	Speed Swing Pettibone 441-D 1985		1	80%	80	40%	7AM-11PM
	Locomotive Crane, 40 Ton American 840DE 1958		1	80%	83	16%	7AM-11PM
	Tamper, Switch, 4S Plasser 09-32-4S 1996		1	80%	83	50%	7AM-11PM
	Crew Truck		1	80%	55	40%	7AM-11PM
	70 Ton Ballast Hopper		1	70%	82	50%	7AM-11PM
	Rail Car Mover Whiting 75TM 1987		1	80%	0	50%	7AM-11PM
	Balast Cribber (Ker 38-3)		1	70%	83	50%	7AM-11PM
	Balast Regulator		1	80%	82	50%	7AM-11PM
along NJ surface alignment	Signals& Comm	21					7AM-11PM
	Construction Equipment						
	Utility Crew Truck-Hi Rail 6 men		4	80%	55	40%	7AM-11PM
	PORTABLE LIGHT PLANT		2	70%	82	50%	7AM-11PM
	35-45 TON GROVE CRANE		2	80%	83	16%	7AM-11PM
along NJ surface alignment	OCS & Wire	9					7AM-11PM
	Construction Equipment						
	Truck Mounted Vertical Earth Drill Sub.		1	80%	80	20%	7AM-11PM
	Water Pump 250 GPM		2	90%	77	50%	7AM-11PM
	PORTABLE LIGHT PLANT		2	80%	82	50%	7AM-11PM
	CAT D6R (Dirt) 175 HP		1	80%	80	40%	7AM-11PM
	Utility Crew Truck- 6 men		2	80%	55	40%	7AM-11PM
	Hi rail Boom Truck 12.5 Ton		1	70%	84	40%	7AM-11PM
	Generator 20 KW Power		2	90%	82	50%	7AM-11PM
	Welder, Generator, 400 Amp		2	80%	82	40%	7AM-11PM
	PORTABLE LIGHT PLANT		2	80%	82	50%	7AM-11PM
	Crane 60 Ton		1	80%	83	16%	7AM-11PM
	Catenary Maint. Car (MTW-100)-		1	80%	84	50%	7AM-11PM
	Wire Train		1	80%	84	50%	7AM-11PM
	PORTABLE LIGHT PLANT		2	80%	82	50%	7AM-11PM
	Utility Crew Truck- 6 men		2	80%	55	40%	7AM-11PM

Hudson Tunnel - Construction Noise - 2021

Staging Area / Construction Site	MAJOR CONSTRUCTION CONTRACTS	Approximate Duration (in months)	QTY	DAILY USAGE (Percentage equipment is in use during a typical 8-hour workday. Example: 75% daily use equals 75% of an 8-hour workday or 6 hours)	dBA at 50ft	Acoustical Use Factor (1 hour)	Working Shifts
along NJ surface alignment	TPSS	25					7AM-11PM
	Construction Equipment						
	Utility Crew Truck-Hi Rail 6 men		4	80%	55	40%	7AM-11PM
	35-45 TON CRANE		2	80%	83	16%	7AM-11PM
	BHOE -CAT 3.00CY		1	70%	80	40%	7AM-11PM
	CAT D6 TRACTOR		1	80%	85	40%	7AM-11PM
	4000 GALLON WATER TRUCK		1	80%	84	20%	7AM-11PM
	CAT LOADER		1	90%	80	40%	7AM-11PM
	PORTABLE LIGHT PLANT		2	80%	82	50%	7AM-11PM
	6 INCH SUBMERSIBLE PUMP		1	90%	77	50%	7AM-11PM
	WALK BEHIND ROLLER		1	70%	85	20%	7AM-11PM
	MEP Finishes (Tunnel Ventilation, Tunnel Lighting , Facility Power Sub Stations & Controllers)						
12th Avenue Staging Area	MEP Finishes- 12th Avenue & Manhattan Tunnels	13					7AM-11PM
	Construction Equipment						
	35-45 TON CRANE		2	80%	83	16%	7AM-11PM
	Compressors (total: electric and/or diesel)		2	90%	80	40%	7AM-11PM
	Man Lift (Shaft Elevator)		1	70%	85	20%	7AM-11PM
	Generator		4	90%	70	50%	7AM-11PM
	Scissor Lift25' Electric		2	80%	0	20%	7AM-11PM
	PORTABLE LIGHT PLANT		4	80%	70	50%	7AM-11PM
	100 HP Vent Fan		1	90%	63	100%	7AM-11PM
Tonnelle Avenue Staging Area	MEP Finishes - Tonnelle Ave. Portal & Palisades Tunnel	18					7AM-11PM
	Construction Equipment						
	35-45 TON CRANE		2	80%	83	16%	7AM-11PM
	Compressors (total: electric and/or diesel)		2	90%	80	40%	7AM-11PM
	Man Lift (Shaft Elevator)		1	70%	85	20%	7AM-11PM
	Generator		4	80%	82	50%	7AM-11PM
	Scissor Lift25' Electric		2	80%	0	20%	7AM-11PM
	PORTABLE LIGHT PLANT		4	80%	82	50%	7AM-11PM
	100 HP Vent Fan		1	90%	63	100%	7AM-11PM
Hoboken Staging Area	MEP Finishes - Hoboken Shaft & Hudson Tunnel	27					7AM-11PM
	Construction Equipment						
	35-45 TON CRANE		2	80%	83	16%	7AM-11PM
	Compressors (total: electric and/or diesel)		2	90%	80	40%	7AM-11PM
	Man Lift (Shaft Elevator)		1	70%	85	20%	7AM-11PM
	Generator		4	80%	70	50%	7AM-11PM
	Scissor Lift25' Electric		2	80%	0	20%	7AM-11PM
	PORTABLE LIGHT PLANT		4	80%	70	50%	7AM-11PM
	100 HP Vent Fan		1	90%	63	100%	7AM-11PM

Hudson Tunnel - Construction Noise - 2021

Staging Area / Construction Site	MAJOR CONSTRUCTION CONTRACTS	Approximate Duration (in months)	QTY	DAILY USAGE (Percentage equipment is in use during a typical 8-hour workday. Example: 75% daily use equals 75% of an 8-hour workday or 6 hours)	dBA at 50ft	Acoustical Use Factor (1 hour)	Working Shifts
Systems Testing , Tie Ins and Commissioning							
	Testing & Commissioning	2					
	Construction Equipment						
	35-45 TON CRANE		1	80%	83	16%	7AM-11PM
	Compressors (total: electric and/or diesel)		1	90%	80	40%	7AM-11PM
	Man Lift (Shaft Elevator)		1	70%	85	20%	7AM-11PM
	Generator		2	90%	82	50%	7AM-11PM
	Scissor Lift25' Electric		2	70%	0	20%	7AM-11PM
	PORTABLE LIGHT PLANT		4	70%	82	50%	7AM-11PM
	100 HP Vent Fan		1	90%	63	100%	7AM-11PM

North River Tunnel Rehabilitation Equipment Noise

Rehabilitation Duration (per tube)	MAJOR CONSTRUCTION CONTRACTS	QTY	DAILY USAGE <i>(Percentage equipment is in use during a typical 8-hour workday. Example: 75% daily use equals 75% of an 8-hour workday or 6 hours)</i>	dBa at 50ft	Acoustical Use Factor (1 hour)	Days/Week	Working Shifts
All - Yard							
	Tractor Trailer	2	75%	84	40%	6	7AM-3:30AM
	185 CFM Diesel Compr	2	75%	80	40%	6	7AM-3:30AM
	Manit 222 100tn-CrawlCrane	1	75%	83	16%	6	7AM-3:30AM
	Grove 50-55tn RT Crane	2	75%	83	16%	6	7AM-3:30AM
	Cat 966H Loader	1	75%	80	40%	6	7AM-3:30AM
	Portable Light Plant	2	50%	70	50%	6	7AM-3:30AM
	400 AMP Diesel Welder	2	75%	73	40%	6	7AM-3:30AM
All - Portal							
	1100 CFM Diesel Compr	1	75%	80	40%	6	7AM-3:30AM
	Manit 222 100tn-CrawlCrane	1	75%	83	16%	6	7AM-3:30AM
	Grove 50-55tn RT Crane	2	75%	83	16%	6	7AM-3:30AM
	Cat 966H Loader	1	75%	80	40%	6	7AM-3:30AM
	Portable Light Plant	2	50%	70	50%	6	7AM-3:30AM
	400 AMP Diesel Welder	2	75%	73	40%	6	7AM-3:30AM
	GIA D4-7 Battery-Diesel Locomotive; G-2ft	2	50%	84	50%	6	7AM-3:30AM
	RR Flatcar Stnd	3	100%	0	50%	6	7AM-3:30AM
	HP Ventilation Fan-145HP	2	75%	63	100%	6	7AM-3:30AM

Rehabilitation Duration (per tube)	MAJOR CONSTRUCTION CONTRACTS	QTY	DAILY USAGE <i>(Percentage equipment is in use during a typical 8-hour workday. Example: 75% daily use equals 75% of an 8-hour workday or 6 hours)</i>	dBA at 50ft	Acoustical Use Factor (1 hour)	Days/Week	Working Shifts
Month 1-12							
	Vactor Truck Service/no pipe	1	75%	85	40%	6	7AM-3:30AM
	185 CFM Diesel Compr	1	75%	80	40%	6	7AM-3:30AM
	Hi-Pressure Washer	2	50%	0	50%	6	7AM-3:30AM
	Brokk 250 Demo Hammer W/Gen	1	75%	88	20%	6	7AM-3:30AM
	Bobcat 743 Skid Loader	1	75%	80	40%	6	7AM-3:30AM
	Cat 930H Loader	1	75%	80	40%	6	7AM-3:30AM
	Lincoln Hi-Rail System	2	100%	0	50%	6	7AM-3:30AM
	RR 15tn HD Towing Cart	4	100%	0	50%	6	7AM-3:30AM
	HP Ventilation Fan-145HP	2	75%	63	100%	6	7AM-3:30AM
Month 3-15							
	ConcPump-Sub;90'BmPmp w/ Oper	1	75%	82	50%	6	7AM-3:30AM
	ConcPump-Sub;BoostPmp w/ Oper	1	75%	82	50%	6	7AM-3:30AM
	185 CFM Diesel Compr	1	75%	80	40%	6	7AM-3:30AM
	Bobcat 743 Skid Loader	1	75%	80	40%	6	7AM-3:30AM
	Cat 930H Loader	1	75%	80	40%	6	7AM-3:30AM
	Lincoln Hi-Rail System	4	100%	0	50%	6	7AM-3:30AM
	RR 15tn HD Towing Cart	3	100%	0	50%	6	7AM-3:30AM
	9yd ready mix truck	2	75%	85	40%	6	7AM-3:30AM
	HP Ventilation Fan-145HP	2	75%	63	100%	6	7AM-3:30AM
Month 11-19							
	185 CFM Diesel Compr	1	75%	80	40%	6	7AM-3:30AM
	Bobcat 743 Skid Loader	1	75%	80	40%	6	7AM-3:30AM
	Cat 930H Loader	1	75%	80	40%	6	7AM-3:30AM
	Lincoln Hi-Rail System	2	100%	0	50%	6	7AM-3:30AM
	RR 15tn HD Towing Cart	3	100%	0	50%	6	7AM-3:30AM
	HP Ventilation Fan-145HP	2	75%	63	100%	6	7AM-3:30AM



FINAL ENVIRONMENTAL IMPACT STATEMENT AND FINAL SECTION 4(f) EVALUATION

APPENDIX 12-2

ARC FEIS Chapter 5.2
Construction-Related Impact to
Land Use, Zoning and Public Policy

5.2 Construction-Related Impact to Land Use, Zoning and Public Policy

A. NEW JERSEY

Permanent property interests would be necessary for the construction of tracks, structures, permanent Life Safety Emergency Access Roads, and fan plants, as discussed in Section 4.2. Prior to the construction of Build Alternative infrastructure, some permanent property interests may be used for construction purposes, such as construction staging or construction access shafts, such as the location of fan plants in North Bergen and Hoboken. In addition, temporary construction easements along the proposed alignment in Secaucus, Jersey City, and North Bergen would be required for the construction of tracks and structures, such as viaducts and retaining walls, as well as temporary construction access roads. Temporary construction easements would be primarily limited to railroad, utility, and vacant land (see Appendix 4.2). In addition, 184 properties would require temporary subsurface easements (tunnel support easements, see Appendix 4.2) for the placement of rock bolts to temporarily support the rock mass through which the tunnels would be excavated prior to installation of the final concrete tunnel lining.

NJ TRANSIT would acquire the 31-acre portion of the Malanka Landfill north of the inactive Boonton Line for the construction of track. Prior to construction activities, a Landfill Closure Plan would need to be approved by NJDEP (see Section 5.12).

Construction of the proposed Secaucus Connection would temporarily disrupt the use of existing access roads to properties within the loop tracks, including PSE&G property and the Jersey City Police Department firing range.

Construction of a fan plant and construction access shaft, and extraction of excavated Palisades tunnels material through the Tonnelle Avenue Construction Access Shaft would cause temporary increases in noise at dwelling units east of the construction site on Paterson Plank Road in North Bergen (250 feet from the site) for a duration of up to six years. Construction activity in North Bergen would also include cut-and-cover tunneling under Tonnelle Avenue and temporary closure of no more than one of its travel lanes at a time. This temporary lane closure and additional truck traffic associated with construction of the Tonnelle Avenue Fan Plant/Construction Access Shaft, Build Alternative-related traction power substation, temporary TBM-power substation, and Amtrak switching station on the east side of Tonnelle Avenue would temporarily impede access to commercial properties such as warehouses and fast-food establishments on Tonnelle Avenue.

Construction of Build Alternative tracks and a permanent access road to Build Alternative infrastructure would demolish the northernmost part of the G&B Baker's Supply Corporation Building on the west side of Tonnelle Avenue. This property is eligible for listing in the National Register of Historic Places (see Chapter 7). Such construction would also impede traffic access to commercial properties on Tonnelle Avenue.

Construction of a fan plant and construction access shaft, and extraction of excavated Hudson River tunnels material through the Hoboken Construction Access Shaft would cause temporary increases in traffic on nearby streets, such as JFK Boulevard East, and noise impacts at dwelling units north of the construction site in Weehawken (140 feet from the site) for a duration of up to seven years. This construction would also cause noise impacts to residences on Manhattan Avenue in Union City, 360 feet west of and 200 feet above the site.

Hours of construction and movement of equipment and materials from both construction access shafts would occur between 7:00 AM and 10:00 PM, with possible 24-hour activities. This operation would introduce trucks on haul routes such as Tonnelle Avenue in North Bergen, JFK Boulevard East near the Hoboken shaft, and Route 7 heading to the Kearny Rail Yard site in Kearny, for extended periods during the day and night.

B. HUDSON RIVER

No construction-related land use impacts are projected in the Hudson River with the Build Alternative.

C. NEW YORK

The top of the tunnels bored on the west side of Manhattan from the Hudson River shoreline to Twelfth Avenue would be approximately 125 feet deep, and would not impact Hudson River Park. Boring of the remainder of the proposed tunnels in Manhattan would begin at the Twelfth Avenue Construction Access Shaft located on the Con Edison facility between West 28th and West 29th Streets and Eleventh and Twelfth Avenues (Block 674) and move north and east to West 34th Street where the NYPSE cavern would be mined. The depth to the top of the uppermost tunnels within Manhattan would range from 100 to 145 feet below-grade. The top of the proposed cavern would range from 95 to 125 feet deep. Therefore, surface impacts resulting from the construction of the tunnels and cavern would be minimal. Tunnels boring would not impact proposed construction in the Special Hudson Yards District, West Side Rail Yard and East Side Rail Yard, the existing LIRR West Side Yard Maintenance Shop, or the High Line.

Construction and operation of the construction access shaft on Block 674 would temporarily displace Con Edison vehicles and equipment from the westernmost part of this block. It is anticipated that these affected Con Edison operations on Block 674 would be relocated temporarily one block north between West 29th and West 30th Streets and Eleventh and Twelfth Avenues (Block 675) to a 0.9-acre portion of that block. A building permit application has been filled with New York City for the development of a hotel on Block 675; however, this application has not yet been approved. That portion of Block 675 would be available for development once construction on Block 674 is completed and the Con Edison operations are returned (see Section 4.2). The duration of this use is estimated to be nine years. Property owners would be compensated for the use of the property during this construction period.

Construction activity associated with fan plants/construction access shafts and NYPSE entrances would cause temporary adverse effects to visibility and access to businesses, particularly along West 33rd, West 34th, and West 35th Streets between Eighth and Fifth Avenues. These businesses would include retail shops, restaurants, and department stores and would result in the temporary loss of storefront space on West 34th Street at Seventh Avenue where the ground floors of two commercial establishments would be excavated to access lower floors for station entrance construction. Office space or residences located in upper floors above commercial uses on ground floors would experience similar visibility and access impacts to those described above; however, no displacements would occur. Temporary noise and vibration impacts to ground-floor receptors would also occur (see Section 5.7).

Construction would also require permanent property interests and securing temporary easements during the construction period. Three commercial establishments would be displaced for a period of up to seven years for the construction of station and elevator entrances. Because of this duration, these displacements and relocation of businesses are considered permanent for which there would be job losses (see Section 4.3 and Appendix 4.2, as well as Section D below). Once construction would be complete, future development of these sites would not be encumbered, and the properties would be reused or redeveloped

for uses permitted by zoning. In addition, 66 properties would require temporary subsurface easements (tunnel support easements, see Appendix 4.2) for the placement of rock bolts to temporarily support the rock mass through which the tunnels and station cavern would be excavated prior to installation of the final concrete tunnel and station linings.

During construction of fan plant/construction access shafts, NYPSE street entrances, and ADA Access/Emergency Personnel Access elevator entrances, temporary closure of segments of curbside travel lanes or rerouting of segments of sidewalks near Build Alternative construction sites would alter vehicular traffic patterns and pedestrian flows. These sidewalk and travel lane segment alterations, ranging in duration from approximately 15 months to 82 months (see Section 3.6) could temporarily change the retail streetscape, and reduce the visual and aesthetic quality of the area. These circulation alterations would be coordinated with similar effects expected to occur from other West Midtown development projects to be implemented during the same overall timeframe. These cumulative impacts are further described in Section 5.18.

Construction and movement of equipment and materials would occur during approved times of the day (proposed between 7:00 AM and 10:00 PM with possible 24-hour activity). This operation would introduce trucks on haul routes from construction access shaft sites to the Lincoln Tunnel for extended periods during the day and night.

D. MITIGATION

- To assure access to properties within the proposed Secaucus Connection during construction, including PSE&G property and the Jersey City Police Department firing range, NJ TRANSIT will relocate the existing grade crossing to clear the main construction area and provide connections to other existing access roads in the area.
- To reduce noise-related land use impacts from construction activity at residences on Paterson Plank Road located 250 feet east of and 70 feet above the Tonnelle Avenue Fan Plant/Construction Access Shaft, NJ TRANSIT will install temporary barriers approximately 20 feet high. Alternative measures such as site enclosures will be investigated to mitigate noise impacts at this location.
- To reduce noise-related land use impacts from construction activity at residences located 140 feet north of the Hoboken Fan Plant/Construction Access Shaft, NJ TRANSIT will install temporary barriers approximately 25 feet high. Alternative measures such as site enclosures will be investigated to mitigate noise impacts at this location.
- To maintain traffic and pedestrian flow during construction, NJ TRANSIT will implement MPT plans for travel lane and sidewalk closures on Tonnelle Avenue and JFK Boulevard. MPT plans will assure access to businesses within construction zones and reduce disruption to commercial properties (see Section 5.3).
- In New Jersey, NJ TRANSIT will adhere to the New Jersey Redevelopment and Housing Law N.J.S.A. 40A:12A. Efforts will be made to relocate affected businesses near their original locations (see Section 4.2).
- In New York, NJ TRANSIT will utilize temporary noise barriers and the deployment of quietest and cleanest operating construction equipment to attenuate sound- and air emissions-related land use impacts.
- In New York, to maintain traffic and pedestrian flow during construction, NJ TRANSIT will implement MPT plans for travel lane and sidewalk closures. MPT plans developed in concert with

New York City agencies and stakeholders, will assure access to businesses within the construction zones and reduce disruption to commercial properties (see Section 5.3).

- In New York, displacements and relocation will be subject to requirements of the New York State Eminent Domain Procedure Law (the "Eminent Domain Procedure Law"). NJ TRANSIT and PANYNJ will work with property owners to obtain favorable relocation assistance, including relocation of displaced businesses near their original locations (see Section 4.2).



FINAL ENVIRONMENTAL IMPACT STATEMENT AND FINAL SECTION 4(f) EVALUATION

APPENDIX 12-3

ARC FEIS Appendix 5.7

Noise and Vibration

APPENDIX 5.7 – NOISE AND VIBRATION

A. CONSTRUCTION NOISE

Construction noise levels at a given location depend on the type and number of pieces of construction equipment being operated, and the distance from the construction site and related activities to a sensitive receptor. Typical peak noise levels of construction equipment at a distance of 50 feet are presented in **Table 5.7-A**. FTA has established a standard methodology for computing construction noise impacts. Since this methodology does not correct effectively for complex terrain, building shielding, and reverberation effects at some of the construction sites in the project area, construction noise levels have been calculated using another computer modeling program that correctly accounts for these factors. FTA also establishes criteria for construction impacts according to both 8-hour L_{eq} and 30-day L_{dn} levels. Generally, however, these criteria are less stringent than state or local noise requirements. They have been used only for areas where local or state noise limits are not specifically in place.

Analysis of Build Alternative impacts examined noise levels produced by construction of fan plants/access shafts, mechanized tunnel boring, cut-and-cover construction, bridge construction, alignment grading and track laying. Utility relocation noise has been analyzed as part of cut-and-cover operations. However, these noise events would be considered to occur at night, when most utility work would be performed. For the noise assessment, 8-hour L_{eq} values and 30-day average L_{dn} values were calculated, assuming appropriate usage factors for the specified time periods.

TABLE 5.7-A: PEAK NOISE LEVELS FROM POTENTIAL BUILD ALTERNATIVE CONSTRUCTION EQUIPMENT

Construction Equipment	L_{max} Level at 50 feet (dBA)
Auger Drill Rig	85
Backhoe	80
Bar Bender	80
Chain Saw	85
Compactor	80
Compressor	70
Compressor (other)	80
Concrete Mixer	85
Concrete Pump	82
Concrete Saw	90
Crane	85
Dozer	85
Excavator	82
Front End Loader	80
Generator	82
Gradall	85
Grader	85
Impact Pile Driver	95
In-Situ Sampling Drill Rig	84
Jackhammer	80
Mounted Impact Hammer	90
Paver	85

Pneumatic Tools	85
Rock Drill	85
Scraper	85
Slurry Trenching Machine	82
Soil Mix Drill Rig	80
Tractor	84
Truck	84
Vibrator	80
Vibratory Pile Driver	95

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

Airborne noise from tunneling operations would not be expected to be noticeable, except at access and spoil extraction points, since operations would be underground. Tunneling operations would occur 24 hours a day. Mining operations would use drilling and controlled blasting, and except for some limited locations where vertical blasting may occur at station opening and fan plant/construction access shaft sites, these activities would be contained underground and would not be noticeable.

When fan plants/construction access shafts would be constructed or cut-and-cover construction would occur, noise sources from excavation activities would include backhoes, bulldozers, cranes, delivery trucks, dump trucks, and jackhammers. After the commencement of tunnel boring, mining activities or cut-and-cover excavation, soil, rock, and debris would be removed through the access shafts and trucked away. Concrete batching operations may occur at the shaft or cut-and-cover site. Potentially noisy construction activities would be expected to occur for a few months at each location during surface excavation. Once the location would be excavated to a depth sufficient to permit activities to occur below-ground, a deck would be installed over the surface of the excavation for the cut-and-cover areas, or tunnel boring or mining would commence from the access shafts. After this time, only noise from spoil removal and surface equipment, such as generators and ventilation fans, would be concentrated at the construction access shafts.

Pile driving for construction of retaining walls and blasting would also be required for fan plant/construction access shaft excavation and cut-and-cover activity. Noise produced by pile driving would vary, depending on soil conditions and equipment and techniques utilized. Typical noise levels for an impact pile driver are 95 dBA at 50 feet, and can be clearly discerned at distances of up to 1,500 feet. Vibratory or sonic pile drivers are about 5 dBA quieter. However, if not properly operated to reduce noise levels, they could generate noise levels that are nearly as high as impact pile driving. Noise produced by blasting would be clearly discernable at receptors near construction sites. Blasting operations would not occur on a regular basis, and would cause only momentary increases in noise levels for the duration of the blasting (usually only a few seconds). Average hourly noise levels would be unaffected by blasting noise because of its short duration. Blasting and pile driving operations would be expected to occur for only a few months at each location.

B. NOISE LEVEL REGULATIONS

NEW JERSEY

NJDEP has established regulations (Chapter 29 – Noise Control) for noise levels from stationary sources, which would be applicable to Build Alternative construction noise from fan plant/construction access shaft construction. These regulations state that a noise impact is considered to occur if continuous noise levels (hourly L_{eq}) at the nearest sensitive receptors exceed 50 dBA during nighttime hours (10 PM to 7 AM) or 65 dBA during daytime hours (7 AM to 10 PM). These noise limits for stationary sources were used to assess the construction and operational noise from the proposed fan plants/construction access shafts in New Jersey (Tonnel Avenue and Hoboken). NJDEP noise regulations exempt construction noise from these limits, with the exception that construction work shall not occur between the hours of 6 PM and 7 AM on weekdays, or between the hours of 6 PM and 9 AM on weekends. Construction activity during all other hours is subject to the NJDEP noise limits described above for stationary noise sources. The State of New Jersey has not promulgated specific regulations concerning construction noise impacts from mobile sources. Therefore, construction impacts for trucks and other mobile equipment have been assessed according to FTA criteria.¹ These criteria state that noise impacts occur from construction if the 8-hour L_{eq} levels at residences are greater than 80 dBA during daytime and 70 dBA at night, or if the 30-day L_{dn} is greater than 75 dBA. Local noise restrictions in New Jersey municipalities are shown in **Table 5.7-B**

TABLE 5.7-B: CONSTRUCTION NOISE RESTRICTIONS OF MUNICIPALITIES IN THE BUILD ALTERNATIVE PROJECT AREA – NEW JERSEY

Municipality	Restrictions
Secaucus	No Construction between the hours of 7 PM to 7 AM
Weehawken	No Construction between the hours of 8 PM to 7 AM
Jersey City	No Construction between the hours of 6 PM to 7 AM

Source: *Transit Link Consultants, 2005*

NEW YORK

According to CEQR (New York - City Environmental Quality Review) regulations, a noise impact occurs in NYC whenever the $L_{eq}(h)$ noise levels from construction activity exceed 65 dBA during daytime hours (7 AM to 10 PM) and 55 dBA during nighttime hours (10 PM to 7 AM). These criteria, which are more stringent than the FTA construction noise guidelines were applied to assess Build Alternative construction noise levels in NYC. The CEQR daytime and nighttime noise limits apply primarily to residential receptors, while only the daytime noise limit applies to receptors with primarily daytime use such as schools, libraries, museums, houses of worship, and commercial and office buildings.

The revised New York City Noise Code (Local Law 05113) that took effect on July 1, 2007 also addresses construction noise. The code requires contractors to submit a Noise Control Plan prior to the start of construction for approval by the City. Also, contractors are required to provide

noise mitigation, such as noise barriers, at construction sites with major noise producing equipment located within 200 feet of a residential receptor or other sensitive land uses. This noise barrier requirement would apply for each of the fan plant/construction access shaft locations in NYC, the cut-and-cover construction on West 34th Street, and the proposed NYPSE entrances.

C. NOISE MITIGATION MEASURES - CONSTRUCTION

Noise from construction equipment is regulated by USEPA noise emission standards. These federal requirements mandate that certain classifications of construction equipment and motor vehicles meet specified noise emission standards, and construction material be handled and transported in such a manner to not create unnecessary noise. In addition, appropriate low-noise-emission-level equipment can be used and operational procedures implemented.

Wooden barriers are effective in reducing noise from construction operations when they break the line of sight between operating equipment and sensitive receptors. In areas with multiple-story buildings, as in New York City, this device would not always be effective in reducing construction noise levels at the upper floors, but would be effective in reducing noise at street level. Since fences are usually erected around construction sites for safety purposes, their height could be specified to contribute to reducing construction noise at ground level receptors, if they create a solid (rather than gapped) wall. The noise barrier would be constructed of wood having a density of at least 4-pounds/square foot (e.g., ¾-inch thick plywood) to provide a transmission loss greater than the expected reduction in noise diffracted over the top of the barrier. The barrier could be positioned atop a Jersey Barrier curb, or could be free-standing with structural posts or guys for support.

Noise control measures could also be used relative to spoil removal operations. To minimize the noise from the backup warning alarms on the trucks, these vehicles would be routed through the construction site to minimize the use of alarms. In addition, vehicles could also be equipped with OSHA-approved quieter backup alarms, and restrictions on truck engine idling near loading sites, are several measures that would be considered.

Blast noise and vibration impacts could be reduced by using modern blasting techniques, such as timed multiple charges and blast mats, which lessen the severity of blasting events.

Limited mitigation techniques would be available for effectively reducing noise from pile driving operations. In certain geologic conditions, vibratory pile drivers could be used, which would generate noise levels about 5 to 7 dBA lower than impact pile drivers. When vibratory pile drivers are utilized, noise from the pile driver generator, which could be over 95 dBA at 50 feet, could be reduced by requiring it to be positioned behind a plywood noise barrier, and by requiring an appropriate muffler. In addition, vibratory pile driving noise could be reduced by requiring that loose vibrating noise-producing fittings be appropriately secured prior to pile driving.

D. VIBRATION ASSESSMENT

CONSTRUCTION VIBRATION ASSESSMENT

Blasting, pile driving, and tunnel boring would cause the most noticeable construction-related vibration in the project area. Expected construction vibration levels would vary, depending on equipment being used, soil type, building foundation and construction characteristics, and the distance from Build Alternative construction activity. In general, no vibration-related damage would occur for buildings in the project area due to proposed construction activity. However, vibration levels at certain locations may be high enough to require mitigation and monitoring.

FTA has not established limits for annoyance from construction vibration. Construction activities producing peak vibrations, such as blasting and pile driving, are often of very short duration; therefore, they are limited in the amount of annoyance they produce.

Blasting may be necessary at fan plant/construction access shaft sites, and in areas where specific non-tunnel boring subterranean excavations would occur, such as for NYPSE and crossover locations. Blasting near the surface may be perceptible at distances up to 1,000 feet from the blast location. Blasting at depths of over 100 feet in the project area would still be perceptible at the surface, and effects would vary with soil type and geology.

Two types of tunnel boring machine (TBM) would be used for the Build Alternative, a soft ground TBM, and a hard rock TBM. In general, expected vibration levels from the hard rock TBM would be considerably higher than from the soft ground TBM. TBMs may produce a noticeable rumbling in nearby buildings, and also produce perceptible vibration. Expected TBM vibration levels, however, would be well below the building damage threshold of 2 inches/second and 0.5 inch/second for historic buildings. . Such impact assessment is also being coordinated with the National Marine Fisheries Society relative to potential effects on fish species, since vibration may be perceptible to fish species near the bottom of the Hudson River.

Pile driving could also produce noticeable vibration levels at receptors up to 400 feet from the activity. However, damage to structures from pile driving usually would occur when it is conducted very close (less than 100 feet) from particular structures. In general, pile driving vibration levels depend on the type of pile driver (impact hammer or vibrating), the hammer weight and drop distance, the rock or soil type, and the depth to which the pile is driven. In the project area, differing soil and rock types would result in differing peak particle velocities for pile driving at different locations.

Pavement breaking would occur in Manhattan during fan plant/construction access shaft and station construction. This activity would include use of jackhammers, hoe rams, and similar equipment. Pavement breaking may be perceptible at distances of over 200 feet; however, it usually only causes damage to locations very close to (less than 80 feet) the pavement breaking equipment.

Excavation activities, such as grading, spoil loading and hauling, and shaft digging, would also occur during Build Alternative construction, through use of bulldozers, dump trucks, graders, and front-end loaders. In general, excavation activities would not produce significant vibration levels, except at locations extremely close to the excavation equipment. Vibration from trucks

traveling to and from excavation activities would not be expected to produce damage or significant annoyance.

VIBRATION MITIGATION MEASURES - CONSTRUCTION

Blast vibration mitigation is usually accomplished by a combination of monitoring and vibration-reducing blast design. At locations where blast impacts would be expected, a blast vibration control program would be implemented by the contractor. Blasting in both New York and New Jersey would be designed and supervised by a state-licensed blaster. Modern blasting techniques, such as timed multiple charges, would be implemented. This procedure would include the design of the number, location, and spacing of shot holes, delay times, pounds per delay, and firing sequences, to minimize vibration at affected receptors.

Vibration monitoring would be conducted at the foundations of nearby buildings (within about 370 feet of blasting operations). Blasting activities causing peak vibration levels in excess of 2 inches/second or 0.5 inch/second for historic buildings in the foundations of nearby sensitive structures would be immediately halted until appropriate blast vibration mitigation measures would be implemented. These measures could include changes in shot design, or replacement of blasting by alternative excavation measures. Blasting in areas overseen by Amtrak would follow that agency's blasting specifications.

In areas where geologic conditions allow, vibratory pile driving or pre-auguring would be used, which could reduce vibration levels. Vibration monitoring would be conducted at the foundations of nearby buildings that could be affected, within about 150 feet of pile driving operations.

To prevent damage to fragile buildings within 80 feet of Build Alternative construction, saw cuts extending completely through the pavement would be implemented where possible. Where practical, concrete cutters would be used on pavement surfaces instead of pavement breakers. This procedure should reduce vibration levels to acceptable levels at most receptors. To verify that construction-induced levels are acceptable, vibration would be monitored at sensitive locations close to (within 40 feet) any pavement breaking activity.

Special inspection and monitoring of historic structures near construction would occur, as determined by NJSHPO and NYSHPO. These procedures could include, in addition to vibration monitoring and reduction procedures described above, pre-construction inspections, and monitoring of vertical and lateral movement of historic buildings to verify that construction activities would not result in unacceptable movement of foundations. Also considered would be creation of a Construction Protection Plan for historic resources within 90 feet of construction areas (see Section 5.7, Chapter 6, Chapter 7 and the draft Programmatic Agreement).



FINAL ENVIRONMENTAL IMPACT STATEMENT AND FINAL SECTION 4(f) EVALUATION

APPENDIX 12-4

TBM Vibration Table (Excerpt from ARC FEIS Chapter 5.7)

For the tunnel boring machines (TBM), empirical vibration data has been obtained for representative-sized TBMs that would be deployed for the proposed underground and underwater tunnels in New Jersey, the Hudson River and New York City under various soil and rock conditions representative of the project area. These values are shown in **Table 5.7-1**.

TABLE 5.7-1: TBM VIBRATION LEVELS

TBM Type	Medium	PPV (in/sec)
Small diameter	Bedrock	0.012 at 25 feet 0.0015 at 100 feet 0.00053 at 200 feet
5 to 6 meter diameter	Bedrock	0.22 at 16 feet 0.09 at 33 feet 0.03 at 66 feet 0.02 at 82 feet 0.015 at 100 feet 0.0052 at 200 feet
5 to 6 meter diameter	Glacial till/dense sand	0.12 at 16 feet 0.05 at 33 feet 0.02 at 66 feet 0.01 at 82 feet 0.008 at 100 feet 0.003 at 200 feet
5 to 6 meter diameter	Soft river silt/clay	0.004 at 33 feet 0.003 at 66 feet 0.001 at 82 feet 0.0008 at 100 feet 0.0003 at 200 feet
8 meter diameter	Bedrock	0.319 at 16 feet 0.131 at 33 feet 0.044 at 66 feet 0.029 at 82 feet 0.020 at 100 feet 0.0072 at 200 feet
8 meter diameter	Glacial till/dense sand	0.174 at 16 feet 0.073 at 33 feet 0.029 at 66 feet 0.015 at 82 feet 0.011 at 100 feet 0.0039 at 200 feet
8 meter diameter	Soft river silt/clay	0.0058 at 33 feet 0.0044 at 66 feet 0.0015 at 82 feet 0.0011 at 100 feet 0.0004 at 200 feet

Source: *Transit Link Consultants, 2008.*

These values are referenced, as applicable, within the following subsections.

The vibration levels used in the FEIS analysis for the TBM reflect data for the larger diameter units operating in various soil conditions.