Appendix I: Alternatives

Table of Contents

Appendix I1: Alternatives – Traffic
Appendix I2: Alternatives – Platform Stair Analysis
Appendix I3: Alternatives – Air Quality
Appendix I4: Tri-Generation Feasibility Study

Appendix I1:
Alternatives - Traffic

2019 Future with the Reduced Density Alternative

			AM				Midday				PM				SAT			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**
Tenth Avenue @ 26th Street	28230	EB	LT	1.15	420.9	F	LT	1.19	420.1	F	LT	1.24	446.7	F	LT	0.92	55.5	E
		NB	TR	0.59	11.0	B	TR	0.87	16.9	B	TR	0.50	10.0	A	TR	0.61	11.3	B
		INTERSECTION			85.4	F			84.6	F			102.8	F			19.1	B
Tenth Avenue @ 28th Street	9918	EB	LT	1.45	550.3	F	LT	1.33	481.6	F	LT	1.11	387.0	F	LT	1.48	555.5	F
		NB	TR	0.68	10.9	B	TR	0.71	11.3	B	TR	0.59	9.8	A	TR	0.54	11.9	B
		INTERSECTION			132.4	F			109.1	F			87.4	F			153.6	F
Tenth Avenue @ 29th Street	9914	WB	TR	0.81	36.0	D	TR	1.00	64.4	E	TR	1.22	450.8	F	TR	0.87	40.8	D
		NB	LT	0.66	10.6	B	LT	0.72	11.6	B	LT	0.45	8.3	A	LT	0.57	12.5	B
		INTERSECTION			17.2	B			25.1	C			161.1	F			20.4	C
Tenth Avenue @ 30th Street	9061	EB	LT	2.39	940.7	F	LT	3.27	1351.0	F	LT	3.34	1351.0	F	LT	2.07	774.6	F
		NB	T	0.59	9.8	A	T	0.67	10.7	B	T	0.41	8.1	A	T	0.52	11.6	B
			R	0.96	53.1	D	R	1.55	442.6	F	R	1.32	279.4	F	R	1.22	230.5	F
		INTERSECTION			322.7	F			535.5	F			607.2	F			284.0	F
Tenth Avenue @ 31st Street	9933	WB	R	1.33	384.3	F	R	2.30	897.7	F	R	2.50	911.5	F	R	1.32	383.2	F
		NB	T	0.71	11.4	B	T	0.82	13.7	B	T	0.94	21.9	C	T	0.60	9.8	A
		INTERSECTION			91.7	F			208.7	F			308.4	F			93.2	F
Tenth Avenue @ 33rd Street	9077	WB	TR	1.01	100.0	F	TR	1.03	178.7	F	TR	0.96	53.4	D	TR	0.80	34.4	C
		NB	LT	0.78	13.9	B	LT	1.11	171.3	F	LT	1.10	165.5	F	LT	0.85	16.1	B
		INTERSECTION			32.4	C			172.7	F			143.9	F			19.8	B
Tenth Avenue @ 34th Street	9076	EB	DefL	0.84	65.8	E	DefL	0.92	81.4	F	DefL	1.17	779.2	F	DefL	0.82	58.1	E
			T	0.47	27.2	C	T	0.51	28.3	C	T	0.46	26.6	C	T	0.29	22.8	C
		WB	T	0.60	28.1	C	T	0.51	26.2	C	T	0.67	29.9	C	TR	0.59	28.3	C
			R	0.72	43.6	D	R	1.29	487.4	F	R	2.35	899.3	F				
		NB	LTR	0.94	20.1	C	LTR	1.10	112.5	F	LTR	1.39	237.3	F	LTR	0.83	14.1	B
		INTERSECTION			24.5	C			120.1	F			301.8	F			18.9	B
Tenth Avenue @ 35th Street	9075	WB	TR	1.67	500.7	F	TR	1.40	387.1	F	TR	1.14	264.6	F	TR	1.13	274.0	F
		NB	LT	0.90	17.1	B	LT	1.02	81.5	F	LT	0.91	16.1	B	LT	0.80	13.0	B
		INTERSECTION			110.5	F			125.5	F			44.5	D			50.9	D
Tenth Avenue @ 36th Street	9074	EB	LT	0.63	29.4	C	LT	0.42	130.9	F	LT	0.42	24.8	C	LT	0.22	22.1	C
		NB	TR	0.93	18.8	B	TR	1.07	101.3	F	TR	1.84	446.2	F	TR	0.88	16.0	B
		INTERSECTION			20.4	C			104.0	F			409.1	F			16.4	B
Tenth Avenue @ 37th Street	9073	WB	TR	0.61	27.7	C	TR	0.60	27.8	C	TR	0.71	31.2	C	TR	0.81	35.5	D
		NB	LT	0.93	21.0	C	LT	0.97	25.3	C	LT	1.71	393.4	F	LT	0.76	13.5	B
		INTERSECTION			21.9	C			25.6	C			346.1	F			18.3	B
Tenth Avenue @ 38th Street	9046	EB	LT	0.85	40.1	D	LT	0.53	26.9	C	LT	0.47	25.7	C	LT	0.48	25.9	C
		NB	TR	0.96	22.0	C	TR	1.01	75.1	E	TR	1.76	415.2	F	TR	0.85	14.4	B
		INTERSECTION			25.3	C			69.2	E			378.1	F			15.9	B
Tenth Avenue @ 39th Street	9032	WB	T	0.44	22.8	C	T	0.44	22.7	C	T	2.13	1552.0	F	T	0.00	16.8	B
			R	0.45	23.9	C	R	0.54	26.5	C	R	1.82	1059.0	F	R	0.00	16.8	B
		NB	LT	0.63	13.3	B	LT	0.64	13.4	B	LT	1.68	416.5	F	LT	0.57	15.8	B
		INTERSECTION			14.8	B			15.1	B			545.7	F			15.8	B
Tenth Avenue @ 40th Street	9047	EB	LT	0.47	21.7	C	LT	0.32	19.5	B	LT	0.57	118.7	F	LT	0.22	18.2	B
		NB	TR	0.65	14.4	B	TR	0.69	15.0	B	TR	1.68	408.4	F	TR	0.53	15.9	B
		INTERSECTION			15.4	B			15.4	B			372.2	F			16.1	B

			AM				Midday				PM				SAT			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**
Tenth Avenue @ 41st Street	9037	WB	T	0.25	13.1	B	T	0.32	13.8	B	T	1.25	510.0	F	T	0.34	13.9	B
			R	0.54	17.5	B	R	0.59	19.3	B	R	0.28	13.8	B	R	0.57	18.1	B
		NB	L	0.88	45.9	D	L	0.64	28.7	C	L	1.55	469.6	F	L	0.25	18.2	B
			T	0.82	25.2	C	T	0.88	42.0	D	T	1.06	113.5	F	T	0.71	28.7	C
		INTERSECTION			24.1	C			33.2	C			188.9	F			23.2	C
Tenth Avenue @ 42nd Street	9609	EB	LT	2.07	760.5	F	LT	2.28	949.2	F	LT	1.89	650.8	F	LT	2.07	812.9	F
		WB	TR	1.06	298.5	F	TR	1.40	403.1	F	TR	0.73	34.9	C	TR	1.48	460.0	F
											T (LnT)	1.28	793.6	F				
		NB	LTR	0.72	20.5	C	LTR	0.90	20.5	C	LTR	0.81	16.4	B	LTR	0.79	23.2	C
		INTERSECTION			157.7	F			179.1	F			104.6	F			190.7	F
Tenth Avenue @ 43st Street	9608	EB	L	0.02	17.1	B	L	0.03	17.3	B	L	0.03	17.2	B	L	0.05	17.5	B
		WB	TR	0.40	21.3	C	TR	0.57	117.4	F	TR	0.49	22.6	C	TR	0.33	20.3	C
		NB	LT	1.20	161.0	F	LT	1.23	177.7	F	LT	0.96	25.4	C	LT	1.01	84.7	F
		INTERSECTION			146.8	F			168.9	F			25.1	C			78.2	E
Tenth Avenue @ 56th Street	13616	EB	LT	0.75	31.0	C	LT	0.44	24.6	C	LT	0.51	25.6	C	LT	1.09	411.2	F
		NB	TR	0.73	11.5	B	TR	0.83	14.3	B	TR	0.64	9.9	A	TR	0.74	11.9	B
		INTERSECTION			17.0	B			16.2	B			12.7	B			75.9	E
Tenth Avenue @ 57st Street	9594	EB	LT	1.08	371.0	F	LT	1.00	61.8	E	LT	0.97	54.1	D	LT	0.92	48.9	D
		WB	TR	0.74	26.5	C	TR	1.04	210.0	F	TR	0.88	37.1	D	TR	0.91	39.9	D
		NB	LTR	0.70	16.7	B	LTR	0.70	14.6	B	LTR	0.70	14.2	B	LTR	0.63	13.6	B
		INTERSECTION			95.8	F			74.6	E			24.9	C			25.9	C
Eleventh Ave/ Twelfth Ave @ 22nd Street	2222	WB (22nd)	R	0.02	10.7	B	R	0.08	13.0	B	R	0.06	12.7	B	R	0.09	13.1	B
		NB (11th)	T	0.07	39.3	D	T	0.08	26.3	C	T	0.06	26.0	C	T	0.16	27.4	C
	28302	SB (11th)	T	0.58	54.5	D	T	0.53	38.9	D	T	0.79	62.3	E	T	0.30	35.0	D
			TR	0.42	53.6	D	TR	0.38	38.2	D	TR	0.69	65.7	E	TR	0.25	35.4	D
		NB (9A)	T	1.09	119.7	F	T	1.06	118.4	F	T	1.17	153.1	F	T	1.14	144.8	F
		SB (9A)	T	0.87	10.0	A	T	0.87	22.7	C	T	0.80	18.6	B	T	0.76	18.5	B
		INTERSECTION			62.8	E			62.9	E			84.1	F			80.7	F
Eleventh Avenue @ 24th Street	28213	EB	R	0.27	27.2	C	R	0.19	26.3	C	R	0.27	27.2	C	R	0.24	26.8	C
		NB	L	0.28	27.0	C	L	0.29	27.2	C	L	0.35	28.0	C	L	0.39	28.4	C
		SB	L	0.25	4.6	A	L	0.28	4.8	A	L	0.26	4.6	A	L	0.19	4.2	A
			TR	1.28	233.8	F	TR	1.44	305.0	F	TR	1.37	271.3	F	TR	0.79	36.6	D
		INTERSECTION			150.9	F			202.6	F			173.1	F			28.5	C
Eleventh Avenue @ 26th Street	9924	EB	TR	1.09	413.4	F	TR	0.92	67.6	E	TR	1.12	405.6	F	TR	0.62	40.3	D
		SB	LT	0.56	5.0	A	LT	0.57	5.0	A	LT	0.53	4.7	A	LT	0.40	4.0	A
		INTERSECTION			81.2	F			15.7	B			81.5	F			9.2	A
Eleventh Avenue @ 27th Street	63721	WB	LT	0.44	26.4	C	LT	0.51	27.9	C	LT	0.59	30.5	C	LT	0.32	23.7	C
		SB	TR	0.49	9.5	A	TR	0.48	9.4	A	TR	0.44	8.9	A	TR	0.32	8.1	A
		INTERSECTION			11.3	B			11.8	B			12.1	B			10.0	A
Eleventh Avenue @ 28th Street	9916	EB	TR	0.47	24.3	C	TR	0.36	21.8	C	TR	0.24	19.7	B	TR	0.34	21.3	C
		SB	LT	0.68	14.5	B	LT	0.68	14.6	B	LT	0.62	13.5	B	LT	0.52	12.4	B
		INTERSECTION			15.6	B			15.2	B			13.9	B			13.3	B
Eleventh Avenue @ 29th Street	9912	WB	LT	0.89	42.4	D	LT	0.98	58.1	E	LT	1.10	295.4	F	LT	0.75	29.2	C
		SB	TR	0.58	16.7	B	TR	0.58	16.7	B	TR	0.53	15.9	B	TR	0.45	15.1	B
		INTERSECTION			22.9	C			26.5	C			94.3	F			18.6	B
Eleventh Avenue @ 30th Street	9909	EB	TR	1.18	337.1	F	TR	1.32	396.7	F	TR	1.06	281.3	F	TR	1.03	179.1	F
		SB	LT	1.17	172.2	F	LT	1.26	210.6	F	LT	1.20	179.0	F	LT	0.85	23.6	C
		INTERSECTION			210.4	F			255.0	F			200.5	F			63.3	E

			AM				Midday				PM				SAT			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**
Eleventh Avenue @ 31st Street	61131	EB	R	0.21	27.5	C	R	0.31	30.2	C	R	0.25	28.5	C	R	0.21	27.3	C
		WB	LT	0.15	25.2	C	LT	0.58	34.9	F	LT	0.36	28.5	C	LT	0.26	26.6	C
		SB	TR	0.69	7.8	A	TR	0.64	7.1	A	TR	0.61	6.8	A	TR	0.47	5.7	A
		INTERSECTION			8.7	A			10.1	B			8.7	A			7.7	A
Eleventh Avenue @ 32nd Street	61132	EB	TR	0.24	28.5	C	TR	0.30	30.6	C	TR	0.00	23.5	C	TR	0.27	29.6	C
		SB	LTR	0.72	8.2	A	LTR	0.73	8.4	A	LTR	0.68	7.5	A	LTR	0.52	6.1	A
		INTERSECTION			8.6	A			8.8	A			7.5	A			6.7	A
Eleventh Avenue @ 33rd Street	9907	WB	L	0.88	66.6	E	L	0.83	114.2	F	L	0.91	72.4	E	L	0.61	38.1	D
			LT	0.90	50.8	D	LT	1.10	100.4	F	LT	0.94	54.9	D	LT	0.68	34.6	C
		SB	TR	0.61	7.0	A	TR	0.55	6.3	A	TR	0.55	6.3	A	TR	0.40	5.3	A
		INTERSECTION			21.1	C			36.4	D			22.1	C			14.9	B
Eleventh Avenue @ 34th Street	9904	EB	L	0.46	21.5	C	L	0.51	23.8	C	L	0.54	24.7	C	L	0.64	31.0	C
			TR	0.57	31.1	C	TR	0.51	29.8	C	TR	0.55	30.5	C	TR	0.66	32.8	C
		WB	L	0.67	34.0	C	L	0.48	21.6	C	L	0.69	34.7	C	L	0.30	18.3	B
			TR	0.63	32.6	C	TR	0.67	32.9	C	TR	0.97	62.1	E	TR	0.44	27.9	C
		SB	LT	0.92	28.9	C	LT	0.91	31.6	C	LT	0.88	28.8	C	LT	0.64	21.2	C
			R	0.38	17.6	B	R	0.47	22.7	C	R	0.44	21.1	C	R	0.50	22.6	C
		INTERSECTION			29.2	C			30.3	C			34.8	C			25.0	C
Eleventh Avenue @ 35th Street	9901	WB	L	0.34	18.6	B	L	0.34	18.6	B	L	0.43	20.7	C	L	0.21	16.5	B
			LR	0.28	17.4	B	LR	0.33	18.3	B	LR	0.45	21.2	C	LR	0.26	17.3	B
			R	0.32	18.4	B	R	0.25	17.6	B	R	0.13	15.6	B	R	0.10	15.1	B
		NB	T	0.09	14.6	B	T	0.10	14.7	B	T	0.17	12.9	B	T	0.11	14.8	B
		SB	T	0.64	17.7	B	T	0.60	20.1	C	T	0.59	19.8	B	T	0.49	18.4	B
		INTERSECTION			17.6	B			19.3	B			18.9	B			17.7	B
Eleventh Avenue @ 36th Street	9898	NB	TR	0.15	6.4	A	TR	0.14	6.4	A	TR	0.16	3.0	A	TR	0.10	6.2	A
		SB	DefL	0.66	11.2	B	LT	0.59	10.0	B	LT	0.60	10.3	B	LT	0.44	8.4	A
			T	0.59	5.2	A												
		INTERSECTION			6.3	A			9.5	A			9.0	A			8.1	A
Eleventh Avenue @ 37th Street	9034	EB	LR	0.10	27.2	C	LR	0.16	28.2	C	LR	0.11	27.3	C	LR	0.00	25.7	C
		WB	L	0.84	64.8	E	L	0.86	67.9	E	L	0.85	64.7	E	L	0.68	45.5	D
			R	0.58	42.7	D	R	0.44	36.5	D	R	0.29	31.6	C	R	0.55	39.8	D
		NB	T	0.08	6.0	A	T	0.07	6.0	A	T	0.12	2.9	A	T	0.08	6.0	A
		SB	T	0.63	5.5	A	T	0.56	9.8	A	T	0.56	9.7	A	T	0.44	8.5	A
		INTERSECTION			12.5	B			16.0	B			14.6	B			13.7	B
Eleventh Avenue @ 38th Street	150008	NB	TR	0.17	8.2	A	TR	0.16	8.2	A	TR	1.29	514.0	F	TR	0.14	8.0	A
		SB	LT	1.12	127.5	F	LT	0.91	23.7	C	LT	0.92	24.6	C	LT	0.73	15.2	B
		INTERSECTION			113.1	F			21.7	C			105.4	F			14.0	B
Eleventh Avenue @ 39th Street	9894	EB	L	0.00	19.3	B	L	0.00	19.3	B	L	0.00	19.3	B	L	0.00	19.3	B
			LR	0.00	19.3	B	LR	0.00	19.3	B	LR	0.00	19.3	B	LR	0.00	19.3	B
		WB	L	0.44	26.8	C	L	0.39	25.2	C	L	0.44	26.3	C	L	0.20	21.8	C
			LR	0.42	26.2	C	LR	0.42	26.1	C	LR	0.65	33.4	C	LR	0.25	22.8	C
		NB	T	0.08	9.8	A	T	0.08	9.9	A	T	1.08	445.6	F	T	0.10	10.0	A
		SB	T	0.85	16.5	B	T	0.70	16.9	B	T	0.71	17.1	B	T	0.60	14.9	B
		INTERSECTION			17.4	B			17.7	B			72.5	E			15.0	B
Eleventh Avenue @ 40th Street	9035	EB	TR	0.64	40.4	D	TR	0.61	38.9	D	TR	1.00	90.0	F	TR	0.50	34.3	C
		NB	R	0.14	8.1	A	R	0.15	6.5	A	R	1.09	261.2	F	R	0.14	6.4	A
		SB	L	0.26	3.4	A	L	0.36	3.8	A	L	1.00	130.5	F	L	0.33	3.6	A
			TR	0.69	6.1	A	TR	0.58	7.0	A	TR	0.56	4.9	A	TR	0.47	4.3	A
		INTERSECTION			8.0	A			8.1	A			91.5	F			6.3	A

			AM				Midday				PM				SAT			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**
Eleventh Avenue @ 41st Street	9036	WB	LT	0.68	32.2	C	LT	0.71	33.4	C	LT	0.48	26.1	C	LT	0.72	33.2	C
		SB	LTR	0.53	9.5	A	LTR	0.52	11.7	B	LTR	0.49	9.4	A	LTR	0.44	8.8	A
											T (LnT)	1.16	172.9	F				
		INTERSECTION			12.5	B			14.7	B			72.9	E			12.9	B
Eleventh Avenue @ 42nd Street	9573	EB	TR	0.89	42.7	D	TR	0.73	31.4	C	TR	0.77	32.4	C	TR	0.92	46.9	D
		WB	L	0.44	19.5	B	L	0.51	20.1	C	L	0.39	221.4	F	L	0.46	19.6	B
			LT	0.29	13.8	B	LT	0.41	15.2	B	LT	0.54	112.2	F	LT	0.38	14.8	B
		SB	LT	1.02	113.4	F	LT	1.04	118.6	F	T	0.82	27.5	C	LT	0.81	25.8	C
			R	0.34	23.0	C	R	0.74	47.4	D	R	0.92	78.7	E	R	0.49	29.4	C
											LT (LnT)	1.31	271.1	F				
		INTERSECTION			84.0	F			83.0	F			110.2	F			28.1	C
Eleventh Avenue @ 43rd Street	9572	WB	LT	0.63	36.2	D	LT	0.85	48.2	D	LT	0.83	45.6	D	LT	0.53	32.9	C
		SB	TR	0.39	3.7	A	TR	0.49	6.4	A	TR	0.59	5.3	A	TR	0.41	3.8	A
											T (LnT)	1.25	254.1	F				
		INTERSECTION			8.2	A			14.1	B			83.4	F			8.3	A
Eleventh Avenue @ 44th Street	9571	EB	LTR	1.27	595.9	F	LTR	0.83	46.7	D	LTR	1.15	509.0	F	LTR	0.82	45.0	D
		SB	L	0.18	3.3	A	L	0.11	6.3	A	L	0.14	6.5	A	L	0.16	6.7	A
			T	0.68	9.2	A	T	0.71	14.8	B	T	1.30	189.4	F	T	0.59	10.1	B
											T (LnT)	1.26	260.4	F				
		INTERSECTION			129.7	F			20.2	C			260.4	F			16.9	B
Eleventh Avenue @ 46th Street	9569	EB	LTR	0.56	33.7	C	LTR	0.56	33.5	C	LTR	0.51	32.6	C	LTR	0.49	32.1	C
		NB	TR	0.25	7.2	A	TR	0.06	6.0	A	TR	0.07	2.8	A	TR	0.12	6.3	A
		SB	L	0.23	4.1	A	L	0.18	7.1	A	L	0.18	7.1	A	L	0.25	7.8	A
			T	0.92	25.4	C	T	0.96	42.6	D	T	0.99	34.3	C	T	0.85	17.9	B
		INTERSECTION			23.2	C			38.0	D			31.1	C			18.0	B
Eleventh Avenue @ 47th Street	63724	WB	LTR	1.00	75.5	E	LTR	1.00	72.8	E	LTR	0.95	59.2	E	LTR	0.90	53.5	D
		NB	L	0.17	9.8	A	L	0.24	13.6	B	L	0.26	10.9	B	L	0.24	12.5	B
			T	0.18	6.6	A	T	0.08	6.1	A	T	0.12	2.9	A	T	0.13	6.3	A
		SB	TR	0.97	50.7	D	TR	0.97	47.2	D	TR	1.06	88.3	F	TR	0.88	19.9	B
		INTERSECTION			49.4	D			50.1	D			75.0	E			25.7	C
Eleventh Avenue @ 54th Street	9561	EB	LTR	1.23	376.7	F	LTR	0.75	44.3	D	LTR	0.73	43.5	D	LTR	0.46	32.9	C
		NB	L	0.85	59.9	E	L	0.47	18.6	B	L	1.54	576.2	F	L	0.85	55.2	E
			TR	0.54	9.9	A	TR	0.41	8.5	A	TR	0.40	4.1	A	TR	0.34	7.8	A
		SB	L	0.56	13.2	B	L	0.35	10.4	B	L	0.36	10.2	B	L	0.22	8.0	A
			TR	0.88	12.7	B	TR	0.75	13.8	B	TR	0.85	17.6	B	TR	0.74	13.5	B
		INTERSECTION			63.9	E			15.6	B			48.6	D			15.5	B
Eleventh Avenue @ 56th Street	13476	EB	LTR	1.08	290.9	F	LTR	0.66	28.8	C	LTR	0.83	35.8	D	LTR	0.48	24.9	C
		NB	TR	0.51	14.1	B	TR	0.42	12.9	B	TR	0.46	9.6	A	TR	0.47	13.5	B
		SB	L	0.28	10.4	B	L	0.23	12.5	B	L	0.21	12.3	B	L	0.17	11.6	B
			T	0.65	11.4	B	T	0.59	14.9	B	T	0.65	15.8	B	T	0.59	14.9	B
		INTERSECTION			93.8	F			17.3	B			19.1	B			16.1	B
Eleventh Avenue @ 57th Street	9558	EB	L	1.14	631.9	F	L	0.66	31.1	C	L	0.54	35.3	D	L	0.64	34.1	C
			TR	1.20	386.5	F	TR	0.95	66.6	E	TR	1.25	495.7	F	TR	0.90	58.4	E
		WB	L	1.03	204.8	F	L	1.21	602.9	F	L	0.72	45.5	D	L	1.22	569.3	F
			TR	0.84	40.1	D	TR	0.77	35.8	D	TR	0.83	38.6	D	TR	1.69	662.0	F
		NB	L	0.47	36.5	D	L	0.67	47.8	D	L	1.06	344.9	F	L	0.95	93.2	F
			TR	0.48	18.6	B	TR	0.40	17.5	B	TR	0.45	15.5	B	TR	0.39	17.4	B
		SB	L	1.32	378.0	F	L	0.98	80.8	F	L	1.52	436.2	F	L	0.82	50.0	D
			TR	0.85	24.3	C	TR	0.69	22.4	C	TR	0.77	24.5	C	TR	0.66	21.6	C
		INTERSECTION			135.7	F			82.0	F			113.3	F			195.7	F

			AM				Midday				PM				SAT			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**
Twelfth Avenue @ 24th Street	9879	WB	L	0.54	69.3	E	L	0.49	46.9	D	L	0.68	71.8	E	L	0.53	47.8	D
			LTR	0.51	68.2	E	LTR	0.51	48.1	D	LTR	0.67	71.6	E	LTR	0.52	47.8	D
			R	0.50	68.9	E	R	0.49	47.9	D	R	0.69	72.9	E	R	0.48	47.2	D
		NB	TR	1.02	93.0	F	TR	1.04	108.7	F	TR	1.14	137.7	F	TR	1.12	132.6	F
		SB	L	0.97	134.1	F	L	0.67	74.9	E	L	0.65	87.7	F	L	1.10	523.8	F
			T	0.90	17.5	B	T	1.02	125.3	F	T	0.87	28.9	C	T	0.84	28.3	C
	INTERSECTION				58.6	E			111.2	F			86.7	F			98.0	F
Twelfth Avenue @ 29th Street	9875	WB	LR	1.90	977.4	F	LR	1.60	774.0	F	LR	2.29	1145.0	F	LR	1.50	696.0	F
		NB	T	0.62	9.3	A	T	0.62	10.7	B	T	0.78	4.0	A	T	0.71	12.4	B
		SB	T	0.74	3.8	A	T	0.73	12.9	B	T	0.70	10.2	B	T	0.78	14.4	B
	INTERSECTION				81.0	F			72.9	E			99.8	F			61.2	E
Twelfth Avenue @ 30th Street	9874	EB	LTR	0.00	64.4	E	LTR	0.00	49.5	D	LTR	0.00	64.4	E	LTR	0.00	49.5	D
		NB	TR	0.78	15.4	B	TR	0.86	19.4	B	TR	0.98	14.9	B	TR	0.84	18.3	B
		SB	L	1.31	403.7	F	L	1.45	421.4	F	L	1.61	540.5	F	L	1.34	398.5	F
			TR	0.87	6.8	A	TR	0.86	19.7	B	TR	0.83	17.9	B	TR	0.88	20.6	C
	INTERSECTION				27.1	C			41.1	D			37.1	D			35.1	D
Twelfth Avenue @ 34th Street	9872	WB	L	0.41	58.1	E	L	0.44	42.8	D	L	0.49	60.1	E	L	0.35	40.6	D
			LR	0.46	59.8	E	LR	0.43	42.6	D	LR	0.45	58.9	E	LR	0.29	39.2	D
			R	0.66	45.1	D	R	0.58	32.2	C	R	0.64	51.8	D	R	0.52	30.3	C
		NB	T	0.90	36.5	D	T	0.85	29.4	C	T	0.99	29.5	C	T	0.89	31.7	C
			R	0.30	20.6	C	R	0.36	20.0	B	R	0.28	8.3	A	R	0.52	23.2	C
		SB	L	0.59	62.4	E	L	0.66	58.4	E	L	1.16	745.6	F	L	0.79	64.9	E
			T	0.86	6.2	A	T	0.77	15.5	B	T	0.76	13.6	B	T	0.82	17.2	B
	INTERSECTION				24.7	C			25.4	C			57.1	E			27.1	C
Twelfth Avenue @ 37th Street	9871	EB	LR	0.12	52.6	D	LR	0.14	43.1	D	LR	0.25	60.6	E	LR	0.16	43.3	D
			R	0.13	53.2	D	R	0.14	43.6	D	R	0.26	62.3	E	R	0.10	42.8	D
		NB	L	0.10	63.7	E	L	0.20	50.4	D	L	0.30	72.6	E	L	0.26	51.6	D
			T	0.97	40.1	D	T	0.83	21.7	C	T	0.91	7.7	A	T	0.87	23.4	C
		SB	TR	1.15	147.7	F	TR	1.09	123.5	F	TR	0.95	30.6	C	TR	1.18	157.3	F
	INTERSECTION				93.9	F			72.4	E			18.6	B			89.9	F
Twelfth Avenue @ 41st Street	9868	EB	LR	0.00	38.2	D	LR	0.02	24.9	C	LR	0.06	47.3	D	LR	0.02	24.9	C
		WB	L	0.09	50.8	D	L	0.09	37.8	D	L	0.08	60.0	E	L	0.07	37.6	D
			R	0.41	56.8	E	R	0.46	44.3	D	R	0.47	67.8	E	R	0.45	43.5	D
		NB	T	1.17	165.1	F	T	1.12	145.7	F	T	1.05	89.7	F	T	1.07	126.5	F
		SB	T	1.18	132.5	F	T	1.03	78.1	E	T	1.00	36.0	D	T	1.14	121.0	F
	INTERSECTION				145.4	F			109.0	F			64.9	E			119.6	F
Twelfth Avenue @ 42nd Street	9867	EB	LTR	0.04	46.2	D	LTR	0.08	32.4	C	LTR	0.08	46.7	D	LTR	0.09	32.6	C
		WB	L	0.32	52.2	D	L	0.61	45.8	D	L	0.66	65.6	E	L	0.51	42.0	D
			R	0.55	33.2	C	R	0.62	22.7	C	R	0.86	67.4	E	R	0.63	24.7	C
		NB	T	1.00	57.0	E	T	1.14	148.6	F	T	1.00	35.9	D	T	1.20	175.0	F
			R	0.39	28.9	C	R	0.51	33.4	C	R	0.30	11.6	B	R	0.23	26.9	C
		SB	L	0.67	59.3	E	L	0.41	42.2	D	L	1.20	358.7	F	L	0.69	48.6	D
			T	0.82	5.8	A	T	0.85	20.4	C	T	0.84	18.6	B	T	0.90	23.3	C
	INTERSECTION				33.4	C			74.9	E			46.8	D			88.4	F
Twelfth Avenue @ 43th Street	9866	WB	LTR	0.78	72.8	E	LTR	0.77	54.2	D	LTR	1.01	150.2	F	LTR	0.69	49.5	D
		NB	L	1.00	172.9	F	L	0.33	59.2	E	L	0.16	68.0	E	L	0.10	52.3	D
			T	0.73	12.8	B	T	0.82	16.7	B	T	0.90	6.9	A	T	0.84	17.6	B
		SB	T	0.79	10.2	B	T	0.72	21.9	C	T	0.80	22.5	C	T	0.93	31.2	C
			R	0.02	4.3	A	R	0.05	13.1	B	R	0.02	10.6	B	R	0.07	13.2	B
	INTERSECTION				15.9	B			21.4	C			20.8	C			25.5	C

			AM				Midday				PM				SAT			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**
Twelfth Avenue @ 44th Street	9892	NB	TR	0.84	20.2	C	TR	0.90	20.8	C	TR	0.99	15.8	B	TR	0.98	30.1	C
		SB	L	1.11	295.2	F	L	0.96	81.9	F	L	1.03	227.0	F	L	0.95	80.0	F
			T	0.83	8.2	A	T	0.65	20.7	C	T	0.76	13.5	B	T	0.89	19.7	B
		INTERSECTION			31.2	C			24.3	C			23.3	C			27.6	C
Twelfth Avenue@ 46th Street	9864	EB	LTR	0.28	56.6	E	LTR	0.13	36.0	D	LTR	0.17	51.9	D	LTR	0.18	36.6	D
		NB	TR	0.98	116.5	F	TR	1.14	183.9	F	TR	1.16	176.5	F	TR	1.13	171.1	F
		SB	L	0.56	70.9	E	L	0.60	71.2	E	L	0.63	84.3	F	L	0.84	97.2	F
			T	0.87	5.9	A	T	0.73	17.6	B	T	0.81	14.2	B	T	0.92	21.7	C
		INTERSECTION			56.1	E			106.4	F			100.9	F			94.5	F
Twelfth Avenue @ 54th Street	9856	EB	R	0.00	5.6	A	R	0.00	6.7	A	R	0.00	5.3	A	R	0.00	6.7	A
		WB	R	0.53	61.5	E	R	0.34	40.6	D	R	0.81	82.0	F	R	0.52	45.7	D
		NB	TR	1.03	108.3	F	TR	1.06	121.1	F	TR	1.26	199.9	F	TR	0.92	22.1	C
		SB	L	0.72	69.8	E	L	0.47	43.2	D	L	0.47	58.5	E	L	0.28	38.8	D
			T	1.20	138.6	F	T	0.75	14.6	B	T	0.76	13.2	B	T	0.89	19.6	B
		INTERSECTION			123.2	F			74.6	E			121.3	F			21.6	C
Twelfth Avenue @ 56th Street (SR)	99001	NB	TR	0.95	58.6	E	TR	0.33	7.6	A	TR	0.43	11.7	B	TR	0.32	7.5	A
		INTERSECTION			58.6	E			7.6	A			11.7	B			7.5	A
Twelfth Avenue @ 56th Street	9883	NB	T	1.18	174.9	F	T	0.84	15.5	B	T	1.26	173.0	F	T	0.80	14.1	B
		SB	L	1.00	56.9	E	L	1.20	479.2	F	L	1.12	391.4	F	L	0.86	62.0	E
			T	0.96	6.6	A	T	0.50	0.5	A	T	0.60	0.8	A	T	0.56	0.7	A
		INTERSECTION			66.0	E			55.1	E			127.6	F			11.4	B
Twelfth Avenue @ 57th Street	9854	WB	R	0.34	31.8	C	R	0.56	39.5	D	R	0.64	239.4	F	R	0.59	40.0	D
		NB	T	0.94	40.4	D	T	0.75	16.0	B	T	0.96	14.0	B	T	0.70	14.9	B
		INTERSECTION			39.1	D			19.3	B			39.5	D			18.8	B
Sixth Avenue @ 28th Street	21627	EB	LT	1.24	352.4	F	LT	1.22	343.0	F	LT	1.35	397.0	F	LT	1.09	287.4	F
		NB	TR	0.88	36.8	D	TR	0.86	21.1	C	TR	0.85	20.3	C	TR	0.89	22.4	C
		INTERSECTION			118.7	F			103.7	F			123.5	F			82.4	F
Sixth Avenue @ 30th Street	21589	EB	LT	1.47	406.7	F	LT	1.39	375.0	F	LT	1.37	356.7	F	LT	0.70	72.1	E
		NB	TR	1.02	108.7	F	TR	0.92	55.0	D	TR	0.93	31.8	C	TR	1.01	85.3	F
		INTERSECTION			207.8	F			161.4	F			140.2	F			82.7	F
Sixth Avenue @ 31st Street	21579	WB	TR	0.64	22.7	C	TR	0.67	23.5	C	TR	0.58	21.4	C	TR	0.71	29.5	C
		NB	LT	0.98	35.2	D	LT	0.92	47.0	D	LT	0.89	24.1	C	LT	0.89	23.8	C
		INTERSECTION			32.1	C			40.9	D			23.5	C			25.4	C
Sixth Avenue @ 35th Street	9786	WB	TR	1.00	59.9	E	TR	0.71	27.5	C	TR	0.77	29.8	C	TR	0.66	25.9	C
		NB	LT	0.65	10.4	B	LT	0.58	13.0	B	LT	0.64	13.8	B	LT	0.63	13.7	B
		INTERSECTION			25.7	C			17.2	B			18.6	B			16.9	B
Sixth Avenue @ 36th Street	9785	EB	L	0.45	39.3	D	L	0.94	81.6	F	L	1.02	166.8	F	L	1.15	228.1	F
			T	0.65	22.5	C	T	0.61	21.5	C	T	0.68	23.0	C	T	0.47	19.0	B
		NB	TR	0.71	18.6	B	TR	0.57	16.4	B	TR	0.62	17.1	B	TR	0.62	17.2	B
		INTERSECTION			20.4	C			23.2	C			33.7	C			39.4	D
Sixth Avenue @ 37th Street	9784	WB	T	0.70	23.7	C	T	0.60	21.2	C	T	0.61	21.3	C	T	0.72	24.2	C
			R	0.57	24.5	C	R	0.75	33.5	C	R	0.75	33.3	C	R	0.68	29.1	C
		NB	LT	0.73	19.0	B	LT	0.60	21.2	C	LT	0.68	18.1	B	LT	0.63	17.2	B
		INTERSECTION			20.7	C			22.4	C			20.3	C			20.2	C
Sixth Avenue @ 42nd St	9779	EB	LT	0.86	38.3	D	LT	0.55	22.9	C	LT	0.75	28.8	C	LT	0.52	22.3	C
		WB	TR	0.89	41.7	D	TR	0.88	37.6	D	TR	0.63	25.1	C	TR	0.64	25.5	C
			R	0.85	61.0	E	R	0.82	50.1	D	R	0.56	29.7	C	R	0.54	29.2	C
		NB	LTR	0.63	10.0	B	LTR	0.60	13.1	B	LTR	0.65	13.9	B	LTR	0.56	12.6	B
		INTERSECTION			24.4	C			22.2	C			19.6	B			17.9	B

			AM				Midday				PM				SAT			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**
Seventh Avenue @ 23rd Street	21670	EB	TR	0.93	47.4	D	TR	0.92	46.0	D	TR	0.81	34.3	C	TR	0.86	38.2	D
		WB	LT	0.64	27.4	C	LT	0.56	25.1	C	LT	0.57	25.0	C	LT	0.50	23.8	C
		SB	LTR	0.93	30.5	C	LTR	0.84	24.9	C	LTR	0.87	25.9	C	LTR	0.83	24.0	C
		INTERSECTION			33.8	C			29.8	C			27.4	C			27.2	C
Seventh Avenue @ 28th Street	21626	EB	TR	0.99	350.3	F	TR	0.88	41.2	D	TR	0.84	37.6	D	TR	0.89	313.7	F
		SB	LT	0.72	12.4	B	LT	0.58	14.2	B	LT	0.59	10.5	B	LT	0.60	14.1	B
		INTERSECTION			109.7	F			22.6	C			18.3	B			97.7	F
Seventh Avenue @ 29th Street	21599	WB	LT	1.34	406.5	F	LT	1.49	464.5	F	LT	1.55	498.7	F	LT	1.08	296.4	F
		SB	TR	0.82	18.9	B	TR	0.67	21.0	C	TR	0.70	15.8	B	TR	0.71	15.8	B
		INTERSECTION			125.9	F			174.0	F			174.6	F			88.1	F
Seventh Avenue @ 30th Street	21588	EB	T	1.42	456.3	F	T	1.40	445.2	F	T	1.37	418.2	F	T	0.77	33.2	C
			R	0.87	47.4	D	R	0.53	25.1	C	R	0.78	223.7	F	R	0.77	35.3	D
		SB	LT	0.78	17.6	B	LT	0.66	20.4	C	LT	0.65	14.8	B	LT	0.57	13.6	B
		INTERSECTION			129.6	F			140.3	F			148.9	F			20.5	C
Seventh Avenue @ 31st Street	21578	WB	LT	1.33	381.3	F	LT	1.40	423.9	F	LT	1.24	344.9	F	LT	1.36	385.4	F
		SB	TR	0.93	26.5	C	TR	0.85	33.9	C	TR	0.83	20.7	C	TR	0.71	17.5	B
		INTERSECTION			124.2	F			155.4	F			112.4	F			141.8	F
Seventh Avenue @ 33rd Street	9750	WB	LT	1.22	582.3	F	LT	1.49	674.3	F	LT	1.16	527.9	F	LT	1.15	464.7	F
		SB	TR	1.15	122.7	F	TR	1.03	79.5	E	TR	1.10	105.1	F	TR	0.91	13.4	B
		INTERSECTION			176.8	F			174.5	F			157.2	F			85.5	F
Seventh Avenue 34th Street	9749	EB	T	1.02	140.3	F	T	0.93	51.6	D	T	0.78	34.4	C	TR	0.47	77.4	E
		WB	LT	0.85	34.6	C	LT	0.87	36.4	D	LT	0.90	38.8	D	LT	0.53	22.6	C
		SB	T	0.97	29.4	C	T	0.88	21.2	C	T	0.90	22.2	C	T	0.77	17.0	B
		INTERSECTION			46.2	D			28.8	C			27.5	C			27.2	C
Seventh Avenue @ 35th Street	9748	WB	L	0.87	51.3	D	L	0.66	33.1	C	L	0.59	30.6	C	L	0.81	44.8	D
			LT	1.35	462.7	F	LT	1.10	363.2	F	LT	1.45	508.0	F	LT	0.95	57.5	E
		SB	TR	0.90	20.9	C	TR	0.86	27.9	C	TR	0.85	18.0	B	TR	0.74	14.8	B
		INTERSECTION			107.1	F			85.1	F			119.1	F			24.9	C
Seventh Avenue @ 36th Street	9747	EB	TR	1.28	444.9	F	TR	1.08	328.2	F	TR	1.31	436.6	F	TR	1.21	416.4	F
		SB	LT	0.85	19.8	B	LT	0.91	26.4	C	LT	0.84	19.1	B	LT	0.69	15.4	B
		INTERSECTION			161.1	F			127.4	F			164.9	F			160.4	F
Seventh Avenue @ 37th Street	9746	WB	LT	0.99	50.6	D	LT	0.82	29.1	C	LT	0.92	38.3	D	LT	0.89	193.7	F
		SB	TR	0.84	22.7	C	TR	0.85	23.3	C	TR	0.87	23.9	C	TR	0.69	18.7	B
		INTERSECTION			32.4	C			25.1	C			28.5	C			84.8	F
Seventh Avenue @ 38th Street	9745	EB	TR	1.18	396.8	F	TR	0.87	33.0	C	TR	0.82	32.2	C	TR	0.97	278.1	F
		SB	LT	0.73	16.2	B	LT	0.84	22.6	C	LT	0.75	16.7	B	LT	0.55	13.4	B
		INTERSECTION			149.0	F			26.0	C			21.1	C			116.8	F
Seventh Avenue @ 42nd Street	9741	EB	TR	0.76	30.4	C	TR	0.51	19.3	B	TR	0.77	30.7	C	TR	0.54	23.6	C
		WB	LT	0.45	22.6	C	LT	0.39	17.6	B	LT	0.53	24.0	C	LT	0.30	20.2	C
		SB	LTR	0.68	13.8	B	LTR	0.71	19.1	B	LTR	0.58	12.4	B	LTR	0.48	11.3	B
		INTERSECTION			19.0	B			18.8	B			19.2	B			16.5	B
Eighth Avenue @ 28th Street	21611	EB	LT	0.80	31.9	C	LT	0.76	30.1	C	LT	0.70	27.7	C	LT	0.59	24.9	C
		NB	TR	0.72	14.5	B	TR	0.65	13.4	B	TR	0.74	14.8	B	TR	0.70	14.1	B
		INTERSECTION			19.5	B			18.5	B			18.2	B			16.7	B
Eighth Avenue @ 29th Street	21598	WB	TR	1.31	410.3	F	TR	1.52	479.3	F	TR	1.83	637.6	F	TR	1.25	365.5	F
		NB	LT	0.73	16.1	B	LT	0.77	20.3	C	LT	0.78	17.3	B	LT	0.71	20.0	C
		INTERSECTION			119.1	F			168.0	F			214.1	F			113.0	F
Eighth Avenue @ 30th Street	21587	EB	LT	1.33	411.7	F	LT	1.24	367.5	F	LT	1.38	427.2	F	LT	1.06	289.1	F
		NB	TR	0.76	18.5	B	TR	0.80	21.1	C	TR	0.84	20.8	C	TR	0.69	22.0	C
		INTERSECTION			180.7	F			161.2	F			186.6	F			124.6	F

			AM				Midday				PM				SAT			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**
Eighth Avenue @ 31st Street	9757	WB	TR	0.93	41.1	D	TR	1.12	370.8	F	TR	1.11	328.9	F	TR	1.10	344.4	F
		NB	LT	0.95	30.0	C	LT	0.96	31.4	C	LT	1.10	120.7	F	LT	0.90	39.7	D
		INTERSECTION			33.2	C			134.1	F			183.5	F			137.4	F
Eighth Avenue @ 33rd Street	9756	WB	TR	0.40	14.2	B	TR	0.51	15.7	B	TR	0.57	16.6	B	TR	0.49	15.3	B
		NB	LT	1.10	142.8	F	LT	1.19	181.9	F	LT	1.27	218.5	F	LT	1.07	129.4	F
		INTERSECTION			121.1	F			147.8	F			173.9	F			105.1	F
Eighth Avenue @ 34th Street	9755	EB	T	0.83	35.4	D	T	0.73	28.3	C	T	0.66	24.9	C	T	0.32	16.9	B
		WB	T	0.44	18.4	B	T	0.48	19.1	B	T	0.49	19.1	B	TR	0.49	19.0	B
			R	0.74	36.5	D	R	0.70	33.5	C	R	0.71	33.9	C				
		NB	LTR	1.10	145.6	F	LTR	1.13	155.2	F	LTR	1.12	150.1	F	LTR	1.04	118.5	F
		INTERSECTION			102.6	F			108.4	F			104.2	F			82.6	F
Eighth Avenue @ 35th Street	9754	WB	TR	1.82	695.7	F	TR	1.27	393.7	F	TR	1.76	668.7	F	TR	1.49	568.8	F
		NB	LT	0.71	12.1	B	LT	0.95	29.9	C	LT	0.77	13.1	B	LT	0.72	12.1	B
		INTERSECTION			194.9	F			110.5	F			170.7	F			128.2	F
Eighth Ave @ 36th Street	9753	EB	LT	0.99	294.3	F	LT	0.81	160.4	F	LT	1.38	462.4	F	LT	1.03	323.5	F
		NB	TR	0.81	16.7	B	TR	1.04	103.0	F	TR	0.89	20.2	C	TR	0.83	17.0	B
		INTERSECTION			102.5	F			118.7	F			174.9	F			106.5	F
Eighth Avenue @ 37th Street	9752	WB	TR	0.90	40.2	D	TR	0.74	25.9	C	TR	0.97	50.9	D	TR	0.99	53.6	D
		NB	LT	0.75	16.7	B	LT	0.90	25.4	C	LT	0.89	21.3	C	LT	0.78	23.2	C
		INTERSECTION			23.3	C			25.5	C			29.0	C			32.0	C
Eighth Avenue @ 38th Street	9043	EB	LT	0.93	41.5	D	LT	0.71	24.2	C	LT	0.59	22.4	C	LT	0.67	24.5	C
		NB	TR	0.87	22.2	C	TR	1.00	39.4	D	TR	1.03	96.7	F	TR	0.94	51.9	D
		INTERSECTION			27.9	C			35.6	D			81.9	F			45.6	D
Eighth Avenue @ 42nd Street	9673	EB	LT	0.76	23.5	C	DefL	0.50	18.9	B	LT	0.73	22.5	C	DefL	0.49	18.1	B
							T	0.43	15.4	B					T	0.37	14.5	B
		WB	T	0.47	26.2	C	TR	0.58	27.8	C	T	0.52	27.0	C	TR	0.36	24.2	C
		NB	L	0.44	33.7	C	L	0.24	18.8	B	L	0.53	39.5	D	L	0.29	19.4	B
			LT	0.80	25.1	C	LT	0.76	24.1	C	LT	0.77	24.3	C	LT	0.65	21.7	C
			R	0.48	24.8	C	R	0.45	23.8	C	R	0.40	22.3	C	R	0.48	23.2	C
		INTERSECTION			25.0	C			22.8	C			24.5	C			20.6	C
Ninth Avenue @ 23rd Street	28199	EB	TR	0.96	61.4	E	TR	0.80	42.3	D	TR	0.77	39.7	D	TR	0.87	47.0	D
		WB	LT	0.92	43.4	D	LT	0.87	36.5	D	LT	0.71	26.5	C	LT	0.68	25.9	C
		SB	L	0.65	30.2	C	L	0.62	27.0	C	L	0.59	27.2	C	L	0.69	30.8	C
			TR	0.97	41.9	D	TR	0.99	44.8	D	TR	0.72	23.1	C	TR	1.07	117.9	F
		INTERSECTION			45.0	D			40.9	D			26.7	C			81.5	F
Ninth Avenue @ W 26th Street	28202	EB	TR	0.46	18.8	B	TR	0.38	17.6	B	TR	0.42	18.2	B	TR	0.67	25.5	C
		SB	L	0.47	18.2	B	L	0.51	19.0	B	L	0.37	16.3	B	L	0.49	19.4	B
			T	0.98	37.0	D	T	0.97	36.4	D	T	0.64	17.5	B	T	1.01	84.3	F
		INTERSECTION			31.5	C			31.3	C			17.6	B			69.6	E
Ninth Avenue @ 28th Street	21609	EB	TR	1.26	407.6	F	TR	1.11	337.0	F	TR	1.00	67.2	E	TR	0.95	54.9	D
		SB	L	0.57	17.9	B	L	0.75	26.0	C	L	0.80	31.2	C	L	0.53	18.0	B
			T	0.96	31.7	C	T	0.96	30.7	C	T	0.61	14.8	B	T	0.99	36.0	D
		INTERSECTION			110.2	F			89.2	F			27.0	C			37.8	D
Ninth Avenue @ 29th Street	9761	WB	LT	0.61	24.7	C	LT	0.76	29.2	C	LT	0.81	31.5	C	LT	0.75	28.4	C
		SB	TR	1.14	138.2	F	TR	1.14	136.7	F	TR	0.80	16.9	B	TR	1.02	90.4	F
		INTERSECTION			112.0	F			108.9	F			21.1	C			73.5	E
Ninth Avenue @ 30th Street	9760	EB	TR	1.30	513.6	F	TR	1.21	504.7	F	TR	1.09	420.4	F	TR	0.93	46.5	D
		SB	L	1.62	428.7	F	L	2.10	655.6	F	L	2.37	767.4	F	L	1.86	538.2	F
			T	0.68	13.7	B	T	0.92	23.8	C	T	0.88	20.3	C	T	0.82	17.6	B
		INTERSECTION			250.2	F			269.6	F			272.9	F			103.5	F

			AM				Midday				PM				SAT			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**
Ninth Avenue @ 31st Street	9759	WB	LTR	0.93	46.4	D	LTR	1.02	140.7	F	LTR	1.48	514.2	F	LTR	1.05	253.1	F
		SB	TR	0.80	13.4	B	TR	0.83	14.2	B	TR	0.81	13.4	B	TR	0.73	11.6	B
		INTERSECTION			22.5	C			48.8	D			195.1	F			85.0	F
Ninth Avenue @ 33rd Street	9078	WB	LT	1.11	394.5	F	LT	1.58	580.2	F	LT	1.81	656.8	F	LT	1.63	643.7	F
		SB	TR	0.93	20.0	B	TR	0.90	17.3	B	TR	0.72	11.4	B	TR	0.78	12.6	B
		INTERSECTION			79.6	E			139.8	F			175.1	F			144.4	F
Ninth Avenue @ 34th Street	9079	EB	T	0.97	66.7	E	T	0.88	50.7	D	T	0.67	33.6	C	TR	0.92	48.3	D
			R	2.02	769.0	F	R	1.49	553.6	F	R	2.03	748.6	F				
		WB	DefL	0.90	63.9	E	LT	0.86	31.7	C	LT	1.10	339.9	F	DefL	0.76	33.8	C
			T	0.56	18.9	B									T	0.30	13.7	B
		SB	LTR	1.28	223.7	F	LTR	1.19	183.3	F	LTR	1.38	269.6	F	LTR	0.96	37.7	D
		INTERSECTION			231.1	F			166.0	F			317.0	F			36.3	D
Ninth Avenue @ 35th Street	9080	WB	LT	1.63	611.4	F	LT	1.33	480.5	F	LT	1.65	627.1	F	LT	1.07	342.8	F
		SB	TR	0.79	19.9	B	TR	0.75	12.2	B	TR	0.75	18.1	B	TR	0.60	9.8	A
		INTERSECTION			160.6	F			109.8	F			163.9	F			79.2	E
Ninth Avenue @ 36th Street	9067	EB	TR	1.14	193.3	F	TR	0.93	100.9	F	TR	1.24	228.8	F	TR	1.09	175.7	F
		SB	LT	1.12	121.4	F	LT	1.06	98.1	F	LT	1.02	82.2	F	LT	0.84	21.7	C
		INTERSECTION			142.9	F			98.8	F			133.0	F			72.3	E
Ninth Avenue @ 37th Street	9068	WB	LT	0.90	46.4	D	LT	0.93	51.3	D	LT	1.18	467.2	F	LT	0.95	52.7	D
		SB	TR	0.70	22.0	C	TR	0.71	16.4	B	T	0.88	23.2	C	TR	0.68	15.6	B
											TR (LnT)	1.21	253.4	F				
		INTERSECTION			27.3	C			23.8	C			184.3	F			24.4	C
Ninth Avenue @ 38th Street	9044	EB	TR	1.21	483.6	F	TR	0.92	48.5	D	TR	0.65	29.9	C	TR	0.73	32.4	C
		SB	LT	0.63	10.1	B	LT	0.66	10.4	B	LT	0.86	16.4	B	LT	0.63	10.0	B
											T (LnT)	1.16	238.7	F				
		INTERSECTION			137.3	F			19.0	B			64.3	E			14.2	B
Ninth Avenue @ 42nd Street	9069	EB	TR	0.88	41.9	D	TR	0.63	161.1	F	TR	0.80	35.8	D	TR	0.60	27.8	C
		WB	DefL	1.14	649.0	F	DefL	1.17	763.6	F	DefL	1.42	833.2	F	DefL	1.06	334.4	F
			T	0.45	20.9	C	T	0.36	18.6	B	T	0.48	21.3	C	T	0.24	17.1	B
		SB	LTR	1.10	145.1	F	LTR	1.20	186.0	F	LTR	1.18	172.8	F	LTR	0.94	34.2	C
		INTERSECTION			138.0	F			195.6	F			183.3	F			51.7	D
Hudson Boulevard NB @ 33rd Street	99022	WB	TR	0.89	25.0	C	TR	0.98	41.2	D	TR	0.90	28.5	C	TR	0.78	22.9	C
		NB	LT	0.10	30.9	C	LT	0.32	42.6	D	LT	0.19	30.2	C	LT	0.13	23.7	C
		INTERSECTION			25.0	C			41.2	D			28.6	C			22.9	C
Hudson Boulevard SB @ 33rd Street	6033	WB	LT	0.83	20.0	B	LT	0.92	27.9	C	LT	0.90	28.8	C	LT	0.78	22.9	C
		INTERSECTION			20.0	B			27.9	C			28.8	C			22.9	C
Sixth Avenue @ 34th Street	21549	EB	T	0.72	21.4	C	T	0.75	23.9	C	T	0.54	15.7	B	T	0.62	52.9	D
		WB	TR	0.63	16.6	B	TR	0.58	15.3	B	TR	0.60	15.8	B	TR	0.48	13.7	B
		NB	T	1.45	334.6	F	T	1.19	212.2	F	T	1.29	256.8	F	T	1.30	256.4	F
		SB	T	1.64	505.2	F	T	1.54	461.4	F	T	1.81	579.6	F	T	1.36	384.1	F
		INTERSECTION			248.0	F			179.2	F			226.3	F			194.2	F
Broadway @ 35th Street	9738	WB	L	0.12	20.9	C	L	0.09	20.6	C	L	0.11	20.9	C	L	0.22	22.6	C
			T	1.68	363.6	F	T	1.34	213.8	F	T	1.57	314.3	F	T	1.20	156.7	F
		SB	T	0.35	8.6	A	T	0.33	10.4	B	T	0.39	8.9	A	T	0.27	8.0	A
			R	0.52	14.7	B	R	0.35	10.9	B	R	0.44	12.9	B	R	0.47	13.9	B
		INTERSECTION			184.0	F			106.1	F			152.3	F			79.0	E
Broadway @ 36th Street	9737	EB	TR	0.82	30.0	C	TR	0.86	33.0	C	TR	0.98	49.0	D	TR	0.78	27.4	C
		SB	L	0.32	35.4	D	L	0.59	43.4	D	L	0.58	42.8	D	L	0.38	36.9	D
			T	0.48	15.4	B	T	0.40	14.4	B	T	0.48	15.4	B	T	0.37	14.1	B
		INTERSECTION			24.2	C			27.7	C			36.8	D			23.4	C

			AM				Midday				PM				SAT			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**
Broadway @ 42nd Street	9731	EB	T	0.49	21.7	C	TR	0.31	16.6	B	T	0.53	22.5	C	TR	0.31	16.5	B
		WB	DefL	1.37	667.5	F	DefL	0.79	44.3	D	LT	0.75	29.6	C	DefL	0.76	40.9	D
			T	0.72	29.8	C	T	0.44	18.3	B					T	0.31	16.8	B
		SB	L	0.55	17.8	B	L	0.75	30.7	C	L	0.43	14.9	B	L	0.70	27.6	C
			T	0.67	16.0	B	T	0.65	18.9	B	T	0.60	14.7	B	T	0.64	18.6	B
		INTERSECTION			90.0	F			21.5	C			20.7	C			20.6	C
Cardinal Stepanic Place @ 41st Street	12232	EB	T	0.03	36.1	D	T	0.03	36.0	D	T	0.03	36.1	D	T	0.03	36.0	D
		WB	L	0.42	4.5	A	L	0.43	4.6	A	L	0.46	5.1	A	L	0.36	4.0	A
			LT	0.35	3.9	A	LT	0.34	3.8	A	LT	0.40	4.5	A	LT	0.36	4.0	A
		INTERSECTION			4.4	A			4.4	A			5.0	A			4.2	A
Dyer Ave @ 30th Street	9060	EB	L	0.13	10.3	B	L	0.22	10.9	B	L	0.39	23.1	C	L	0.23	11.0	B
			T	0.32	11.7	B	T	0.35	11.9	B	T	0.31	21.0	C	T	0.29	11.4	B
		WB	R	0.02	19.6	B	R	0.04	19.7	B	R	0.14	20.9	C	R	0.08	20.2	C
		SB	L	0.58	25.4	C	L	0.33	21.6	C	L	0.44	23.3	C	L	0.26	20.8	C
		INTERSECTION			16.8	B			14.0	B			22.2	C			13.3	B
Dyer Ave @ 31st Street	149997	WB	LTR	0.43	10.6	B	LTR	0.54	12.1	B	LTR	0.87	57.4	E	LTR	0.52	11.8	B
		NB	LT	0.28	25.4	C	LT	0.41	27.2	C	LT	0.83	45.2	D	LT	0.49	28.4	C
		SB	TR	0.69	32.8	C	TR	0.43	27.4	C	TR	0.91	50.1	D	TR	0.33	26.0	C
		INTERSECTION			22.0	C			19.3	B			52.5	D			19.1	B
Dyer Ave @ 34th Street	9081	EB	T	0.29	12.2	B	T	0.35	12.8	B	T	0.28	12.0	B	T	0.26	11.8	B
		WB	T	0.29	12.1	B	T	0.33	12.6	B	T	0.61	16.6	B	T	0.20	11.3	B
			R	0.15	8.8	A	R	0.22	9.5	A	R	2.77	1354.0	F	R	0.36	11.0	B
		SB	L	1.09	123.5	F	L	0.63	47.1	D	L	0.79	59.2	E	L	0.49	40.4	D
			LR	1.11	131.7	F	LR	0.59	46.2	D	LR	0.81	63.2	E	LR	0.52	41.3	D
			R	0.83	139.5	F	R	0.62	48.4	D	R	0.83	67.5	E	R	0.47	40.8	D
		INTERSECTION			62.4	E			21.6	C			200.6	F			19.6	B
Dyer Ave @ 35th Street	9064	WB	LTR	0.70	33.6	C	LTR	0.62	31.0	C	LTR	0.81	212.2	F	LTR	0.54	29.1	C
		NB	LT	0.07	8.0	A	LT	0.09	9.1	A	LT	0.33	26.7	C	LT	0.16	8.6	A
		SB	TR	0.86	41.2	D	TR	0.53	29.5	C	TR	0.71	33.6	C	TR	0.43	27.9	C
		INTERSECTION			36.1	D			27.3	C			95.6	F			23.9	C
Dyer Ave @ 36th Street	9066	EB	TR	0.78	96.7	F	TR	0.76	89.9	F	TR	0.81	101.9	F	TR	0.66	32.6	C
		NB	TR	0.20	26.1	C	TR	0.27	31.3	C	TR	1.68	561.2	F	TR	0.44	29.3	C
		SB	L	0.62	34.9	C	L	0.39	28.9	C	L	0.57	33.1	C	L	0.47	30.4	C
			LT	0.78	35.3	D	LT	0.47	28.3	C	LT	0.65	31.4	C	LT	0.51	28.9	C
			R	0.41	7.0	A	R	0.33	10.0	A	R	0.46	11.7	B	R	0.31	9.8	A
		INTERSECTION			45.9	D			45.1	D			150.1	F			27.5	C
Dyer Avenue @ 41st Street	9038	WB	TR	0.44	29.7	C	TR	0.61	32.8	C	L	0.28	20.7	C	TR	0.47	30.0	C
											TR	1.32	495.5	F				
		NB	L	0.44	24.7	C	L	0.41	24.3	C	LT	0.31	21.1	C	L	0.59	28.6	C
			LT	0.53	23.6	C	LT	0.59	24.5	C					LT	0.66	25.6	C
		INTERSECTION			25.8	C			27.4	C			294.2	F			27.4	C

			AM				Midday				PM				SAT			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**
Dyer Avenue @ 42nd Street	9070	EB	LT	0.37	21.1	C	LT	0.51	23.5	C	LT	0.38	21.2	C	LT	0.39	21.6	C
		WB	TR	0.22	19.3	B	TR	0.48	22.8	C	TR	0.29	20.3	C	TR	0.35	20.9	C
											T (LnT)	1.57	1378.0	F				
		NB	L	0.34	10.4	B	L	0.46	12.5	B	L	0.17	9.2	A	L	0.35	10.6	B
			R	0.24	9.8	A	R	0.47	23.9	C	R	0.17	12.3	B	R	0.34	10.7	B
		INTERSECTION			15.6	B			20.8	C			96.8	F			15.9	B

			AM				Midday				PM				Saturday MD			
Unsignalized Intersection	**Node**	**Approach**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**
Twelfth And 33rd	9873	WB	R	0.70	33.1	D	R	2.01	517.4	F	R	1.71	362.9	F	R	0.73	37.8	E
		INTERSECTION			-	-			-	-			-	-			-	-
Twelfth And 47th	9863	WB	R	0.54	25.4	D	R	0.64	34.1	D	R	2.02	527.4	F	R	1.02	119.2	F
		INTERSECTION			-	-			-	-			-	-			-	-
Lincoln Tunnel Expressway @ 33rd Street	149998	SB	R	0.23	16.9	C	R	0.19	18.0	C	R	0.26	23.0	C	R	0.10	14.6	B
		INTERSECTION			-	-			-	-			-	-			-	-

2019 Reduced Density Alternative with Proposed Mitigation

			AM				Midday				PM				Saturday MD			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**	**Movt.**	**V/C Ratio**	**Delay Sec/Veh**	**LOS**
Tenth Avenue @ 26th Street	28230	EB	LT	1.11	398.2	F	LT	1.15	396.1	F	LT	1.20	420.8	F	LT	0.92	55.5	E
		NB	TR	0.60	11.8	B	TR	0.88	18.6	B	TR	0.51	10.8	B	TR	0.61	11.3	B
		INTERSECTION			81.9	F			82.0	F			97.9	F			19.1	B
Tenth Avenue @ 28th Street	9918	EB	LT	1.40	518.6	F	LT	1.29	452.3	F	LT	0.87	202.9	F	LT	1.43	522.1	F
		NB	TR	0.69	11.8	B	TR	0.72	12.3	B	TR	0.71	17.4	B	TR	0.55	12.8	B
		INTERSECTION			125.6	F			103.7	F			55.4	E			145.6	F
Tenth Avenue @ 29th Street	9914	WB	TR	0.81	36.0	D	TR	0.91	43.2	D	TR	1.18	422.6	F	TR	0.87	40.8	D
		NB	LT	0.66	10.6	B	LT	0.77	14.8	B	LT	0.46	9.0	A	LT	0.57	12.5	B
		INTERSECTION			17.2	B			22.1	C			151.4	F			20.4	C
Tenth Avenue @ 30th Street	9061	EB	LT	1.07	202.8	F	LT	1.46	373.0	F	LT	1.49	373.3	F	LT	0.92	124.9	F
		NB	T	0.59	9.8	A	T	0.67	10.7	B	T	0.42	8.1	A	T	0.52	11.6	B
			R	0.69	18.1	B	R	0.79	45.8	D	R	0.88	55.9	E	R	0.83	41.3	D
		INTERSECTION			74.5	E			145.6	F			167.5	F			51.7	D
Tenth Avenue @ 31st Street	9933	WB	R	1.24	329.7	F	R	2.21	841.5	F	R	2.30	803.8	F	R	1.27	352.6	F
		NB	T	0.74	13.4	B	T	0.84	15.0	B	T	0.98	30.6	C	T	0.61	10.6	B
		INTERSECTION			81.4	F			197.3	F			278.9	F			87.0	F
Tenth Avenue @ 33rd Street	9077	WB	TR	0.69	31.7	C	TR	0.76	33.6	C	TR	0.72	31.5	C	TR	0.58	26.3	C
			R	0.62	36.3	D	R	0.68	42.6	D	R	0.65	39.9	D	R	0.50	30.2	C
		NB	LT	0.99	30.2	C	LT	1.07	148.0	F	LT	1.06	144.0	F	LT	0.85	16.1	B
		INTERSECTION			30.7	C			126.0	F			122.6	F			18.3	B
Tenth Avenue @ 34th Street	9076	EB	DefL	0.72	44.1	D	DefL	0.84	62.7	E	DefL	1.14	745.6	F	DefL	0.76	47.4	D
			T	0.44	23.6	C	T	0.48	26.0	C	T	0.47	26.1	C	T	0.27	21.3	C
		WB	T	0.54	24.1	C	T	0.48	24.2	C	T	0.66	28.9	C	TR	0.55	26.0	C
			R	0.62	32.9	C	R	1.18	414.2	F	R	2.24	839.0	F				
		NB	LT	0.91	20.8	C	LT	0.99	75.4	E	LT	1.27	181.8	F	LT	0.79	14.3	B
			R	0.42	13.3	B	R	0.59	17.0	B	R	0.41	11.0	B	R	0.28	9.7	A
		INTERSECTION			22.5	C			84.3	F			247.7	F			17.9	B
Tenth Avenue @ 35th Street	9075	WB	TR	1.51	413.5	F	TR	1.30	335.5	F	TR	1.03	212.0	F	TR	1.04	231.3	F
		NB	LT	0.96	25.4	C	LT	0.85	21.7	C	LT	0.97	24.1	C	LT	0.67	11.8	B
		INTERSECTION			100.2	F			66.8	E			45.5	D			43.6	D
Tenth Avenue @ 36th Street	9074	EB	LT	0.63	29.4	C	LT	0.41	121.1	F	LT	0.42	24.8	C	LT	0.22	22.1	C
		NB	T	0.82	13.7	B	T	0.89	27.6	C	T	1.48	283.6	F	T	0.71	11.2	B
			R	0.37	9.1	A	R	0.84	27.6	C	R	0.88	28.4	C	R	0.67	15.7	B
		INTERSECTION			15.7	B			36.0	D			227.0	F			12.5	B
Tenth Avenue @ 37th Street	9073	WB	TR	0.61	27.7	C	TR	0.60	27.8	C	TR	0.76	35.3	D	TR	0.81	35.5	D
		NB	LT	0.93	21.2	C	LT	0.97	25.3	C	LT	1.63	354.5	F	LT	0.76	13.5	B
		INTERSECTION			22.1	C			25.6	C			312.9	F			18.3	B
Tenth Avenue @ 38th Street	9046	EB	LT	0.85	40.1	D	LT	0.64	33.5	C	LT	0.50	27.8	C	LT	0.48	25.9	C
		NB	TR	0.96	22.3	C	TR	0.91	24.8	C	TR	1.68	376.5	F	TR	0.85	14.4	B
		INTERSECTION			25.6	C			25.9	C			343.3	F			15.9	B
Tenth Avenue @ 39th Street	9032	WB	T	0.44	22.8	C	T	0.44	22.7	C	T	2.13	1552.0	F	T	0.00	16.8	B
			R	0.45	23.9	C	R	0.54	26.5	C	R	1.82	1059.0	F	R	0.00	16.8	B
		NB	LT	0.63	13.3	B	LT	0.64	13.4	B	LT	1.69	418.6	F	LT	0.57	15.8	B
		INTERSECTION			14.8	B			15.1	B			547.2	F			15.8	B
Tenth Avenue @ 40th Street	9047	EB	L	0.36	21.7	C	L	0.25	19.8	B	L	0.40	24.1	C	L	0.17	18.1	B
			T	0.28	18.9	B	T	0.19	17.9	B	T	0.40	85.1	F	T	0.12	17.3	B
		NB	TR	0.66	14.4	B	TR	0.69	15.0	B	TR	1.56	350.8	F	TR	0.53	15.9	B
		INTERSECTION			15.2	B			15.3	B			315.6	F			16.1	B

			AM				Midday				PM				Saturday MD			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**
Tenth Avenue @ 41st Street	9037	WB	T	0.25	13.1	B	T	0.32	13.8	B	T	1.25	510.0	F	T	0.34	13.9	B
			R	0.54	17.5	B	R	0.59	19.3	B	R	0.28	13.8	B	R	0.57	18.1	B
		NB	L	0.88	45.9	D	L	0.64	28.7	C	L	1.55	469.6	F	L	0.25	18.2	B
			T	0.82	25.3	C	T	0.88	42.0	D	T	1.06	114.6	F	T	0.71	28.7	C
		INTERSECTION			24.2	C			33.2	C			189.5	F			23.2	C
Tenth Avenue @ 42nd Street	9609	EB	LT	1.93	679.6	F	LT	2.05	814.4	F	LT	1.77	582.1	F	LT	1.86	693.8	F
		WB	TR	1.02	279.0	F	TR	1.36	376.9	F	TR	0.71	33.0	C	TR	1.43	430.0	F
											T (LnT)	1.09	639.8	F				
		NB	LTR	0.73	22.1	C	LTR	0.92	22.8	C	LTR	0.84	17.8	B	LTR	0.81	25.3	C
		INTERSECTION			145.8	F			164.0	F			94.1	F			174.7	F
Tenth Avenue @ 43st Street	9608	EB	L	0.02	17.1	B	L	0.03	17.3	B	L	0.03	17.2	B	L	0.05	17.5	B
		WB	TR	0.40	21.3	C	TR	0.57	117.4	F	TR	0.49	22.6	C	TR	0.33	20.3	C
		NB	LT	0.94	39.2	D	LT	0.96	53.6	D	LT	0.96	25.7	C	LT	1.01	84.7	F
		INTERSECTION			37.4	D			62.7	E			25.4	C			78.2	E
Tenth Avenue @ 56th Street	13616	EB	LT	0.75	31.0	C	LT	0.44	24.6	C	LT	0.51	25.6	C	LT	1.09	411.2	F
		NB	TR	0.73	11.5	B	TR	0.83	14.3	B	TR	0.64	9.9	A	TR	0.74	11.9	B
		INTERSECTION			17.0	B			16.2	B			12.7	B			75.9	E
Tenth Avenue @ 57st Street	9594	EB	LT	1.08	371.0	F	LT	1.00	61.8	E	LT	0.97	54.1	D	LT	0.92	48.9	D
		WB	TR	0.74	26.5	C	TR	1.04	210.0	F	TR	0.88	37.1	D	TR	0.91	39.9	D
		NB	LTR	0.70	16.7	B	LTR	0.70	14.6	B	LTR	0.70	14.3	B	LTR	0.63	13.6	B
		INTERSECTION			95.6	F			74.6	E			24.9	C			25.9	C
Eleventh Ave/ Twelfth Ave @ 22nd Street	2222	WB	R	0.02	10.7	B	R	0.08	13.0	B	R	0.06	12.7	B	R	0.09	13.1	B
		NB	T	0.07	39.3	D	T	0.08	26.3	C	T	0.06	26.0	C	T	0.16	27.4	C
		WB	L	0.56	54.0	D	L	0.53	38.9	D	L	0.79	62.3	E	L	0.32	35.4	D
			LR	0.48	55.5	E	LR	0.38	38.2	D	LR	0.69	65.7	E	LR	0.18	34.2	C
		NB	T	1.09	119.7	F	T	1.06	118.4	F	T	1.17	153.1	F	T	1.14	144.8	F
		SB	T	0.87	10.0	A	T	0.87	22.7	C	T	0.80	18.6	B	T	0.76	18.5	B
		INTERSECTION			62.7	E			62.9	E			84.1	F			80.7	F
Eleventh Avenue @ 24th Street	28213	EB	R	0.28	28.2	C	R	0.20	27.2	C	R	0.28	28.2	C	R	0.24	26.8	C
		NB	L	0.29	27.9	C	L	0.30	28.1	C	L	0.37	29.0	C	L	0.39	28.4	C
		SB	L	0.25	4.6	A	L	0.28	4.8	A	L	0.26	4.6	A	L	0.19	4.2	A
			TR	1.24	211.0	F	TR	1.39	278.4	F	TR	1.32	246.4	F	TR	0.79	36.6	D
		INTERSECTION			137.1	F			185.6	F			158.1	F			28.5	C
Eleventh Avenue @ 26th Street	9924	EB	TR	1.09	413.4	F	TR	0.92	67.6	E	TR	1.12	405.6	F	TR	0.62	40.3	D
		SB	LT	0.56	5.0	A	LT	0.57	5.0	A	LT	0.53	4.7	A	LT	0.40	4.0	A
		INTERSECTION			81.2	F			15.7	B			81.5	F			9.2	A
Eleventh Avenue @ 27th Street	63721	WB	LT	0.44	26.4	C	LT	0.51	27.9	C	LT	0.59	30.5	C	LT	0.32	23.7	C
		SB	TR	0.49	9.5	A	TR	0.48	9.4	A	TR	0.44	8.9	A	TR	0.32	8.1	A
		INTERSECTION			11.3	B			11.8	B			12.1	B			10.0	A
Eleventh Avenue @ 28th Street	9916	EB	TR	0.47	24.3	C	TR	0.36	21.8	C	TR	0.24	19.7	B	TR	0.34	21.3	C
		SB	LT	0.68	14.5	B	LT	0.68	14.6	B	LT	0.62	13.5	B	LT	0.52	12.4	B
		INTERSECTION			15.6	B			15.2	B			13.9	B			13.3	B
Eleventh Avenue @ 29th Street	9912	WB	LT	0.89	42.4	D	LT	0.90	41.8	D	LT	0.86	125.0	F	LT	0.75	29.2	C
		SB	TR	0.58	16.7	B	TR	0.63	19.8	B	TR	0.73	28.4	C	TR	0.45	15.1	B
		INTERSECTION			22.9	C			25.0	C			55.5	E			18.6	B
Eleventh Avenue @ 30th Street	9909	EB	TR	0.57	36.9	D	TR	0.62	38.6	D	TR	0.51	32.6	C	TR	0.49	22.7	C
		SB	LT	1.04	113.4	F	LT	1.11	139.4	F	LT	1.02	101.4	F	LT	0.77	20.5	C
		INTERSECTION			95.7	F			115.3	F			87.0	F			21.0	C

			AM				Midday				PM				Saturday MD			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**
Eleventh Avenue @ 31st Street	61131	EB	R	0.17	22.7	C	R	0.26	24.8	C	R	0.21	23.3	C	R	0.17	22.7	C
		WB	L	0.12	21.3	C	L	0.48	27.7	C	L	0.28	23.4	C	L	0.21	22.3	C
		SB	TR	0.76	12.4	B	TR	0.71	11.3	B	TR	0.68	10.7	B	TR	0.52	9.0	A
		INTERSECTION			12.9	B			13.0	B			11.8	B			10.2	B
Eleventh Avenue @ 32nd Street	61132	EB	TR	0.24	28.5	C	TR	0.30	30.6	C	TR	0.00	23.5	C	TR	0.27	29.6	C
		SB	LTR	0.72	8.2	A	LTR	0.73	8.4	A	LTR	0.68	7.5	A	LTR	0.52	6.1	A
		INTERSECTION			8.6	A			8.8	A			7.5	A			6.7	A
Eleventh Avenue @ 33rd Street	9907	WB	L	0.59	30.2	C	L	0.64	42.0	D	L	0.60	30.4	C	L	0.57	36.2	D
			LT	0.64	26.7	C	LT	0.69	27.4	C	LT	0.65	26.8	C	LT	0.71	35.4	D
		SB	TR	0.74	15.0	B	TR	0.67	14.4	B	TR	0.66	13.4	B	TR	0.40	5.3	A
		INTERSECTION			18.7	B			19.6	B			17.7	B			15.0	B
Eleventh Avenue @ 34th Street	9904	EB	L	0.46	21.7	C	L	0.51	23.8	C	L	0.51	22.4	C	L	0.64	31.0	C
			TR	0.59	31.5	C	TR	0.51	29.8	C	TR	0.52	28.3	C	TR	0.66	32.8	C
		WB	L	0.68	34.7	C	L	0.48	21.6	C	L	0.66	31.1	C	L	0.30	18.3	B
			TR	0.65	33.0	C	TR	0.67	32.9	C	TR	0.91	49.5	D	TR	0.44	27.9	C
		SB	LT	0.92	28.9	C	LT	0.91	31.6	C	LT	0.92	34.0	C	LT	0.64	21.2	C
			R	0.38	17.6	B	R	0.47	22.7	C	R	0.47	23.3	C	R	0.50	22.6	C
		INTERSECTION			29.4	C			30.3	C			34.9	C			25.0	C
Eleventh Avenue @ 35th Street	9901	WB	L	0.30	17.9	B	L	0.34	18.5	B	L	0.43	20.7	C	L	0.22	16.7	B
			LR	0.32	18.0	B	LR	0.32	18.1	B	LR	0.45	21.2	C	LR	0.24	17.1	B
			R	0.32	18.4	B	R	0.27	17.8	B	R	0.14	15.6	B	R	0.10	15.1	B
		NB	T	0.09	14.6	B	T	0.10	14.7	B	T	0.17	12.9	B	T	0.11	14.8	B
		SB	T	0.64	17.7	B	T	0.60	20.1	C	T	0.59	19.8	B	T	0.49	18.4	B
		INTERSECTION			17.6	B				A			18.9	B			17.7	B
Eleventh Avenue @ 36th Street	9898	NB	TR	0.15	6.4	A	TR	0.14	6.4	A	TR	0.16	3.0	A	TR	0.10	6.2	A
		SB	DefL	0.66	11.2	B	LT	0.59	10.0	A	LT	0.60	10.3	B	LT	0.44	8.4	A
			T	0.59	5.2	A												
		INTERSECTION			6.3	A			9.5	A			9.0	A			8.1	A
Eleventh Avenue @ 37th Street	9034	EB	LR	0.09	25.5	C	LR	0.15	26.3	C	LR	0.10	25.6	C	LR	0.00	25.7	C
		WB	L	0.76	51.2	D	L	0.76	51.6	D	L	0.76	49.6	D	L	0.68	45.5	D
			R	0.52	37.5	D	R	0.40	33.1	C	R	0.27	29.2	C	R	0.55	39.8	D
		NB	T	0.08	6.8	A	T	0.07	6.8	A	T	0.12	3.7	A	T	0.08	6.0	A
		SB	T	0.65	6.9	A	T	0.58	11.0	B	T	0.58	11.0	B	T	0.44	8.5	A
		INTERSECTION			12.2	B			15.4	B			14.2	B			13.7	B
Eleventh Avenue @ 38th Street	150008	NB	TR	0.16	7.4	A	TR	0.16	8.2	A	TR	1.15	418.0	F	TR	0.14	8.0	A
		SB	LT	1.08	108.0	F	LT	0.91	23.7	C	LT	0.90	22.4	C	LT	0.73	15.2	B
		INTERSECTION			95.8	F			21.7	C			87.7	F			14.0	B
Eleventh Avenue @ 39th Street	9894	EB	L	0.00	19.3	B	L	0.00	19.3	B	L	0.00	19.3	B	L	0.00	19.3	B
			LR	0.00	19.3	B	LR	0.00	19.3	B	LR	0.00	19.3	B	LR	0.00	19.3	B
		WB	L	0.43	26.5	C	L	0.42	25.7	C	L	0.44	26.3	C	L	0.20	21.8	C
			LR	0.43	26.5	C	LR	0.39	25.6	C	LR	0.65	33.4	C	LR	0.25	22.8	C
		NB	T	0.08	9.8	A	T	0.08	9.9	A	T	1.08	445.6	F	T	0.10	10.0	A
		SB	T	0.86	16.7	B	T	0.70	16.9	B	T	0.71	17.2	B	T	0.60	14.9	B
		INTERSECTION			17.6	B			17.7	B			72.3	E			15.0	B
Eleventh Avenue @ 40th Street	9035	EB	TR	0.64	40.4	D	TR	0.61	38.9	D	TR	1.00	90.0	F	TR	0.50	34.3	C
		NB	R	0.14	8.1	A	R	0.15	6.5	A	R	1.09	261.2	F	R	0.14	6.4	A
		SB	L	0.26	3.4	A	L	0.36	3.8	A	L	1.00	130.5	F	L	0.33	3.6	A
			TR	0.69	6.2	A	TR	0.58	7.0	A	TR	0.56	4.9	A	TR	0.47	4.3	A
		INTERSECTION			8.0	A			8.1	A			91.2	F			6.3	A

			AM				Midday				PM				Saturday MD			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**
Eleventh Avenue @ 41st Street	9036	WB	LT	0.68	32.2	C	LT	0.71	33.4	C	LT	0.48	26.1	C	LT	0.72	33.2	C
		SB	LTR	0.53	9.5	A	LTR	0.52	11.7	B	LTR	0.49	9.4	A	LTR	0.44	8.8	A
											T (LnT)	1.16	172.9	F				
		INTERSECTION			12.5	B			14.7	B			72.9	E			12.9	B
Eleventh Avenue @ 42nd Street	9573	EB	TR	0.92	45.7	D	TR	0.75	33.6	C	TR	0.79	33.9	C	TR	0.92	46.9	D
		WB	L	0.36	17.8	B	L	0.52	21.4	C	L	0.41	232.7	F	L	0.46	19.5	B
			LT	0.35	14.8	B	LT	0.43	16.0	B	LT	0.53	111.1	F	LT	0.39	14.9	B
		SB	LT	1.02	113.4	F	LT	1.01	107.4	F	T	0.82	27.5	C	LT	0.81	25.8	C
			R	0.34	23.0	C	R	0.67	38.1	D	R	0.92	78.7	E	R	0.49	29.4	C
											LT (LnT)	1.31	271.1	F				
		INTERSECTION			84.5	F			76.2	E			110.9	F			28.2	C
Eleventh Avenue @ 43rd Street	9572	WB	LT	0.63	36.2	D	LT	0.85	48.2	D	LT	0.83	45.6	D	LT	0.53	32.9	C
		SB	TR	0.39	3.7	A	TR	0.49	6.4	A	TR	0.59	5.3	A	TR	0.41	3.8	A
											T (LnT)	1.25	254.1	F				
		INTERSECTION			8.2	A			14.1	B			83.4	F			8.3	A
Eleventh Avenue @ 44th Street	9571	EB	LTR	1.04	432.9	F	LTR	0.68	36.7	D	LTR	1.09	470.7	F	LTR	0.71	37.7	D
		SB	L	0.18	3.3	A	L	0.11	6.3	A	L	0.13	5.4	A	L	0.16	6.7	A
			T	0.68	9.2	A	T	0.71	14.8	B	T	1.24	158.3	F	T	0.59	10.1	B
											T (LnT)	1.08	175.0	F				
		INTERSECTION			96.1	F			18.4	B			214.6	F			15.4	B
Eleventh Avenue @ 46th Street	9569	EB	LTR	0.56	33.7	C	LTR	0.56	33.5	C	LTR	0.51	32.6	C	LTR	0.49	32.1	C
		NB	TR	0.25	7.2	A	TR	0.06	6.0	A	TR	0.07	2.8	A	TR	0.12	6.3	A
		SB	L	0.23	4.1	A	L	0.18	7.1	A	L	0.18	7.1	A	L	0.25	7.8	A
			T	0.92	25.4	C	T	0.96	42.6	D	T	0.99	34.3	C	T	0.85	17.9	B
		INTERSECTION			23.2	C			38.0	D			31.1	C			18.0	B
Eleventh Avenue @ 47th Street	63724	WB	LTR	0.95	62.4	E	LTR	0.95	60.2	E	LTR	0.90	50.7	D	LTR	0.90	53.5	D
		NB	L	0.17	10.0	A	L	0.23	13.8	B	L	0.26	11.4	B	L	0.22	11.3	B
			T	0.18	7.0	A	T	0.08	6.5	A	T	0.12	3.3	A	T	0.13	6.3	A
		SB	T	0.89	21.9	C	T	0.90	27.0	C	T	0.99	57.8	E	T	0.80	15.4	B
			R	0.07	3.3	A	R	0.06	6.4	A	R	0.07	6.5	A	R	0.06	6.1	A
		INTERSECTION			26.9	C			32.6	C			50.8	D			22.5	C
Eleventh Avenue @ 54th Street	9561	EB	LTR	1.23	376.7	F	LTR	0.75	44.3	D	LTR	0.73	43.5	D	LTR	0.46	32.9	C
		NB	L	0.85	59.9	E	L	0.47	18.6	B	L	1.54	576.2	F	L	0.85	55.2	E
			TR	0.54	9.9	A	TR	0.41	8.5	A	TR	0.40	4.1	A	TR	0.34	7.8	A
		SB	L	0.56	13.2	B	L	0.35	10.4	B	L	0.36	10.2	B	L	0.22	8.0	A
			TR	0.88	12.7	B	TR	0.75	13.8	B	TR	0.85	17.6	B	TR	0.74	13.5	B
		INTERSECTION			63.9	E			15.6	B			48.6	D			15.5	B
Eleventh Avenue @ 56th Street	13476	EB	LTR	1.08	290.9	F	LTR	0.66	28.8	C	LTR	0.83	35.8	D	LTR	0.48	24.9	C
		NB	TR	0.51	14.1	B	TR	0.42	12.9	B	TR	0.46	9.6	A	TR	0.47	13.5	B
		SB	L	0.28	10.4	B	L	0.23	12.5	B	L	0.21	12.3	B	L	0.17	11.6	B
			T	0.65	11.4	B	T	0.59	14.9	B	T	0.65	15.8	B	T	0.59	14.9	B
		INTERSECTION			93.8	F			17.3	B			19.1	B			16.1	B

			AM				Midday				PM				Saturday MD			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**
Eleventh Avenue @ 57th Street	9558	EB	L	1.14	631.9	F	L	0.68	33.7	C	L	0.57	38.5	D	L	0.64	34.1	C
			T	1.12	351.2	F	T	0.73	39.0	D	T	0.63	142.3	F	T	0.47	28.8	C
			R	0.09	23.3	C	R	0.13	24.6	C	R	0.59	37.2	D	R	0.34	27.6	C
		WB	L	1.04	206.7	F	L	1.17	575.1	F	L	0.62	33.7	C	L	1.02	429.8	F
			TR	0.84	40.1	D	TR	0.81	38.4	D	TR	0.90	47.1	D	TR	1.69	662.0	F
		NB	L	0.47	36.5	D	L	0.64	43.1	D	L	0.96	273.8	F	L	0.95	93.2	F
			TR	0.48	18.6	B	TR	0.39	16.8	B	TR	0.43	13.7	B	TR	0.39	17.4	B
		SB	L	1.32	378.0	F	L	0.94	71.6	E	L	1.42	379.4	F	L	0.82	50.0	D
			TR	0.85	24.3	C	TR	0.68	21.4	C	TR	0.73	22.1	C	TR	0.66	21.6	C
		INTERSECTION			129.1	F			76.3	E			66.1	E			179.6	F
Twelfth Avenue @ 24th Street	9879	WB	L	0.51	68.0	E	L	0.53	50.2	D	L	0.68	71.8	E	L	0.53	47.8	D
			LTR	0.52	68.5	E	LTR	0.54	50.8	D	LTR	0.67	71.6	E	LTR	0.51	47.3	D
			R	0.53	70.0	E	R	0.55	52.3	D	R	0.69	72.9	E	R	0.50	47.9	D
		NB	TR	1.02	93.0	F	TR	1.01	96.8	F	TR	1.14	137.7	F	TR	1.12	132.6	F
		SB	L	0.97	134.1	F	L	0.67	74.9	E	L	0.65	87.7	F	L	1.10	523.8	F
			T	0.90	17.5	B	T	0.99	109.4	F	T	0.87	28.9	C	T	0.84	28.3	C
		INTERSECTION			58.6	E			98.8	F			86.7	F			98.0	F
Twelfth Avenue @ 29th Street	9875	WB	LR	1.67	813.4	F	LR	1.42	637.8	F	LR	2.00	951.5	F	LR	1.33	569.2	F
		NB	T	0.64	10.8	B	T	0.64	12.5	B	T	0.80	4.4	A	T	0.74	14.5	B
		SB	T	0.76	4.2	A	T	0.75	15.1	B	T	0.71	12.0	B	T	0.81	16.9	B
		INTERSECTION			69.2	E			63.8	E			84.9	F			54.4	D
Twelfth Avenue @ 30th Street	9874	EB	LTR	0.00	64.4	E	LTR	0.00	49.5	D	LTR	0.00	64.4	E	LTR	0.00	49.5	D
		NB	TR	0.79	16.9	B	TR	0.87	20.6	C	TR	1.01	23.8	C	TR	0.86	20.4	C
		SB	L	1.18	332.3	F	L	1.36	374.4	F	L	1.36	401.0	F	L	1.17	308.5	F
			TR	0.88	8.6	A	TR	0.87	20.9	C	TR	0.86	20.7	C	TR	0.90	23.3	C
		INTERSECTION			25.8	C			39.7	D			37.6	D			33.6	C
Twelfth Avenue @ 33rd Street		WB	R	0.33	32.1	C	R	0.38	25.4	C	R	0.72	51.4	D	R	0.29	24.0	C
		NB	T	0.88	35.3	D	T	0.93	35.3	D	T	0.93	20.2	C	T	0.96	38.3	D
		INTERSECTION			35.0	C			34.1	C			24.6	C			37.0	D
Twelfth Avenue @ 34th Street	9872	WB	L	0.47	60.3	E	L	0.40	41.8	D	L	0.46	59.1	E	L	0.33	40.1	D
			LR	0.47	60.2	E	LR	0.42	42.0	D	LR	0.52	61.3	E	LR	0.31	39.6	D
			R	0.65	44.6	D	R	0.61	33.5	C	R	0.62	49.2	D	R	0.52	30.3	C
		NB	T	0.90	36.5	D	T	0.85	29.4	C	T	1.02	36.9	D	T	0.89	31.7	C
			R	0.30	20.6	C	R	0.36	20.0	B	R	0.29	9.3	A	R	0.52	23.2	C
		SB	L	0.59	62.4	E	L	0.66	58.4	E	L	0.99	581.8	F	L	0.79	64.9	E
			T	0.86	6.2	A	T	0.77	15.5	B	T	0.76	13.6	B	T	0.82	17.2	B
		INTERSECTION			24.7	C			25.4	C			53.2	D			27.1	C
Twelfth Avenue @ 37th Street	9871	EB	LR	0.15	54.7	D	LR	0.14	44.1	D	LR	0.25	60.6	E	LR	0.18	44.5	D
			R	0.13	54.9	D	R	0.15	44.7	D	R	0.26	62.3	E	R	0.10	43.6	D
		NB	L	0.10	63.7	E	L	0.20	50.4	D	L	0.30	72.6	E	L	0.26	51.6	D
			T	0.97	40.8	D	T	0.83	21.7	C	T	0.92	7.9	A	T	0.87	23.4	C
		SB	TR	1.13	135.3	F	TR	1.08	115.9	F	TR	0.95	30.6	C	TR	1.16	148.8	F
		INTERSECTION			88.0	F			68.7	E			18.6	B			85.7	F
Twelfth Avenue @ 41st Street	9868	EB	LR	0.00	39.6	D	LR	0.02	24.9	C	LR	0.06	47.3	D	LR	0.02	25.5	C
		WB	L	0.09	50.8	D	L	0.09	37.8	D	L	0.08	60.0	E	L	0.07	37.6	D
			R	0.41	56.8	E	R	0.46	44.3	D	R	0.47	67.8	E	R	0.45	43.5	D
		NB	T	1.14	151.3	F	T	1.09	135.2	F	T	1.02	77.5	E	T	1.05	117.2	F
		SB	T	1.15	120.5	F	T	1.03	78.1	E	T	1.00	36.0	D	T	1.13	112.7	F
		INTERSECTION			132.9	F			103.9	F			58.5	E			111.3	F

			AM				Midday				PM				Saturday MD			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**
Twelfth Avenue @ 42nd Street	9867	EB	LTR	0.04	46.2	D	LTR	0.08	32.4	C	LTR	0.08	46.7	D	LTR	0.10	33.4	C
		WB	L	0.32	52.2	D	L	0.61	45.8	D	L	0.66	65.6	E	L	0.53	43.5	D
			R	0.55	33.2	C	R	0.63	23.6	C	R	0.86	67.4	E	R	0.65	26.0	C
		NB	T	1.00	57.0	E	T	1.11	136.8	F	T	1.00	35.9	D	T	1.18	162.1	F
			R	0.42	29.5	C	R	0.50	32.3	C	R	0.32	11.8	B	R	0.22	26.1	C
		SB	L	0.67	59.3	E	L	0.43	43.3	D	L	1.20	358.7	F	L	0.69	48.6	D
			T	0.82	5.8	A	T	0.85	20.4	C	T	0.84	18.6	B	T	0.89	22.0	C
		INTERSECTION			33.4	C			70.2	E			46.8	D			82.6	F
Twelfth Avenue @ 43th Street	9866	WB	LTR	0.78	72.8	E	LTR	0.77	54.2	D	LTR	0.94	105.0	F	LTR	0.69	49.5	D
		NB	L	1.00	172.9	F	L	0.33	59.2	E	L	0.16	68.0	E	L	0.10	52.3	D
			T	0.73	12.8	B	T	0.82	16.7	B	T	0.92	7.9	A	T	0.84	17.6	B
		SB	T	0.79	10.2	B	T	0.72	21.9	C	T	0.81	24.2	C	T	0.93	31.2	C
			R	0.02	4.3	A	R	0.05	13.1	B	R	0.02	11.4	B	R	0.07	13.2	B
		INTERSECTION			15.9	B			21.4	C			19.9	B			25.5	C
Twelfth Avenue @ 44th Street	9892	NB	TR	0.84	21.1	C	TR	0.90	20.8	C	TR	1.01	20.8	C	TR	0.98	30.1	C
		SB	L	1.08	280.6	F	L	0.96	81.9	F	L	0.96	185.2	F	L	0.95	80.0	E
			T	0.84	9.0	A	T	0.65	20.7	C	T	0.78	14.8	B	T	0.89	19.7	B
		INTERSECTION			31.2	C			24.3	C			24.9	C			27.6	C
Twelfth Avenue@ 46th Street	9864	EB	LTR	0.29	57.7	E	LTR	0.13	36.8	D	LTR	0.18	53.8	D	LTR	0.19	37.4	D
		NB	TR	0.96	100.2	F	TR	1.13	174.6	F	TR	1.13	163.4	F	TR	1.11	162.1	F
		SB	L	0.59	73.7	E	L	0.60	71.2	E	L	0.63	84.3	F	L	0.84	97.2	F
			T	0.87	5.7	A	T	0.72	16.7	B	T	0.79	12.8	B	T	0.91	20.3	C
		INTERSECTION			49.0	D			101.1	F			93.4	F			89.5	F
Twelfth Avenue@ 47th Street		WB	R	0.65	48.9	D	R	0.72	41.4	D	R	0.91	76.0	E	R	0.64	41.8	D
		NB	T	0.80	26.5	C	T	0.86	27.1	C	T	0.84	8.4	A	T	0.81	21.4	C
		INTERSECTION			28.7	C			28.9	C			17.9	B			23.2	C
Twelfth Avenue @ 54th Street	9856	EB	R	0.00	5.6	A	R	0.00	6.3	A	R	0.00	5.3	A	R	0.00	6.7	A
		WB	R	0.53	61.5	E	R	0.35	41.7	D	R	0.81	82.0	F	R	0.52	45.7	D
		NB	TR	1.03	108.3	F	TR	1.04	114.8	F	TR	1.26	199.9	F	TR	0.92	22.1	C
		SB	L	0.72	69.8	E	L	0.49	44.5	D	L	0.47	58.5	E	L	0.28	38.8	D
			T	1.20	138.6	F	T	0.74	13.9	B	T	0.76	13.2	B	T	0.89	19.6	B
		INTERSECTION			123.2	F			70.8	E			121.3	F			21.6	C
Twelfth Avenue @ 56th Street (SR)	99001	EB	L	0.74	33.8	C	L	0.90	78.9	E	L	0.74	65.6	E	L	0.48	48.5	D
			T	1.07	111.4	F	T	1.28	241.4	F	T	1.27	234.8	F	T	0.96	88.0	F
		NB	TR	0.95	58.6	E	TR	0.34	7.6	A	TR	0.43	11.7	B	TR	0.32	7.5	A
		INTERSECTION			72.3	E			101.2	F			98.6	F			37.3	D
Twelfth Avenue @ 56th Street	9883	NB	T	1.16	166.2	F	T	0.86	17.4	B	T	1.26	173.0	F	T	0.80	14.1	B
		SB	L	1.00	56.9	E	L	1.11	414.4	F	L	1.12	391.4	F	L	0.86	62.0	E
			T	0.96	6.6	A	T	0.50	0.5	A	T	0.60	0.8	A	T	0.56	0.7	A
		INTERSECTION			63.3	E			49.7	D			127.6	F			11.4	B
Twelfth Avenue @ 57th Street	9854	WB	R	0.34	31.8	C	R	0.56	39.5	D	R	0.64	239.4	F	R	0.59	40.0	D
		NB	T	0.94	40.4	D	T	0.75	16.0	B	T	0.96	14.0	B	T	0.70	14.9	B
		INTERSECTION			39.1	D			19.3	B			39.5	D			18.8	B
Sixth Avenue @ 28th Street	21627	EB	LT	1.21	332.1	F	LT	1.19	323.2	F	LT	1.32	375.2	F	LT	1.06	270.6	F
		NB	TR	0.90	42.6	D	TR	0.88	23.0	C	TR	0.87	22.0	C	TR	0.91	24.7	C
		INTERSECTION			117.7	F			100.0	F			118.8	F			80.4	F
Sixth Avenue @ 30th Street	21589	EB	L	0.58	23.8	C	L	0.54	19.3	B	L	0.46	17.4	B	L	0.32	15.2	B
			T	1.03	238.4	F	T	0.81	97.4	F	T	0.87	121.8	F	T	0.36	34.3	D
		NB	TR	0.89	40.3	D	TR	0.92	55.0	D	TR	0.93	31.8	C	TR	1.01	85.3	F
		INTERSECTION			83.8	F			59.9	E			51.4	D			73.9	E

			AM				Midday				PM				Saturday MD			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**
Sixth Avenue @ 31st Street	21579	WB	TR	0.64	22.7	C	TR	0.67	23.5	C	TR	0.58	21.4	C	TR	0.71	29.5	C
		NB	LT	0.98	35.2	D	LT	0.92	47.0	D	LT	0.89	24.1	C	LT	0.89	23.8	C
		INTERSECTION			32.1	C			40.9	D			23.5	C			25.4	C
Sixth Avenue @ 35th Street	9786	WB	TR	0.90	40.7	D	TR	0.71	27.5	C	TR	0.77	29.8	C	TR	0.66	25.9	C
		NB	LT	0.69	13.2	B	LT	0.58	13.0	B	LT	0.64	13.8	B	LT	0.63	13.7	B
		INTERSECTION			21.7	C			17.2	B			18.6	B			16.9	B
Sixth Avenue @ 36th Street	9785	EB	L	0.45	39.3	D	L	0.94	81.6	F	L	0.92	98.8	F	L	1.15	228.1	F
			T	0.65	22.5	C	T	0.61	21.5	C	T	0.64	20.9	C	T	0.47	19.0	B
		NB	TR	0.71	18.6	B	TR	0.57	16.4	B	TR	0.65	19.1	B	TR	0.62	17.2	B
		INTERSECTION			20.4	C			23.2	C			27.6	C			39.4	D
Sixth Avenue @ 37th Street	9784	WB	T	0.70	23.7	C	T	0.60	21.2	C	T	0.61	21.3	C	T	0.72	24.2	C
			R	0.57	24.5	C	R	0.75	33.5	C	R	0.75	33.3	C	R	0.68	29.1	C
		NB	LT	0.73	19.0	B	LT	0.60	21.2	C	LT	0.68	18.1	B	LT	0.63	17.2	B
		INTERSECTION			20.7	C			22.4	C			20.3	C			20.2	C
Sixth Avenue @ 42nd St	9779	EB	LT	0.86	38.3	D	LT	0.55	22.9	C	LT	0.75	28.8	C	LT	0.52	22.3	C
		WB	TR	0.89	41.7	D	TR	0.87	36.6	D	TR	0.63	25.1	C	TR	0.61	24.9	C
			R	0.85	61.0	E	R	0.84	53.5	D	R	0.56	29.7	C	R	0.60	31.8	C
		NB	LTR	0.63	10.0	A	LTR	0.60	13.1	B	LTR	0.65	13.9	B	LTR	0.56	12.6	B
		INTERSECTION			24.4	C			22.2	C			19.6	B			17.9	B
Seventh Avenue @ 23rd Street	21670	EB	TR	0.93	47.4	D	TR	0.92	46.0	D	TR	0.81	34.3	C	TR	0.86	38.2	D
		WB	LT	0.64	27.4	C	LT	0.56	25.1	C	LT	0.57	25.0	C	LT	0.50	23.8	C
		SB	LTR	0.93	30.6	C	LTR	0.84	24.9	C	LTR	0.87	25.9	C	LTR	0.83	24.0	C
		INTERSECTION			33.9	C			29.8	C			27.4	C			27.2	C
Seventh Avenue @ 28th Street	21626	EB	TR	0.95	317.8	F	TR	0.88	41.2	D	TR	0.84	37.6	D	TR	0.86	283.1	F
		SB	LT	0.74	13.5	B	LT	0.58	14.2	B	LT	0.60	10.5	B	LT	0.61	15.2	B
		INTERSECTION			101.0	F			22.6	C			18.3	B			89.9	F
Seventh Avenue @ 29th Street	21599	WB	LT	1.27	362.3	F	LT	1.45	439.6	F	LT	1.51	472.0	F	LT	0.95	206.7	F
		SB	TR	0.86	22.3	C	TR	0.68	22.2	C	TR	0.72	16.9	B	TR	0.80	22.1	C
		INTERSECTION			116.2	F			166.2	F			166.4	F			69.7	E
Seventh Avenue @ 30th Street	21588	EB	T	1.35	410.7	F	T	1.33	400.3	F	T	1.26	354.2	F	T	0.77	33.2	C
			R	0.81	38.5	D	R	0.50	22.8	C	R	0.71	154.8	F	R	0.77	35.3	D
		SB	LT	0.82	20.5	C	LT	0.69	23.1	C	LT	0.70	18.1	B	LT	0.57	13.6	B
		INTERSECTION			119.1	F			129.2	F			125.3	F			20.5	C
Seventh Avenue @ 31st Street	21578	WB	L	0.21	17.4	B	L	0.37	19.9	B	L	0.37	20.0	B	L	0.25	17.8	B
			T	1.18	326.1	F	T	1.08	294.8	F	T	0.91	198.8	F	T	1.17	311.8	F
		SB	TR	0.93	26.7	C	TR	0.85	33.0	C	TR	0.83	20.8	C	TR	0.71	17.5	B
		INTERSECTION			96.7	F			94.7	F			58.2	E			100.6	F
Seventh Avenue @ 33rd Street	9750	WB	L	0.79	60.0	E	L	0.90	76.2	E	L	0.70	50.9	D	L	0.43	33.2	C
			T	0.53	162.3	F	T	0.74	254.4	F	T	0.61	180.6	F	T	0.76	244.3	F
		SB	TR	0.83	13.0	B	TR	0.76	10.5	B	TR	0.81	11.9	B	TR	0.66	6.2	A
		INTERSECTION			25.2	C			38.6	D			27.0	C			34.9	C
Seventh Avenue @ 34th Street	9749	EB	T	1.06	153.9	F	T	0.88	42.4	D	T	0.82	37.6	D	TR	0.47	77.4	E
		WB	LT	0.88	37.7	D	LT	0.80	30.2	C	LT	0.93	43.6	D	LT	0.53	22.6	C
		SB	T	0.97	29.5	C	T	0.93	26.9	C	T	0.91	23.0	C	T	0.77	17.0	B
		INTERSECTION			49.5	D			29.8	C			29.6	C			27.2	C
Seventh Avenue @ 35th Street	9748	WB	L	0.80	40.8	D	L	0.60	29.6	C	L	0.53	28.0	C	L	0.74	37.3	D
			LT	0.99	251.8	F	LT	0.81	145.0	F	LT	1.07	277.7	F	LT	0.69	29.9	C
		SB	TR	0.90	21.0	C	TR	0.87	28.9	C	TR	0.86	18.3	B	TR	0.74	14.8	B
		INTERSECTION			66.3	E			48.6	D			72.0	E			19.5	B

			AM				Midday				PM				Saturday MD			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**
Seventh Avenue @ 36th Street	9747	EB	TR	1.06	310.1	F	TR	0.90	199.1	F	TR	1.09	300.2	F	TR	1.01	293.4	F
		SB	LT	0.85	19.8	B	LT	0.92	27.8	C	LT	0.85	19.4	B	LT	0.69	15.4	B
		INTERSECTION			116.2	F			85.1	F			117.4	F			115.9	F
Seventh Avenue @ 37th Street	9746	WB	LT	0.96	44.2	D	LT	0.82	29.1	C	LT	0.92	38.3	D	LT	0.87	175.3	F
		SB	TR	0.86	24.6	C	TR	0.87	24.1	C	TR	0.88	24.4	C	TR	0.71	19.8	B
		INTERSECTION			31.4	C			25.6	C			28.8	C			78.6	E
Seventh Avenue @ 38th Street	9745	EB	TR	1.14	374.0	F	TR	0.87	33.0	C	TR	0.82	32.2	C	TR	0.94	253.3	F
		SB	LT	0.75	17.4	B	LT	0.85	23.0	C	LT	0.76	16.9	B	LT	0.56	14.3	B
		INTERSECTION			141.8	F			26.2	C			21.2	C			107.6	F
Seventh Avenue @ 42nd Street	9741	EB	TR	0.76	30.4	C	TR	0.51	19.3	B	TR	0.77	30.7	C	TR	0.54	23.6	C
		WB	LT	0.45	22.6	C	LT	0.39	17.6	B	LT	0.53	24.0	C	LT	0.30	20.2	C
		SB	LTR	0.68	13.8	B	LTR	0.71	19.1	B	LTR	0.58	12.4	B	LTR	0.48	11.3	B
		INTERSECTION			19.0	B			18.8	B			19.2	B			16.5	B
Eighth Avenue @ 28th Street	21611	EB	LT	0.80	31.9	C	LT	0.76	30.1	C	LT	0.70	27.7	C	LT	0.59	24.9	C
		NB	TR	0.72	14.5	B	TR	0.65	13.4	B	TR	0.74	14.8	B	TR	0.70	14.1	B
		INTERSECTION			19.5	B			18.5	B			18.3	B			16.7	B
Eighth Avenue @ 29th Street	21598	WB	TR	1.24	366.3	F	TR	1.48	455.2	F	TR	1.78	608.8	F	TR	1.22	343.9	F
		NB	LT	0.76	18.5	B	LT	0.79	21.6	C	LT	0.80	18.6	B	LT	0.73	21.5	C
		INTERSECTION			109.3	F			161.2	F			205.8	F			108.3	F
Eighth Avenue @ 30th Street	21587	EB	LT	1.26	369.0	F	LT	1.20	348.0	F	LT	1.31	384.1	F	LT	1.06	289.1	F
		NB	TR	0.80	21.2	C	TR	0.82	22.7	C	TR	0.88	24.5	C	TR	0.69	22.0	C
		INTERSECTION			164.6	F			154.2	F			171.2	F			124.6	F
Eighth Avenue @ 31st Street	9757	WB	T	0.49	17.9	B	T	0.49	68.9	E	T	0.64	85.6	F	T	0.50	64.1	E
			R	0.83	42.9	D	R	1.29	178.7	F	R	1.06	94.3	F	R	1.23	155.1	F
		NB	LT	1.00	41.1	D	LT	0.96	31.4	C	LT	1.07	108.2	F	LT	0.90	39.7	D
		INTERSECTION			36.7	D			56.2	E			102.2	F			58.8	E
Eighth Avenue @ 33rd Street	9756	WB	TR	0.41	14.9	B	TR	0.53	16.5	B	TR	0.58	17.4	B	TR	0.50	16.1	B
		NB	LT	1.07	128.1	F	LT	1.16	163.8	F	LT	1.24	199.6	F	LT	1.04	115.7	F
		INTERSECTION			109.0	F			133.6	F			159.5	F			94.4	F
Eighth Avenue @ 34th Street	9755	EB	T	0.87	39.7	D	T	0.75	30.0	C	T	0.72	27.9	C	T	0.32	16.9	B
		WB	T	0.45	18.6	B	T	0.49	19.9	B	T	0.51	20.1	C	TR	0.49	19.0	B
			R	0.78	40.2	D	R	0.73	36.4	D	R	0.78	40.6	D				
		NB	LTR	1.10	146.0	F	LTR	1.10	138.9	F	LTR	1.09	134.6	F	LTR	1.04	118.5	F
		INTERSECTION			102.8	F			98.5	F			94.3	F			82.6	F
Eighth Avenue @ 35th Street	9754	WB	TR	1.70	622.6	F	TR	1.23	373.4	F	TR	1.70	632.0	F	TR	1.44	534.1	F
		NB	LT	0.75	14.2	B	LT	0.97	34.5	C	LT	0.79	14.4	B	LT	0.73	13.1	B
		INTERSECTION			176.1	F			109.7	F			162.0	F			121.7	F
Eighth Avenue @ 36th Street	9753	EB	LT	0.90	219.2	F	LT	0.73	109.8	F	LT	1.26	386.9	F	LT	0.94	253.2	F
		NB	TR	0.82	16.8	B	TR	1.04	103.0	F	TR	0.90	20.5	C	TR	0.83	17.0	B
		INTERSECTION			79.1	E			104.9	F			148.2	F			86.0	F
Eighth Avenue @ 37th Street	9752	WB	TR	0.90	40.2	D	TR	0.74	25.9	C	TR	0.97	50.9	D	TR	0.99	53.6	D
		NB	LT	0.76	16.8	B	LT	0.90	25.4	C	LT	0.90	21.6	C	LT	0.78	23.2	C
		INTERSECTION			23.4	C			25.5	C			29.2	C			32.0	C
Eighth Avenue @ 38th Street	9043	EB	LT	0.93	41.5	D	LT	0.71	24.2	C	LT	0.62	24.5	C	LT	0.67	24.5	C
		NB	TR	0.88	22.5	C	TR	1.00	39.4	D	TR	0.98	75.0	E	TR	0.94	51.9	D
		INTERSECTION			28.1	C			35.6	D			65.0	E			45.6	D

			AM				Midday				PM				Saturday MD			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**
Eighth Avenue @ 42nd Street	9673	EB	LT	0.76	23.5	C	DefL	0.50	18.9	B	LT	0.73	22.5	C	DefL	0.49	18.1	B
							T	0.43	15.4	B					T	0.37	14.5	B
		WB	T	0.47	26.2	C	TR	0.58	27.8	C	T	0.52	27.0	C	TR	0.36	24.2	C
		NB	L	0.34	28.1	C	L	0.24	18.7	B	L	0.58	43.3	D	L	0.29	19.5	B
			LT	0.81	25.5	C	LT	0.76	24.1	C	LT	0.77	24.4	C	LT	0.65	21.7	C
			R	0.48	24.8	C	R	0.45	23.8	C	R	0.40	22.3	C	R	0.48	23.2	C
		INTERSECTION			25.1	C			22.8	C			24.6	C			20.6	C
Ninth Avenue @ 23rd Street	28199	EB	TR	0.96	61.4	E	TR	0.80	42.3	D	TR	0.77	39.7	D	TR	0.87	47.0	D
		WB	LT	0.92	43.4	D	LT	0.87	36.5	D	LT	0.71	26.5	C	LT	0.68	25.9	C
		SB	L	0.65	30.2	C	L	0.62	27.0	C	L	0.59	27.2	C	L	0.69	30.8	C
			TR	0.98	42.7	D	TR	0.99	44.8	D	TR	0.72	23.2	C	TR	1.07	117.9	F
		INTERSECTION			45.4	D			40.9	D			26.7	C			81.5	F
Ninth Avenue @ 26th Street	28202	EB	TR	0.46	18.8	B	TR	0.38	17.6	B	TR	0.42	18.2	B	TR	0.73	30.2	C
		SB	L	0.47	18.2	B	L	0.51	19.0	B	L	0.37	16.3	B	L	0.44	15.7	B
			T	0.98	37.0	D	T	0.97	36.4	D	T	0.64	17.5	B	T	0.94	41.6	D
		INTERSECTION			31.5	C			31.3	C			17.6	B			37.8	D
Ninth Avenue @ 28th Street	21609	EB	T	1.02	325.9	F	T	0.72	117.6	F	T	0.71	29.4	C	T	0.70	28.9	C
			R	0.27	21.8	C	R	0.29	19.3	B	R	0.21	18.0	B	R	0.22	18.5	B
		SB	L	0.51	13.5	B	L	0.75	26.0	C	L	0.80	31.2	C	L	0.53	18.0	B
			T	0.88	19.8	B	T	0.96	30.7	C	T	0.62	14.9	B	T	0.99	36.0	D
		INTERSECTION			71.8	E			42.0	D			19.2	B			33.0	C
Ninth Avenue @ 29th Street	9761	WB	LT	0.63	25.8	C	LT	0.78	30.9	C	LT	0.81	31.5	C	LT	0.79	31.9	C
		SB	TR	1.12	127.6	F	TR	1.11	124.9	F	TR	0.80	17.0	B	TR	0.98	67.6	E
		INTERSECTION			104.2	F			100.6	F			21.1	C			57.9	E
Ninth Avenue @ 30th Street	9760	EB	TR	1.21	448.9	F	TR	1.16	469.1	F	TR	1.01	369.7	F	TR	0.86	37.7	D
		SB	L	1.61	424.6	F	L	2.10	655.6	F	L	2.24	704.2	F	L	1.76	485.8	F
			T	0.68	15.3	B	T	0.67	14.3	B	T	0.66	14.8	B	T	0.61	14.1	B
		INTERSECTION			225.9	F			252.9	F			242.8	F			91.2	F
Ninth Avenue @ 31st Street	9759	WB	LTR	0.93	46.4	D	LTR	0.90	62.7	E	LTR	1.43	482.4	F	LTR	0.92	162.3	F
		SB	TR	0.80	13.4	B	TR	0.91	21.0	C	TR	0.83	14.7	B	TR	0.79	16.0	B
		INTERSECTION			22.5	C			32.4	C			184.0	F			60.4	E
Ninth Avenue @ 33rd Street	9078	WB	L	0.50	32.3	C	L	0.72	44.9	D	L	1.11	121.5	F	L	0.74	45.7	D
			T	0.78	202.8	F	T	1.09	350.6	F	T	1.17	357.7	F	T	0.89	251.5	F
		SB	TR	0.93	20.1	C	TR	0.90	17.3	B	TR	0.91	18.3	B	TR	0.78	12.6	B
		INTERSECTION			42.9	D			73.8	E			86.2	F			49.7	D
Ninth Avenue @ 34th Street	9079	EB	T	0.90	51.2	D	T	0.82	42.4	D	T	0.65	31.2	C	TR	0.92	48.3	D
			R	1.76	615.0	F	R	1.36	473.4	F	R	1.85	645.3	F				
		WB	DefL	0.83	48.6	D	LT	0.82	26.8	C	LT	1.07	315.1	F	DefL	0.76	33.8	C
			T	0.54	16.7	B									T	0.30	13.7	B
		SB	LT	1.30	239.3	F	LT	1.14	162.8	F	LT	1.08	141.6	F	LT	0.86	27.7	C
			R	0.50	29.6	C	R	0.54	29.5	C	R	1.81	407.5	F	R	0.41	22.0	C
		INTERSECTION			214.6	F			140.7	F			252.7	F			30.2	C
Ninth Avenue @ 35th Street	9080	WB	LT	1.52	542.5	F	LT	1.29	451.4	F	LT	1.60	591.2	F	LT	0.75	98.4	F
		SB	TR	0.83	24.6	C	TR	0.77	13.3	B	TR	0.78	20.1	C	TR	0.79	22.5	C
		INTERSECTION			147.0	F			104.6	F			155.8	F			38.3	D
Ninth Avenue @ 36th Street	9067	EB	TR	1.10	174.8	F	TR	0.87	66.1	E	TR	1.16	189.1	F	TR	1.06	158.8	F
		SB	L	0.64	15.7	B	L	0.40	11.2	B	L	0.39	11.1	B	L	0.38	9.6	A
			T	0.88	26.8	C	T	0.92	21.8	C	T	0.89	28.8	C	T	0.68	14.9	B
		INTERSECTION			69.6	E			33.0	C			82.9	F			61.7	E

			AM				Midday				PM				Saturday MD			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**
Ninth Avenue @ 37th Street	9068	WB	LT	0.90	46.4	D	LT	0.93	51.3	D	LT	1.14	438.7	F	LT	0.95	52.7	D
		SB	TR	0.71	22.2	C	TR	0.71	16.4	B	T	0.91	26.6	C	TR	0.68	15.6	B
											TR (LnT)	1.28	289.4	F				
		INTERSECTION			27.5	C			23.8	C			186.2	F			24.4	C
Ninth Avenue @ 38th Street	9044	EB	TR	1.21	483.6	F	TR	0.92	48.5	D	TR	0.65	29.9	C	TR	0.73	32.4	C
		SB	LT	0.64	10.2	B	LT	0.66	10.4	B	LT	0.87	16.9	B	LT	0.63	10.0	A
											T (LnT)	1.16	238.7	F				
		INTERSECTION			136.6	F			19.0	B			64.6	E			14.2	B
Ninth Avenue @ 42nd Street	9069	EB	TR	0.88	41.9	D	TR	0.61	144.1	F	TR	0.77	33.6	C	TR	0.56	25.7	C
		WB	DefL	1.14	649.0	F	DefL	1.14	729.5	F	DefL	1.36	779.1	F	DefL	0.99	294.7	F
			T	0.45	20.9	C	T	0.35	17.8	B	T	0.47	20.4	C	T	0.23	15.8	B
		SB	LT	1.07	130.0	F	LT	1.17	173.8	F	LT	1.15	162.2	F	LT	0.93	35.0	C
			R	0.13	16.9	B	R	0.21	19.1	B	R	0.24	19.4	B	R	0.22	19.7	B
		INTERSECTION			127.1	F			179.9	F			169.0	F			48.5	D
Olympic Blvd NB @ 33rd Street	99022	WB	TR	0.90	26.3	C	TR	0.98	41.2	D	TR	0.91	30.1	C	TR	0.78	22.9	C
		NB	LT	0.10	30.9	C	LT	0.32	42.6	D	LT	0.19	30.2	C	LT	0.13	23.7	C
		INTERSECTION			26.3	C			41.2	D			30.1	C			22.9	C
Olympic Blvd SB @ 33rd Street	6033	WB	LT	0.84	20.9	C	LT	0.90	25.4	C	LT	0.91	30.6	C	LT	0.78	22.9	C
		INTERSECTION			20.9	C			25.4	C			30.6	C			22.9	C
Sixth Avenue @ 34th Street	21549	EB	T	0.75	22.9	C	T	0.75	23.9	C	T	0.57	16.4	B	T	0.62	52.9	D
		WB	TR	0.65	17.0	B	TR	0.58	15.3	B	TR	0.62	16.1	B	TR	0.48	13.7	B
		NB	T	1.45	334.6	F	T	1.19	212.2	F	T	1.29	256.8	F	T	1.30	256.4	F
		SB	T	1.64	505.2	F	T	1.54	461.4	F	T	1.81	579.6	F	T	1.36	384.1	F
		INTERSECTION			245.5	F			179.2	F			223.6	F			194.2	F
Broadway @ 35th Street	9738	WB	L	0.10	18.8	B	L	0.08	19.1	B	L	0.10	19.5	B	L	0.20	20.9	C
			T	1.53	293.6	F	T	1.26	176.9	F	T	1.47	269.5	F	T	1.13	125.8	F
		SB	T	0.37	10.7	B	T	0.35	11.9	B	T	0.40	10.3	B	T	0.28	9.2	A
			R	0.57	18.7	B	R	0.37	12.7	B	R	0.47	15.2	B	R	0.50	16.4	B
		INTERSECTION			150.8	F			89.5	F			132.1	F			65.2	E
Broadway @ 36th Street	9737	EB	TR	0.82	30.0	C	TR	0.86	33.0	C	TR	0.93	38.4	D	TR	0.78	27.4	C
		SB	L	0.32	35.4	D	L	0.59	43.4	D	L	0.58	42.8	D	L	0.38	36.9	D
			T	0.48	15.4	B	T	0.40	14.4	B	T	0.51	17.3	B	T	0.37	14.1	B
		INTERSECTION			24.2	C			27.7	C			31.4	C			23.4	C
Broadway @ 42nd Street	9731	EB	T	0.48	20.8	C	TR	0.31	16.6	B	T	0.53	22.5	C	TR	0.31	16.5	B
		WB	DefL	1.32	626.4	F	DefL	0.79	44.3	D	LT	0.75	29.6	C	DefL	0.76	40.9	D
			T	0.70	28.2	C	T	0.44	18.3	B					T	0.31	16.8	B
		SB	L	0.57	19.2	B	L	0.75	30.7	C	L	0.43	14.9	B	L	0.70	27.6	C
			T	0.68	17.1	B	T	0.65	18.9	B	T	0.60	14.7	B	T	0.64	18.6	B
		INTERSECTION			85.7	F			21.5	C			20.7	C			20.6	C
Cardinal Stepanic Place @ 41st Street	12232	EB	T	0.03	36.1	D	T	0.03	36.0	D	T	0.03	36.1	D	T	0.03	36.0	D
		WB	L	0.39	4.2	A	L	0.39	4.3	A	L	0.45	5.0	A	L	0.41	4.4	A
			LT	0.38	4.2	A	LT	0.38	4.1	A	LT	0.42	4.6	A	LT	0.31	3.6	A
		INTERSECTION			4.4	A			4.4	A			5.0	A			4.2	A
Dyer Ave @ 30th Street	9060	EB	L	0.13	10.3	B	L	0.22	10.9	B	L	0.39	23.1	C	L	0.23	11.0	B
			T	0.32	11.7	B	T	0.35	11.9	B	T	0.31	21.0	C	T	0.29	11.4	B
		WB	R	0.02	19.6	B	R	0.04	19.7	B	R	0.14	20.9	C	R	0.08	20.2	C
		SB	L	0.58	25.4	C	L	0.33	21.6	C	L	0.44	23.3	C	L	0.26	20.8	C
		INTERSECTION			16.8	B			14.0	B			22.2	C			13.3	B

			AM				Midday				PM				Saturday MD			
Signalized Intersection	**Node**	**Approach**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**
Dyer Ave @ 31st Street	149997	WB	LTR	0.37	9.9	A	LTR	0.47	10.9	B	LTR	0.75	30.5	C	LTR	0.45	10.7	B
		NB	LT	0.28	25.4	C	LT	0.41	27.2	C	LT	0.83	45.2	D	LT	0.49	28.4	C
		SB	TR	0.69	32.8	C	TR	0.43	27.4	C	TR	0.91	50.1	D	TR	0.33	26.0	C
		INTERSECTION			21.7	C			18.7	B			38.9	D			18.5	B
Dyer Ave @ 34th Street	9081	EB	T	0.32	13.5	B	T	0.35	12.8	B	T	0.29	12.1	B	T	0.26	11.8	B
		WB	T	0.31	13.4	B	T	0.33	12.6	B	T	0.62	16.7	B	T	0.20	11.3	B
			R	0.14	7.9	A	R	0.22	9.5	A	R	2.77	1354.0	F	R	0.36	11.0	B
		SB	L	0.97	86.1	F	L	0.63	47.1	D	L	0.81	61.6	E	L	0.48	40.2	D
			LR	0.95	81.3	F	LR	0.61	47.4	D	LR	0.82	63.7	E	LR	0.52	41.6	D
			R	0.76	94.8	F	R	0.60	47.3	D	R	0.81	64.2	E	R	0.47	40.8	D
		INTERSECTION			43.8	D			21.6	C			198.4	F			19.6	B
Dyer Ave @ 35th Street	9064	WB	LTR	0.70	33.6	C	LTR	0.62	31.0	C	LTR	0.77	184.7	F	LTR	0.54	29.1	C
		NB	LT	0.07	8.0	A	LT	0.09	9.1	A	LT	0.33	26.7	C	LT	0.16	8.6	A
		SB	TR	0.86	41.2	D	TR	0.53	29.5	C	TR	0.71	33.6	C	TR	0.43	27.9	C
		INTERSECTION			36.1	D			27.3	C			85.9	F			23.9	C
Dyer Ave @ 36th Street	9066	EB	TR	0.75	83.9	F	TR	0.73	79.0	E	TR	0.75	67.9	E	TR	0.66	32.6	C
		NB	TR	0.20	26.9	C	TR	0.27	31.3	C	TR	1.51	461.2	F	TR	0.44	29.3	C
		SB	L	0.64	35.9	D	L	0.41	30.0	C	L	0.66	40.5	D	L	0.44	29.6	C
			LT	0.77	34.9	C	LT	0.49	29.3	C	LT	0.77	38.3	D	LT	0.53	29.1	C
			R	0.42	7.6	A	R	0.33	10.5	B	R	0.48	13.7	B	R	0.31	9.8	A
		INTERSECTION			42.7	D			42.2	D			125.1	F			27.5	C
Dyer Avenue @ 41st Street	9038	WB	TR	0.44	29.7	C	TR	0.61	32.8	C	L	0.28	20.7	C	TR	0.47	30.0	C
											TR	1.32	495.5	F				
		NB	L	0.39	23.8	C	L	0.41	24.3	C	LT	0.31	21.1	C	L	0.59	28.6	C
			LT	0.55	23.7	C	LT	0.59	24.5	C					LT	0.66	25.6	C
		INTERSECTION			25.8	C			27.4	C			294.2	F			27.4	C
Dyer Avenue @ 42nd Street	9070	EB	LT	0.37	21.1	C	LT	0.51	23.5	C	LT	0.38	21.2	C	LT	0.39	21.6	C
		WB	TR	0.22	19.3	B	TR	0.48	22.8	C	TR	0.29	20.3	C	TR	0.35	20.9	C
											T (LnT)	1.57	1378.0	F				
		NB	L	0.34	10.4	B	L	0.46	12.5	B	L	0.17	9.2	A	L	0.35	10.6	B
			R	0.24	9.8	A	R	0.47	23.9	C	R	0.17	12.3	B	R	0.34	10.7	B
		INTERSECTION			15.6	B			20.8	C			96.8	F			15.9	B

			AM				Midday				PM				Saturday MD			
Unsignalized Intersection	**Node**	**Approach**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**	**Movt.**	**V/C** Ratio	**Delay** Sec/Veh	**LOS**
Lincoln Tunnel Expressway @ 33rd Street	149998	SB	R	0.23	16.9	C	R	0.19	18.0	C	R	0.26	23.0	C	R	0.10	14.6	B
		INTERSECTION			-	-			-	-			-	-			-	-

Appendix I2:
Alternatives – Platform Stair Analysis

7th Avenue/ 34th Street Station, 2019 Future Conditions with Reduced Density Alternative

AM

Control Area	Stairway	Width (ft)	Effective Width (ft)	Existing 2009 AM Peak 15-Minute Up (Entry)	Down (Exit)	Friction	SVCD Capacity	V/SVCD Ratio	LOS	No Build Increment Up (Entry)	Down (Exit)	No Build- 2019 AM Peak 15-Minute Up (Entry)	Down (Exit)	V/SVCD Ratio	LOS	Build Increment Up (Entry)	Down (Exit)	2019 Build Condition AM Peak 15-Minute Up (Entry)	Down (Exit)	V/SVCD Ratio	LOS	Mitigation Inches	Signf. Impact?
R135	New Stair	N/A	N/A	N/A	N/A	N/A	N/A	N/A		35	69	369	275	0.53	B	1	2	371	276	0.54	B		
R135	U3	10.2	9.0	670	412	0.9	1208	0.90	C	35	103	369	309	0.56	B	1	3	371	311	0.56	B		
R138	ML12	9.8	8.5	437	448	0.9	1148	0.77	C	59	238	495	686	1.03	D	4	11	499	697	1.04	D	1.28	No
R138	ML14	9.8	8.5	964	201	0.8	1020	1.14	D	88	238	1052	439	1.46	E	6	11	1058	450	1.48	E	1.14	No
R142	U5	13.1	11.9	44	587	0.8	1422	0.44	A	44	211	88	798	0.62	B	8	17	97	815	0.64	B		

PM

Control Area	Stairway	Width (ft)	Effective Width (ft)	Existing 2009 PM Peak 15-Minute Up (Entry)	Down (Exit)	Friction	SVCD Capacity	V/SVCD Ratio	LOS	No Build Increment Up (Entry)	Down (Exit)	No Build- 2019 PM Peak 15-Minute Up (Entry)	Down (Exit)	V/SVCD Ratio	LOS	Build Increment Up (Entry)	Down (Exit)	2019 Build Condition PM Peak 15-Minute Up (Entry)	Down (Exit)	V/SVCD Ratio	LOS	Mitigation Inches	Signf. Impact?
R135	New Stair	N/A	N/A	N/A	N/A	N/A	N/A	N/A		67	27	178	522	0.65	B	3	1	182	523	0.66	B		
R135	U3	10.2	9.0	222	991	0.8	1074	1.13	D	67	40	178	536	0.66	B	3	1	182	537	0.67	B		
R138	ML12	9.8	8.5	133	804	0.8	1020	0.92	C	125	64	258	868	1.10	D	10	5	268	873	1.12	D	1.36	No
R138	ML14	9.8	8.5	497	674	0.9	1148	1.02	D	188	64	685	737	1.24	D	15	5	700	742	1.26	D	1.44	No
R142	U5	13.1	11.9	504	137	0.8	1422	0.45	B	75	31	579	168	0.52	B	22	9	600	177	0.55	B		

8th Avenue/ 34th Street Station, 2019 Future Conditions with Reduced Density Alternative

AM

Control Area	Stairway	Width (ft)	Effective Width (ft)	Existing 2009 AM Peak 15-Minute Up (Entry)	Down (Exit)	Friction	V/ SVCD Ratio	SVCD Ratio	LOS	No Build Increment Up (Entry)	Down (Exit)	No Build- 2019 AM Peak 15-Minute Up (Entry)	Down (Exit)	Revised Friction	Revised SVCD	V/ SVCD Ratio	LOS	Build Increment Up (Entry)	Down (Exit)	2019 Build Condition AM Peak 15-Minute Up (Entry)	Down (Exit)	V/ SVCD Ratio	LOS	Mitigation Inches	Signf. Impact?
N67	M23/M24	7.9	6.7	568	85	0.8	798	0.82	C	158	227	555	312	0.9	1046	0.83	C	81	13	637	325	0.92	C		
N67	M21/M22	8.1	6.9	26	306	0.8	822	0.40	A	45	510	241	816	0.8	930	1.14	D	23	30	264	846	1.19	D	4.65	No
N71/N70	M27/M28	6	5	31	167	0.8	600	0.33	A	10	347	41	514	0.8	600	0.92	C	5	17	46	531	0.96	C		
N71/N70	M29/M30	6	5	30	277	0.8	600	0.51	B	10	177	40	454	0.8	600	0.82	C	5	7	45	461	0.84	C		

PM

Control Area	Stairway	Width (ft)	Effective Width (ft)	Existing 2009 PM Peak 15-Minute Up (Entry)	Down (Exit)	Friction	V/ SVCD Ratio	SVCD Ratio	LOS	No Build Increment Up (Entry)	Down (Exit)	No Build- 2019 PM Peak 15-Minute Up (Entry)	Down (Exit)	Revised Friction	Revised SVCD	V/ SVCD Ratio	LOS	Build Increment Up (Entry)	Down (Exit)	2019 Build Condition PM Peak 15-Minute Up (Entry)	Down (Exit)	V/ SVCD Ratio	LOS	Mitigation Inches	Signf. Impact?
N67	M23/M24	7.9	6.7	260	239	0.9	898	0.56	B	902	73	1084	312	0.8	930	1.50	E	50	30	1134	342	1.59	E	5.31	Yes
N67	M21/M22	8.1	6.9	22	362	0.8	822	0.47	B	258	165	357	526	0.9	1046	0.84	C	14	68	371	594	0.92	C		
N71/N70	M27/M28	6	5	329	88	0.8	600	0.69	B	86	97	415	185	0.8	600	1.00	D/C	3	40	418	225	1.07	D	4.35	No
N71/N70	M29/M30	6	5	116	192	0.9	675	0.46	B	86	42	203	234	0.9	675	0.65	B	3	18	206	252	0.68	B		

*Note, stairs M23/M24 and M21/M22 to be relocated and rebuilt to 9' wide in conjuntion with widening of 33rd Street underpass componant of the Farley project

Appendix I3:
Alternatives – Air Quality

Table of Contents

1. Reduced Density Alternative
Emission tables for each scenario

2. Trigen Alternative
Emission tables for oil and natural gas

REDUCED DENSITY ALTERNATIVE

WRY Development Sites
Pollutant Emission Rates and Stack Parameters with Fuel Oil Under Lower Density Alternative

Site No.	Pollutant	Fuel Factors [1]	Proposed Development Size	Annual Fuel Consumption	AP-42 Emission Factors [2]	Estimated Emission Rates [5]		Stack Parameters			
								Heat Input [3]	Stack		
									Height	Diameter	Ex. Velocity
		gal/ft²-yr	ft²	gal/year	lb/10 ³ gal	lb/year	g/sec	MMBtu/hr	meters	meters	m/sec
AQ Scenario 1 - Max Commercial Scenario											
WRY-1	**NOx**	0.38	544,000	206,720	20	4,134	0.217	12.1	182.9	0.762	9.144
	SO2				28.4	5,871	0.308				
	PM2.5				2.13	440	0.023				
	PM10				2.38	492	0.026				
WRY-2	**NOx**	0.38	570,000	216,600	20	4,332	0.227	12.6	173.7	0.9144	9.144
	SO2				28.4	6,151	0.323				
	PM2.5				2.13	461	0.024				
	PM10				2.38	516	0.027				
WRY-3	**NOx**	0.38	457,500	173,850	20	3,477	0.183	10.1	143.3	0.8636	9.144
	SO2				28.4	4,937	0.259				
	PM2.5				2.13	370	0.019				
	PM10				2.38	414	0.022				
WRY-4	**NOx**	0.38	300,000	114,000	20	2,280	0.120	6.7	128.0	0.762	9.144
	SO2				28.4	3,238	0.170				
	PM2.5				2.13	243	0.013				
	PM10				2.38	271	0.014				
WRY-5	**NOx**	0.38	470,500	178,790	20	3,576	0.188	10.4	143.3	0.6096	9.144
	SO2				28.4	5,078	0.267				
	PM2.5				2.13	381	0.020				
	PM10				2.38	426	0.022				
WRY-6	**NOx**	0.38	425,000	161,500	20	3,230	0.170	9.4	173.7	0.8128	9.144
	SO2				28.4	4,587	0.241				
	PM2.5				2.13	344	0.018				
	PM10				2.38	384	0.020				
WRY-7	**NOx**	0.38	537,500	204,250	20	4,085	0.214	11.9	143.3	0.8128	9.144
	SO2				28.4	5,801	0.305				
	PM2.5				2.13	435	0.023				
	PM10				2.38	486	0.026				
WC-1	**NOx**	0.38	1,852,000	703,760	20	14,075	0.739	41.1	232.9	1.6764	9.144
	SO2				28.4	19,987	1.049				
	PM2.5				2.13	1,499	0.079				
	PM10				2.38	1,675	0.088				
AQ Scenario 2 - Max Residential/Office Option											
WRY-1	**NOx**	0.38	631,500	239,970	20	4,799	0.252	14.0	204.2	0.762	9.144
	SO2				28.4	6,815	0.358				
	PM2.5				2.13	511	0.027				
	PM10				2.38	571	0.030				
WRY-2	**NOx**	0.38	670,000	254,600	20	5,092	0.267	14.9	198.1	0.9144	9.144
	SO2				28.4	7,231	0.380				
	PM2.5				2.13	542	0.028				
	PM10				2.38	606	0.032				
WRY-3	**NOx**	0.38	557,500	211,850	20	4,237	0.222	12.4	167.6	0.8636	9.144
	SO2				28.4	6,017	0.316				
	PM2.5				2.13	451	0.024				
	PM10				2.38	504	0.026				
WRY-4	**NOx**	0.38	300,000	114,000	20	2,280	0.120	6.7	128.0	0.762	9.144
	SO2				28.4	3,238	0.170				
	PM2.5				2.13	243	0.013				
	PM10				2.38	271	0.014				
WRY-5	**NOx**	0.38	533,000	202,540	20	4,051	0.213	11.8	161.5	0.6096	9.144
	SO2				28.4	5,752	0.302				
	PM2.5				2.13	431	0.023				
	PM10				2.38	482	0.025				
WRY-6	**NOx**	0.38	500,000	190,000	20	3,800	0.199	11.1	192.0	0.8128	9.144
	SO2				28.4	5,396	0.283				
	PM2.5				2.13	405	0.021				
	PM10				2.38	452	0.024				
WRY-7	**NOx**	0.38	612,500	232,750	20	4,655	0.244	13.6	161.5	0.8128	9.144
	SO2				28.4	6,610	0.347				
	PM2.5				2.13	496	0.026				
	PM10				2.38	554	0.029				
WC-1	**NOx**	0.38	1,300,000	494,000	20	9,880	0.519	28.8	232.9	1.6764	9.144
	SO2				28.4	14,030	0.737				
	PM2.5				2.13	1,052	0.055				
	PM10				2.38	1,176	0.062				

WRY Development Sites
Pollutant Emission Rates and Stack Parameters with Fuel Oil Under Lower Density Alternative

Site No.	Pollutant	Fuel Factors [1]	Proposed Development Size	Annual Fuel Consumption	AP-42 Emission Factors [2]	Estimated Emission Rates [5]		Stack Parameters			
								Heat Input [6]	Stack		
									Height	Diameter	Ex. Velocity
		gal/ft²-yr	ft²	gal/year	lb/10 ³ gal	lb/year	g/sec	MMBtu/hr	meters	meters	m/sec
AQ Scenario 3 - Max Residential/Hotel Option											
WRY-1	**NOx**	0.38	644,000	244,720	20	4,894	0.257	14.3	207.3	0.762	9.144
	SO2				28.4	6,950	0.365				
	PM2.5				2.13	521	0.027				
	PM10				2.38	582	0.031				
WRY-2	**NOx**	0.38	720,000	273,600	20	5,472	0.287	16.0	210.3	0.9144	9.144
	SO2				28.4	7,770	0.408				
	PM2.5				2.13	583	0.031				
	PM10				2.38	651	0.034				
WRY-3	**NOx**	0.38	595,000	226,100	20	4,522	0.237	13.2	179.8	0.8636	9.144
	SO2				28.4	6,421	0.337				
	PM2.5				2.13	482	0.025				
	PM10				2.38	538	0.028				
WRY-4	**NOx**	0.38	300,000	114,000	20	2,280	0.120	6.7	128.0	0.762	9.144
	SO2				28.4	3,238	0.170				
	PM2.5				2.13	243	0.013				
	PM10				2.38	271	0.014				
WRY-5	**NOx**	0.38	595,500	226,290	20	4,526	0.238	13.2	176.8	0.6096	9.144
	SO2				28.4	6,427	0.337				
	PM2.5				2.13	482	0.025				
	PM10				2.38	539	0.028				
WRY-6	**NOx**	0.38	562,500	213,750	20	4,275	0.224	12.5	210.3	0.8128	9.144
	SO2				28.4	6,071	0.319				
	PM2.5				2.13	455	0.024				
	PM10				2.38	509	0.027				
WRY-7	**NOx**	0.38	687,500	261,250	20	5,225	0.274	15.2	179.8	0.8128	9.144
	SO2				28.4	7,420	0.390				
	PM2.5				2.13	556	0.029				
	PM10				2.38	622	0.033				
WC-1	**NOx**	0.38	902,400	342,912	20	6,858	0.360	20.0	228.6	1.6764	9.144
	SO2				28.4	9,739	0.511				
	PM2.5				2.13	730	0.038				
	PM10				2.38	816	0.043				

Notes:

1. Fuel consumption rates (0.38 gallons of No. 2 fuel oil per square foot) are based on fuel factors presented in the CEQR Technical Manual Appendix 7 for residential buildings in NYC
2. Emission factors for fuel oil are obtained from the EPA Table 1.3-1 "Criteria Pollutant Emission Factors for Fuel Oil Combustion for Boilers with less then 100 MMBtu/hr"
3. SO2 emission factors from fuel oil combustion are estimated using the equation SO2=142S, where S= sulfur content (O.2%) in fuel oil No.2
4. PM10 and PM2.5 emission factors from fuel combustion that include both filterable and condensable PM emissions were estimated using cumulative particle size distribution from Table 1.3.7 "Cumulative Particle Size Distribution" and size-specific emission factors for uncontrolled commercial boilers burning residual or distillate oil
5. Short-term emission rates were estimated based on assumption that fuel would be consumed in a 100 day (2,400 hrs) heating season
6. Boiler heat input (MMBtu/hr) was estimated based on annual fuel consumption rate, duration of heating season, and fuel heating value of 140,000 Btu/gal

TRIGEN ALTERNATIVE

Trigen Emission

Pollutant	Winter (Dec-Mar)		Other Months	
	Commercial g/s	Residential g/s	Commercial g/s	Residential g/s
$PM_{2.5}$	0.1231	0.0211	0.1117	0.0104
NOx	0.4533	0.0440	0.4526	0.0420
SO_2	0.1943	0.1796	0.0067	0.0043
PM_{10}	0.1247	0.0227	0.1117	0.0104

Appendix I4:

Alternatives – Tri-Generation Energy Supply Alternative

Hudson Yards
Western Rail Yard

Tri-Generation Feasibility Study

January 2009

Updated May 2009

COMMISSIONED BY
RG WRY LLC

PREPARED BY
Endurant Energy LLC
New York, NY

Greg Rouse
Director of Technology

John Kelly
Vice President, Technology Solutions

Amir Yanni
Vice President, Development and Construction

Disclaimer

This report was prepared by Endurant Energy LLC ('Endurant') as an account of preliminary concepts and financial projections for integrating tri-generation into the Hudson Yards. This work was sponsored by RG WRY LLC c/o The Related Companies L.P. Neither Endurant, RG WRY LLC, members of these companies, nor any person acting on behalf of any of the parties:

a. makes any warrant, expressed or implied with respect to the results in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately-owned rights, or
b. assumes any liability with respect to the use of, or for any and all damages resulting from the use of, any information, apparatus, method, or process disclosed in this report.

Executive Summary

Tri-generation would lower the operating cost and reduce the environmental impact of the planned Western Rail Yard (WRY) development. Installing individual tri-generation systems in the buildings on the Western Rail Yard would:

- lower annual energy costs by about four million dollars
- reduce the development's carbon footprint by the equivalent of removing three quarters (3/4) of a residential tower
- increase each building's Energy Star rating between 3 and 7 points and each building's energy performance for earning LEED points

The collection of systems proposed in this study would increase the WRY's development cost by an estimated $36,800,000. This cost estimate includes anticipated NYSERDA incentives (based on what's currently available), but excludes federal, state and city taxes as well as any tax incentives promoting energy efficiency and on-site energy generation that may be available at the time of development.

The additional space required in each building to house the proposed tri-generation systems is not expected to impact the overall size of each building in a meaningful way or reduce the development's rentable and sellable square footage.

Endurant does not recommend, nor does this study assume, any reduction in base building HVAC and electrical system capacities to complement the anticipated generation of chilled water, hot water and electricity in each building by tri-generation. All the capital costs associated with the tri-generation system for this study are additive to what would otherwise be planned.

Financing Options

The cost to install tri-generation in each building could be assumed by RG WRY LLC ("the developer") on a building by building basis, in accordance with the system's design, installation, and operation. A third party, such as Endurant, would represent the developer throughout the design and build process.

Alternatively, the systems could be financed, designed, built, owned and operated by a third party company as part of a long-term contract for third party supply of electricity and thermal energy. In order to secure third party financing, the developer would need to guarantee a minimum demand for energy, heating and cooling from each building. The developer could be a whole or part owner in the third party company to realize the return on investment.

If the developer chooses the latter approach, then the following list of companies could be solicited to finance, develop and own the tri-generation systems:

- NRG Thermal, www.nrgthermal.com, subsidiary of a large independent power producer
- Veolia Energy, www.veoliaenergyna.com, a leader in waste energy
- PEPCo Energy Services, www.pepcoenergy.com, Philadelphia Electric subsidiary
- Constellation Energy, www.constellation.com

- DCO Energy, www.dcoenergy.com

Tri-Generation Systems

This report analyzes the first cost, energy cost savings, emissions and space requirements of the following two tri-generation system designs:

- **Commercial Tower:** This 5.8 MW system configuration for a prototypical Western Rail Yard commercial tower will utilize three (3) Caterpillar 3520 engines with jacket water and exhaust heat recovery to produce hot water. A hot water fired absorption chiller will be used to increase the thermal utilization of the engine plant during hotter months.
- **Residential Tower:** This 520 kW system configuration for a prototypical Western Rail Yard residential tower will utilize a UTC Pure Comfort C600 micro-turbine system. This system consists of three (3) packaged Capstone C200 micro-turbines with integrated exhaust heat to hot water recovery that will fire one (1) absorption chiller capable of producing hot and chilled water.

Each system was selected and sized to optimize the financial return, carbon reduction, and source energy reduction of tri-generation for a particular building type in The Hudson Yards development. The systems may be considered independently for one or two buildings, or installed in all buildings according to their type.

Residential Tower Piggy Back Scenario – Will be studied

In the case of the Commercial Tower system, the system could supply heating, cooling, and/or electricity to separate, but nearby, residential buildings without changing the design or size of the Commercial Tower system significantly. Residential towers' demand schedules are suitably complementary to that of a commercial tower to enable a piggy back scenario, provided the interconnection and distribution costs are reasonable. The first cost, energy cost savings, emissions and space requirements of this "Residential Tower Piggy Back" scenario will be studied in detail once design begins on the buildings proposed for the Western Rail Yards. For the purposes of the Western Rail Yards Draft Environmental Impact Statement (DEIS), the potential criteria pollutant and GHG emissions of a "Residential Tower Piggy Back" scenario would be less than if each Residential building had its own dedicated tri-generation system, the model studied in this report.

District Plant Scenario - Rejected

Prior to developing the scope of work for this Feasibility study, Endurant and RG WRY LLC assessed the cost and operational effectiveness of large "district" tri-generation facilities that generated power, chilled water, and hot water centrally for distribution throughout the development. This scenario was rejected for a variety of reasons, including, but not limited to the following:

- **Distribution Network** - A district plant would cost between 2 and 3.5 times more than a series of individual building systems, due in large part to the cost of distribution. In the Western Rail Yard, hot and chilled water would be required to be distributed above the platform covering the rail yards, but protected with significant structure and earth. Since two thirds of the development is to be built on a platform the magnitude of this cost difference is anticipated to be between 20 to 50 million dollars.

- **Phasing Challenges** - A district plant would have to be constructed and paid for as the first step in the WRY before any of the buildings were completed and occupied. Only once the buildings were occupied, could the plant begin to generate revenue to pay back its investment. After the district plant was constructed, it could take 10 to 20 years for its full capacity to be utilized.
- **Real Estate Values**- A district plant would require more space per kWh/Btu of capacity than the combined total of individual building systems. Space is very expensive to construct and operate on this particular site given the presence of the rail tracks below.
- **Ownership Structure Limitations** – It is not certain at this time that RG WRY, LLC would own and operate all the buildings in the development. Obligating future and unknown owners of buildings to purchase power from a district plant would devalue the property. Conversely, having the ability for onsite power generation capabilities within the building increases the value of an individual building.
- **Procurement Problems** - A district plant would be more energy efficient than individual building systems due to economies of scale. However, the size and type of engine a district plant would require is only currently manufactured in Europe. Thus maintenance and spare parts may not be readily available, as they would for the type of equipment installed in building-specific systems.
- **Inadequate Financial Payback** - A district plant could reduce the development's total energy use by 25-30% measured in Btu's, but this translates to only 11-17% in energy cost savings. The payback would be inadequate to cover the cost premium and other negative factors related to a district plant as compared to independent building systems.

Advanced Tri-generation Technology Scenario - Rejected

Endurant also studied other, more advanced tri-generation technologies than those described in this report, including fuel cells, energy storage, and digester power. These options were ultimately rejected in favor of those selected because they offered lower rates of return and required significantly more space, a particularly valuable commodity for this development because of its lack of underground space. Endurant does recommend a study of solar PV in or after 2010, by when Endurant believes it will be a viable (i.e. cost effective) renewable energy accompaniment to tri-generation.

Operating Strategy

For this study, the tri-generation systems were assumed to operate exclusively during Peak Electricity Demand periods, as defined by Con Ed, the local electricity and gas distribution company. Currently, Con Ed ascribes Peak Demand charges to electricity used between 8:00AM and 10:00PM, Monday through Friday.

A preliminary assessment of GHG emissions from base load and non-base load power generation was made using the most recent eGRID data for the New York City / Westchester subregion. It was assumed that non-baseload plants would operate during peak hours, as defined by Con Ed, while nighttime and weekend hour electricity is produced from non-fossil fuel sources. Based on those assumptions, operating the tri-generation systems exclusively during Peak periods maximizes the system's GHG emission reduction. A detailed assessment as to what extent and at what times power consumed in New York City is generated from nuclear and large-scale hydroelectric power plants, which have low associated carbon emissions, was not available. Due to the assumptions EnergyStar makes about source

energy, operating the tri-generation system around the clock, rather than just during Peak periods, would increase each building's EPA Energy Star rating.

Because the cost of electricity trends with natural gas prices during Peak periods, it is always cost effective to generate electricity on-site through tri-generation during Peak demand periods. During Off-peak periods, it can be more cost effective to generate electricity on-site through tri-generation than purchase it from Con Ed when the price of natural gas is very low, as it is right now. The more time the tri-generation system can be operated cost effectively (e.g. 18 hours a day rather than just the 14 Peak demand hours and on Saturdays and Sundays), the better the system's IRR. This study takes a conservative approach to calculating the system's IRR by assuming the tri-generation systems are only operated during Peak periods.

Energy Cost and Environmental Benefits

The energy cost savings and environmental benefits for each case are summarized below:

TABLE 1 - SUMMARY OF ENERGY COST AND ENVIRONMENTAL BENEFITS

Tri-Generation System (Case)	Annual Energy Cost Savings	Carbon Reduction for Case	Source Btu Reduction (%) and Energy Star points*
Commercial	$2,500,000	6%	7-8
Residential	$270,000	5%	2-3

*The source energy percentage reduction is approximately equal to the expected additional EPA Energy Star points that would be gained by adding tri-generation (e.g. 7% reduction equates approximately to an additional seven (7) Energy Star points).

Based on today's (November 2008) energy prices, tri-generation (if installed in all buildings) would reduce the development's energy costs by $4,390,000 each year and reduce the development's carbon emissions by the equivalent of removing three quarters (3/4) of a prototypical residential tower in the development.

Economics

The payback period and internal rate of return (IRR) for each case are summarized below[1]:

TABLE 2: FIRST COST, PAYBACK AND IRR

Tri-Generation System (Prototype Building)	First Cost	Payback, Years	IRR over 30 years %
Commercial	$20 million	8	11
Residential	$2.4 million	9	10

These financial projections assume that the system is installed on a lower floor of each building concurrent with the building's construction and unused for two years while the building is substantially completed. At year three, the system is assumed to operate at 40% capacity. At year four, the system is

[1] IRR based on unlevered cash flows, which are the negative cash flows representing costs to build the project and the positive cash flows from the net operating income of the project. This unlevered IRR does not include the effect of financing or taxes.

assumed to operate at 70% capacity. After year five, the system is assumed to run at 100% capacity. The building would need to be 90% occupied for the building to run at 100% capacity.

These cost estimates include anticipated NYSERDA incentives (based on what's currently available), but excludes federal, state and city taxes as well as any tax incentives promoting energy efficiency and distributed energy generation that may be available at the time of development.

The two systems were sized to optimize payback periods and carbon reduction.

Building Interfaces

The space requirements for each system are summarized below.

TABLE 3: PLANT FOOTPRINTS

Tri-Generation System (Case)	Plan Area, ft2	Height, ft
Commercial	17,000	26
Residential	5,500	16

The figures include a conservative 25% "adjustment factor" (extra room as contingency) to account for columns and other impediments to the most ideal equipment layout. The adjustment factor does not eliminate all space constraints.

These space requirements are additive to base building mechanical space requirements, as Endurant does not recommend, nor does this study assume, any reduction in base building HVAC and electrical system capacities to complement the tri-generation systems.

Permitting

None of the prototype systems evaluated require special emission controls to meet New York State standards (NYCRR Chapter III, subpart 201). The system analyzed for the Commercial prototypical building would have to be registered with the State because the annual nitrogen oxide (NOx) emissions will exceed 12.5 tons, the cut off for registration.

Emissions and Exhaust Stacks

As required for the Western Rail Yards EIS, the exhaust heights and emissions are summarized below for each case individually, and aggregated for the entire development.

TABLE 4: EXHAUST STACK AND EMISSIONS FOR EACH INDIVIDUAL PROTOTYPICAL BUILDING

	Commercial	Residential
Stack Height[2]	~10 feet above roof	Exhaust adjacent to boiler room
Stack Inlet Diameter[2]	~1.5 feet	3 feet
Stack Outlet Diameter[2]	~One foot	2 feet
Exhaust velocity[2]	~20 ft/second	~20 ft/second
CO, ton/year	62.1	0.931
NOx, ton/year	14.5	0.35
SOx, ton/year[3]	0.062	0.039
PM 2.5, ton/year[2]	1.038	0.076
PM 10, ton/year[2]	1.038	.076
HAP, ton/year[2]	7.621	0.012

TABLE 5 - SITE AND BUILDING EMISSIONS

Tri-generation System (Case)	Building #	Type	Tri-gen (kW)	NOx (tons/yr)	CO (tons)/yr
Commercial	WC-1	Office	5,880	14.5	62.1
Residential	WR-1	Residential	520	0.39	0.931
Residential	WR-2	Residential	520	0.39	0.931
Residential	WR-3	Residential	520	0.39	0.931
Residential	WR-4	Residential	520	0.39	0.931
Residential	WR-5	Residential	520	0.39	0.931
Residential	WR-6	Residential	520	0.39	0.931
Residential	WR-7	Residential	520	0.39	0.931
Total for Site			**9,520**	**18**	**69**

In addition to carbon and NOx, natural gas fired engines and turbines emit negligible amounts of sulfur oxides (SOx), particulates and hydrocarbons. The figures provided above for these negligible pollutants are derived from the United States Environmental Protection Agency (EPA) document titled "AP-42" and related EPA reference documents. AP-42 is a collection of emission factors for different emission sources. The emission factors found in AP-42 provide generally accepted means of estimating emissions when more representative data is not available[4].

[2] These dimensions and velocities are ballpark estimates. A detailed stack design study would be required to pinpoint the correct values. Stack design is complicated, as it needs to accommodate a wide range of flow rates and temperatures.

[3] Based on the United States Environmental Protection Agency (EPA) document titled "AP-42" or other appropriate EPA reference documents. AP-42 is a collection of emission factors for different emission sources. The emission factors found in AP-42 provide a generally accepted way of estimating emissions when more representative data are not available. The most recent version of AP-42 (dated April 2000) can be found at: http://www.epa.gov/ttn/chief/ap42/ch03/index.html and were used here to determine emissions levels for air pollutants beyond NOx and CO.

[4] The most recent version of AP-42 (dated April 2000) can be found at: http://www.epa.gov/ttn/chief/ap42/ch03/index.html

More specific data was not available from the equipment manufacturers for these pollutants. A particular engine or turbine's SOx emissions will depend on the amount of sulfur in the specific batch of natural gas used. This quantity would be significantly lower that found in fuel oil. The particulate and hydrocarbon emissions depend largely on the type of lubricating oil used at the site.

Next Steps

RG WRY LLC's next step to incorporate tri-generation into The Hudson Yards development would be to develop a financing strategy. Once the financing is understood, the developer could proceed with designing the systems. The systems should be designed in concert with each building's schematic design to optimize the layout and operational efficiency of the tri-generation system, thereby maximizing the rate of return on investment.

Glossary

Baseline Rate – electric, steam or gas rates that would be used for building without onsite generation.

CO – carbon monoxide

Contract Demand – a component of the standby rate is based on the maximum demand of the building (or complex) over an 11 or 12 month period. This component is a fixed monthly charge regardless of whether the onsite generation operates or not.

District Energy -- District energy systems produce electricity, hot water, steam and/or chilled water at a central plant and then distribute the energy through underground wires and pipes to adjacent buildings connected to the system.

Distribution system – the network of electric cables, switchgear, transformers, hot water piping, chilled water piping, valves, and pumps needed to distribute energy across the site and between buildings.

Energy conservation and sustainable programs – programs to reduce energy consumption and to add renewable generation can be used to help fund some of the district energy infrastructure.

HAP – Hazardous Air Pollutant as defined by Section 112(b) of the Clean Air Act.

IRR – Internal Rate of Return. Endurant calculated the IRR based on unlevered cash flows, which are the negative cash flows representing costs to build the project and the positive cash flows from the net operating income of the project. This unlevered IRR does not include the effect of financing or taxes.

LEED – Leadership in Energy and Environmental Design.

Market Services – Revenue from special programs offered by the utility or New York ISO. This primarily includes revenue for demand response programs.

O&M – Operations and Maintenance – This includes routine maintenance, overhauls, and management fees.

Off-peak electricity – electricity delivered on weekends or weekdays from 10 pm to 8am, EST.

On-peak electricity – electricity delivered weekdays from 8am to 10pm, EST

Payback – Endurant used a payback method to calculate the number of years required, at estimated annual cash flows for each year, to payback the capital costs. This method was used to account for the impact of reduced occupancy after initial construction.

Platform – The Rail Yard development is being built over the existing Penn Station rail yard with four sub-floors below a main platform that will serve as the main access level with streets, pedestrian walkways, and green space.

PM 2.5 - particulate matter found in exhaust with a mean aerodynamic diameter less than 2.5 microns. The number reported here also included condensable particulate matter, which is particulate matter or droplets that form outside of the exhaust stack after the exhaust condenses.

PM 10 - particulate matter found in exhaust with a mean aerodynamic diameter less than 10 microns. The number reported here also included condensable particulate matter, which is particulate matter or droplets that form outside of the exhaust stack after the exhaust condenses.

Standby Rate – the electric, gas or steam rates that apply to a building that has onsite generation but still relies on the utility for a portion of their energy needs. This rate typically applies to all electric power, steam, or gas purchased for the building.

Standby Sales – this accounts for backup power sales to tenants in the building. If the tri-generation plant is designed to do so, it can provide back up power to subscribed customers when grid power goes down.

SOx – oxides of sulfur. These are a contributor to acid rain. This pollutant is typically very low in natural gas fired equipment.

Tri-generation - the simultaneous generation of electricity, heating, and/or chilled water at a cluster of buildings or a single building.

Table of Contents

Disclaimer 2
Executive Summary 3
Financing Options 3
Tri-Generation Systems 4
Operating Strategy 5
Energy Cost and Environmental Benefits 6
Economics 6
Building Interfaces 7
Permitting 7
Emissions and Exhaust Stacks 7
Next Steps 9
Glossary 10
Table of Contents 12
Table of Figures 14
Table of Tables 14
1 Purpose 15
2 Approach 15
2.1 Modeling 15
2.2 Optimization 15
2.3 Con Edison Rates 16
2.4 System Costs 16
2.5 Assumptions 17
3 Results of Analysis 18
3.1 Commercial: A Single Commercial Tower 18
3.1.1 Baseline Energy Model 18
3.1.2 Tri-Generation Energy Savings 19
3.1.3 Savings/Profit Potential 20
3.1.4 Cost Estimates ..... **Error! Bookmark not defined.**
3.1.5 Payback 21
3.1.6 Environmental Results 22
3.1.7 Space and Interface Requirements 22
3.1.8 Conclusions 23
3.2 Residential: A Single Residential Tower 24

3.2.1 Baseline Energy Model 24
3.2.2 Tri-Generation Energy Savings 25
3.2.3 Savings/Profit Potential 26
3.2.4 Cost Estimates 27
3.2.5 Payback 27
3.3 Environmental Results 27
3.3.1 Space and Interface Requirements 28
3.3.2 Conclusions 29
4 Financing and Ownership 30
4.1 Build-Own-Operate-Maintain (BOOM) 30
4.2 Build-Own-Operate-Transfer (BOOT) 30
4.3 Joint Venture (JV) 31
4.4 Design-Build-Operate-Maintain (DBOM) 31
Appendix A: Project Background 32
East/West Rail Yard Overview 32
Western Rail Yard (WRY) 33
Special Features of the Proposal 33
Appendix B: Site Building Layout 34

Table of Figures

Figure 1: Commercial Case profiles for winter and summer electric and natural gas demands. 18
Figure 2: Preliminary Commercial Case on and off peak electricity consumption. 19
Figure 3: Preliminary Commercial Case natural gas consumption by month. 19
Figure 4: Residential Case profiles for winter and summer electric and natural gas demands 25
Figure 5: Preliminary Residential Case On and Off Peak Electricity Consumption 25
Figure 6: Preliminary Residential Case Natural Gas Consumption by Month 25
Figure 7: Potential Financing and Ownership Models 30

Table of Tables

Table 1 - Summary of Energy Cost and Environmental Benefits 6
Table 2: First Cost, Payback and IRR 6
Table 3: Plant footprints 7
Table 4: Exhaust Stack and Emissions for each Case, individually 8
Table 5 - Site and Building Emissions 8
Table 6 Summary of Energy Analysis Assumption 17
Table 7: tri-generation Energy Savings for Commercial Case 20
Table 8: Typical Energy Cost Savings for Commercial Case 20
Table 9: Estimated Costs for Commercial Case 21
Table 10: Commercial Case Payback 22
Table 11: Commercial Case Environmental Results 22
Table 12: Commercial Case Space and Interface Requirements 22
Table 13: tri-generation Energy Savings for Residential Case 26
Table 14: Typical Energy Cost Savings for Residential Case 26
Table 15: Estimated Costs for Residential Case 27
Table 16: Residential Case Payback 27
Table 17: Residential Case Environmental Results 28
Table 18: Residential Case Space and Interface Requirements 28
Table 19: Rail Yard Building Plan 33

1 Purpose

The purpose of this Tri-generation Feasibility Study is to determine the economic return, emissions, building space impacts, and energy savings associated with two tri-generation scenarios for The Western Rail Yard development, based on two prototypical building energy models.

1. Endurant and RG WRY LLC defined the two scenarios after determining one large-scale district energy plant supplying the entire Western Rail Yard proposed development was not economically feasible. The two scenarios were defined as follows: (1) A "Commercial" scenario, in which a tri-generation system is designed and sized to fit in and serve a standalone commercial office tower. (2) A "Residential" scenario, in which a tri-generation system is designed and sized to fit in and serve a standalone residential or hotel tower.

2 Approach

The Endurant-led team developed hourly building energy models, tri-generation system concepts, rough cost estimates, space requirements, financial pro forma, and criteria pollutant emissions for each scenario using the following proposed buildings as model cases.

- **Commercial Scenario:** Tri-generation for a single prototypical commercial tower
- **Residential Scenario:** Tri-generation for a single prototypical residential tower scenario.

2.1 Modeling

Endurant used a combination of building energy models and actual building data to establish the baseline 8,760 hour energy consumption for each case. Model data for the WR1 residential tower was provided by Viridian Energy & Environmental, LLC.

2.2 Optimization

The specific tri-generation systems (e.g. equipment selection and sizing) designed for each building case was initially guided by the desire to maximize carbon emission reductions while bounding the payback to 7-years at maximum. A 7-year payback corresponds to an IRR of approximately 13% over 30 years. Endurant typically designs tri-generation systems to achieve a 5-year payback, the maximum most developers will accept, but because RG WRY LLC indicated carbon was also a priority, Endurant extended the payback to 7 years to yield greater carbon reductions from the systems. RG WRY LLC's dual focus on carbon reduction and cost effectiveness also led Endurant to assume the tri-generation systems would be operated during Peak Electrical Demand periods exclusively, rather than continuously as is more common for co-generation systems. Operating natural gas-fueled tri-generation systems during Off-peak periods can be more expensive than purchasing the equivalent energy from the grid, depending on the cost of natural gas relative to electricity. Further, based on a preliminary assessment of eGRID data it appears that during Off-Peak periods, a greater portion of New York State power is generated from nuclear and large-scale hydroelectric power plants, which have lower GHG emissions than natural gas-fueled onsite tri-generation. The precise source mix used in New York City during Peak and Off-Peak hours has not been evaluated in detail.

Subsequent to this study's initial report, RG WRY LLC better informed Endurant's assumptions about the plant's construction, which increased the system's first cost and delayed its operation, extending the projected payback from 7 years to 9 years. Specifically, RG WRY LLC asked Endurant to include an estimated cost for an exhaust stack where one would be required. Endurant had previously excluded exhaust stacks from the economic analysis because they are difficult to estimate without an exhaustive design undertaking. RG WRY LLC also clarified that the tri-generation systems would be built concurrently with the buildings, not as a retrofit. Endurant's initial report assumed the systems would be installed after the building was completed and at least 90% occupied, at which point the tri-generation systems would be able to operate at full capacity (maximum cost efficiency) from day one of operation. RG WRY LLC believed such an approach would increase construction costs significantly and disrupt the development's tenants unnecessarily. When built concurrently with the building, a tri-generation system will sit idle for two years while the building's construction is substantially completed, and then ramp up over the next three years with the building's occupancy (and demand for power, chilled water and hot water) increases.

2.3 Con Edison Rates

Endurant calculated project revenue as the difference between the cost of purchasing all of the development's energy from Con Edison at Market rates and the cost to operate and maintain the tri-generation systems and purchase the remaining energy needed from Con Ed at Standby rates. Market rates are based on day-ahead location-based marginal electricity pricing (LBMP). In reality, a portion of the energy for both scenarios could be, and will likely be, purchased from a third party as part of a long term energy supply contract. The variables associated with this sort of energy purchasing are too great to factor into the analysis at this stage, and it is unlikely that the conclusions reached would be significantly different.

All electricity purchased from Con Ed on a meter with a tri-generation system is billed according the Standby rate schedule (SC14RA Rate II, Rider M). The Standby rates are generally a little lower than Market rates (SC4 Rate II schedule, accounting for LBMP.) Also, the Standby rate includes a fixed monthly contract demand component and daily demand charges, while the Market rate has monthly demand charges. The feasibility analysis assumes tenants would never be billed more for the energy produced by the tri-generation plant than they would otherwise pay for energy direct from Con Ed.

Natural gas purchased from Con Ed on a meter with a tri-generation system is purchased under Rider H of the SC 2 rate schedule. Rider H discounts the natural gas cost relative to the Market rate.

Important note: For tenants to realize the cost savings of tri-generation, all electricity must be purchased through the same meter to which the tri-generation system is hooked up and billed through the Owner of that meter.

2.4 System Costs

The costs for the Commercial and Residential scenarios analyzed include all of the expected costs for installing a tri-generation system and tying into the normally required HVAC system.

The costs assume the tri-generation plants are built during the construction phase of the building.

The costs do not reflect any base building HVAC system savings as Endurant does not recommend reducing the size of the standard HVAC equipment that would normally be installed because a tri-generation plant is being installed. Though some of the HVAC system may not be used when the tri-generation plant is operating, the tri-generation system may need to be taken offline periodically (assume 24 hours each month) for repairs, at which point the building should be able to operate standalone.

The Commercial building tri-generation system requires exhaust stacks, for which ballpark costs have been included. The assumptions used to size these stacks should be revisited during each building system's conceptual design process and the costs recalculated. The Residential case uses microturbines, which do not require the exhaust to be routed to the roof.

Estimated system costs are based on current pricing as of November 2008 and are subject to change.

2.5 Assumptions

TABLE 6 SUMMARY OF ENERGY ANALYSIS ASSUMPTION

Assumption	Value
Construction Type	New Construction, tri-gen plant built concurrently with building
Construction Time	2 years. No operation assumed during this time.
Operational phasing	40% at commissioning (year 3), increasing linearly to 100% by year 5.
Space Heating System On	1-Nov
Space Heating System Off	15-Apr
Chiller System On	1-May
Chiller System Off	15-Oct
Availability	1 outage per month lasting 24 hours (~95% availability)
Run Hours	8 AM to 10 PM, Monday to Friday, Off on Holidays
Contract Demand	Full contract demand assumed. Reducing the contract demand by 2MW for the Commercial case could increase annual savings by $200,000. This has a minimal impact on the IRR while adding significant financial risk to the project. ConEd applies significant penalties if the contract demand is exceeded.
Escalations	No revenue, expense, or commodity price escalation assumed. It is assumed that gas and electric commodity prices will continue to track each other linearly, as they have for the last 5 years. In general, revenue and expense items escalate with inflation. The ratio of revenue to expenses is such that any increase in inflation improves the IRR by an equal percentage.
Baseline Electric Rates	SC4, Rate II used for base case (no tri-generation)
Standby Electric Rates	SC 14RA, Rider M used for tri-generation cases
Gas Rates	SC 2, Used Rider H for tri-generation fuel
Taxes	No sales or income taxes assumed. These are highly dependent on the final deal structure and this provides most neutral assumption for now.

3 Results of Analysis

3.1 Commercial: A Single Commercial Tower

Tri-generation was evaluated for a prototype Western Rail Yard commercial tower. The optimal configuration used three (3) Caterpillar 3520s with heat recovery and an absorption chiller. As discussed in the earlier **Optimization** section of this report, the preliminary consideration of the plant's operating scheme indicates that it would be most favorable to operate the systems during Con Edison's Peak Electricity Demand period only.

3.1.1 Baseline Energy Model

Figure 1 shows typical hourly demand profiles for electricity and natural gas use for the Commercial case for the first (winter) and third (summer) quarters of the year. Figures 5 and 6 (page 22) provide monthly electric and natural gas use. The hourly electric load profile for the prototype commercial tower was much flatter than the Residential case. The natural gas loads for the building are fairly flat on an hourly basis but vary significantly from season to season as they are about 7 or 8 times less in the summer than in the winter. The peak aggregated electric demand is 11 MW in the summer and just under 9 MW in the winter. The base load power requirement for the building is about 4 MW. It should be noted that certain types of tenants can change the load profile and peak load demands. For instance, adding a large data centre will increase the base load electricity demand and contingencies for this type of tenant should be addressed during the conceptual design phase of development.

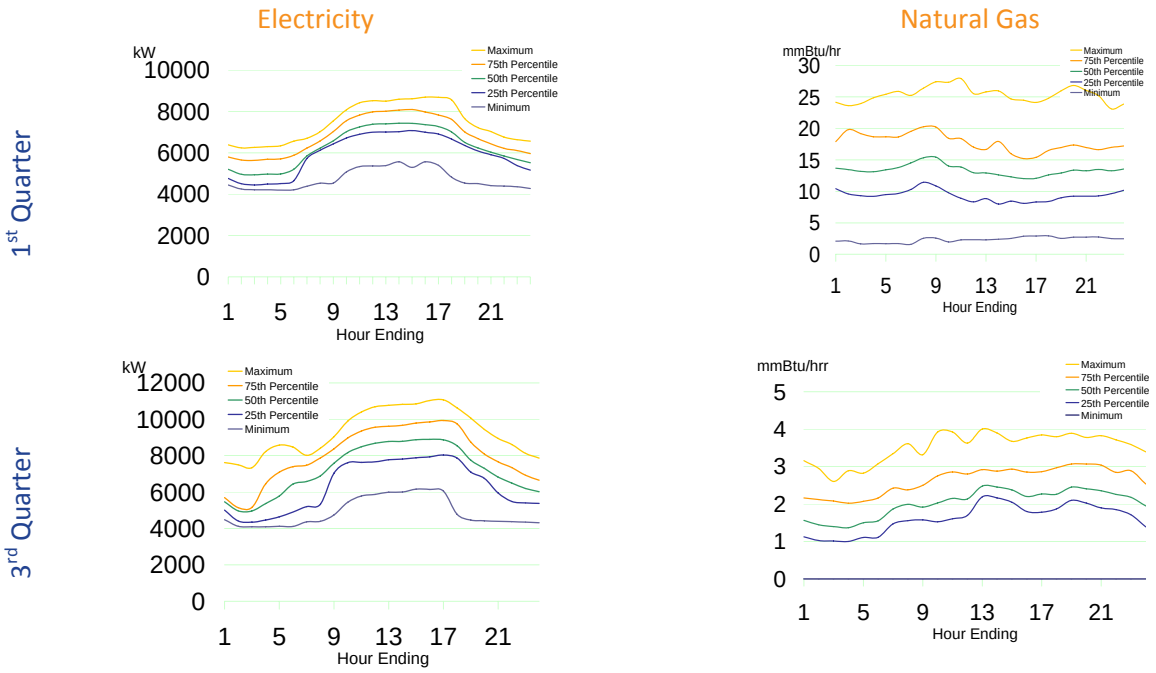

FIGURE 1: COMMERCIAL CASE PROFILES FOR WINTER AND SUMMER ELECTRIC AND NATURAL GAS DEMANDS.

Demand for electricity is highest in the summer months when demand for hot water is lowest. An absorption chiller improves the thermal efficiency in the summer by providing a thermal load, beyond what the building would otherwise use, for the waste heat generated by the tri-generation system's power generation plant. The system's efficiency is lowest in the shoulder months when the building's need for both heat and cooling is relatively low so not all of the waste heat can be utilized

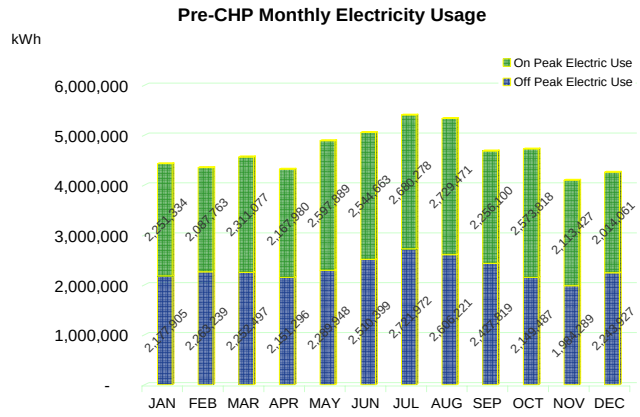

FIGURE 2: PRELIMINARY COMMERCIAL CASE ON AND OFF PEAK ELECTRICITY CONSUMPTION.

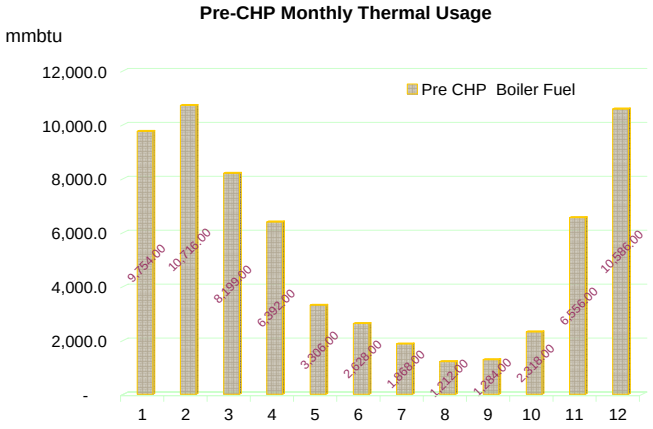

FIGURE 3: PRELIMINARY COMMERCIAL CASE NATURAL GAS CONSUMPTION BY MONTH.

3.1.2 Tri-Generation Energy Savings

Table 7 (following page) shows the results of energy calculations for the Commercial prototype system. The first five rows of the table show the rated output, rated heat rate, and estimated maximum instantaneous outputs of the tri-generation system. The outputs are net of standard de-rating factors used by Endurant for tri-generation projects to account for typical installation effects and differences between manufacturers' name plate ratings and actual outputs of the equipment. The next two rows show the estimated annual purchased electricity from the grid and the annual electricity produced by the system. Similarly, the next four rows show the estimated annual hot water produced by the

supplemental boilers and chillers and the hot water and chilled water produced by the tri-generation system.

TABLE 7: TRI-GENERATION ENERGY SAVINGS FOR COMMERCIAL CASE

	Baseline	Tri-Generation
Rated Output, kW	-	6,100
Heat Rate, btu/kW HHV	-	10,000
Max Net Electric Output, kW	-	5,900
Max Hot Water Output, mmBtu	-	24
Max Chilled Water Output, tons	-	1,200
Annual Purchased Electricity, kWh	-	56,616,000
Annual Electricity Produced, kWh	-	35,292,000
Annual Supplemental Boiler Load, mmBtu	55,000	37,000
Annual Tri-gen HW Produced, mmBtu	-	18,000
Annual Supplemental Chiller Water, ton-hrs	8,734,000	7,036,000
Annual Tri-gen Chiller Water Produced, ton-hrs	-	1,697,000
Annual HHV Efficiency	-	57.2%*
Annual Source Energy, mmBtu	710,000	657,000

* Although the Commercial prototype system did not meet NYSERDA's efficiency criteria of 60% based on the fuel higher heating value, it is Endurant's opinion that the projected system efficiency of 57% can be improved through scheduling, thermal load following and design refinements. As such, a NYSERDA grant was assumed to be available.

3.1.3 Savings/Profit Potential

Table 8 shows typical pre and post tri-generation energy use, costs, and savings for the Commercial case. In this analysis, the hot water was valued based on costs of natural gas needed to heat the water. The Western Rail Yard is not currently served by Con Ed steam and using steam to generate hot water would be more expensive than generating it with natural gas fired boilers.

TABLE 8: TYPICAL ENERGY COST SAVINGS FOR COMMERCIAL CASE

Energy	Pre Tri-gen	Post Tri-gen	Pre Tri-gen $	Post Tri-gen $	Savings
steam, mlb	-	-	$ -	$ -	$ -
steam demand, mlb/hr	-	-	$ -	$ -	$ -
steam standby, mlb/hr	-	-	$ -	$ -	$ -
Electric on peak, kWh	28,837,000	7,513,000	$ 3,594,000	$ 745,000	$ 2,849,000
Electric off peak, kWh	27,779,000	27,779,000	$ 1,865,000	$ 1,865,000	$ -
monthly demand charges, kW	10,000	9,000	$ 3,768,000	$ -	$ 3,768,000
daily demand charges, kW	10,000	3,000	$ -	$ 638,000	$ (638,000)
Standby charges, kW		11,000	$ -	$ 1,009,000	$ (1,009,000)
gas/supp gas, mmBtu	65,000	43,000	$ 658,000	$ 445,000	$ 213,000
engine fuel, mmBtu	-	211,000	$ -	$ 2,182,000	$ (2,182,000)
operation and maintenance	-	-	$ -	$ 491,000	$ (491,000)
Total Energy Costs			**$ 9,885,000**	**$ 7,375,000**	**$ 2,510,000**

3.1.4 Potential "Clustering"

The commercial tower's tri-generation system efficiency and energy cost savings could be increased by interlocking any adjacent residential towers into the commercial tower's system. The residential towers' demand schedules would be suitably complementary to that of the commercial tower to enable the commercial tower to feed the residential building's loads without a significant, if any, increase to the size of the commercial building system. For this scenario to be cost effective, the interconnection and distribution costs would need to be reasonable. --The first cost, energy cost savings, emissions and space requirements of this "Residential Tower Piggy Back" scenario will be studied in detail once design begins on the buildings proposed for the Western Rail Yards. For the purposes of the Western Rail Yards Environmental Impact Statement (EIS), the potential emissions profile of a "Residential Piggy Back" scenario would be less than if the Residential building had its own dedicated tri-generation system, the model studied in this report.

Table 9 shows cost estimates for the Commercial case. These costs are for the installation of the tri-generation plant in the building and the connection of the plant to the building's energy distribution systems.

TABLE 9: ESTIMATED COSTS FOR COMMERCIAL CASE[5]

Category		Cost $
Major Equipment		
	Engine Generation	**$ 2,143,000**
	Heat Recovery Heat Exchangers	**$ 488,000**
	Absorption Chiller	**$ 1,200,000**
	Synchronizing Switchgear.	**$ 608,000**
	Substation and Dist. Gear	**$ 666,000**
	Power Convertors	**$ 1,638,000**
	Gas Booster Compressors	**$ 451,000**
	Packaging	**$ 1,736,000**
Labor		**$ 7,913,000**
General Conditions[6]		**$ 1,694,000**
Other[7]		**$ 3,299,000**
Exhaust Stack		**$800,000**
Gross Project Cost		**$ 22,636,000**
NYSERDA Incentive		**$ 2,158,000**
Net Project Cost		**$ 20,478,000**

3.1.5 Payback

If it were possible to install the tri-generation plant as a retrofit, it would take just 6.9 years for the plant's annual energy savings of $2.5 million to recover the $19.7 million capital investment. However,

[5] Costs are based on current pricing as of November 2008 and are subject to change.

[6] General Conditions include estimated costs for tri-generation plant building permit, interconnect, freight, miscellaneous materials, air permit and contingency.

[7] Other includes costs for engineering, development fees, construction management fees, and transaction fees.

in a new construction scenario, the plant is constructed at the base of the building and then left idle for two years while the building's construction is substantially completed. Then the IRR and payback scenario assumes the building's occupancy ramps up from 40% to 100% over the next three years. The plant is assumed to operate at full capacity once the building is 90% occupied. These assumptions extend the payback to 11.3 years.

TABLE 10: COMMERCIAL CASE PAYBACK

	New Construction
Annual Energy Savings	$ 2,500,000
Owners Plant Costs	$ 20,480,000
IRR	8.0%
Payback, years	11.3

3.1.6 Environmental Results

Environmental results for the Commercial prototype system are shown in Table 11. This case meets NOx and CO emission requirements without special emission controls.

TABLE 11: COMMERCIAL CASE ENVIRONMENTAL RESULTS

Prime Mover Generated NOx, ton/year	14.5
Prime Mover Generated CO, ton/year	62.1
Prime Mover Generated PM 2.5 ton/year	1.038
Prime Mover Generated PM 10, ton/year	1.038
Prime Mover Generated HAP, ton/year	7.621
Prime Mover Generated CO2, ton/year	15,000
Source Btu Reduction	7.6%
Endurant Estimated Carbon Reduction	6.2%

3.1.7 Space and Interface Requirements

Interface requirements for the Commercial case are shown in Table 12. Important installation notes are shown below the table.

TABLE 12: COMMERCIAL CASE SPACE AND INTERFACE REQUIREMENTS

Interface Requirement	Amount	Comments
Width, ft	85	
Length, ft	200	
Height, ft	26	
Net Electrical Output, kW	5,900	
Generator Output Voltage	13kV	Voltage can be change to whatever is needed
Net Electrical Input, kW	250	Only required when plant is starting
Input Voltage		Only required when plant is starting
Hot Water Output, mmBtu	24	
Hot Water Outlet Temperature, F	210	

Interface Requirement	Amount	Comments
Hot Water Return Temperature, F	190	
Hot Water Flow, gpm	2,400	
Net Chilled Water Output, tons	1,200	
Chilled Water Outlet Temperature, F	49	
Chilled Water Return Temperature, F	55	
Chilled Water Flow, gpm	4,800	
Engine 1 Exhaust Flow, lb/s	8.5	
Engine 1 Exhaust Temp, F	893	
Engine 1 Exhaust Stack Inlet Diameter, ft	1.5	
Engine 1 Exhaust Stack Outlet Diameter, ft	1	
Engine 2 Exhaust Flow, lb/s	8.5	
Engine 2 Exhaust Temp, F	893	
Engine 2 Exhaust Stack Inlet Diameter, ft	1.5	
Engine 2 Exhaust Stack Outlet Diameter, ft	1	
Engine 3 Exhaust Flow, lb/s	8.5	
Engine 3 Exhaust Temp, F	893	
Engine 3 Exhaust Stack Inlet Diameter, ft	1.5	
Engine 3 Exhaust Stack Outlet Diameter, ft	1	
Condenser Water Heat Rejection, mmBtu	27.4	Max heat rejection to condenser water
Condenser Water Heat Rejection Flow, gpm	3,700	Max heat rejection to condenser water
Condenser Water Heat Rejection Outlet Temp, F	100	Max heat rejection to condenser water
Condenser Water Heat Rejection Return Temp, F	85	Max heat rejection to condenser water
Access Doors (W x H)	10 x 10	For installing and replacing major equipment
Combustion Air Inlet Flow, scfm	19,000	Not cooled
Engine Room Ventilation Inlet Flow, scfm	145,000	Use ambient air temp, no cooling
Engine Room Ventilation Outlet Flow, scfm	145,000	Use ambient air temp, no cooling
Gas Booster Room Ventilation Inlet, scfm	9,600	Assumes 6 air turns per minute, use ambient air temp, no cooling
Gas Booster Room Ventilation Outlet, scfm	9,600	Assumes 6 air turns per minute, use ambient air temp, no cooling

Installation Note: Individual engine exhaust ducting should remain separate from each other to prevent damage due to exhaust backflow when one unit is down and the other units are running. The separate exhaust ducting can go up through a common chimney or shaft.

3.1.8 Conclusions

The prototypical Commercial building system provided higher GHG emission reduction, energy efficiency, and economic returns than the prototypical Residential building system.

As noted in the Savings/Profit Potential paragraph, the commercial tower's tri-generation system efficiency and energy cost savings could be increased by interlocking any adjacent residential towers into the commercial tower's system. The residential towers' demand schedules would be suitably complementary to that of the commercial tower to enable the commercial tower to feed the residential building's loads without a significant, if any, increase to the size of the commercial building system. For this "Residential Tower Piggy Back" scenario to be cost effective, the interconnection and distribution costs would need to be reasonable.

Endurant recommends utilization of the Caterpillar 3500 series engines for the commercial buildings. Certain European engines from Caterpillar and other manufacturers have efficiencies approaching 45%

which can reduce the carbon output from the engines and source energy BTUs of the building several more percentage points. Endurant did not recommend these engines because they are much larger (6 to 8 MW), making them more costly to install on a per kW basis. The smaller Caterpillar engines can be pre-packaged in modules. The European engines are too large to pre-package so all of the installation labor has to be performed at the site and rigging and maintenance are more difficult. Endurant has had good experiences with Caterpillar 3500 series engines.

3.2 Residential: A Single Residential Tower

Tri-generation was evaluated for prototypical Western Rail Yard residential tower. The optimal configuration for this case used a C600 micro-turbine package from UTC. This package includes three (3) Capstone 200 kW micro-turbines in one enclosure and an absorption chiller on a separate skid. The absorption chiller is capable of producing both hot and chilled water. As with the commercial building analysis, it was assumed that the turbines would be operated only during Con Ed's Peak Electricity Demand periods.

3.2.1 Baseline Energy Model

Figure 4 below shows typical hourly demand profiles for electricity and natural gas use for the Residential case for the first (winter) and third (summer) quarters of the year. Figures 8 and 9 (following page) show monthly electricity and natural gas use. The hourly electric load profile for the prototypical residential building has two peaks, one in the morning and one in the evening. The electric loads at midday are almost as low as the baseload during the middle of the night. Though larger plant sizes were evaluated, the optimal size was close to the baseload of approximately 600 kW. A plant larger than the baseload did not produce favorable economic returns because it can only produce higher output during a few hours of the day and therefore could not pay for itself. The peak aggregated electric demand is 1,800 kW in the summer and 1,300 MW in the winter.

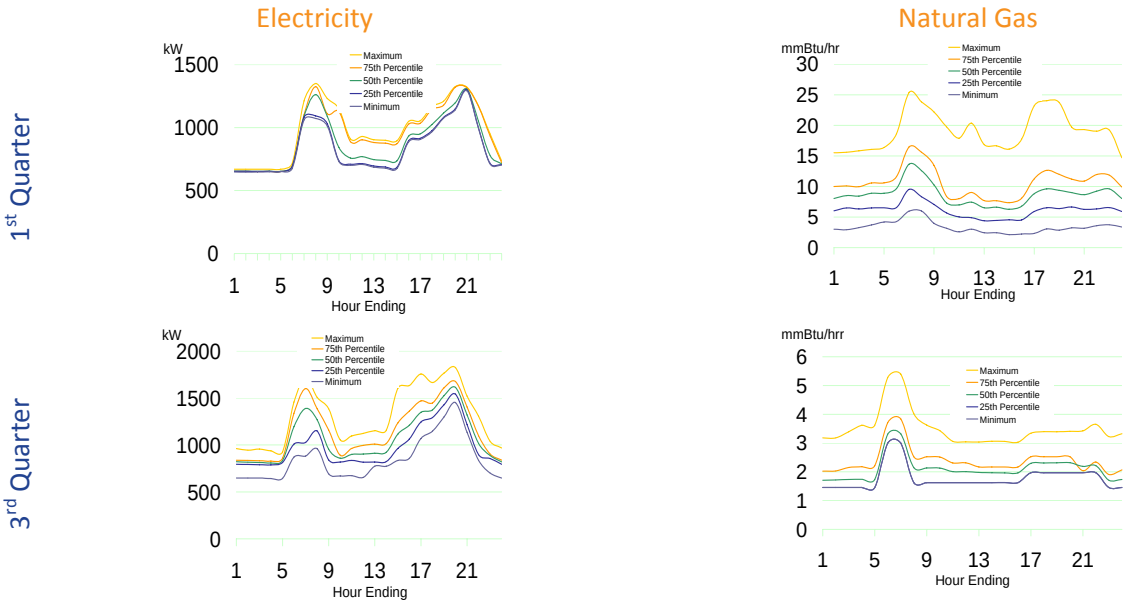

FIGURE 4: RESIDENTIAL CASE PROFILES FOR WINTER AND SUMMER ELECTRIC AND NATURAL GAS DEMANDS

As with the other case, the shoulder months had the lowest efficiency because the building consumes less hot water than what the turbines are capable of producing and ambient weather is not warm enough to use a substantial proportion of the chiller output.

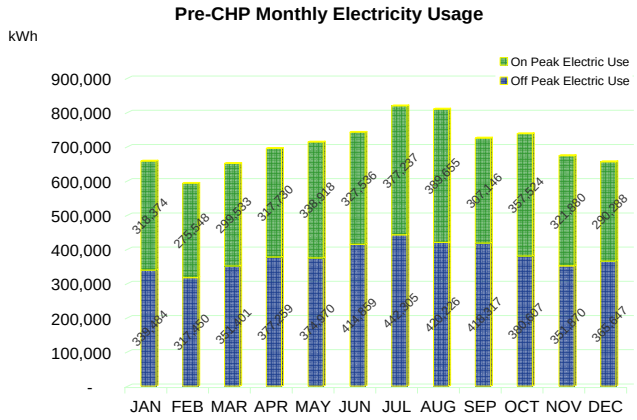

FIGURE 5: PRELIMINARY RESIDENTIAL CASE ON AND OFF PEAK ELECTRICITY CONSUMPTION

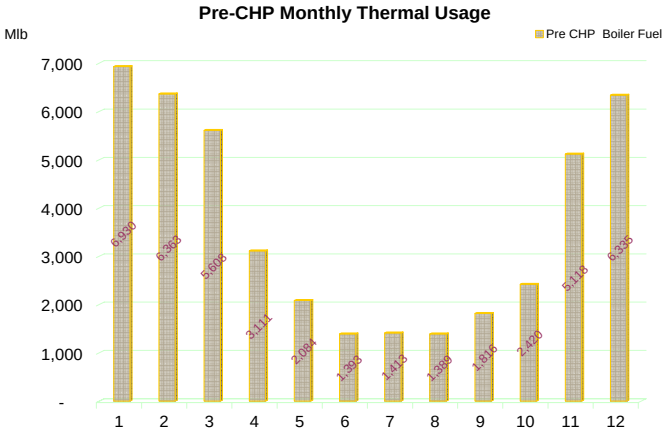

FIGURE 6: PRELIMINARY RESIDENTIAL CASE NATURAL GAS CONSUMPTION BY MONTH

3.2.2 Tri-Generation Energy Savings

Table 13 shows the results of energy calculations for the prototypical Residential building. The first five rows of the table show the rated output, rated heat rate, and estimated maximum instantaneous outputs of the tri-generation system. The outputs are net of standard de-rating factors used by Endurant for tri-generation projects to account for typical installation effects, and differences between manufacturers name plate ratings and actual outputs of the equipment. The next two rows show the estimated annual purchased electricity from the grid and the annual electricity produced by the system.

Similarly, the next four rows show the estimated annual hot water produced by the supplemental boilers and chillers and the hot water and chilled water produced by the tri-generation system. The efficiencies in this case were not as high.

TABLE 13: TRI-GENERATION ENERGY SAVINGS FOR RESIDENTIAL CASE

	Baseline	Tri-Generation
Rated Output, kW	-	600
Heat Rate, btu/kW HHV	-	11,800
Max Net Electric Output, kW	-	520
Max Hot Water Output, mmBtu	-	2
Max Chilled Water Output, tons	-	253
Annual Purchased Electricity, kWh	8,486,000	6,621,000
Annual Electricity Produced, kWh	-	1,703,000
Annual Supplemental Boiler Load, mmBtu	37,000	34,000
Annual Tri-gen HW Produced, mmBtu	-	3,200
Annual Supplemental Chiller Water, ton-hrs	1,705,000	1,309,000
Annual Tri-gen Chiller Water Produced, ton-hrs	-	396,000
Annual HHV Efficiency	-	52.1%
Annual Source Energy, mmBtu	141,000	137,000

3.2.3 Savings/Profit Potential

Table 14 shows typical pre and post tri-generation energy use, costs, and savings for the prototypical Residential building tri-generation system. In this analysis, the hot water was valued based on the cost of natural gas needed to heat the water. The Hudson Yards does not currently have Con Ed steam and using steam to generate hot water would be more expensive than generating it with natural gas fired boilers.

TABLE 14: TYPICAL ENERGY COST SAVINGS FOR RESIDENTIAL CASE

	Pre Tri-gen	Post Tri-gen	Pre Tri-gen $	Post Tri-gen $	Savings
steam, mlb	-	-	$ -	$ -	$ -
steam demand, mlb/hr	-	-	$ -	$ -	$ -
steam standby, mlb/hr	-	-	$ -	$ -	$ -
electric on peak, kWh	3,932,000	1,932,000	$ 490,000	$ 202,000	$ 288,000
electric off peak, kWh	4,554,000	4,554,000	$ 305,000	$ 305,000	$ -
monthly demand charges, kW	1,600	1,500	$ 614,000	$ -	$ 614,000
daily demand charges, kW	1,600	900	$ -	$ 211,000	$ (211,000)
standby charges, kW	-	1,900	$ -	$ 171,000	$ (171,000)
gas/supp gas, mmBtu	44,000	40,000	$ 449,000	$ 411,000	$ 33,000
engine fuel, mmBtu	-	23,000	$ -	$ 245,000	$ (245,000)
operation and maintenance	-	-	$ -	$ 43,000	$ (43,000)
Total Energy Costs	**-**	**-**	**$ 1,858,000**	**$ 1,588,000**	**$ 265,000**

3.2.4 Cost Estimates

Table 15 shows cost estimates for the prototypical Residential building tri-generation system. These costs are for the installation of a tri-generation plant in the building and include costs for connecting to the building's energy distribution systems.

TABLE 15: ESTIMATED COSTS FOR RESIDENTIAL CASE[8]

Category		Cost $
Major Equipment		
	Turbine Package	$ 1,020,000
	Absorption Chiller	$ 207,000
	Substation and Dist. Gear	$ 59,000
Total Major Equipment		$ 1,286,000
General Conditions[9]		$ 151,000
Other[10]		$ 407,000
Gross Project Cost		$ 1,844,000
NYSERDA Incentive		$ -210,000
Net Project Cost		**$ 1,634,000**

3.2.5 Payback

If it were possible to install the tri-generation plant as a retrofit, it would take just seven years for the plant's annual energy savings of $270,000 to recover the $2.4 million capital investment. However, in a new construction scenario, the plant is constructed at the base of the building and then left idle for two years while the building's construction is substantially completed. Then the IRR and payback scenario assumes the building's occupancy ramps up from 40% to 100% over the next three years. The plant is assumed to operate at full capacity once the building is 90% occupied. These assumptions extend the payback to 9.2 years.

TABLE 16: RESIDENTIAL CASE PAYBACK

	New Construction
Annual Energy Savings	$ 270,000
Owners Plant Costs	$ 2,370,000
IRR	10.0
Payback, years	9.2

3.3 Environmental Results

[8] Costs are based on current pricing as of November 2008 and are subject to change.

[9] General Conditions include estimated costs for Tri-Gen plant building permit, interconnect, freight, miscellaneous materials, air permit and contingency.

[10] Other includes costs for engineering, development fees, construction management fees, and transaction fees.

Environmental results for the Residential case are shown in Table 17. This case has lower NOx and carbon emissions than the Commercial scenario because the plant is much smaller. Consequently, the plant also displaces less grid power, thereby limiting its potential benefit relative to the Commercial scenario as well.

TABLE 17: RESIDENTIAL CASE ENVIRONMENTAL RESULTS

Prime Mover Generated NOx, ton/year	0.352
Prime Mover Generated CO, ton/year	0.931
Prime Mover Generated PM 2.5 ton/year	0.076
Prime Mover Generated PM 10, ton/year	0.076
Prime Mover Generated HAP, ton/year	0.012
Prime Mover Generated CO2, ton/year	1,400
Source Btu Reduction	2.7%
Endurant Estimated Carbon Reduction	5.4%

3.3.1 Space and Interface Requirements

Interface requirements for the Residential case are shown in Table 18. Important installation notes are shown below the table.

TABLE 18: RESIDENTIAL CASE SPACE AND INTERFACE REQUIREMENTS

Interface Requirement	Amount	Comments
Width, ft	55	
Length, ft	100	
Height, ft	16	
Net Electrical Output, kW	520	
Generator Output Voltage	480V	
Net Electrical Input, kW	60	Only required when plant is starting
Input Voltage	480V	Only required when plant is starting
Hot Water Output, mmBtu	2.0	
Hot Water Outlet Temperature, F	210.0	
Hot Water Return Temperature, F	190.0	
Hot Water Flow, gpm	200	
Chilled Water Output, tons	253	
Chilled Water Outlet Temperature, F	49	
Chilled Water Return Temperature, F	55	
Chilled Water Flow, gpm	1,000	
C600 Exhaust Flow, lb/s	8.7	
C600 Exhaust Temp, F	565	
C600 Combined Exhaust Duct Inlet Diameter, ft	3	
C600 Combined Exhaust Duct Outlet Diameter, ft	2	
Condenser Water Heat Rejection, mmBtu	5.1	Max heat rejection to condenser water
Condenser Water Heat Rejection Flow, gpm	679	Max heat rejection to condenser water
Condenser Water Heat Rejection Outlet Temp, F	100	Max heat rejection to condenser water
Condenser Water Heat Rejection Return Temp, F	85	Max heat rejection to condenser water
Access Doors (W x H)	10 x 12	For installing and replacing major equipment
Combustion Air Inlet Flow, scfm	6,900	Not cooled

Interface Requirement	Amount	Comments
Engine Room Ventilation Inlet Flow, scfm	33,000	Use ambient air temp, no cooling
Engine Room Ventilation Outlet Flow, scfm	33,000	Use ambient air temp, no cooling
Gas Booster Room Ventilation Inlet, scfm	7,200	Assumes 6 air turns per minute, use ambient air temp, no cooling
Gas Booster Room Ventilation Outlet, scfm	7,200	Assumes 6 air turns per minute, use ambient air temp, no cooling

Installation Note: Individual prime mover exhaust ducting should remain separate from each other to prevent damage due to exhaust backflow when one unit is down and the other units are running. The separate exhaust ducting can go up through a common chimney or shaft.

3.3.2 Conclusions

The Residential case was did not perform as well as the commercial case in terms of GHG emission reduction, energy efficiency, and economic returns. The optimal size of the plant was close to the building's base load, which limited the benefits from tri-generation. In the Commercial case, the peak loads tended to be flatter, which allowed the power plant to be sized larger relative to the peak loads of the building.

Endurant also considered using small natural gas reciprocating engines but found that the Capstone C200 microturbine efficiency is on par with engines in the 600 to 800 kW size range. The microturbine has much lower emissions and an on board inverter with protective relay functions, making it less costly to install. These units also have a relatively small footprint. This microturbine uses air bearings so that an onsite oil supply and water cooling are not required, significantly reducing sub-system equipment and installation costs. The C200 microturbine is consider relatively new right now, but by the time The Hudson Yards development enters design, the system should be well tested.

4 Financing and Ownership

The most common financing structure for a tri-generation project is the formation of a separate project company ("Project Company"), which can be wholly or partially owned by the building(s) owner(s). In a few cases, third parties are called on to own the entire project company. Financing of the Project Company is proposed under a number of alternative structures, depending upon RG WRY LLC's preference for risk and reward. Below is a summary of the typical financing options. It is recommended that a third party, such as Endurant, represent the owner (RG WRY LLC) throughout the design/build and financing process. The Project Company would contract out engineering, procurement, construction, startup, operations, and maintenance (EPCO&M) services. The following is a list of major companies that could be solicited for EPCO&M services. These companies would likely provide financing, if requested.

- NRG Thermal, www.nrgthermal.com, subsidiary of largest independent power producer
- DCO Energy, www.dcoenergy.com
- PEPCo Energy Services, www.pepcoenergy.com, Philadelphia Electric subsidiary
- Veolia Energy, www.veoliaenergyna.com, Veolia a leader in waste energy
- Constellation Energy, www.constellation.com



FIGURE 7: POTENTIAL FINANCING AND OWNERSHIP MODELS

4.1 Build-Own-Operate-Maintain (BOOM)

Project Company will provide 100% of the required equity capital and arrange debt financing. The Project Company will own, operate, and maintain the Project throughout its useful life. The Building(s) will receive Backup Power and Rental Income.

4.2 Build-Own-Operate-Transfer (BOOT)

Project Company will provide 100% of the required equity capital and arrange debt financing. The Project Company would own, operate, and maintain the Project through an established term. The building(s) will receive Backup Power and, during the term, Rental Income. At the end of the term, RG

WRY LLC will have the option to buy the Project Company based upon an established capitalization of income.

4.3 Joint Venture (JV)

Project Company and RG WRY LLC will each invest equity capital in the Project and will jointly arrange debt financing. The Project Company would operate and maintain the Project throughout its useful life. Project Company returns will be distributed *pari passu* proportional to equity investment and RG WRY LLC will have the option to invest up to 49% of the required equity capital. The Building(s) will receive Backup Power and could receive Rental Income.

4.4 Design-Build-Operate-Maintain (DBOM)

RG WRY LLC investors will provide 100% of required equity and a third party would operate and maintain the Project throughout its entire useful life.

Appendix A: Project Background

Tri-generation systems increase the fuel efficiency of electricity generation by capturing typically wasted heat to produce hot water, steam, heat, and air-conditioning for buildings. These locally sited electricity-generating units displace older, less efficient remote power plants, which often use dirtier fuels and cannot utilize waste heat which represents 65 to 70% of the input fuel's energy potential. In addition to environmental benefits, owners whose buildings are connected to these energy systems realize economic benefits by reducing peak electric demand and allocating space otherwise needed for heating and cooling equipment to more productive retail, office, or institutional uses.

Tri-generation was evaluated during the Rail Yard RFP process. This included development of plant and energy distribution layouts and costs. The team proposed to put one central district energy plant in EC-1 or -2 to serve the East rail yard and a second district energy plant in EC-3 to serve the West rail yard. Total capital costs for district energy were in the range of $300 million with the largest portion of this capital devoted to the energy distribution. The development team initially dismissed this option due to its high capital cost. However, the capital cost assessment did not consider the possible rate of return for the investment.

Now having won the bid to develop the Eastern and Western Rail Yards, RG WRY LLC is revisiting the opportunity for tri-generation at the individual building scale. RG WRY LLC hired Endurant to guide the development team through a feasibility study. The study will determine which tri-generation options is feasible, model the economic and sustainability performance of each option, identify business models, and estimate the life-cycle cost of each option.

The results will include a report describing the study process, a summary of why options were dismissed, layouts, and costs for feasible options, optimization of designs, economic assessments, and financing/operations strategies.

East/West Rail Yard Overview



The RG WRY LLC development will dramatically transform the Hudson Yards into New York's next great neighborhood. This dynamic mixed-use neighborhood, designed as an extension of the City's fabric and public realm, will be a blend of architectural styles characteristic of New York's skyline, with streets lined with shops, restaurants, galleries, and arts and culture. The community will feature world-leading sustainability and extensive affordable housing, centered on an expansive public space destined to be one of New York's premiere gathering places.

A proposed building layout plan is shown in Appendix B while Table 19 summarizes the currently planned uses and sizes.

TABLE 19: RAIL YARD BUILDING PLAN

Location	RG ERY LLC and RG WRY LLC #	Type	Uses	Sq-ft	Floors	Operation*
West	WC-3	Office	Office	2,000,000	60	2016
West	WR-1	Residential	50% condo 50% rent	600,000	50	2014
West	WR-2	Residential	50% condo 50% rent	600,000	50	2014
West	WR-3	Residential	50% condo 50% rent	600,000	50	2015
West	WR-4	Residential	Condo	600,000	50	2016
West	WR-5	Residential	Condo	600,000	50	2017
West	WR-6	Residential	Condo	600,000	50	2017
West	WR-7	Residential	Condo	600,000	50	2018
West		School	NA	120,000		

* RG WRY LLC to review and update as appropriate

RG WRY LLC explained that the development is still very fluid as no tenant commitments have been finalized. RG WRY LLC has a small window of opportunity to evaluate and integrate tri-generation into the building designs. The development team includes:

- Jaros, Baum, and Bolles (JBB), which has responsibility for design of certain buildings, will provide input and insight on the building designs and system integration above the platform.
- Syska Hennessy, which has responsibility for design of the site structures and utilities under the platform.
- Kohn, Penderson, and Fox Architects (KPF), which is the site master plan architect, will provide layouts for input into the equipment and system layouts and building impacts, in conjunction with JBB.

Western Rail Yard (WRY)

The 13-acre WRY, bordered by West 30th and 33rd Streets, between 11th and 12th Avenues, needs to now go through the City zoning/ULURP approval process. The RG ERY LLC and RG WRY LLC plan adheres to the design guidelines outlined in the MTA's RFP, and the development consists of approximately 5.75 million sf, including:

- 8 buildings, 5.75 million sf total
- 3.63 million sf residential
- 1.92 million sf commercial office space within one building
- 192,000 sf of retail
- 120,000 sf PS/IS school
- Over five (5) acres of public open space

Special Features of the Proposal

RG WRY LLC plan will achieve LEED certification by the U.S. Green Building Council, representing one of the most significant commitments to green development in the United States.

Appendix B: Site Building Layout

FIGURE 11: SITE BUILDING LAYOUT

