PILGRIM
TRANSPORTATION
OF NEW YORK, INC.

APPENDIX K

K.1 Construction Air Estimates and Assumptions Tables

K.2 NYS Thruway Emission Calculations Tables

K.3 Analysis of GHG Emissions for the Proposed Pilgrim Pipeline

PILGRIM
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APPENDIX K.1

Construction Air Estimates and Assumptions Tables

Table K-1: Project Construction - General Factors and Assumptions

Parameter	Factor	Factor Units	Additional Descriptors	
Work weeks	4	weeks/month		
Work days	6	days/week		
Work hours	12	hours/day		
Total Pipeline Length	129	miles		
Concurrent Spreads	5	spreads		
Construction Duration	10	months or	*215*	days
Construction Rate	*0.6*	miles/day		
HDD Rate	1	foot/hour		
1 ton-per-day =	*37882.6975*	grams/hour		
100% PM =	100%	PM_{10} and	100%	$PM_{2.5}$
1 ton =	*909184.74*	grams		
Max No. Workers	1600	workers		
Max ROW Width	100	feet		
Max ROW Disturbed	*1433.1*	acres	**includes pump stations*	
Disturbed Land	*2.221860465*	acres/mile-spread		
Dust control	0.5	fraction controlled		

Table K-2: Project Construction - Construction Equipment Factors and Assumptions

NON HDD CONSTRUCTION EQUIPMENT						HDD CONSTRUCTION EQUIPMENT	
Counties		Operating Miles				Drilling Length	Drilling Time
Name	ID	Mainline	Laterals	Total	%	Feet	Hours
Albany	36001	12.33	1.5	13.83	11%	5606	5606
Greene	36039	24.76		24.76	19%	10037	10037
Orange	36071	33.67	7.9	41.57	32%	16851	16851
Rensselaer	36083	2.35	0.7	3.05	2%	1236	1236
Rockland	36087	3.03		3.03	2%	1228	1228
Ulster	36111	40.35	3.5	43.85	34%	17776	17776
Notes: Divided Roseton Lateral in half							

Table K-3: Project Construction - Worker Commuter Trip Factors

Worker Commute	Miles Round Trip		People/car
car/truck	20	to warehouse	1.5
BUS	50	to work site	30

Table K-4: Project Construction - Delivery Vehicle Factors

Delivery Vehicle	Miles RT	Trips/day	Days	Comment
Single	50	9	215	3 daily deliveries from site to each spread (Mar '16 thr
Combo	300	22	30	Pipe delivery to site (Apr '16)
Combo	300	15	152	Materials delivery to site (Nov '15 through Mar '16)

Table K-5: Summary of Construction Equipment Operating Hours

Equip Type	Est. hours per Spread	Total Hours Runtime	SCC
Lube Truck	30	150	2270002051
Fuel Truck	60	300	2270002051
Truck Tractor	300	1500	2270002066
Mech Rig	210	1050	2270002039
Welding Rigs	600	3000	2270002039
Boom Trk	60	300	2270002081
5-Ton FB	300	1500	2270002081
Skid Truck	60	300	2270002051
Water Trk	30	150	2270002051
D-6 Dozer	300	1500	2270002069
D-7 Dozer	150	750	2270002069
D-8 Dozer	360	1800	2270002069
70K Excavator	450	2250	2270002036
100K Excavator	330	1650	2270002036
60K Pipelayer	480	2400	2270002045
90K Pipelayer	120	600	2270002045
Bending Mach	60	300	2270002051
Tack Rigs	60	300	2270002051
Pad Machine	30	150	2270002051
10KV Light Plant	120	600	2270002027
Low Head WP	60	300	2270006010
Fill Pump	30	150	2270006010
Test Pump	30	150	2270006010
1200 CFM AC	120	600	2270006015
350 CFM AC	60	300	2270006015
HDD	NA	NA	2270002033
Signal Boards/Light Plants	NA	600	2270002027
Bore/Drill Rigs	NA	NA	2270002033
Excavators	NA	3900	2270002036
Concrete/Industrial Saws	NA	4050	2270002039
Cranes	NA	3000	2270002045
Off-highway Trucks	NA	1650	2270002051
Tractors/Loaders/Backhoes	NA	1500	2270002066
Crawler Tractor/Dozers	NA	4050	2270002069
Other Construction Equipment	NA	1800	2270002081
Pumps	NA	600	2270006010
Air compressors	NA	900	2270006015

Table K-6: Estimate of Hours of Operation by Construction Operation and Vehicle Type

Nonroad days per operation per mile (assuming 20 days total)	Operation	Pick-up		Bus		Lube Truck		Fuel Truck		Truck Tractor	
		# units	est. hours	# units	est. hours	# units	est. hours	# units	est. hours	# units	est. hours
	Supervision	12									
1.25	General Services	6				1	30	2	60	4	120
1.25	Clear	6		1							
1.25	Grade	7		1							
1.25	String	4		1						6	180
1.25	Bend	6		1							
1.25	Lay	5		1							
1.25	Weld	1		1							
1.25	Coat	2		1							
1.25	Trench	7		1							
1.25	Rock Trench	4		1							
1.25	Lower	7		1							
1.25	Pad & Backfill	5		1							
1.25	Tie-in	21		3							
1.25	Clean-up	7		1							
1.25	Test	7		1							
	Road Boring	12		3							
	HDD	12								6	
1.25	Environmental Control	3									
	Totals	**134**		**19**		**1**		**2**		**16**	
	Nonroad hours of Operation per mile						**30**		**60**		**300**

Table K-6: Estimate of Hours of Operation
by Construction Operation and Vehicle Type

Nonroad days per operation per mile (assuming 20 days total)	Operation	Mech Rig		Welding Rigs		Boom Trk		5-Ton FB		Skid Truck	
		# units	est. hours	# units	est. hours	# units	est. hours	# units	est. hours	# units	est. hours
	Supervision										
1.25	General Services	7	210			2	60	1	30	2	60
1.25	Clear										
1.25	Grade										
1.25	String										
1.25	Bend										
1.25	Lay			4	120						
1.25	Weld			8	240						
1.25	Coat							2	60		
1.25	Trench										
1.25	Rock Trench							1	30		
1.25	Lower			2	60						
1.25	Pad & Backfill										
1.25	Tie-in			6	180						
1.25	Clean-up							3	90		
1.25	Test										
	Road Boring			2				3			
	HDD			3							
1.25	Environmental Control							3	90		
Totals		**7**		**25**		**2**		**13**		**2**	
Nonroad hours of Operation per mile			**210**		**600**		**60**		**300**		**60**

Table K-6: Estimate of Hours of Operation
by Construction Operation and Vehicle Type

Nonroad days per operation per mile (assuming 20 days total)	Operation	Water Trk		D-6 Dozer		D-7 Dozer		D-8 Dozer		70K Excavator	
		# units	est. hours	# units	est. hours	# units	est. hours	# units	est. hours	# units	est. hours
	Supervision										
1.25	General Services	1	30								
1.25	Clear			2	60					3	90
1.25	Grade			1	30	1	30	6	180	2	60
1.25	String			1	30					2	60
1.25	Bend										
1.25	Lay										
1.25	Weld			1	30						
1.25	Coat										
1.25	Trench			1	30						
1.25	Rock Trench					1	30			4	120
1.25	Lower										
1.25	Pad & Backfill					2	60			2	60
1.25	Tie-in			3	90						
1.25	Clean-up			1	30	1	30	6	180	2	60
1.25	Test										
	Road Boring	3									
	HDD	6								3	
1.25	Environmental Control										
	Totals	**10**		**10**		**5**		**12**		**18**	
	Nonroad hours of Operation per mile		**30**		**300**		**150**		**360**		**450**

Table K-6: Estimate of Hours of Operation
by Construction Operation and Vehicle Type

Nonroad days per operation per mile (assuming 20 days total)	Operation	100K Excavator		60K Pipelayer		90K Pipelayer		Bending Mach		Boring Mach	
		# units	est. hours	# units	est. hours	# units	est. hours	# units	est. hours	# units	est. hours
	Supervision										
1.25	General Services										
1.25	Clear										
1.25	Grade										
1.25	String										
1.25	Bend			2	60			2	60		
1.25	Lay			2	60						
1.25	Weld										
1.25	Coat										
1.25	Trench	5	150								
1.25	Rock Trench	2	60								
1.25	Lower	1	30	2	60	1	30				
1.25	Pad & Backfill										
1.25	Tie-in	3	90	9	270	3	90				
1.25	Clean-up										
1.25	Test			1	30						
	Road Boring	3								3	
	HDD										
1.25	Environmental Control										
	Totals	**14**		**16**		**4**		**2**		**3**	
	Nonroad hours of Operation per mile		**330**		**480**		**120**		**60**		

Table K-6: Estimate of Hours of Operation
by Construction Operation and Vehicle Type

Nonroad days per operation per mile (assuming 20 days total)	Operation	Tack Rigs		Pad Machine		HDD Rig		10KV Light Plant		Low Head WP	
		# units	est. hours	# units	est. hours	# units	est. hours	# units	est. hours	# units	est. hours
	Supervision										
1.25	General Services										
1.25	Clear										
1.25	Grade										
1.25	String										
1.25	Bend										
1.25	Lay	2	60								
1.25	Weld										
1.25	Coat										
1.25	Trench										
1.25	Rock Trench										
1.25	Lower			1	30						
1.25	Pad & Backfill										
1.25	Tie-in										
1.25	Clean-up										
1.25	Test							4	120	2	60
	Road Boring										
	HDD					3					
1.25	Environmental Control										
	Totals	**2**		**1**		**3**		**4**		**2**	
	Nonroad hours of Operation per mile		**60**		**30**				**120**		**60**

Table K-6: Estimate of Hours of Operation
by Construction Operation and Vehicle Type

Nonroad days per operation per mile (assuming 20 days total)	Operation	Fill Pump		Test Pump		1200 CFM AC		900 CFM AC		350 CFM AC	
		# units	est. hours	# units	est. hours	# units	est. hours	# units	est. hours	# units	est. hours
	Supervision										
1.25	General Services										
1.25	Clear										
1.25	Grade										
1.25	String										
1.25	Bend										
1.25	Lay										
1.25	Weld										
1.25	Coat									2	60
1.25	Trench										
1.25	Rock Trench										
1.25	Lower										
1.25	Pad & Backfill										
1.25	Tie-in										
1.25	Clean-up										
1.25	Test	1	30	1	30	4	120				
	Road Boring					3					
	HDD							3			
1.25	Environmental Control										
Totals		**1**		**1**		**7**		**3**		**2**	
Nonroad hours of Operation per mile			**30**		**30**		**120**				**60**

Table K-7: Calculation of Construction Activity Emissions

Construction Equipment	Equipment Engine HP	Fuel		SCC	Number of Operating Hours	Project Emission Totals (tons)							
		Diesel	Gasoline			CO_2	CO	NO_X	PM_{10}[1]	$PM_{2.5}$[1]	SO_2	VOC	Total HAPs
Nonroad Construction Equipment						Non Road							
Signal Boards/Light Plants	25	X		2270002027	#N/A	3.45	0.01	0.03	0.00	0.00	0.00	0.00	0.00
Bore/Drill Rigs	300	X		2270002033	52734	468.34	0.91	3.51	0.22	0.22	0.09	0.27	0.07
Excavators	300	X		2270002036	#N/A	738.33	0.60	1.85	0.23	0.23	0.13	0.21	0.01
Concrete/Industrial Saws	300	X		2270002039	#N/A	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Cranes	300	X		2270002045	#N/A	117.22	0.09	0.43	0.03	0.03	0.02	0.04	0.01
Off-highway Trucks	300	X		2270002051	#N/A	12.39	0.00	0.02	0.00	0.00	0.00	0.00	0.00
Tractors/Loaders/Backhoes	300	X		2270002066	#N/A	1.78	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Crawler Tractor/Dozers	300	X		2270002069	#N/A	513.87	0.50	1.49	0.17	0.17	0.09	0.15	0.01
Other Construction Equipment	100	X		2270002081	#N/A	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nonroad Commercial Equipment													
Pumps	11	X		2270006010	#N/A	0.87	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Air compressors	75	X		2270006015	#N/A	10.97	0.03	0.07	0.01	0.01	0.00	0.01	0.00
On-road construction vehicles						MOVES							
Single Unit Long-haul Truck						86.53	0.10	0.22	0.01	0.01	0.00	0.02	0.00
Combination Long-haul Truck[2]						1909.72	1.51	6.28	0.24	0.24	0.01	0.24	0.04
Construction Areas[3]						Fugitive Dust							
Area under construction (Exposed Soils)						0.00	0.00	0.00	788.21	78.82	0.00	0.00	0.00
Wind erosion post-construction (Exposed Soils)[4]						0.00	0.00	0.00	113.45	17.02	0.00	0.00	0.00
Construction Workers						MOVES							
Truck/Car						2,084.93	14.25	2.03	0.06	0.06	0.03	0.26	0.02
Bus						521.00	0.84	2.53	0.11	0.11	0.00	0.20	0.03
					Total Construction Equipment	**3,864.07**	**3.78**	**13.90**	**0.92**	**0.92**	**0.35**	**0.96**	**0.15**
					Construction Worker Commutes	**2,605.93**	**15.09**	**4.56**	**0.17**	**0.17**	**0.03**	**0.46**	**0.05**
					Total Fugitive Dust	**0.00**	**0.00**	**0.00**	**901.66**	**95.84**	**0.00**	**0.00**	**0.00**

Notes:

[1] Assume ratios of PM_{10} and $PM_{2.5}$ are equal to total PM.

[2] Includes November 2015 and December 2015 deliveries.

[3] Assumes one year for complete re-vegetation of disturbed areas.

[4] Includes 150 MV dispatched from each site daily

Table K-8.1: Calculation of Construction Vehicle Emissions - Construction Segment 36001

Construction Equipment	Equipment Engine HP	Fuel		SCC	Number of Operating Hours	NONROAD2008 Emission Factor (g/hp-hr)							AP-42 Emission Factor (g/hp-hr)	Engine Load Factor	Project Emission Totals (tons)							
		Diesel	Gasoline			CO_2	CO	NO_x	PM_{10}[1]	$PM_{2.5}$[1]	SO_2	VOC	Total HAPs		CO_2	CO	NO_x	PM_{10}[1]	$PM_{2.5}$[1]	SO_2	VOC	Total HAPs
Nonroad Construction Equipment																						
Signal Boards/Light Plants	25	X		2270002027	64	918.66	3.78	7.15	0.58	0.58	0.20	0.76	0.01	0.43	0.69	0.00	0.01	0.00	0.00	0.00	0.00	0.00
HDD Bore/Drill Rigs	300	X		2270002033	5606	118.17	0.23	0.88	0.06	0.06	0.02	0.07	0.01	0.43	93.99	0.18	0.70	0.04	0.04	0.02	0.05	0.01
Excavators	300	X		2270002036	415	1835.78	1.49	4.59	0.58	0.58	0.31	0.52	0.01	0.59	148.18	0.12	0.37	0.05	0.05	0.03	0.04	0.00
Concrete/Industrial Saws	300	X		2270002039	431	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.59	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cranes	300	X		2270002045	319	378.90	0.31	1.39	0.11	0.11	0.07	0.12	0.01	0.59	23.53	0.02	0.09	0.01	0.01	0.00	0.01	0.00
Off-highway Trucks	300	X		2270002051	175	204.54	0.08	0.33	0.05	0.05	0.03	0.05	0.01	0.21	2.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tractors/Loaders/Backhoes	300	X		2270002066	159	11.50	0.04	0.07	0.01	0.01	0.00	0.01	0.01	0.59	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Crawler Tractor/Dozers	300	X		2270002069	431	1230.36	1.20	3.56	0.42	0.42	0.22	0.37	0.01	0.59	103.13	0.10	0.30	0.03	0.03	0.02	0.03	0.00
Other Construction Equipment	100	X		2270002081	191	12.13	0.05	0.06	0.01	0.01	0.00	0.01	0.01	0.43	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nonroad Commercial Equipment																						
Pumps	11	X		2270006010	64	492.56	3.76	4.14	0.42	0.42	0.11	0.56	0.01	0.43	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Air compressors	75	X		2270006015	96	1238.86	3.91	8.03	0.63	0.63	0.24	0.58	0.01	0.21	2.05	0.01	0.01	0.00	0.00	0.00	0.00	0.00
On-road construction vehicles					**VMT**	**MOVES Emission Factors (g/VMT)**																
Single Unit Long-haul Truck		X			10,286	813.12	0.93	2.04	0.08	0.08	0.01	0.22	0.03		9.20	0.01	0.02	0.00	0.00	0.00	0.00	0.00
Combination Long-haul Truck[2]		X			93,766	1968.58	1.56	6.47	0.24	0.24	0.01	0.25	0.04		203.02	0.16	0.67	0.03	0.03	0.00	0.03	0.00
Construction Areas					**Area (acre-month)**	**WRAP Fugitive Dust Handbook Emission Factor (tons/acre-month)**																
Area under construction (Exposed Soils)					1523.54	NA	NA	NA	0.11	0.011	NA	NA	NA		0.00	0.00	0.00	167.59	16.76	0.00	0.00	0.00
Wind erosion post-construction (Exposed Soils)[3]					1828.25	NA	NA	NA	0.016	0.002	NA	NA	NA		0.00	0.00	0.00	24.12	3.62	0.00	0.00	0.00
Construction Workers					**VMT**	**MOVES Emission Factors (g/VMT)**																
Truck/Car[4]					556,184	362.33	2.48	0.35	0.01	0.01	0.01	0.05	0.00		221.65	1.51	0.22	0.01	0.01	0.00	0.03	0.00
Bus					60,952	826.19	1.33	4.02	0.17	0.17	0.01	0.31	0.04		55.39	0.09	0.27	0.01	0.01	0.00	0.02	0.00

Notes:

[1] Assume ratios of PM_{10} and $PM_{2.5}$ are equal to total PM.

[2] Includes November 2015 and December 2015 deliveries.

[3] Assumes one year for complete re-vegetation of disturbed areas.

[4] Includes 150 MV dispatched from each site daily

Table K-8.2: Calculation of Construction Vehicle Emissions - Construction Segment 36039

Construction Equipment	Equipment Engine HP	Fuel		SCC	Number of Operating Hours	NONROAD2008 Emission Factor (g/hp-hr)							AP-42 Emission Factor (g/hp-hr)	Engine Load Factor	Project Emission Totals (tons)							
		Diesel	Gasoline			CO_2	CO	NO_x	PM_{10}[1]	$PM_{2.5}$[1]	SO_2	VOC	Total HAPs		CO_2	CO	NO_x	PM_{10}[1]	$PM_{2.5}$[1]	SO_2	VOC	Total HAPs
Nonroad Construction Equipment																						
Signal Boards/Light Plants	25	X		2270002027	114	234.10	0.96	1.82	0.15	0.15	0.05	0.19	0.01	0.43	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bore/Drill Rigs	300	X		2270002033	10037	30.11	0.06	0.23	0.01	0.01	0.01	0.02	0.01	0.43	42.88	0.08	0.32	0.02	0.02	0.01	0.02	0.01
Excavators	300	X		2270002036	742	467.82	0.38	1.17	0.15	0.15	0.08	0.13	0.01	0.59	67.60	0.05	0.17	0.02	0.02	0.01	0.02	0.00
Concrete/Industrial Saws	300	X		2270002039	771	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.59	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cranes	300	X		2270002045	571	96.56	0.08	0.35	0.03	0.03	0.02	0.03	0.01	0.59	10.73	0.01	0.04	0.00	0.00	0.00	0.00	0.00
Off-highway Trucks	300	X		2270002051	314	52.12	0.02	0.08	0.01	0.01	0.01	0.01	0.01	0.21	1.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tractors/Loaders/Backhoes	300	X		2270002066	285	2.93	0.01	0.02	0.00	0.00	0.00	0.00	0.01	0.59	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Crawler Tractor/Dozers	300	X		2270002069	771	313.54	0.31	0.91	0.11	0.11	0.05	0.09	0.01	0.59	47.05	0.05	0.14	0.02	0.02	0.01	0.01	0.00
Other Construction Equipment	100	X		2270002081	343	3.09	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.43	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nonroad Commercial Equipment																						
Pumps	11	X		2270006010	114	35.88	0.27	0.30	0.03	0.03	0.01	0.04	0.01	0.43	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Air compressors	75	X		2270006015	171	90.23	0.28	0.58	0.05	0.05	0.02	0.04	0.01	0.21	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
On-road construction vehicles					**VMT**	**MOVES Emission Factors (g/VMT)**																
Single Unit Long-haul Truck		X			18,414	813.12	0.93	2.04	0.08	0.08	0.01	0.22	0.03		16.47	0.02	0.04	0.00	0.00	0.00	0.00	0.00
Combination Long-haul Truck[2]		X			167,871	1968.58	1.56	6.47	0.24	0.24	0.01	0.25	0.04		363.48	0.29	1.19	0.04	0.04	0.00	0.05	0.01
Construction Areas					**Area (acre-month)**	**WRAP Fugitive Dust Handbook Emission Factor (tons/acre-month)**																
Area under construction (Exposed Soils)					2727.62	NA	NA	NA	0.11	0.011	NA	NA	NA		0.00	0.00	0.00	300.04	30.00	0.00	0.00	0.00
Wind erosion post-construction (Exposed Soils)[3]					3273.14	NA	NA	NA	0.016	0.002	NA	NA	NA		0.00	0.00	0.00	43.19	6.48	0.00	0.00	0.00
Construction Workers					**VMT**	**MOVES Emission Factors (g/VMT)**																
Truck/Car[4]					995,742	362.33	2.48	0.35	0.01	0.01	0.01	0.05	0.00		396.82	2.71	0.39	0.01	0.01	0.01	0.05	0.00
Bus					109,122	826.19	1.33	4.02	0.17	0.17	0.01	0.31	0.04		99.16	0.16	0.48	0.02	0.02	0.00	0.04	0.01

Notes:

[1] Assume ratios of PM_{10} and $PM_{2.5}$ are equal to total PM.

[2] Includes November 2015 and December 2015 deliveries.

[3] Assumes one year for complete re-vegetation of disturbed areas.

[4] Includes 150 MV dispatched from each site daily

Table K-8.3: Calculation of Construction Vehicle Emissions - Construction Segment 36071

Construction Equipment	Equipment Engine HP	Fuel		SCC	Number of Operating Hours	NONROAD2008 Emission Factor (g/hp-hr)							AP-42 Emission Factor (g/hp-hr)	Engine Load Factor	Project Emission Totals (tons)							
		Diesel	Gasoline			CO_2	CO	NO_x	PM_{10}[1]	$PM_{2.5}$[1]	SO_2	VOC	Total HAPs		CO_2	CO	NO_x	PM_{10}[1]	$PM_{2.5}$[1]	SO_2	VOC	Total HAPs
Nonroad Construction Equipment																						
Signal Boards/Light Plants	25	X		2270002027	192	689.07	2.83	5.37	0.43	0.43	0.15	0.57	0.01	0.43	1.56	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Bore/Drill Rigs	300	X		2270002033	16851	88.63	0.17	0.66	0.04	0.04	0.02	0.05	0.01	0.43	211.92	0.41	1.59	0.10	0.10	0.04	0.12	0.02
Excavators	300	X		2270002036	1246	1376.99	1.12	3.45	0.44	0.44	0.23	0.39	0.01	0.59	334.08	0.27	0.84	0.11	0.11	0.06	0.10	0.00
Concrete/Industrial Saws	300	X		2270002039	1294	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.59	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cranes	300	X		2270002045	959	284.21	0.23	1.04	0.08	0.08	0.05	0.09	0.01	0.59	53.04	0.04	0.19	0.02	0.02	0.01	0.02	0.00
Off-highway Trucks	300	X		2270002051	527	153.43	0.06	0.25	0.04	0.04	0.02	0.04	0.01	0.21	5.61	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Tractors/Loaders/Backhoes	300	X		2270002066	479	8.63	0.03	0.05	0.01	0.01	0.00	0.01	0.01	0.59	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Crawler Tractor/Dozers	300	X		2270002069	1294	922.88	0.90	2.67	0.31	0.31	0.16	0.28	0.01	0.59	232.52	0.23	0.67	0.08	0.08	0.04	0.07	0.00
Other Construction Equipment	100	X		2270002081	575	9.10	0.04	0.04	0.01	0.01	0.00	0.00	0.01	0.43	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nonroad Commercial Equipment																						
Pumps	11	X		2270006010	192	463.47	3.54	3.89	0.39	0.39	0.10	0.53	0.01	0.43	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Air compressors	75	X		2270006015	288	1165.69	3.68	7.56	0.60	0.60	0.23	0.54	0.01	0.21	5.81	0.02	0.04	0.00	0.00	0.00	0.00	0.00
On-road construction vehicles					**VMT**	**MOVES Emission Factors (g/VMT)**																
Single Unit Long-haul Truck		X			30,916	813.12	0.93	2.04	0.08	0.08	0.01	0.22	0.03		27.65	0.03	0.07	0.00	0.00	0.00	0.01	0.00
Combination Long-haul Truck[2]		X			281,841	1968.58	1.56	6.47	0.24	0.24	0.01	0.25	0.04		610.25	0.48	2.01	0.08	0.08	0.00	0.08	0.01
Construction Areas					**Area (acre-month)**	**WRAP Fugitive Dust Handbook Emission Factor (tons/acre-month)**																
Area under construction (Exposed Soils)					4579.44	NA	NA	NA	0.11	0.011	NA	NA	NA		0.00	0.00	0.00	503.74	50.37	0.00	0.00	0.00
Wind erosion post-construction (Exposed Soils)[3]					5495.33	NA	NA	NA	0.016	0.002	NA	NA	NA		0.00	0.00	0.00	72.51	10.88	0.00	0.00	0.00
Construction Workers					**VMT**	**MOVES Emission Factors (g/VMT)**																
Truck/Car[4]					1,671,769	362.33	2.48	0.35	0.01	0.01	0.01	0.05	0.00		666.24	4.55	0.65	0.02	0.02	0.01	0.08	0.01
Bus					183,208	826.19	1.33	4.02	0.17	0.17	0.01	0.31	0.04		166.48	0.27	0.81	0.04	0.04	0.00	0.06	0.01

Notes:

[1] Assume ratios of PM_{10} and $PM_{2.5}$ are equal to total PM.

[2] Includes November 2015 and December 2015 deliveries.

[3] Assumes one year for complete re-vegetation of disturbed areas.

[4] Includes 150 MV dispatched from each site daily

Table K-8.4: Calculation of Construction Vehicle Emissions - Construction Segment 36083

Construction Equipment	Equipment Engine HP	Fuel		SCC	Number of Operating Hours	NONROAD2008 Emission Factor (g/hp-hr)							AP-42 Emission Factor (g/hp-hr)	Engine Load Factor	Project Emission Totals (tons)							
		Diesel	Gasoline			CO_2	CO	NO_x	PM_{10}[1]	$PM_{2.5}$[1]	SO_2	VOC	Total HAPs		CO_2	CO	NO_x	PM_{10}[1]	$PM_{2.5}$[1]	SO_2	VOC	Total HAPs
Nonroad Construction Equipment																						
Signal Boards/Light Plants	25	X		2270002027	14	384.65	1.58	3.00	0.24	0.24	0.08	0.32	0.01	0.43	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bore/Drill Rigs	300	X		2270002033	1236	49.48	0.10	0.37	0.02	0.02	0.01	0.03	0.01	0.43	8.68	0.02	0.06	0.00	0.00	0.00	0.01	0.00
Excavators	300	X		2270002036	91	768.65	0.62	1.92	0.24	0.24	0.13	0.22	0.01	0.59	13.68	0.01	0.03	0.00	0.00	0.00	0.00	0.00
Concrete/Industrial Saws	300	X		2270002039	95	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cranes	300	X		2270002045	70	158.65	0.13	0.58	0.05	0.05	0.03	0.05	0.01	0.59	2.17	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Off-highway Trucks	300	X		2270002051	39	85.64	0.03	0.14	0.02	0.02	0.01	0.02	0.01	0.21	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tractors/Loaders/Backhoes	300	X		2270002066	35	4.81	0.01	0.03	0.00	0.00	0.00	0.00	0.01	0.59	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Crawler Tractor/Dozers	300	X		2270002069	95	515.16	0.50	1.49	0.17	0.17	0.09	0.16	0.01	0.59	9.52	0.01	0.03	0.00	0.00	0.00	0.00	0.00
Other Construction Equipment	100	X		2270002081	42	5.08	0.02	0.02	0.00	0.00	0.00	0.00	0.01	0.43	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nonroad Commercial Equipment																						
Pumps	11	X		2270006010	14	122.17	0.93	1.03	0.10	0.10	0.03	0.14	0.01	0.43	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Air compressors	75	X		2270006015	21	307.28	0.97	1.99	0.16	0.16	0.06	0.14	0.01	0.21	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
On-road construction vehicles					**VMT**	**MOVES Emission Factors (g/VMT)**																
Single Unit Long-haul Truck		X			2,268	813.12	0.93	2.04	0.08	0.08	0.01	0.22	0.03		2.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Combination Long-haul Truck[2]		X			20,679	1968.58	1.56	6.47	0.24	0.24	0.01	0.25	0.04		44.77	0.04	0.15	0.01	0.01	0.00	0.01	0.00
Construction Areas					**Area (acre-month)**	**WRAP Fugitive Dust Handbook Emission Factor (tons/acre-month)**																
Area under construction (Exposed Soils)					335.99	NA	NA	NA	0.11	0.011	NA	NA	NA		0.00	0.00	0.00	36.96	3.70	0.00	0.00	0.00
Wind erosion post-construction (Exposed Soils)[3]					403.19	NA	NA	NA	0.016	0.002	NA	NA	NA		0.00	0.00	0.00	5.32	0.80	0.00	0.00	0.00
Construction Workers					**VMT**	**MOVES Emission Factors (g/VMT)**																
Truck/Car[4]					122,658	362.33	2.48	0.35	0.01	0.01	0.01	0.05	0.00		48.88	0.33	0.05	0.00	0.00	0.00	0.01	0.00
Bus					13,442	826.19	1.33	4.02	0.17	0.17	0.01	0.31	0.04		12.21	0.02	0.06	0.00	0.00	0.00	0.00	0.00

Notes:

[1] Assume ratios of PM_{10} and $PM_{2.5}$ are equal to total PM.

[2] Includes November 2015 and December 2015 deliveries.

[3] Assumes one year for complete re-vegetation of disturbed areas.

[4] Includes 150 MV dispatched from each site daily

Table K-8.5: Calculation of Construction Vehicle Emissions - Construction Segment 36087

Construction Equipment	Equipment Engine HP	Fuel		SCC	Number of Operating Hours	NONROAD2008 Emission Factor (g/hp-hr)							AP-42 Emission Factor (g/hp-hr)	Engine Load Factor	Project Emission Totals (tons)							
		Diesel	Gasoline			CO_2	CO	NO_X	PM_{10}[1]	$PM_{2.5}$[1]	SO_2	VOC	Total HAPs		CO_2	CO	NO_X	PM_{10}[1]	$PM_{2.5}$[1]	SO_2	VOC	Total HAPs
Nonroad Construction Equipment																						
Signal Boards/Light Plants	25	X		2270002027	14	463.52	1.91	3.61	0.29	0.29	0.10	0.38	0.01	0.43	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bore/Drill Rigs	300	X		2270002033	1228	59.62	0.12	0.45	0.03	0.03	0.01	0.03	0.01	0.43	10.39	0.02	0.08	0.00	0.00	0.00	0.01	0.00
Excavators	300	X		2270002036	91	926.27	0.75	2.32	0.29	0.29	0.16	0.26	0.01	0.59	16.38	0.01	0.04	0.01	0.01	0.00	0.00	0.00
Concrete/Industrial Saws	300	X		2270002039	94	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cranes	300	X		2270002045	70	191.18	0.15	0.70	0.06	0.06	0.03	0.06	0.01	0.59	2.60	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Off-highway Trucks	300	X		2270002051	38	103.21	0.04	0.17	0.03	0.03	0.02	0.03	0.01	0.21	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tractors/Loaders/Backhoes	300	X		2270002066	35	5.80	0.02	0.03	0.00	0.00	0.00	0.00	0.01	0.59	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Crawler Tractor/Dozers	300	X		2270002069	94	620.80	0.60	1.80	0.21	0.21	0.11	0.19	0.01	0.59	11.40	0.01	0.03	0.00	0.00	0.00	0.00	0.00
Other Construction Equipment	100	X		2270002081	42	6.12	0.03	0.03	0.00	0.00	0.00	0.00	0.01	0.43	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nonroad Commercial Equipment																						
Pumps	11	X		2270006010	14	627.33	4.79	5.27	0.53	0.53	0.13	0.72	0.01	0.43	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Air compressors	75	X		2270006015	21	1577.83	4.98	10.23	0.81	0.81	0.31	0.74	0.01	0.21	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00
On-road construction vehicles					**VMT**	**MOVES Emission Factors (g/VMT)**																
Single Unit Long-haul Truck		X			2,253	813.12	0.93	2.04	0.08	0.08	0.01	0.22	0.03		2.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Combination Long-haul Truck[2]		X			20,543	1968.58	1.56	6.47	0.24	0.24	0.01	0.25	0.04		44.48	0.04	0.15	0.01	0.01	0.00	0.01	0.00
Construction Areas					**Area (acre-month)**	**WRAP Fugitive Dust Handbook Emission Factor (tons/acre-month)**																
Area under construction (Exposed Soils)					333.79	NA	NA	NA	0.11	0.011	NA	NA	NA		0.00	0.00	0.00	36.72	3.67	0.00	0.00	0.00
Wind erosion post-construction (Exposed Soils)[3]					400.55	NA	NA	NA	0.016	0.002	NA	NA	NA		0.00	0.00	0.00	5.29	0.79	0.00	0.00	0.00
Construction Workers					**VMT**	**MOVES Emission Factors (g/VMT)**																
Truck/Car[4]					121,854	362.33	2.48	0.35	0.01	0.01	0.01	0.05	0.00		48.56	0.33	0.05	0.00	0.00	0.00	0.01	0.00
Bus					13,354	826.19	1.33	4.02	0.17	0.17	0.01	0.31	0.04		12.13	0.02	0.06	0.00	0.00	0.00	0.00	0.00

Notes:

[1] Assume ratios of PM_{10} and $PM_{2.5}$ are equal to total PM.

[2] Includes November 2015 and December 2015 deliveries.

[3] Assumes one year for complete re-vegetation of disturbed areas.

[4] Includes 150 MV dispatched from each site daily

Table K-8.6: Calculation of Construction Vehicle Emissions - Construction Segment 36087

Construction Equipment	Equipment Engine HP	Fuel		SCC	Number of Operating Hours	NONROAD2008 Emission Factor (g/hp-hr)							AP-42 Emission Factor (g/hp-hr)	Engine Load Factor	Project Emission Totals (tons)							
		Diesel	Gasoline			CO_2	CO	NO_x	PM_{10}[1]	$PM_{2.5}$[1]	SO_2	VOC	Total HAPs		CO_2	CO	NO_x	PM_{10}[1]	$PM_{2.5}$[1]	SO_2	VOC	Total HAPs
Nonroad Construction Equipment																						
Signal Boards/Light Plants	25	X		2270002027	202	309.72	1.27	2.41	0.19	0.19	0.07	0.26	0.01	0.43	0.74	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Bore/Drill Rigs	300	X		2270002033	17776	39.84	0.08	0.30	0.02	0.02	0.01	0.02	0.01	0.43	100.48	0.19	0.75	0.05	0.05	0.02	0.06	0.03
Excavators	300	X		2270002036	1315	618.93	0.50	1.55	0.20	0.20	0.11	0.18	0.01	0.59	158.40	0.13	0.40	0.05	0.05	0.03	0.05	0.00
Concrete/Industrial Saws	300	X		2270002039	1365	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.59	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cranes	300	X		2270002045	1011	127.74	0.10	0.47	0.04	0.04	0.02	0.04	0.01	0.59	25.15	0.02	0.09	0.01	0.01	0.00	0.01	0.00
Off-highway Trucks	300	X		2270002051	556	68.96	0.03	0.11	0.02	0.02	0.01	0.02	0.01	0.21	2.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tractors/Loaders/Backhoes	300	X		2270002066	506	3.88	0.01	0.02	0.00	0.00	0.00	0.00	0.01	0.59	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Crawler Tractor/Dozers	300	X		2270002069	1365	414.81	0.40	1.20	0.14	0.14	0.07	0.13	0.01	0.59	110.24	0.11	0.32	0.04	0.04	0.02	0.03	0.00
Other Construction Equipment	100	X		2270002081	607	4.09	0.02	0.02	0.00	0.00	0.00	0.00	0.01	0.43	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nonroad Commercial Equipment																						
Pumps	11	X		2270006010	202	162.89	1.24	1.37	0.14	0.14	0.04	0.19	0.01	0.43	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Air compressors	75	X		2270006015	303	409.70	1.29	2.66	0.21	0.21	0.08	0.19	0.01	0.21	2.15	0.01	0.01	0.00	0.00	0.00	0.00	0.00
On-road construction vehicles					**VMT**	**MOVES Emission Factors (g/VMT)**																
Single Unit Long-haul Truck		X			32,612	813.12	0.93	2.04	0.08	0.08	0.01	0.22	0.03		29.17	0.03	0.07	0.00	0.00	0.00	0.01	0.00
Combination Long-haul Truck[2]		X			297,300	1968.58	1.56	6.47	0.24	0.24	0.01	0.25	0.04		643.72	0.51	2.12	0.08	0.08	0.00	0.08	0.01
Construction Areas					**Area (acre-month)**	**WRAP Fugitive Dust Handbook Emission Factor (tons/acre-month)**																
Area under construction (Exposed Soils)					4830.61	NA	NA	NA	0.11	0.011	NA	NA	NA		0.00	0.00	0.00	531.37	53.14	0.00	0.00	0.00
Wind erosion post-construction (Exposed Soils)[3]					5796.73	NA	NA	NA	0.016	0.002	NA	NA	NA		0.00	0.00	0.00	76.48	11.47	0.00	0.00	0.00
Construction Workers					**VMT**	**MOVES Emission Factors (g/VMT)**																
Truck/Car[4]					1,763,461	362.33	2.48	0.35	0.01	0.01	0.01	0.05	0.00		702.78	4.80	0.68	0.02	0.02	0.01	0.09	0.01
Bus					193,256	826.19	1.33	4.02	0.17	0.17	0.01	0.31	0.04		175.61	0.28	0.85	0.04	0.04	0.00	0.07	0.01

Notes:

[1] Assume ratios of PM_{10} and $PM_{2.5}$ are equal to total PM.

[2] Includes November 2015 and December 2015 deliveries.

[3] Assumes one year for complete re-vegetation of disturbed areas.

[4] Includes 150 MV dispatched from each site daily

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APPENDIX K.2

NYS Thruway Emission Calculations Tables

Appendix K.2
Methodology

New York State Thruway Emissions Comparison to the Project Construction Emissions

Annual average daily trip data was collected for New York State Thruway by road segments from the NYDOT. Using the segment length and daily trip data, total vehicle miles traveled (VMT) was calculated for the construction time period of 10 months for segments along the Project. These VMT values were combined by NYDOT Region.
Reference: https://www.dot.ny.gov/divisions/engineering/technical-services/highway-data-services/inventory-listing March 20, 2015

Vehicle mixture information from the NYDOT was used to scale the emissions by the percentage of each type of vehicle on the road. This information was separated by NYDOT Region.
Reference: NYDOT Mobile6.2 Emission Factors, Vehicle Distribution by NYSDOT Region for Class 01 (Interstates).

Using the EPA MOVES2010b model, emission rates were calculated by county based on the vehicle mixture. They were then averaged based on NYDOT Region to get an emission rate in g/VMT.

The emission rates were then multiplied by the VMT calculated based on NYDOT information and converted to tons.

Table K-9: Summary of NYSDOT On-Road Vehicle Pollutant Emission Rates and Route I-87 Project Area VMT

NYSDOT Region	Emission Rate g/VMT							VMT
	CO2_Equiv	CO	NOx	Total_PM10	Total_PM25	SO2	VOC	
Region 1	686.93	10.72	2.16	0.06	0.04	0.01	0.32	395,286,546
Region 8	707.18	12.37	2.35	0.07	0.04	0.01	0.38	1,143,359,616

Table K-10: Comparison of Project VMT Emissions to NYSDOT Region VMT Emissions

VMT Emission Source	Emissions (tons)						
	CO2_Equiv	CO	NOx	Total_PM10	Total_PM25	SO2	VOC
Region 1							
NYDOT	298,687.22	4,659.62	938.00	27.90	17.31	4.04	140.70
PROJECT	1,365.19	4.95	3.28	0.12	0.12	0.01	0.21
PROJECT as % of NYSDOT	0.46%	0.11%	0.35%	0.44%	0.71%	0.36%	0.15%
Region 8							
NYDOT	889,419.03	15,557.49	2,959.82	85.22	53.76	11.62	479.31
PROJECT	3,129.09	11.35	7.52	0.28	0.28	0.03	0.49
PROJECT as % of NYSDOT	0.35%	0.07%	0.25%	0.33%	0.52%	0.28%	0.10%

Table K-11: Comparison of Project VMT Emissions NYSDOT Regions Combined

Emission Source	Total Emissions (tons)						
	CO2_Equiv	CO	NOx	Total_PM10	Total_PM25	SO2	VOC
NYS Thruway (I-87)	1,188,106	20,217	3,898	113	71	16	620
Project (Construction)	4,494	16	11	0.40	0.40	0.05	0.70
Project as a % of Thruway	0.38%	0.08%	0.28%	0.36%	0.57%	0.30%	0.11%

Notes

Region 1 = Albany County, Greene County

Region 8 = Orange County, Rockland County, Ulster County

Pilgrim emissions (non road and on road) only for those counties where the highway parallels the project are provided in Appendix K.1

Only NYS Thruway(I-87) segments that are near the Project are included

PM emission do not include fugitive dust, they are tailpipe and tire/brake wear only for both sources

1 g = 0.0022 lbs

2000 lb = 1 ton

Table K-12: MOVES -Pollutant Emissions and Distance Traveled by Vehicle Type and NYS County

County	Source Type	Fuel	Pollutant Emissions by Source Type (g)											Distance Traveled by Source Type (mi)
			CO2_Equiv	CO	NOx	Total_PM10	Total_PM25	Brake_PM10	Tire_PM10	Brake_PM25	Tire_PM25	SO2	VOC	
Albany														
36001	11	1	2.379E+09	92953000	4710440	406029	373876	4057	15422	1062	3698	36589	4453290	6073440
36001	21	1	2.049E+11	1.393E+09	109178000	6506268	5991041	4928300	3203380	1290130	768197	3153430	15608600	631209024
36001	32	1	3.956E+10	385744992	60464900	1681017	1547900	1174080	480944	307352	115334	607728	7918480	90976600
36001	32	2	7.33E+09	16471900	24164600	1227115	1190338	150035	75117	39276	18014	49722	3099280	11418100
36001	42	1	3600875	77282	12423	43	40	89	22	23	5	55	2113	2439
36001	42	2	369251264	618366	1806560	69917	67822	8261	2374	2162	569	2506	102863	233871
36001	43	1	56421104	1853380	278687	1918	1766	2009	446	526	107	866	55169	50547
36001	43	2	1.013E+09	1635630	4900340	219816	213227	55170	13835	14442	3318	6873	365683	906105
36001	52	1	8.502E+09	146023008	30791400	116156	106958	343378	74315	89889	17821	130682	4350490	8094320
36001	52	2	1.921E+10	17051200	45666100	1714047	1662676	933818	214507	244455	51441	130319	3993440	18576200
36001	53	1	1.175E+09	20254000	4315360	16596	15281	49110	10634	12856	2550	18053	606888	1157810
36001	53	2	2.648E+09	2653870	6695320	258731	250975	133623	30743	34980	7372	17962	644087	2663820
36001	61	1	3199334	238655	30272	239	220	78	19	21	5	49	7340	1767
36001	61	2	4.288E+10	33234300	136043008	4956253	4807694	1414500	368754	370287	88430	290992	5901810	22035000
36001	62	2	6.54E+10	54879500	224032000	8572506	8315557	2262580	595659	592299	142844	443850	9252330	32377100
Greene	Used NY State values in lieu of county (no MOVES data for this county)													
36039	11	1	8.22E+10	3.08E+09	159743008	13056536	12022655	140201	532886	36702	127790	1232680	152360000	209868992
36039	21	1	7.08E+12	4.65E+10	3.65E+09	209243296	192673232	170295008	110691000	44579800	26544600	106240000	538297984	21811499008
36039	32	1	1.367E+12	1.296E+10	2.028E+09	54060156	49779208	40569800	16618700	10620400	3985310	20474500	273316992	3143709952
36039	32	2	2.533E+11	569177984	829595008	42402396	41131384	5184350	2595620	1357160	622450	1718160	107092000	394555008
36039	42	1	124423176	2603860	420414	1393	1283	3086	744	808	178	1865	72544	84294
36039	42	2	1.276E+10	21367300	62021100	2415954	2343537	285445	82036	74724	19673	86587	3554290	8081440
36039	43	1	1.95E+09	63083900	9335230	61687	56802	69416	15410	18172	3695	29178	1902820	1746660
36039	43	2	3.5E+10	56518200	168232992	7595606	7367933	1906380	478074	499053	114646	237504	12635700	31310600
36039	52	1	2.938E+11	4.873E+09	1.046E+09	3736293	3440418	11865200	2567900	3106080	615804	4402710	149095008	279700000
36039	52	2	6.637E+11	589193984	1.568E+09	59228028	57452696	32267600	7412180	8447010	1777500	4503200	137988000	641905024
36039	53	1	4.059E+10	675244992	146586000	533813	491540	1696960	367448	444231	88117	608220	20795100	40008400
36039	53	2	9.148E+10	91703000	229856992	8940287	8672316	4617280	1062300	1208710	254747	620674	22255600	92048600
36039	61	1	110549464	8217100	1001910	7694	7084	2711	670	710	161	1657	254137	61067
36039	61	2	1.482E+12	1.148E+09	4.67E+09	171261088	166127360	48877100	12742100	12795100	3055650	10055300	203928992	761422976
36039	62	2	2.26E+12	1.896E+09	7.691E+09	296217984	287338816	78182304	20582700	20466600	4935890	15337300	319702016	1118800000

Table K-12: MOVES -Pollutant Emissions and Distance Traveled by Vehicle Type and NYS County

County	Source Type	Fuel	Pollutant Emissions by Source Type (g)											Distance Traveled by Source Type (mi)
			CO2_Equiv	CO	NOx	Total_PM10	Total_PM25	Brake_PM10	Tire_PM10	Brake_PM25	Tire_PM25	SO2	VOC	
Orange														
36071	11	1	1.491E+09	51629800	2875620	233811	215295	2543	9664	666	2317	21786	2769800	3805860
36071	21	1	1.284E+11	784228992	65706800	3746915	3450200	3088260	2007360	808446	481382	1877620	9679250	395540000
36071	32	1	2.479E+10	220102000	36600300	968064	891403	735726	301378	192599	72273	361854	4911660	57009500
36071	32	2	4.593E+09	10321900	15032100	768960	745911	94017	47071	24612	11288	31158	1942130	7155040
36071	42	1	2256448	44394	7593	25	23	56	13	15	3	33	1314	1529
36071	42	2	231387296	387492	1123810	43813	42500	5176	1488	1355	357	1570	64458	146553
36071	43	1	35355640	1086420	168693	1105	1017	1259	279	330	67	516	34191	31675
36071	43	2	634795840	1024950	3048360	137745	133616	34572	8670	9050	2079	4307	229151	567800
36071	52	1	5.328E+09	82268200	18892500	66902	61604	215174	46568	56328	11167	77811	2708360	5072210
36071	52	2	1.204E+10	10684900	28407500	1074089	1041892	585167	134419	153185	32235	81663	2502440	11640600
36071	53	1	736155136	11391100	2647260	9559	8802	30774	6664	8056	1598	10749	377839	725531
36071	53	2	1.659E+09	1663020	4164960	162131	157271	83734	19265	21920	4620	11256	403610	1669250
36071	61	1	2004832	143095	18119	138	127	49	12	13	3	29	4534	1107
36071	61	2	2.687E+10	20825900	84628096	3105779	3012685	886378	231075	232036	55414	182347	3698300	13808000
36071	62	2	4.098E+10	34389600	139364000	5371866	5210845	1417820	373263	371158	89512	278134	5797860	20288800
Rensselaer														
36083	11	1	877576960	34292200	1739830	150531	138611	1497	5689	392	1364	13498	1642910	2240620
36083	21	1	7.559E+10	513960992	40325600	2412114	2221095	1818150	1181790	475956	283403	1163370	5758340	232866000
36083	32	1	1.459E+10	142308992	22333100	623218	573866	433143	177430	113388	42549	224203	2921290	33563100
36083	32	2	2.704E+09	6076820	8922340	452709	439139	55351	27712	14490	6646	18343	1143390	4212380
36083	42	1	1328439	28511	4589	16	15	33	8	9	2	20	779	900
36083	42	2	136224288	228127	667040	25794	25021	3048	876	798	210	924	37948	86280
36083	43	1	20814918	683748	102935	711	655	741	165	194	39	320	20353	18648
36083	43	2	373722848	603417	1809360	81094	78664	20353	5104	5328	1224	2536	134908	334280
36083	52	1	3.136E+09	53871000	11373000	43063	39652	126679	27416	33162	6575	48211	1604980	2986160
36083	52	2	7.086E+09	6290520	16861300	632348	613394	344505	79136	90184	18977	48077	1473260	6853150
36083	53	1	433395872	7472110	1593910	6153	5665	18118	3923	4743	941	6660	223893	427141
36083	53	2	976730368	979068	2472120	95451	92590	49296	11342	12905	2720	6626	237617	982736
36083	61	1	1180296	88045	11181	89	82	29	7	8	2	18	2708	652
36083	61	2	1.582E+10	12260800	50231200	1828461	1773659	521836	136041	136606	32624	107353	2177300	8129170
36083	62	2	2.413E+10	20246100	82719800	3162568	3067774	834713	219751	218511	52698	163745	3413370	11944600

Table K-12: MOVES -Pollutant Emissions and Distance Traveled by Vehicle Type and NYS County

County	Source Type	Fuel	Pollutant Emissions by Source Type (g)											Distance Traveled by Source Type (mi)
			CO2_Equiv	CO	NOx	Total_PM10	Total_PM25	Brake_PM10	Tire_PM10	Brake_PM25	Tire_PM25	SO2	VOC	
Rockland														
36087	11	1	1.328E+09	45980200	2554780	199555	183752	2264	8606	593	2064	19402	2466710	3389400
36087	21	1	1.144E+11	698414016	58375700	3198302	2945024	2750330	1787710	719982	428706	1672160	8620090	352257984
36087	32	1	2.207E+10	196016992	32516600	826294	760860	655219	268400	171523	64364	322258	4374200	50771200
36087	32	2	4.091E+09	9192460	13364200	684816	664289	83729	41920	21919	10053	27748	1729610	6372100
36087	42	1	2009539	39536	6746	21	20	50	12	13	3	29	1170	1361
36087	42	2	206067632	345090	999119	39019	37849	4610	1325	1207	318	1398	57404	130516
36087	43	1	31486826	967535	149871	943	868	1121	249	293	60	459	30450	28209
36087	43	2	565332608	912793	2710130	122673	118995	30789	7721	8060	1852	3836	204076	505668
36087	52	1	4.745E+09	73266000	16784600	57116	52593	191628	41473	50164	9945	69296	2411990	4517180
36087	52	2	1.072E+10	9515730	25255600	956557	927885	521135	119710	136423	28707	72727	2228610	10366800
36087	53	1	655601408	10144600	2351900	8160	7514	27407	5934	7175	1423	9573	336494	646139
36087	53	2	1.478E+09	1481040	3702840	144390	140061	74571	17156	19521	4114	10024	359445	1486590
36087	61	1	1785452	127437	16097	118	108	44	11	11	3	26	4038	986
36087	61	2	2.393E+10	18547000	75238304	2765930	2683029	789386	205790	206645	49350	162393	3293610	12297000
36087	62	2	3.65E+10	30626500	123901000	4784041	4640646	1262680	332419	330544	79717	247698	5163430	18068600
Ulster														
36111	11	1	210434736	8923380	415646	36623	33723	359	1364	94	327	3237	381148	537280
36111	21	1	1.813E+10	133879000	9231420	586822	540352	435977	283383	114130	67958	278965	1390550	55839200
36111	32	1	3.499E+09	37124400	5133980	151619	139613	103864	42546	27189	10203	53762	706962	8048140
36111	32	2	648463552	1457170	2147210	108555	105302	13273	6645	3475	1594	4399	274174	1010090
36111	42	1	318547	7445	1081	4	4	8	2	2	0	5	184	216
36111	42	2	32665436	54703	160527	6185	6000	731	210	191	50	222	9100	20689
36111	43	1	4991222	178979	23578	173	159	178	39	47	9	77	4960	4472
36111	43	2	89615400	144694	435433	19446	18863	4881	1224	1278	294	608	32350	80157
36111	52	1	752094912	14035100	2706650	10476	9646	30376	6574	7952	1577	11561	374697	716055
36111	52	2	1.699E+09	1508410	4057780	151631	147086	82609	18976	21625	4551	11528	353275	1643330
36111	53	1	103924728	1946210	379256	1497	1378	4344	941	1137	226	1597	52217	102425
36111	53	2	234211680	234772	594931	22888	22202	11821	2720	3094	652	1589	56978	235652
36111	61	1	283026	23109	2475	22	20	7	2	2	0	4	678	156

Table K-12: MOVES -Pollutant Emissions and Distance Traveled by Vehicle Type and NYS County

County	Source Type	Fuel	Pollutant Emissions by Source Type (g)											Distance Traveled by Source Type (mi)
			CO2_Equiv	CO	NOx	Total_PM10	Total_PM25	Brake_PM10	Tire_PM10	Brake_PM25	Tire_PM25	SO2	VOC	
36111	61	2	3.793E+09	2940030	12088400	438449	425308	125132	32621	32757	7823	25742	522096	1949300
36111	62	2	5.786E+09	4854850	19907000	758357	735626	200157	52694	52397	12636	39265	818496	2864200

Category Field	Value	Description
countyID	36001	Albany County
countyID	36039	Greene County
countyID	36071	Orange County
countyID	36083	Rensselaer County
countyID	36087	Rockland County
countyID	36111	Ulster County
sourceTypeID	11	Motorcycle
sourceTypeID	21	Passenger Car
sourceTypeID	32	Light Commercial Truck
sourceTypeID	42	Transit Bus
sourceTypeID	43	School Bus
sourceTypeID	52	Single Unit Short-haul Truck
sourceTypeID	53	Single Unit Long-haul Truck
sourceTypeID	61	Combination Short-haul Truck
sourceTypeID	62	Combination Long-haul Truck
fuelTypeID	1	Gasoline
fuelTypeID	2	Diesel Fuel

Table K-13: Vehicle Pollutant Emission Rate Factors by Vehicle Type and NYS County

County	NYSDOT Region			g/VMT										
Soure Code	Source Description	Fuel Type	Group Code	CO2_Equiv	CO	NOx	Total_PM10	Total_PM25	Brake_PM10	Tire_PM10	Brake_PM25	Tire_PM25	SO2	VOC
Albany	DOT Region 1													
11	Motorcycle	Gasoline	E	391.67	15.30	0.78	0.07	0.06	0.00	0.00	0.00	0.00	0.01	0.73
21	Passenger Car	Gasoline	A	324.62	2.21	0.17	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.02
32	Light Commercial Truck	Gasoline	B	434.79	4.24	0.66	0.02	0.02	0.01	0.01	0.00	0.00	0.01	0.09
32	Light Commercial Truck	Diesel	F	641.99	1.44	2.12	0.11	0.10	0.01	0.01	0.00	0.00	0.00	0.27
42	Transit Bus	Gasoline	D	1476.37	31.69	5.09	0.02	0.02	0.04	0.01	0.01	0.00	0.02	0.87
42	Transit Bus	Diesel	H	1578.87	2.64	7.72	0.30	0.29	0.04	0.01	0.01	0.00	0.01	0.44
43	School Bus	Gasoline	D	1116.21	36.67	5.51	0.04	0.03	0.04	0.01	0.01	0.00	0.02	1.09
43	School Bus	Diesel	I	1118.00	1.81	5.41	0.24	0.24	0.06	0.02	0.02	0.00	0.01	0.40
52	Single Unit Short-haul Truck	Gasoline	B	1050.33	18.04	3.80	0.01	0.01	0.04	0.01	0.01	0.00	0.02	0.54
52	Single Unit Short-haul Truck	Diesel	F	1034.02	0.92	2.46	0.09	0.09	0.05	0.01	0.01	0.00	0.01	0.21
53	Single Unit Long-haul Truck	Gasoline	C	1014.65	17.49	3.73	0.01	0.01	0.04	0.01	0.01	0.00	0.02	0.52
53	Single Unit Long-haul Truck	Diesel	G	993.89	1.00	2.51	0.10	0.09	0.05	0.01	0.01	0.00	0.01	0.24
61	Combination Short-haul Truck	Gasoline	C	1810.60	135.06	17.13	0.14	0.12	0.04	0.01	0.01	0.00	0.03	4.15
61	Combination Short-haul Truck	Diesel	G	1945.88	1.51	6.17	0.22	0.22	0.06	0.02	0.02	0.00	0.01	0.27
62	Combination Long-haul Truck	Diesel	G	2019.96	1.70	6.92	0.26	0.26	0.07	0.02	0.02	0.00	0.01	0.29
Greene	DOT Region 1													
11	Motorcycle	Gasoline	E	391.65	14.68	0.76	0.06	0.06	0.00	0.00	0.00	0.00	0.01	0.73
21	Passenger Car	Gasoline	A	324.61	2.13	0.17	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.02
32	Light Commercial Truck	Gasoline	B	434.77	4.12	0.65	0.02	0.02	0.01	0.01	0.00	0.00	0.01	0.09
32	Light Commercial Truck	Diesel	F	641.96	1.44	2.10	0.11	0.10	0.01	0.01	0.00	0.00	0.00	0.27
42	Transit Bus	Gasoline	D	1476.06	30.89	4.99	0.02	0.02	0.04	0.01	0.01	0.00	0.02	0.86
42	Transit Bus	Diesel	H	1578.80	2.64	7.67	0.30	0.29	0.04	0.01	0.01	0.00	0.01	0.44
43	School Bus	Gasoline	D	1116.16	36.12	5.34	0.04	0.03	0.04	0.01	0.01	0.00	0.02	1.09
43	School Bus	Diesel	I	1117.94	1.81	5.37	0.24	0.24	0.06	0.02	0.02	0.00	0.01	0.40
52	Single Unit Short-haul Truck	Gasoline	B	1050.29	17.42	3.74	0.01	0.01	0.04	0.01	0.01	0.00	0.02	0.53
52	Single Unit Short-haul Truck	Diesel	F	1033.98	0.92	2.44	0.09	0.09	0.05	0.01	0.01	0.00	0.01	0.21
53	Single Unit Long-haul Truck	Gasoline	C	1014.60	16.88	3.66	0.01	0.01	0.04	0.01	0.01	0.00	0.02	0.52
53	Single Unit Long-haul Truck	Diesel	G	993.85	1.00	2.50	0.10	0.09	0.05	0.01	0.01	0.00	0.01	0.24
61	Combination Short-haul Truck	Gasoline	C	1810.30	134.56	16.41	0.13	0.12	0.04	0.01	0.01	0.00	0.03	4.16
61	Combination Short-haul Truck	Diesel	G	1945.80	1.51	6.13	0.22	0.22	0.06	0.02	0.02	0.00	0.01	0.27
62	Combination Long-haul Truck	Diesel	G	2019.86	1.69	6.87	0.26	0.26	0.07	0.02	0.02	0.00	0.01	0.29

Table K-13: Vehicle Pollutant Emission Rate Factors by Vehicle Type and NYS County

County	NYSDOT Region			g/VMT										
Soure Code	Source Description	Fuel Type	Group Code	CO2_Equiv	CO	NOx	Total_PM10	Total_PM25	Brake_PM10	Tire_PM10	Brake_PM25	Tire_PM25	SO2	VOC
Orange	DOT Region 8													
11	Motorcycle	Gasoline	E	391.67	13.57	0.76	0.06	0.06	0.00	0.00	0.00	0.00	0.01	0.73
21	Passenger Car	Gasoline	A	324.63	1.98	0.17	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.02
32	Light Commercial Truck	Gasoline	B	434.79	3.86	0.64	0.02	0.02	0.01	0.01	0.00	0.00	0.01	0.09
32	Light Commercial Truck	Diesel	F	641.98	1.44	2.10	0.11	0.10	0.01	0.01	0.00	0.00	0.00	0.27
42	Transit Bus	Gasoline	D	1475.77	29.03	4.97	0.02	0.02	0.04	0.01	0.01	0.00	0.02	0.86
42	Transit Bus	Diesel	H	1578.86	2.64	7.67	0.30	0.29	0.04	0.01	0.01	0.00	0.01	0.44
43	School Bus	Gasoline	D	1116.20	34.30	5.33	0.03	0.03	0.04	0.01	0.01	0.00	0.02	1.08
43	School Bus	Diesel	I	1117.99	1.81	5.37	0.24	0.24	0.06	0.02	0.02	0.00	0.01	0.40
52	Single Unit Short-haul Truck	Gasoline	B	1050.33	16.22	3.72	0.01	0.01	0.04	0.01	0.01	0.00	0.02	0.53
52	Single Unit Short-haul Truck	Diesel	F	1034.02	0.92	2.44	0.09	0.09	0.05	0.01	0.01	0.00	0.01	0.21
53	Single Unit Long-haul Truck	Gasoline	C	1014.64	15.70	3.65	0.01	0.01	0.04	0.01	0.01	0.00	0.01	0.52
53	Single Unit Long-haul Truck	Diesel	G	993.89	1.00	2.50	0.10	0.09	0.05	0.01	0.01	0.00	0.01	0.24
61	Combination Short-haul Truck	Gasoline	C	1811.05	129.26	16.37	0.12	0.11	0.04	0.01	0.01	0.00	0.03	4.10
61	Combination Short-haul Truck	Diesel	G	1945.88	1.51	6.13	0.22	0.22	0.06	0.02	0.02	0.00	0.01	0.27
62	Combination Long-haul Truck	Diesel	G	2019.95	1.70	6.87	0.26	0.26	0.07	0.02	0.02	0.00	0.01	0.29
Rensselaer	DOT Region 1													
11	Motorcycle	Gasoline	E	391.67	15.30	0.78	0.07	0.06	0.00	0.00	0.00	0.00	0.01	0.73
21	Passenger Car	Gasoline	A	324.62	2.21	0.17	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.02
32	Light Commercial Truck	Gasoline	B	434.79	4.24	0.67	0.02	0.02	0.01	0.01	0.00	0.00	0.01	0.09
32	Light Commercial Truck	Diesel	F	641.98	1.44	2.12	0.11	0.10	0.01	0.01	0.00	0.00	0.00	0.27
42	Transit Bus	Gasoline	D	1476.04	31.68	5.10	0.02	0.02	0.04	0.01	0.01	0.00	0.02	0.87
42	Transit Bus	Diesel	H	1578.86	2.64	7.73	0.30	0.29	0.04	0.01	0.01	0.00	0.01	0.44
43	School Bus	Gasoline	D	1116.20	36.67	5.52	0.04	0.04	0.04	0.01	0.01	0.00	0.02	1.09
43	School Bus	Diesel	I	1117.99	1.81	5.41	0.24	0.24	0.06	0.02	0.02	0.00	0.01	0.40
52	Single Unit Short-haul Truck	Gasoline	B	1050.33	18.04	3.81	0.01	0.01	0.04	0.01	0.01	0.00	0.02	0.54
52	Single Unit Short-haul Truck	Diesel	F	1034.02	0.92	2.46	0.09	0.09	0.05	0.01	0.01	0.00	0.01	0.21
53	Single Unit Long-haul Truck	Gasoline	C	1014.64	17.49	3.73	0.01	0.01	0.04	0.01	0.01	0.00	0.02	0.52
53	Single Unit Long-haul Truck	Diesel	G	993.89	1.00	2.52	0.10	0.09	0.05	0.01	0.01	0.00	0.01	0.24
61	Combination Short-haul Truck	Gasoline	C	1810.27	135.04	17.15	0.14	0.13	0.04	0.01	0.01	0.00	0.03	4.15
61	Combination Short-haul Truck	Diesel	G	1945.88	1.51	6.18	0.22	0.22	0.06	0.02	0.02	0.00	0.01	0.27
62	Combination Long-haul Truck	Diesel	G	2019.95	1.70	6.93	0.26	0.26	0.07	0.02	0.02	0.00	0.01	0.29

Table K-13: Vehicle Pollutant Emission Rate Factors by Vehicle Type and NYS County

County	NYSDOT Region			g/VMT										
Soure Code	Source Description	Fuel Type	Group Code	CO2_Equiv	CO	NOx	Total_PM10	Total_PM25	Brake_PM10	Tire_PM10	Brake_PM25	Tire_PM25	SO2	VOC
Rockland	DOT Region 8													
11	Motorcycle	Gasoline	E	391.67	13.57	0.75	0.06	0.05	0.00	0.00	0.00	0.00	0.01	0.73
21	Passenger Car	Gasoline	A	324.62	1.98	0.17	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.02
32	Light Commercial Truck	Gasoline	B	434.79	3.86	0.64	0.02	0.01	0.01	0.01	0.00	0.00	0.01	0.09
32	Light Commercial Truck	Diesel	F	641.98	1.44	2.10	0.11	0.10	0.01	0.01	0.00	0.00	0.00	0.27
42	Transit Bus	Gasoline	D	1476.52	29.05	4.96	0.02	0.01	0.04	0.01	0.01	0.00	0.02	0.86
42	Transit Bus	Diesel	H	1578.87	2.64	7.66	0.30	0.29	0.04	0.01	0.01	0.00	0.01	0.44
43	School Bus	Gasoline	D	1116.20	34.30	5.31	0.03	0.03	0.04	0.01	0.01	0.00	0.02	1.08
43	School Bus	Diesel	I	1117.99	1.81	5.36	0.24	0.24	0.06	0.02	0.02	0.00	0.01	0.40
52	Single Unit Short-haul Truck	Gasoline	B	1050.33	16.22	3.72	0.01	0.01	0.04	0.01	0.01	0.00	0.02	0.53
52	Single Unit Short-haul Truck	Diesel	F	1034.03	0.92	2.44	0.09	0.09	0.05	0.01	0.01	0.00	0.01	0.21
53	Single Unit Long-haul Truck	Gasoline	C	1014.64	15.70	3.64	0.01	0.01	0.04	0.01	0.01	0.00	0.01	0.52
53	Single Unit Long-haul Truck	Diesel	G	993.89	1.00	2.49	0.10	0.09	0.05	0.01	0.01	0.00	0.01	0.24
61	Combination Short-haul Truck	Gasoline	C	1810.80	129.25	16.33	0.12	0.11	0.04	0.01	0.01	0.00	0.03	4.10
61	Combination Short-haul Truck	Diesel	G	1945.89	1.51	6.12	0.22	0.22	0.06	0.02	0.02	0.00	0.01	0.27
62	Combination Long-haul Truck	Diesel	G	2019.96	1.70	6.86	0.26	0.26	0.07	0.02	0.02	0.00	0.01	0.29
Ulster	DOT Region 8													
11	Motorcycle	Gasoline	E	391.67	16.61	0.77	0.07	0.06	0.00	0.00	0.00	0.00	0.01	0.71
21	Passenger Car	Gasoline	A	324.62	2.40	0.17	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.02
32	Light Commercial Truck	Gasoline	B	434.79	4.61	0.64	0.02	0.02	0.01	0.01	0.00	0.00	0.01	0.09
32	Light Commercial Truck	Diesel	F	641.99	1.44	2.13	0.11	0.10	0.01	0.01	0.00	0.00	0.00	0.27
42	Transit Bus	Gasoline	D	1474.75	34.47	5.00	0.02	0.02	0.04	0.01	0.01	0.00	0.02	0.85
42	Transit Bus	Diesel	H	1578.88	2.64	7.76	0.30	0.29	0.04	0.01	0.01	0.00	0.01	0.44
43	School Bus	Gasoline	D	1116.11	40.02	5.27	0.04	0.04	0.04	0.01	0.01	0.00	0.02	1.11
43	School Bus	Diesel	I	1118.00	1.81	5.43	0.24	0.24	0.06	0.02	0.02	0.00	0.01	0.40
52	Single Unit Short-haul Truck	Gasoline	B	1050.33	19.60	3.78	0.01	0.01	0.04	0.01	0.01	0.00	0.02	0.52
52	Single Unit Short-haul Truck	Diesel	F	1034.02	0.92	2.47	0.09	0.09	0.05	0.01	0.01	0.00	0.01	0.21
53	Single Unit Long-haul Truck	Gasoline	C	1014.64	19.00	3.70	0.01	0.01	0.04	0.01	0.01	0.00	0.02	0.51
53	Single Unit Long-haul Truck	Diesel	G	993.89	1.00	2.52	0.10	0.09	0.05	0.01	0.01	0.00	0.01	0.24
61	Combination Short-haul Truck	Gasoline	C	1814.27	148.13	15.87	0.14	0.13	0.04	0.01	0.01	0.00	0.03	4.35
61	Combination Short-haul Truck	Diesel	G	1945.88	1.51	6.20	0.22	0.22	0.06	0.02	0.02	0.00	0.01	0.27
62	Combination Long-haul Truck	Diesel	G	2019.96	1.70	6.95	0.26	0.26	0.07	0.02	0.02	0.00	0.01	0.29

Table K-14: Vehicle Pollutant Emission Rates Sorted by Vehicle Group Code and Totaling of Particulate Matter Emission Rates.

NYSDOT Region / County		Pollutant Emission Rates (g/VMT)											Totals PM Emission Rates	
Region 1														
Albany	Group Code	CO2_Equiv	CO	NOx	Total_PM10	Total_PM25	Brake_PM10	Tire_PM10	Brake_PM25	Tire_PM25	SO2	VOC	Total_PM10	Total_PM25
Passenger Cars/Trucks	A	324.62	2.21	0.17	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.02	0.02	0.01
Lite-Duty Trucks	B	742.56	11.14	2.23	0.02	0.02	0.03	0.01	0.01	0.00	0.01	0.31	0.05	0.02
Heavy Duty Vehicles	C	1412.62	76.28	10.43	0.07	0.07	0.04	0.01	0.01	0.00	0.02	2.34	0.13	0.08
School/Transit Buses	D	1296.29	34.18	5.30	0.03	0.03	0.04	0.01	0.01	0.00	0.02	0.98	0.07	0.04
Motercycles	E	391.67	15.30	0.78	0.07	0.06	0.00	0.00	0.00	0.00	0.01	0.73	0.07	0.06
Light Duty Trucks	F	838.01	1.18	2.29	0.10	0.10	0.03	0.01	0.01	0.00	0.01	0.24	0.14	0.11
Heavy Duty Vehicles	G	1653.24	1.40	5.20	0.20	0.19	0.06	0.02	0.02	0.00	0.01	0.27	0.27	0.21
Transit Buses	H	1578.87	2.64	7.72	0.30	0.29	0.04	0.01	0.01	0.00	0.01	0.44	0.34	0.30
School Busses	I	1118.00	1.81	5.41	0.24	0.24	0.06	0.02	0.02	0.00	0.01	0.40	0.32	0.25
Greene	Group Code	CO2_Equiv	CO	NOx	Total_PM10	Total_PM25	Brake_PM10	Tire_PM10	Brake_PM25	Tire_PM25	SO2	VOC	Total_PM10	Total_PM25
Passenger Cars/Trucks	A	324.61	2.13	0.17	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.02	0.02	0.01
Lite-Duty Trucks	B	742.53	10.77	2.19	0.02	0.01	0.03	0.01	0.01	0.00	0.01	0.31	0.05	0.02
Heavy Duty Vehicles	C	1412.45	75.72	10.04	0.07	0.06	0.04	0.01	0.01	0.00	0.02	2.34	0.12	0.08
School/Transit Buses	D	1296.11	33.50	5.17	0.03	0.02	0.04	0.01	0.01	0.00	0.02	0.98	0.07	0.04
Motercycles	E	391.65	14.68	0.76	0.06	0.06	0.00	0.00	0.00	0.00	0.01	0.73	0.07	0.06
Light Duty Trucks	F	837.97	1.18	2.27	0.10	0.10	0.03	0.01	0.01	0.00	0.01	0.24	0.14	0.11
Heavy Duty Vehicles	G	1653.17	1.40	5.17	0.20	0.19	0.06	0.02	0.02	0.00	0.01	0.27	0.27	0.21
Transit Buses	H	1578.80	2.64	7.67	0.30	0.29	0.04	0.01	0.01	0.00	0.01	0.44	0.34	0.30
School Busses	I	1117.94	1.81	5.37	0.24	0.24	0.06	0.02	0.02	0.00	0.01	0.40	0.32	0.25
Rensselaer	Group Code	CO2_Equiv	CO	NOx	Total_PM10	Total_PM25	Brake_PM10	Tire_PM10	Brake_PM25	Tire_PM25	SO2	VOC	Total_PM10	Total_PM25
Passenger Cars/Trucks	A	324.62	2.21	0.17	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.02	0.02	0.01
Lite-Duty Trucks	B	742.56	11.14	2.24	0.02	0.02	0.03	0.01	0.01	0.00	0.01	0.31	0.05	0.02
Heavy Duty Vehicles	C	1412.46	76.27	10.44	0.08	0.07	0.04	0.01	0.01	0.00	0.02	2.34	0.13	0.08
School/Transit Buses	D	1296.12	34.17	5.31	0.03	0.03	0.04	0.01	0.01	0.00	0.02	0.98	0.08	0.04
Motercycles	E	391.67	15.30	0.78	0.07	0.06	0.00	0.00	0.00	0.00	0.01	0.73	0.07	0.06
Light Duty Trucks	F	838.00	1.18	2.29	0.10	0.10	0.03	0.01	0.01	0.00	0.01	0.24	0.14	0.11
Heavy Duty Vehicles	G	1653.24	1.40	5.21	0.20	0.19	0.06	0.02	0.02	0.00	0.01	0.27	0.27	0.21
Transit Buses	H	1578.86	2.64	7.73	0.30	0.29	0.04	0.01	0.01	0.00	0.01	0.44	0.34	0.30
School Busses	I	1117.99	1.81	5.41	0.24	0.24	0.06	0.02	0.02	0.00	0.01	0.40	0.32	0.25

Table K-14: Vehicle Pollutant Emission Rates Sorted by Vehicle Group Code and Totaling of Particulate Matter Emission Rates.

NYSDOT Region / County		Pollutant Emission Rates (g/VMT)											Totals PM Emission Rates	
Region 8														
Orange	Group Code	CO2_Equiv	CO	NOx	Total_PM10	Total_PM25	Brake_PM10	Tire_PM10	Brake_PM25	Tire_PM25	SO2	VOC	Total_PM10	Total_PM25
Passenger Cars/Trucks	A	324.63	1.98	0.17	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.02	0.02	0.01
Lite-Duty Trucks	B	742.56	10.04	2.18	0.02	0.01	0.03	0.01	0.01	0.00	0.01	0.31	0.05	0.02
Heavy Duty Vehicles	C	1412.85	72.48	10.01	0.07	0.06	0.04	0.01	0.01	0.00	0.02	2.31	0.12	0.08
School/Transit Buses	D	1295.98	31.67	5.15	0.03	0.02	0.04	0.01	0.01	0.00	0.02	0.97	0.07	0.04
Motercycles	E	391.67	13.57	0.76	0.06	0.06	0.00	0.00	0.00	0.00	0.01	0.73	0.06	0.06
Light Duty Trucks	F	838.00	1.18	2.27	0.10	0.10	0.03	0.01	0.01	0.00	0.01	0.24	0.14	0.11
Heavy Duty Vehicles	G	1653.24	1.40	5.16	0.20	0.19	0.06	0.02	0.02	0.00	0.01	0.27	0.27	0.21
Transit Buses	H	1578.86	2.64	7.67	0.30	0.29	0.04	0.01	0.01	0.00	0.01	0.44	0.34	0.30
School Busses	I	1117.99	1.81	5.37	0.24	0.24	0.06	0.02	0.02	0.00	0.01	0.40	0.32	0.25
Rockland	Group Code	CO2_Equiv	CO	NOx	Total_PM10	Total_PM25	Brake_PM10	Tire_PM10	Brake_PM25	Tire_PM25	SO2	VOC	Total_PM10	Total_PM25
Passenger Cars/Trucks	A	324.62	1.98	0.17	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.02	0.02	0.01
Lite-Duty Trucks	B	742.56	10.04	2.18	0.01	0.01	0.03	0.01	0.01	0.00	0.01	0.31	0.05	0.02
Heavy Duty Vehicles	C	1412.72	72.47	9.98	0.07	0.06	0.04	0.01	0.01	0.00	0.02	2.31	0.12	0.07
School/Transit Buses	D	1296.36	31.67	5.13	0.02	0.02	0.04	0.01	0.01	0.00	0.02	0.97	0.07	0.03
Motercycles	E	391.67	13.57	0.75	0.06	0.05	0.00	0.00	0.00	0.00	0.01	0.73	0.06	0.05
Light Duty Trucks	F	838.01	1.18	2.27	0.10	0.10	0.03	0.01	0.01	0.00	0.01	0.24	0.14	0.11
Heavy Duty Vehicles	G	1653.25	1.40	5.16	0.20	0.19	0.06	0.02	0.02	0.00	0.01	0.27	0.27	0.21
Transit Buses	H	1578.87	2.64	7.66	0.30	0.29	0.04	0.01	0.01	0.00	0.01	0.44	0.34	0.30
School Busses	I	1117.99	1.81	5.36	0.24	0.24	0.06	0.02	0.02	0.00	0.01	0.40	0.32	0.25
Ulster	Group Code	CO2_Equiv	CO	NOx	Total_PM10	Total_PM25	Brake_PM10	Tire_PM10	Brake_PM25	Tire_PM25	SO2	VOC	Total_PM10	Total_PM25
Passenger Cars/Trucks	A	324.62	2.40	0.17	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.02	0.02	0.01
Lite-Duty Trucks	B	742.56	12.11	2.21	0.02	0.02	0.03	0.01	0.01	0.00	0.01	0.31	0.05	0.02
Heavy Duty Vehicles	C	1414.46	83.57	9.78	0.08	0.07	0.04	0.01	0.01	0.00	0.02	2.43	0.13	0.08
School/Transit Buses	D	1295.43	37.24	5.14	0.03	0.03	0.04	0.01	0.01	0.00	0.02	0.98	0.08	0.04
Motercycles	E	391.67	16.61	0.77	0.07	0.06	0.00	0.00	0.00	0.00	0.01	0.71	0.07	0.06
Light Duty Trucks	F	838.00	1.18	2.30	0.10	0.10	0.03	0.01	0.01	0.00	0.01	0.24	0.14	0.11
Heavy Duty Vehicles	G	1653.24	1.40	5.23	0.20	0.19	0.06	0.02	0.02	0.00	0.01	0.27	0.27	0.21
Transit Buses	H	1578.88	2.64	7.76	0.30	0.29	0.04	0.01	0.01	0.00	0.01	0.44	0.34	0.30
School Busses	I	1118.00	1.81	5.43	0.24	0.24	0.06	0.02	0.02	0.00	0.01	0.40	0.32	0.25

Table K-15: NYS Vehicle Mix Distribution by NYSDOT Region for Interstate Highway Travel

Vehicle Class Abbreviation	Fuel Type	Group Code	Vehicle Class Description	% Mixture		MOVES Source Identifier		
				Region 1	Region 8			
LDGV	Gas	A	Passenger Cars/Trucks	40.16	42.18	21		
LDGT	Gas	B	Lite-Duty Trucks	43.67	37.64	32	52	
HDGV2B	Gas	C	Heavy Duty Vehicles	6.25	9.33	53	61	
HDGB	Gas	D	School/Transit Buses	0.19	0.33	42	43	
MC	Gas	E	Motorcycles	0.48	0.47	11		
LDDT	Diesel	F	Light Duty Trucks	1.20	0.87	32	52	
HDDV	Diesel	G	Heavy Duty Vehicles	6.91	7.50	53	61	62
HDDBT	Diesel	H	Transit Buses	0.57	0.66	42		
HDDBS	Diesel	I	School Busses	0.57	0.99	43		

Source: NYS DOT Mobile6.2 Emission Factors, Vehicle Distribution by NYSDOT Region for Class 01 (Interstates)

Table K-16: Summary of Total Pollutant Vehicle Emission Rates by NYSDOT Region

Region 1									
			g/VMT						
Source Name	Group Code	Group Mixture	CO2_Equiv	CO	NOx	Total_PM10	Total_PM25	SO2	VOC
Passenger Cars/Trucks	A	40.16%	130.367	0.876	0.069	0.009	0.005	0.002	0.010
Lite-Duty Trucks	B	43.67%	324.272	4.811	0.970	0.022	0.010	0.005	0.136
Heavy Duty Vehicles	C	6.25%	88.282	4.755	0.644	0.008	0.005	0.001	0.146
School/Transit Buses	D	0.19%	2.463	0.065	0.010	0.000	0.000	0.000	0.002
Motercycles	E	0.48%	1.880	0.072	0.004	0.000	0.000	0.000	0.004
Light Duty Trucks	F	1.20%	10.056	0.014	0.027	0.002	0.001	0.000	0.003
Heavy Duty Vehicles	G	6.91%	114.237	0.097	0.359	0.019	0.014	0.001	0.018
Transit Buses	H	0.57%	8.999	0.015	0.044	0.002	0.002	0.000	0.003
School Busses	I	0.57%	6.372	0.010	0.031	0.002	0.001	0.000	0.002
Total Emission Rate for Region 1			**686.929**	**10.716**	**2.157**	**0.064**	**0.040**	**0.009**	**0.324**
Region 8									
Passenger Cars/Trucks	A	42.18%	136.927	0.895	0.070	0.010	0.005	0.002	0.010
Lite-Duty Trucks	B	37.64%	279.500	4.038	0.824	0.019	0.009	0.004	0.116
Heavy Duty Vehicles	C	9.33%	131.865	7.107	0.926	0.012	0.007	0.002	0.219
School/Transit Buses	D	0.33%	4.277	0.111	0.017	0.000	0.000	0.000	0.003
Motercycles	E	0.47%	1.841	0.069	0.004	0.000	0.000	0.000	0.003
Light Duty Trucks	F	0.87%	7.291	0.010	0.020	0.001	0.001	0.000	0.002
Heavy Duty Vehicles	G	7.50%	123.993	0.105	0.389	0.020	0.016	0.001	0.020
Transit Buses	H	0.66%	10.421	0.017	0.051	0.002	0.002	0.000	0.003
School Busses	I	0.99%	11.068	0.018	0.053	0.003	0.003	0.000	0.004
Total Emission Rate for Region 8			**707.181**	**12.370**	**2.353**	**0.068**	**0.043**	**0.009**	**0.381**

Table K-17: Calculation of Vehicle Miles Traveled by NYS County for NYS Thruway in Project Area

County	NYSDOT Region	Roadway Segment Length (mi)	Average Annual Daily Trips (AADT)	Annual Average VMT
ALBANY	Region1	0.04	37639	451668
ALBANY	Region1	0.33	37639	3726261
ALBANY	Region1	1	37639	11291700
ALBANY	Region1	2.35	37639	26535495
ALBANY	Region1	0.12	44462	1600632
ALBANY	Region1	0.31	44462	4134966
ALBANY	Region1	0.59	44462	7869774
ALBANY	Region1	1.41	44693	18905139
ALBANY	Region1	0.13	44693	1743027
ALBANY	Region1	2.11	44693	28290669
ALBANY	Region1	3.02	44693	40491858
GREENE	Region1	2.83	34076	28930524
GREENE	Region1	0.73	34076	7462644
GREENE	Region1	1.73	34076	17685444
GREENE	Region1	2.15	34076	21979020
GREENE	Region1	0.06	34076	613368
GREENE	Region1	0.04	34076	408912
GREENE	Region1	0.79	34165	8097105
GREENE	Region1	3.84	34165	39358080
GREENE	Region1	0.37	34165	3792315
GREENE	Region1	5.01	34165	51349995
GREENE	Region1	0.33	34165	3382335
GREENE	Region1	0.08	37639	903336
GREENE	Region1	5.87	37639	66282279

Notes:

Annual Avg VMT = Segment Length x AADT x 300 (days: 10 month construction length)

Summary	
DOT Region	VMT
Region1	395286546
Region 8	1143359616

Table K-17: Calculation of Vehicle Miles Traveled by NYS County for NYS Thruway in Project Area

County	NYSDOT Region	Roadway Segment Length (mi)	Average Annual Daily Trips (AADT)	Annual Average VMT
ULSTER	Region 8	4.23	40952	51968088
ULSTER	Region 8	0.92	40952	11302752
ULSTER	Region 8	0.98	40952	12039888
ULSTER	Region 8	0.71	40952	8722776
ULSTER	Region 8	2.23	40952	27396888
ULSTER	Region 8	0.07	40952	859992
ULSTER	Region 8	0.48	40952	5897088
ULSTER	Region 8	0.34	40952	4177104
ULSTER	Region 8	4.36	40130	52490040
ULSTER	Region 8	1.02	40130	12279780
ULSTER	Region 8	2.38	40130	28652820
ULSTER	Region 8	0.41	40130	4935990
ULSTER	Region 8	1.07	40130	12881730
ULSTER	Region 8	1.37	40130	16493430
ULSTER	Region 8	0.73	40130	8788470
ULSTER	Region 8	1.58	40130	19021620
ULSTER	Region 8	0.82	40130	9871980
ULSTER	Region 8	0.54	40130	6501060
ULSTER	Region 8	0.3	40130	3611700
ULSTER	Region 8	0.14	40130	1685460
ULSTER	Region 8	0.23	36812	2540028
ULSTER	Region 8	2.36	36812	26062896
ULSTER	Region 8	0.14	36812	1546104
ULSTER	Region 8	2.82	36812	31142952
ULSTER	Region 8	3.79	36812	41855244
ULSTER	Region 8	0.77	36812	8503572
ULSTER	Region 8	4.52	34076	46207056

Table K-17: Calculation of Vehicle Miles Traveled by NYS County for NYS Thruway in Project Area

County	NYSDOT Region	Roadway Segment Length (mi)	Average Annual Daily Trips (AADT)	Annual Average VMT
ORANGE	Region 8	0.86	88552	22846416
ORANGE	Region 8	2.46	88552	65351376
ORANGE	Region 8	2.44	88552	64820064
ORANGE	Region 8	0.52	88552	13814112
ORANGE	Region 8	0.61	88552	16205016
ORANGE	Region 8	0.82	88552	21783792
ORANGE	Region 8	0.25	88552	6641400
ORANGE	Region 8	1.13	88552	30019128
ORANGE	Region 8	0.23	88552	6110088
ORANGE	Region 8	0.15	88552	3984840
ORANGE	Region 8	0.04	88552	1062624
ORANGE	Region 8	0.23	88552	6110088
ORANGE	Region 8	0.19	88552	5047464
ORANGE	Region 8	1.22	47092	17235672
ORANGE	Region 8	0.63	47092	8900388
ORANGE	Region 8	0.54	47092	7628904
ORANGE	Region 8	3.53	47092	49870428
ORANGE	Region 8	1.43	47092	20202468
ORANGE	Region 8	1.83	47092	25853508
ORANGE	Region 8	1.4	47092	19778640
ORANGE	Region 8	0.16	47092	2260416
ORANGE	Region 8	2.22	47092	31363272
ORANGE	Region 8	1.05	47092	14833980
ORANGE	Region 8	0.57	47092	8052732
ORANGE	Region 8	0.32	47092	4520832
ORANGE	Region 8	0.32	40952	3931392
ORANGE	Region 8	1.19	40952	14619864
ORANGE	Region 8	2.2	40952	27028320
ORANGE	Region 8	1.69	40952	20762664
ORANGE	Region 8	0.96	40952	11794176

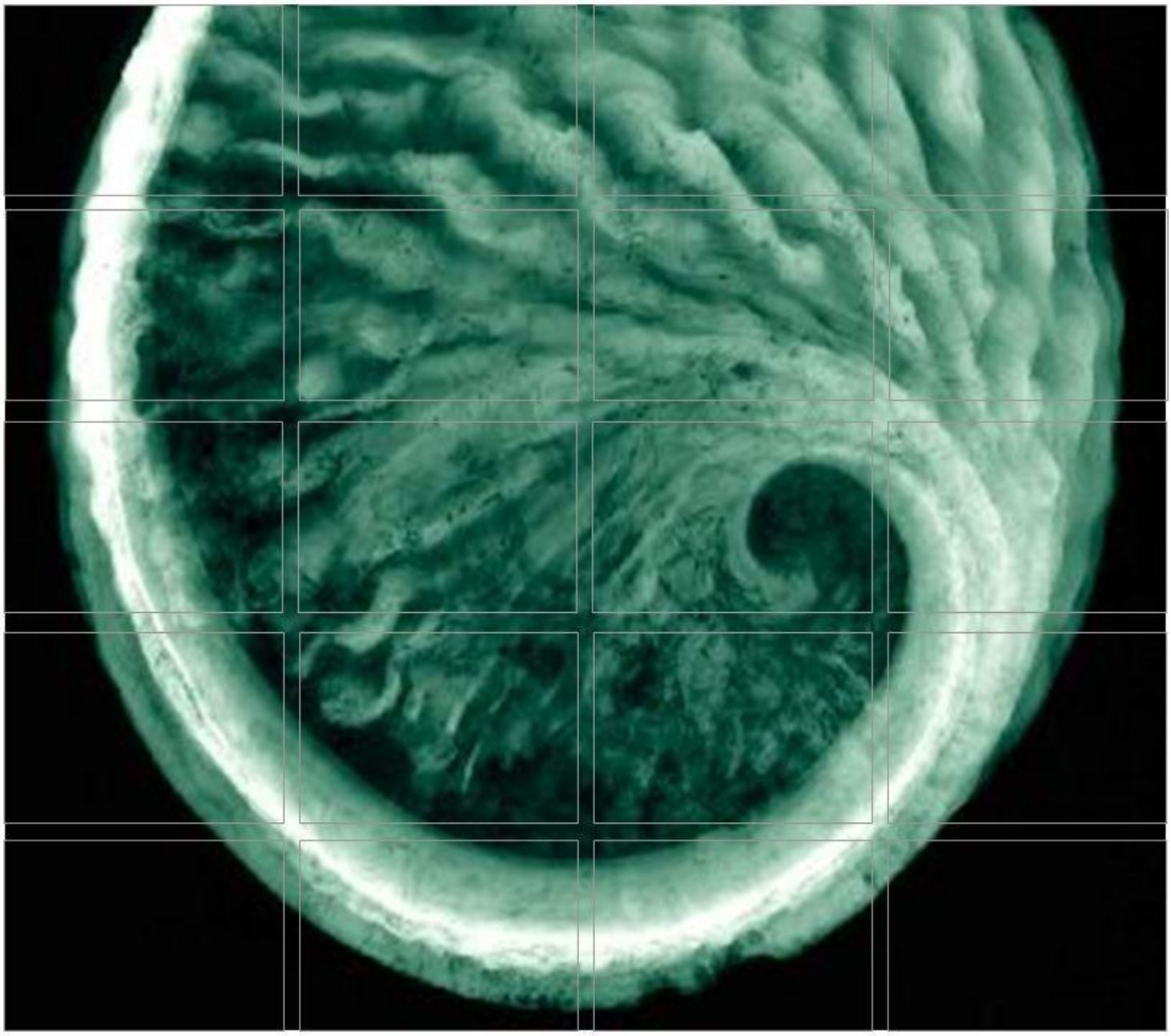
Table K-17: Calculation of Vehicle Miles Traveled by NYS County for NYS Thruway in Project Area

County	NYSDOT Region	Roadway Segment Length (mi)	Average Annual Daily Trips (AADT)	Annual Average VMT
ROCKLAND	Region 8	0.44	87764	11584848
ROCKLAND	Region 8	0.73	87764	19220316
ROCKLAND	Region 8	0.56	87764	14744352
ROCKLAND	Region 8	1.07	87764	28172244
ROCKLAND	Region 8	1.97	87764	51868524
ROCKLAND	Region 8	0.3	87764	7898760

PILGRIM
TRANSPORTATION
OF NEW YORK, INC.

APPENDIX K.3

Analysis of GHG Emissions for the Proposed Pilgrim Pipeline



Analysis of GHG Emissions from the Proposed Pilgrim Pipeline

For Pilgrim Pipeline Holdings, LLP

Prepared by Environmental Resources Management

November 11, 2014

www.erm.com

ERM

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1.0 INTRODUCTION

Pilgrim Pipeline Holdings, LLC plans to develop a pipeline system that consists of two parallel pipelines. Crude oil will be transported on one pipeline from Albany, New York to Linden, New Jersey. After the crude is processed at refineries located in PADD 1[1], the refined petroleum products will be transported via a separate pipeline from Linden, New Jersey back to Albany, New York.

Pilgrim Pipeline Holdings, LLC requested that Environmental Resources Management, Inc. (ERM) perform a comparison of the operational greenhouse gas (GHG) air emissions from transporting the crude and refined products on the proposed Pilgrim pipeline project versus the current method of transporting the same volumes of crude and refined products along the Hudson River using barges.

This report is structured as follows:

- *Section 2* provides an overview of the scope of work for the assessment and the boundary conditions applied to the assessment.
- *Section 3* provides a description of the proposed pipeline project, as well as the assumptions used to calculate the emissions from this option.
- *Section 4* provides the a description of the assumptions used to determine the GHG emissions associated with transporting the same volumes of crude and refined products using barges as would be transported by the proposed pipeline project and an assessment of those emissions.
- *Section 5* provides a comparison of the emissions from both options.

[1] The Petroleum Administration for Defense Districts (PADDs) are geographic aggregations of the US States (and the District of Columbia) into five districts: PADD 1 represents the East Coast.

2.0 SCOPE OF WORK AND BOUNDARY CONDITIONS

This study's objective is to define and assess the anticipated operational air emissions of GHGs of the proposed pipelines, and barges transporting the same volumes, so as to enable a like-for-like analysis. The boundary conditions applied associated with the transportation activities are summarized as follows in *Table 1*:

Table 1: Boundary Conditions

Stage	Pipeline	Barge
Loading	Assumed no GHG emissions are produced because the pipeline is gravity loaded	Assumed no GHG emissions are produced because is the barges are gravity loaded
Transportation	Indirect emissions[2] from electricity to power pumps to allow pipeline transportation and direct[3] fugitive emissions from valves. No back-up generators will be provided along the pipeline	Direct emissions[4] from combustion engines for barge movement. Fugitive emissions were not included in the calculations because they are *de minimis* (see *Section 4*)
Unloading	Assumed no GHG emissions associated with unloading because the pipeline is unloaded by gravity	Direct emissions from operation of pumps on barges to unload crude oil/products
Maintenance, inspections and other support activities	Not included in the calculations because the contribution is expected to be *de minimis*	Not included in the calculations because the contribution is expected to be *de minimis*

Considering that both options will transport the same volumes of crude oil and refined petroleum products per year, the broader associated lifecycle emissions (such as from end combustion of the products and crude oil refining) have not been assessed as these emissions would be the same in both options.

This desktop study was based on research conducted by ERM.

[2] For the purposes of this assessment, indirect emissions from the pipeline are from the generation and distribution of purchased electricity.

[3] For the purposes of this assessment, direct emissions refer to GHG emissions that are from sources that are part of the pipeline or barge transportation system, such as combustion engines.

[4] *See* n.3 above.

3.0 PIPELINE TRANSPORT GHG EMISSIONS

3.1 Approach and Assumptions

The Pilgrim Pipeline project is designed to transport 73 million barrels of crude oil per year from Albany, New York to Linden, New Jersey and 73 million barrels of refined petroleum products per year from Linden, New Jersey to Albany, New York (total annual capacity of 146 million barrels). The project has been designed to utilize a total pump capacity of 18,000 horsepower (hp) to transport crude oil approximately 169 miles from Albany to Linden (utilizing three pump stations). In addition, 15,000 hp of pump capacity will be required to transport the refined petroleum products approximately 169 miles from Linden to Albany (also using three pump stations). Twenty mainline valves will be located on each of the pipelines.

The following assumptions and methodologies were used to estimate the total GHG emissions associated with the pipeline transport:

- The electricity used to power these pumps will be taken off the grid and, therefore, the indirect GHG emissions associated with producing this power is assumed to be based on the mixture of multiple energy/fuel sources such as coal, fuel oil, natural gas, hydropower, wind power, etc. that makes up the grid mix for the location of electricity consumption.

- Pump efficiency of 97% motor and drive efficiency (ABB Group, 2009).

- Continuous operation of the pumps at the pump stations for 8,760 hours per year.

- 2.23 horsepower-hours (hp-hr) of work would be required to pump one barrel of crude oil from Albany, NY to Linden, NJ (calculated based on the crude oil pipeline pump power, annual throughput, and annual hours of operation).

- 1.86 hp-hr of work would be required to pump one barrel of refined petroleum products from Linden, NJ to Albany, NY (calculated based on the refined petroleum product pipeline pump power, annual throughput, and annual hours of operation).

- Annual indirect electricity usage in megawatt-hour (MWh) per year was estimated based on the amount of work required to pump one barrel of crude oil and one barrel of refined petroleum products, the annual pipeline throughput, and the annual hours of operation.

- Emission factors for carbon dioxide (CO_2) and CO_2 equivalent (CO_2e) emissions associated with electricity generation were obtained from the U.S. Environmental

Protection Agency Emissions & Generation Resource Integrated Database (eGRID), 9th Ed. (USEPA, 2014) (using Year 2010 data, Version 1.0 for upstate New York).

- The annual U.S. electricity transmission and distribution losses are approximately 6 percent (EIA, 2014).

- GHG emissions associated with the construction of the Pilgrim Pipeline, decommissioning, maintenance, or backup generators were not included in this analysis.

- Both pipelines were assumed be unheated.

3.2 Results

Based on the foregoing information and assumptions, the calculated total annual GHG emissions associated with transporting 73 million barrels of crude oil per year from Albany, New York to Linden, New Jersey, and then transporting 73 million barrels of refined petroleum products per year from Linden, New Jersey to Albany, New York are 58,642 metric tons carbon dioxide equivalent (CO_2e) /year. *Table 2* shows the breakdown of these emissions, and *Appendix 1* provides further details of the calculations used to derive these values.

Table 2: Pilgrim Pipeline Annual Operational GHG Emissions

GHG Source	Annual Emissions (metric ton CO_2e per year)
Fugitive emissions from valves	0.011
Electricity consumption for pumps (generation emissions)	55,323
Electricity consumption for pumps (transmission and distribution losses)	3,319
Total	**58,642**

The direct emissions associated with the pipelines from leaks from the mainline valves along the pipeline are *de minimis* (0.011 metric tons CO_2e/year).

4.0 BARGE TRANSPORT GHG EMISSIONS

4.1 Approach and Assumptions

After analyzing the GHG emissions associated with the pipeline option, ERM assessed the GHG emissions associated with transporting the same volumes via barge on the Hudson River (73 million barrels of crude oil per year and 73 million barrels of refined petroleum products per year).

The following assumptions and methodologies were used to estimate emissions from barge transport along the Hudson River:

- Barges are variable in terms of capacity; however, for these calculations the capacity of a typical barge was assumed to be 100,000 barrels (MTU America Inc., 2012).
- Emissions were calculated for round trips, with the barges full on the initial trip and empty on the return leg.
- The number of barge trips per day (for loaded and empty barges) were calculated based on the volumes transported per day (bbls/day) and average barge capacity.
- A one-way transport distance along the Hudson River from the Port of Albany in NY to Arthur Kill, NJ is approximately 160 miles (as measured by ERM using Google Earth).
- The tugs used to tow or push the barges have variable engine horsepower and the transport of these barges are also influenced by seasonal variations in river flow volume, tide stage, cargo volume, degree of ice, and other environmental variables. For the purposes of these calculations, the following assumptions were made:
    - Propulsion engine power ratings for self-propelled tugboats that tow or push the barges were based on a Twin MTU 16V 4000 engine (i.e., two engines) with each twin engine delivering 1,760 kilowatts (2,360 hp) at 1,800 revolutions per minute (rpm)[5] (MTU America Inc., 2012).
    - Auxiliary engine power ratings for tugboats that tow or push the barges were based on two auxiliary engines per tugboat, each with a power rating of 100 kilowatts (ICF International, 2009).

[5] Make and model number for tug-barge configurations on the Hudson River were not available so typical tugboat make and models used in the East Coast region of the United States were used in the analysis (MTU America Inc., 2012).

- The main propulsion engines and auxiliary engines for the tugboats pushing loaded barges were assumed to run at 90 percent load (MTU America Inc., 2012) and 31 percent load (ICF 2009), respectively.

- The auxiliary engine load factors for the tugboats towing or pushing empty barges were assumed to be the same as for moving the loaded barges (0.31 or 31 percent). The main propulsion engine load factors for the tugboats were assumed to be 2 percent (0.02) (ICF 2009).

- The tugboats are expected to travel at an average speed of 10.5 knots for both loaded and empty barges, pushing 500-foot 100,000-barrel barges. Knots (nautical miles per hour) were converted to miles per hour by multiplying by a factor of 1.15 miles per nautical mile (MTU America Inc., 2012).

- River barge transportation variations due to river flow volume, tidal influence, ice, idling, and other transportation variables were not analyzed.

- Greenhouse gas emissions were calculated using factors obtained from Chapter 2 and 3 of the ICF 2009 document.

- The barges were assumed to be unheated.

- The emissions associated with on-barge pumps used for unloading were determined using the following assumptions:

  - A full trip includes both loading and unloading a barge; therefore, the pumps used for unloading are only used during half of a full trip.

  - Reasonable time to unload would be about half a day (12 hours).

  - To unload within half a day at least 7 x 1629 gpm pumps would be needed.

- No allowances were made for Hudson River barge air emission exemptions.

3.2 Results

Table 3 shows that the annual GHG emissions associated with transporting the same volume of crude and refined products via barge are 72,888 metric tons CO_2e /year. *Appendix 2* provides further details of the calculations applied.

Table 3: Barge Transportation Annual GHG Emissions

GHG Source	Annual Emissions (metric ton CO_2e per year)
Combustion engine for barge transportation	71,418
Combustion of fuel to power unloading pumps	1,469
Total	**72,888**

The emissions from the barge option are produced by the combustion of hydrocarbons in the main propulsion engines and the auxiliary engines of the tugboats used to move the barges.

5.0 COMPARISON OF BARGE AND PIPELINE GHG EMISSIONS

A comparison of the GHG emissions from the pipeline and barge options is presented in *Table 4*.

Table 4: Comparison of GHG Air Emissions

Transport Option	Annual Emissions (metric ton CO_2e per year)
Proposed pipeline	58,642
Hudson River barges	72,888
Percent Difference Between Pipeline to Barge Emissions Total	19.5% reduction using the pipeline

As *Table 4* shows, the estimated annual total emissions of GHGs (in CO_2e) for transporting the crude and refined products via pipeline are approximately 20% lower than transporting the same volume of crude and refined products by barge.

Overall, the pipeline option does not represent a significant source of GHG emissions. To put the total GHG emissions from the pipeline option in context, if a major source (i.e., a power plant) makes a modification that caused its GHG emissions to increase by 75,000 tons CO_2e/year,[6] that source must obtain a Prevention of Significant Deterioration (PSD) permit that includes a GHG limit. The total emissions from the pipeline project are below this threshold. The emissions from the pipeline are also significantly lower than the overall GHG emissions produced by large power plants, which can exceed 2 million metric tons CO_2e / year (USEPA GHGRP).

[6] PSD applicability calculations are based on short tons (2,000 lbs), not metric tons (USEPA Mar. 2011).

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APPENDIX 1: Calculation Tables and Results for the Proposed Pilgrim Pipeline

Table A1-1 Direct Greenhouse Gas Emissions from Pipeline Transport

Location	Number of Mainline Valves along Pipeline[a]	TOC Emission Factor [b, c]	TOC Emissions[b]		CH_4 Emissions[c]		CO_2e Emissions[d]
	#	(lb/hr) / component	lb/hr	ton/year	lb/hr	ton/year	ton/year
Pipeline transport of Bakken light crude from Albany, NY to Linden, NJ	20	1.85E-05	0.00037	0.0016	0.000056	0.00024	0.0061
Pipeline transport of petroleum products from Linden, NJ to Albany, NY	20	1.85E-05	0.00037	0.0016	0.000056	0.00024	0.0061
Total:			**0.00074**	**0.0032**	**0.00011**	**0.00049**	**0.012**

Note:

[a] Number of mainline valves (MLVs) to be operated on the crude and product pipelines were provided by project design.

[b] Total organic carbon (TOC) emission factors for valves taken from USEPA's Equipment Leak Emission Estimates (USEPA, 1995). Emission factors pertaining to Oil and Gas Production Operations for Heavy Oil were used.

[c] Methane (CH_4) emissions were estimated from the TOC emission rates based on typical weight fraction of 0.15 for CH_4. (USEPA AP-42, Section 5.2, Transportation and Marketing of Petroleum Liquids, June 2006).

[d] CO_2e emissions were estimated based on a 100-year global warming potential of 25 for CH_4.

Table A1-2 Indirect Greenhouse Gas Emissions from Electricity Use by the Pipeline Transport

Pipeline Transport Location	e-Grid Region [a]	Annual Through-put (bbl/yr)[b]	Pipeline Pump Power (hp)[c]	Annual Hours of Operation (hr/yr)[d]	Work Required to Pump Crude or Petroleum Product (hp-hr/bbl)[e]	Annual Indirect Electricity Usage (MWh/yr)[f]	Greenhouse Gas Emission Factors for Electric Motor-Driven Pumps Powered from Grid (lb/MWh)[a]			Greenhouse Gas Annual Emissions (tons/year)[g]			Total GHG Emissions (ton/year)	Greenhouse Gas Annual Emissions (metric tons/year)[i]
							CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2e[h]	CO_2e
Bakken light crude from Albany, NY to Linden, NJ	NYUP	73,000,000	18,557	8,760	2.23	121,221	545.79	0.0163	0.00724	33,080	0.99	0.44	33,236	30,151
Petroleum products from Linden, NJ to Albany, NY	NYUP	73,000,000	15,464	8,760	1.86	101,017	546.79	0.0163	0.00724	27,618	0.82	0.37	27,747	25,172
						Electricity Generation Emissions:				**60,698**	**1.81**	**0.80**	**60,983**	**55,323**
						Transmission Loss Emissions [j]				**3,642**	**0.11**	**0.048**	**3,659**	**3,319**
						Total:				**64,340**	**1.92**	**0.85**	**64,642**	**58,642**

Note:

[a] The e-Grid (Emissions and Generation Resource Integrated Database) region for Upstate New York as well as electricity generation emission factors for each greenhouse gas (GHG) were taken from US EPA's eGRID2012 version 1 database, Year 2010 (USEPA, 2014).

[b] Based on 0.2 million barrels per day each of crude oil and refined petroleum products, 365 days per year.

[c] Based on a total pump size of 18,000 HP for moving crude oil over 169 miles (three pump stations) and a total pump size of 15,000 HP for moving refined petroleum products, respectively over 169 miles (three pump stations). Also accounted for a 97% motor and drive efficiency (ABB Group, 2009)

[d] Assumes the pumps (in pump stations) would be operating continuously for 8,760 hours per year.

[e] The work required to pump one barrel of crude oil or refined petroleum products between Albany, NY and Linden, NJ was calculated based on the pipeline pump power, annual throughput, and annual hours of operation.

[f] Annual indirect electricity usage was estimated based on the amount of work required to pump one barrel each of crude oil and refined petroleum products, annual throughput, and annual hours of operation.

[g] GHG emissions in tons per year were calculated based on the GHG emission factors and annual indirect electricity usage.

[h] Total GHGs were estimated as CO_2 equivalents (CO_2e), accounting for 100-year global warming potentials of CO_2 (1), CH_4 (25) and N_2O (298); see 40 CFR 98 Subpart A Table A-1.

[i] GHG emissions in metric tons per year were calculated using the conversion factor: 1 metric ton = 1.10231 tons.

[j] The US Energy Information Administration estimates that national electricity transmission and distribution losses average about 6% of the electricity that is transmitted and distributed in the United States each year (EIA, 2014).

APPENDIX 2: Calculation Tables and Results for the Barge Transportation Option

Table A2-3 Direct Greenhouse Gas Emissions from Barge Transport

Transport Mode	Volume Transported Per Day, Throughput (bbls/ day)[a]	Number of Calls Per Day[b]	Transport Distance, One Way (miles)[c]	Fuel Type[d]	Propulsion Engine[e]		Auxiliary Engines[f]		Speed (miles/ hr)[g]	Activity (hours/ trip)[h]	Propulsion Engine Emission Factors (g/kWh)			Auxiliary Engine Emission Factors (g/kWh)			Greenhouse Gas Annual Emissions (ton/year)[i]			Total GHG Emissions (ton/year)	Greenhouse Gas Annual Emissions (metric ton/year)
					Total Max. Power Rating (kW)	Engine Load Factor	Total Max. Power Rating (kW)	Engine Load Factor			CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2e	CO_2e
Loaded barges with towboats transporting refined petroleum northbound from Arthur Kill, NJ to Port of Albany, NY	200,000	2.0	160	ULSD	3,520	0.90	200	0.31	12.1	13.3	690	0.090	0.020	690	0.090	0.020	23,764	3.10	0.69	24,046	21,814
Empty barges with towboats going southbound from Albany, NY to Arthur Kill, NJ	0	2.0	160	ULSD	3,520	0.02	200	0.31	12.1	13.3	2854	23.97	54.82	690	0.090	0.020	2,598	18.05	41.16	15,316	13,895
Loaded barges with towboats transporting crude oil southbound from Port of Albany, NY to Arthur Kill, NJ	200,000	2.0	160	ULSD	3,520	0.90	200	0.31	12.1	13.3	690	0.090	0.020	690	0.090	0.020	23,764	3.10	0.69	24,046	21,814
Empty barges with towboats going northbound from Arthur Kill, NJ to Port of Albany, NY	0	2.0	160	ULSD	3,520	0.02	200	0.31	12.1	13.3	2854	23.97	54.82	690	0.090	0.020	2,598	18.05	41.16	15,316	13,895
																Total:	**52,723**	**42.3**	**83.7**	**78,725**	**71,418**

Notes:

[a]Based on 73 million barrels of crude oil and 73 million barrels of refined petroleum products transported annually (365 days), and 100,000 barrels per call.

[b]Number of barge trips per day (for loaded and empty barges) were calculated based on volume of crude transported per day (bbls/day) and assuming the capacity of a typical barge would be 100,000 barrels.

[c]Based on a round trip distance of 320 miles along the Hudson River from The Port of Albany in NY to Arthur Kill, NJ. This results to a one-way transport distance of 160 miles.

[d]The tugboat engines were assumed to fire ultra low sulfur diesel (ULSD) with a fuel sulfur content of 0.0015 percent or 15 parts per million (ppm).

[e]Propulsion engine power ratings for self-propelled tugboats that tow or push the barges were based on a Twin MTU 16V 4000 engine (i.e. two engines), with each twin engine delivering 1,760 kilowatts (2,360 horsepower) at 1,800 revolutions per minute (rpm). The tug locks into the bow of a barge and from a dead stop takes the engines to 100 percent load to get the barge moving. From that point and through the entire voyage, the engines run at 80-to 90-percent load (MTU America Inc., 2012). For the purpose of this assessment, the main propulsion engines for the tugboats pushing loaded barges are assumed to run at 90 percent load. For empty barges during the return trips, the main propulsion engine load factors for the tugboats were assumed to be the same as for the loaded trip (i.e., 0.90 or 90 percent).

[f]Auxiliary engine power ratings for tugboats that tow or push the barges were taken from ICF International, 2009, Table 3-10 (i.e., approximately two auxiliary engines per tugboat, each with a power rating of 100 kilowatts). The auxiliary engines for the tugboats pushing loaded barges are assumed to run at 31 percent load (ICF International, 2009, Table 3-4). For empty barges during the return trips, the auxiliary engine load factors for the tugboats were assumed to be the same as for the loaded trip (i.e., 0.31 or 31 percent).

[g]The tugboats are expected to travel at an average speed of 10.5 knots pushing a 500-foot 100,000-barrel barges. Knots (nautical miles per hour) converted to miles/hour by multiplying by a factor of 1.15 miles/nautical mile.

[h]Activity (duration) calculated using tugboat speed and distance traveled per trip.

[i]Greenhouse gas emissions in tons per year were calculated calculated using emission factors for Category 1 Tier 2 main propulsion engines (minimum power of 1000 kW) and Category 1 Tier 2 auxiliary engines (mininum power of 130 kW) (ICF 2009, Table 3-8). The tugboats were assumed to have Category 1 main and auxiliary engines since about 90 percent of all tug, tow, push, and assist tugs are Category 1 and 10 percent are Category 2 (ICF International, 2009, Section 3.4.2). Total greenhouse gases were estimated as CO_2 equivalents (CO_2e), accounting for 100-year global warming potentials of CO_2 (1), CH_4 (25) and N_2O (298).At reduced load (i.e. loads less than 20 percent), emission factors for the integrated tug-barge propulsion engines were calculated using equation 5 and 6 of the ICF 2009 document. CH_4 propulsion emission factors are multiplied by hydrocarbon (HC) low load adjustment factors for load factors below 20 percent based upon the premise that CH_4 emissions are tied to HC emissions. N_2O propulsion emission factors are multiplied by NOx low load adjustment factors on the premise that N_2O is linked to NOx (see pg 2-18 and 2-19 of the ICF 2009 document). According to the ICF 2009 document (pg 2-19), there is no need for a low load adjustment factor for auxiliary engines because they are generally operated in banks.

Table A2-4 Direct Greenhouse Gas Emissions from Barge Unloading

Barge Pump Engine Emissions factors (lb/hp-hr)					Pump Engine Power (hp)	Number of pumps	Pump Size (gpm)	Unloading time for 1 pump (hrs)	Unloading time for 7 pumps (hrs)	Number of trips per year	Criteria Pollutant Emissions (tons/year)				
CO	NOx	SO_2	PM_{10}	CO_2							CO	NOx	SO_2	PM_{10}	CO_2
6.68E-03	0.031	2.05E-03	2.20E-03	1.15	180	7	1629	85.9	12.3	182.5	8.535	39.610	2.619	2.811	1,469

The source for the greenhouse gas emissions factors was US EPA AP-42 Section 3.3 http://www.epa.gov/ttn/chief/ap42/ch03/final/c03s03.pdf

Conversion Factors

1 Gallon [Fluid] 0.023809524 bbls Oil

1 lb 0.00045359 metric tons

Assumptions

A full trip considered to include both loading and unloading a barge; therefore, the pumps used for unloading are only used during half of a full trip