I-95 Rappahannock River Crossing Northbound

AM Peak Hour Intersection Turning Movements - VISSIM Model Calibration Results Summary

Approach	Movement	Existing 6-7 AM						Existing 7-8 AM (Peak Hour)						Existing 8-9 AM						Existing 6-9 AM (Peak Period)					
		Volume Input	Volume Throughput	Diff.	Percent Diff.	vol allow diff	vol w/in allow?	Volume Input	Volume Throughput	Diff.	Percent Diff.	vol allow diff	vol w/in allow?	Volume Input	Volume Throughput	Diff.	Percent Diff.	vol allow diff	vol w/in allow?	Volume Input	Volume Throughput	Diff.	Percent Diff.	vol allow diff	vol w/in allow?
Route 3 at Central Park Boulevard (Signalized)																									
NB	NB Left	2	2	0	0%	20%	Y	3	4	1	33%	20%	N	8	9	1	13%	20%	Y	13	15	2	15%	20%	Y
	NB Through	7	7	0	0%	20%	Y	18	16	-2	-11%	20%	Y	19	19	0	0%	20%	Y	44	42	-2	-5%	20%	Y
	NB Right	187	187	0	0%	20%	Y	184	185	1	1%	20%	Y	151	150	-1	-1%	20%	Y	522	522	0	0%	20%	Y
SB	SB Left	14	13	-1	-7%	20%	Y	16	17	1	6%	20%	Y	17	17	0	0%	20%	Y	47	47	0	0%	20%	Y
	SB Through	3	3	0	0%	20%	Y	12	13	1	8%	20%	Y	34	33	-1	-3%	20%	Y	49	49	0	0%	20%	Y
	SB Right	49	50	1	2%	20%	Y	98	96	-2	-2%	20%	Y	121	120	-1	-1%	20%	Y	268	266	-2	-1%	20%	Y
EB	EB Left	135	125	-10	-7%	20%	Y	243	245	2	1%	20%	Y	341	335	-6	-2%	20%	Y	719	705	-14	-2%	20%	Y
	EB Through	2763	2766	3	0%	10%	Y	2809	2800	-9	0%	10%	Y	2346	2353	7	0%	10%	Y	7918	7919	1	0%	10%	Y
	EB Right	33	33	0	0%	20%	Y	47	45	-2	-4%	20%	Y	66	70	4	6%	20%	Y	146	148	2	1%	20%	Y
WB	WB Left	75	74	-1	-1%	20%	Y	81	82	1	1%	20%	Y	146	129	-17	-12%	20%	Y	302	285	-17	-6%	20%	Y
	WB Through	994	980	-14	-1%	20%	Y	1325	1282	-43	-3%	10%	Y	1294	1304	10	1%	10%	Y	3613	3566	-47	-1%	10%	Y
	WB Right	25	24	-1	-4%	20%	Y	21	20	-1	-5%	20%	Y	32	31	-1	-3%	20%	Y	78	75	-3	-4%	20%	Y
Route 3 at Carl D. Silver Parkway (Signalized)																									
NB	NB Left	8	8	0	0%	20%	Y	1	1	0	0%	20%	Y	7	7	0	0%	20%	Y	16	16	0	0%	20%	Y
	NB Through	0	0	0	0%	20%	Y	3	3	0	0%	20%	Y	6	5	-1	-17%	20%	Y	9	8	-1	-11%	20%	Y
	NB Right	10	10	0	0%	20%	Y	9	9	0	0%	20%	Y	12	13	1	8%	20%	Y	31	32	1	3%	20%	Y
SB	SB Left	276	272	-4	-1%	20%	Y	313	318	5	2%	20%	Y	308	306	-2	-1%	20%	Y	897	896	-1	0%	20%	Y
	SB Through	2	2	0	0%	20%	Y	2	2	0	0%	20%	Y	10	10	0	0%	20%	Y	14	14	0	0%	20%	Y
	SB Right	30	30	0	0%	20%	Y	41	40	-1	-2%	20%	Y	82	80	-2	-2%	20%	Y	153	150	-3	-2%	20%	Y
EB	EB Left	128	131	3	2%	20%	Y	156	152	-4	-3%	20%	Y	210	202	-8	-4%	20%	Y	494	485	-9	-2%	20%	Y
	EB Through	2832	2819	-13	0%	10%	Y	2849	2860	11	0%	10%	Y	2302	2336	34	1%	10%	Y	7983	8015	32	0%	10%	Y
	EB Right	4	3	-1	-25%	20%	N	4	4	0	0%	20%	Y	2	2	0	0%	20%	Y	10	9	-1	-10%	20%	Y
WB	WB Left	8	10	2	25%	20%	N	13	13	0	0%	20%	Y	19	18	-1	-5%	20%	Y	40	41	1	3%	20%	Y
	WB Through	1056	1043	-13	-1%	10%	Y	1385	1351	-34	-2%	10%	Y	1383	1383	0	0%	10%	Y	3824	3777	-47	-1%	10%	Y
	WB Right	346	346	0	0%	20%	Y	410	403	-7	-2%	20%	Y	609	589	-20	-3%	20%	Y	1365	1338	-27	-2%	10%	Y
Route 3 at Gateway Boulevard (Signalized)																									
NB	NB Left	290	291	1	0%	20%	Y	263	263	0	0%	20%	Y	253	255	2	1%	20%	Y	806	809	3	0%	20%	Y
	NB Through	0	0	0	0%	20%	Y	1	1	0	0%	20%	Y	1	1	0	0%	20%	Y	2	2	0	0%	20%	Y
	NB Right	112	113	1	1%	20%	Y	140	143	3	2%	20%	Y	173	171	-2	-1%	20%	Y	425	427	2	0%	20%	Y
SB	SB Left	0	0	0	0%	20%	Y	5	4	-1	-20%	20%	Y	4	4	0	0%	20%	Y	9	8	-1	-11%	20%	Y
	SB Through	0	0	0	0%	20%	Y	2	2	0	0%	20%	Y	7	7	0	0%	20%	Y	9	9	0	0%	20%	Y
	SB Right	12	12	0	0%	20%	Y	15	16	1	7%	20%	Y	16	16	0	0%	20%	Y	43	44	1	2%	20%	Y
EB	EB Left	72	71	-1	-1%	20%	Y	73	68	-5	-7%	20%	Y	27	29	2	7%	20%	Y	172	168	-4	-2%	20%	Y
	EB Through	1219	1213	-6	0%	10%	Y	1614	1634	20	1%	10%	Y	1427	1410	-17	-1%	10%	Y	4260	4257	-3	0%	10%	Y
	EB Right	208	215	7	3%	20%	Y	271	267	-4	-1%	20%	Y	299	306	7	2%	20%	Y	778	788	10	1%	20%	Y
WB	WB Left	86	85	-1	-1%	20%	Y	104	104	0	0%	20%	Y	132	137	5	4%	20%	Y	322	326	4	1%	20%	Y
	WB Through	892	896	4	0%	20%	Y	1044	1043	-1	0%	10%	Y	1032	1021	-11	-1%	10%	Y	2968	2960	-8	0%	10%	Y
	WB Right	0	0	0	0%	20%	Y	7	6	-1	-14%	20%	Y	15	15	0	0%	20%	Y	22	21	-1	-5%	20%	Y
Route 17 at Falls Run Drive (Signalized)																									
NB	NB Left	3	3	0	0%	20%	Y	2	1	-1	-50%	20%	N	3	3	0	0%	20%	Y	8	7	-1	-13%	20%	Y
	NB Through	0	0	0	0%	20%	Y	0	0	0	0%	20%	Y	0	0	0	0%	20%	Y	0	0	0	0%	20%	Y
	NB Right	1	2	1	100%	20%	N	12	13	1	8%	20%	Y	1	1	0	0%	20%	Y	14	16	2	14%	20%	Y
SB	SB Left	34	35	1	3%	20%	Y	41	36	-5	-12%	20%	Y	51	52	1	2%	20%	Y	126	123	-3	-2%	20%	Y
	SB Through	0	0	0	0%	20%	Y	1	1	0	0%	20%	Y	0	0	0	0%	20%	Y	1	1	0	0%	20%	Y
	SB Right	34	33	-1	-3%	20%	Y	25	29	4	16%	20%	Y	34	33	-1	-3%	20%	Y	93	95	2	2%	20%	Y
EB	EB Left	19	21	2	11%	20%	Y	25	24	-1	-4%	20%	Y	19	21	2	11%	20%	Y	63	66	3	5%	20%	Y
	EB Through	959	1008	49	5%	20%	Y	1416	1411	-5	0%	10%	Y	1448	1448	0	0%	10%	Y	3823	3867	44	1%	10%	Y
	EB Right	1	2	1	100%	20%	N	10	9	-1	-10%	20%	Y	1	1	0	0%	20%	Y	12	12	0	0%	20%	Y
WB	WB Left	4	4	0	0%	20%	Y	21	20	-1	-5%	20%	Y	4	5	1	25%	20%	N	29	29	0	0%	20%	Y
	WB Through	1480	1378	-102	-7%	10%	Y	2098	2002	-96	-5%	10%	Y	1919	1933	14	1%	10%	Y	5497	5313	-184	-3%	10%	Y
	WB Right	47	44	-3	-6%	20%	Y	80	75	-5	-6%	20%	Y	61	60	-1	-2%	20%	Y	188	179	-9	-5%	20%	Y

Approach	Movement	Existing 6-7 AM						Existing 7-8 AM (Peak Hour)						Existing 8-9 AM						Existing 6-9 AM (Peak Period)					
		Volume Input	Volume Throughput	Diff.	Percent Diff.	vol allow diff	vol w/in allow?	Volume Input	Volume Throughput	Diff.	Percent Diff.	vol allow diff	vol w/in allow?	Volume Input	Volume Throughput	Diff.	Percent Diff.	vol allow diff	vol w/in allow?	Volume Input	Volume Throughput	Diff.	Percent Diff.	vol allow diff	vol w/in allow?
Route 17 at McLane Drive (Signalized)																									
NB	NB Left	15	15	0	0%	20%	Y	15	15	0	0%	20%	Y	25	25	0	0%	20%	Y	55	55	0	0%	20%	Y
	NB Through	6	6	0	0%	20%	Y	4	5	1	25%	20%	N	6	6	0	0%	20%	Y	16	17	1	6%	20%	Y
	NB Right	6	6	0	0%	20%	Y	7	6	-1	-14%	20%	Y	9	9	0	0%	20%	Y	22	21	-1	-5%	20%	Y
SB	SB Left	20	20	0	0%	20%	Y	20	18	-2	-10%	20%	Y	82	79	-3	-4%	20%	Y	122	117	-5	-4%	20%	Y
	SB Through	4	4	0	0%	20%	Y	4	5	1	25%	20%	N	10	13	3	30%	20%	N	18	22	4	22%	20%	N
	SB Right	8	8	0	0%	20%	Y	8	8	0	0%	20%	Y	16	15	-1	-6%	20%	Y	32	31	-1	-3%	20%	Y
EB	EB Left	5	5	0	0%	20%	Y	5	5	0	0%	20%	Y	5	5	0	0%	20%	Y	15	15	0	0%	20%	Y
	EB Through	975	1005	30	3%	20%	Y	1434	1429	-5	0%	10%	Y	1462	1461	-1	0%	10%	Y	3871	3895	24	1%	10%	Y
	EB Right	33	31	-2	-6%	20%	Y	30	29	-1	-3%	20%	Y	33	34	1	3%	20%	Y	96	94	-2	-2%	20%	Y
WB	WB Left	29	28	-1	-3%	20%	Y	24	23	-1	-4%	20%	Y	38	37	-1	-3%	20%	Y	91	88	-3	-3%	20%	Y
	WB Through	1508	1403	-105	-7%	10%	Y	2176	2074	-102	-5%	10%	Y	1943	1963	20	1%	10%	Y	5627	5440	-187	-3%	10%	Y
	WB Right	37	33	-4	-11%	20%	Y	39	38	-1	-3%	20%	Y	43	46	3	7%	20%	Y	119	117	-2	-2%	20%	Y
Route 17 at Sanford Drive/ Gateway Drive (Signalized)																									
NB	NB Left	10	8	-2	-20%	20%	Y	29	25	-4	-14%	20%	Y	28	26	-2	-7%	20%	Y	67	59	-8	-12%	20%	Y
	NB Through	10	8	-2	-20%	20%	Y	19	16	-3	-16%	20%	Y	12	12	0	0%	20%	Y	41	36	-5	-12%	20%	Y
	NB Right	58	58	0	0%	20%	Y	114	114	0	0%	20%	Y	137	136	-1	-1%	20%	Y	309	308	-1	0%	20%	Y
SB	SB Left	172	175	3	2%	20%	Y	285	285	0	0%	20%	Y	273	267	-6	-2%	20%	Y	730	727	-3	0%	20%	Y
	SB Through	0	0	0	0%	20%	Y	27	28	1	4%	20%	Y	59	52	-7	-12%	20%	Y	86	80	-6	-7%	20%	Y
	SB Right	15	13	-2	-13%	20%	Y	36	34	-2	-6%	20%	Y	83	87	4	5%	20%	Y	134	134	0	0%	20%	Y
EB	EB Left	20	21	1	5%	20%	Y	53	49	-4	-8%	20%	Y	77	78	1	1%	20%	Y	150	148	-2	-1%	20%	Y
	EB Through	1006	1000	-6	-1%	10%	Y	1380	1369	-11	-1%	10%	Y	1448	1446	-2	0%	10%	Y	3834	3815	-19	0%	10%	Y
	EB Right	10	10	0	0%	20%	Y	28	28	0	0%	20%	Y	28	29	1	4%	20%	Y	66	67	1	2%	20%	Y
WB	WB Left	63	60	-3	-5%	20%	Y	289	264	-25	-9%	20%	Y	168	183	15	9%	20%	Y	520	507	-13	-3%	20%	Y
	WB Through	1549	1452	-97	-6%	10%	Y	2174	2062	-112	-5%	10%	Y	1913	1941	28	1%	10%	Y	5636	5455	-181	-3%	10%	Y
	WB Right	165	159	-6	-4%	20%	Y	337	316	-21	-6%	20%	Y	354	365	11	3%	20%	Y	856	840	-16	-2%	20%	Y
Route 17 Business at Short Street (Unsignalized)																									
NB	NB Left	82	82	0	0%	20%	Y	100	99	-1	-1%	20%	Y	104	102	-2	-2%	20%	Y	286	283	-3	-1%	20%	Y
	NB Through	0	0	0	0%	20%	Y	3	3	0	0%	20%	Y	2	3	1	50%	20%	N	5	6	1	20%	20%	Y
	NB Right	10	10	0	0%	20%	Y	18	19	1	6%	20%	Y	25	26	1	4%	20%	Y	53	55	2	4%	20%	Y
SB	SB Left	2	2	0	0%	20%	Y	3	4	1	33%	20%	N	5	4	-1	-20%	20%	Y	10	10	0	0%	20%	Y
	SB Through	2	1	-1	-50%	20%	N	0	0	0	0%	20%	Y	0	0	0	0%	20%	Y	2	1	-1	-50%	20%	N
	SB Right	0	0	0	0%	20%	Y	6	5	-1	-17%	20%	Y	7	8	1	14%	20%	Y	13	13	0	0%	20%	Y
EB	EB Left	0	0	0	0%	20%	Y	4	5	1	25%	20%	N	5	6	1	20%	20%	Y	9	11	2	22%	20%	N
	EB Through	595	587	-8	-1%	20%	Y	1167	1131	-36	-3%	10%	Y	1438	1419	-19	-1%	10%	Y	3200	3137	-63	-2%	10%	Y
	EB Right	43	44	1	2%	20%	Y	60	57	-3	-5%	20%	Y	70	72	2	3%	20%	Y	173	173	0	0%	20%	Y
WB	WB Left	3	4	1	33%	20%	N	5	5	0	0%	20%	Y	13	14	1	8%	20%	Y	21	23	2	10%	20%	Y
	WB Through	838	802	-36	-4%	20%	Y	1200	1171	-29	-2%	10%	Y	1108	1081	-27	-2%	10%	Y	3146	3054	-92	-3%	10%	Y
	WB Right	0	0	0	0%	20%	Y	2	2	0	0%	20%	Y	2	2	0	0%	20%	Y	4	4	0	0%	20%	Y
Route 17 Business at Olde Forge Drive (Signalized)																									
NB	NB Left	6	8	2	33%	20%	N	2	2	0	0%	20%	Y	14	13	-1	-7%	20%	Y	22	23	1	5%	20%	Y
	NB Right	31	29	-2	-6%	20%	Y	32	32	0	0%	20%	Y	50	51	1	2%	20%	Y	113	112	-1	-1%	20%	Y
EB	EB Through	601	593	-8	-1%	20%	Y	1175	1139	-36	-3%	10%	Y	1457	1435	-22	-2%	10%	Y	3233	3167	-66	-2%	10%	Y
	EB Right	6	5	-1	-17%	20%	Y	13	14	1	8%	20%	Y	11	11	0	0%	20%	Y	30	30	0	0%	20%	Y
WB	WB Left	8	10	2	25%	20%	N	20	20	0	0%	20%	Y	37	38	1	3%	20%	Y	65	68	3	5%	20%	Y
	WB Through	798	797	-1	0%	20%	Y	1205	1176	-29	-2%	10%	Y	1084	1083	-1	0%	10%	Y	3087	3056	-31	-1%	10%	Y

Lowest 15% of intersection movements not included in calibration thresholds

I-95 Rappahannock River Crossing Northbound

PM Peak Hour Intersection Turning Movements - VISSIM Model Calibration Results Summary

Approach	Movement	Existing 3-4 PM						Existing 4-5 PM						Existing 5-6 PM (Peak Hour)						Existing 6-7 PM						Existing 3-7 PM (Peak Period)					
		Volume Input	Volume Throughput	Diff.	Percent Diff.	vol allow diff	vol w/in allow?	Volume Input	Volume Throughput	Diff.	Percent Diff.	vol allow diff	vol w/in allow?	Volume Input	Volume Throughput	Diff.	Percent Diff.	vol allow diff	vol w/in allow?	Volume Input	Volume Throughput	Diff.	Percent Diff.	vol allow diff	vol w/in allow?	Volume Input	Volume Throughput	Diff.	Percent Diff.	vol allow diff	vol w/in allow?
Route 3 at Central Park Boulevard (Signalized)																															
NB	NB Left	98	101	3	3%	20%	Y	87	84	-3	-3%	20%	Y	88	91	3	3%	20%	Y	87	82	-5	-6%	20%	Y	360	358	-2	-1%	20%	Y
	NB Through	128	136	8	6%	20%	Y	133	131	-2	-2%	20%	Y	115	120	5	4%	20%	Y	133	140	7	5%	20%	Y	509	527	18	4%	20%	Y
	NB Right	507	500	-7	-1%	20%	Y	475	480	5	1%	20%	Y	491	482	-9	-2%	20%	Y	394	386	-8	-2%	20%	Y	1867	1848	-19	-1%	10%	Y
SB	SB Left	77	79	2	3%	20%	Y	73	73	0	0%	20%	Y	91	93	2	2%	20%	Y	61	61	0	0%	20%	Y	302	306	4	1%	20%	Y
	SB Through	152	158	6	4%	20%	Y	166	163	-3	-2%	20%	Y	220	225	5	2%	20%	Y	166	169	3	2%	20%	Y	704	715	11	2%	20%	Y
	SB Right	410	404	-6	-1%	20%	Y	418	423	5	1%	20%	Y	516	504	-12	-2%	20%	Y	418	416	-2	0%	20%	Y	1762	1747	-15	-1%	10%	Y
EB	EB Left	305	301	-4	-1%	20%	Y	331	326	-5	-2%	20%	Y	333	330	-3	-1%	20%	Y	331	324	-7	-2%	20%	Y	1300	1281	-19	-1%	10%	Y
	EB Through	1582	1570	-12	-1%	10%	Y	1704	1701	-3	0%	10%	Y	1798	1812	14	1%	10%	Y	1417	1431	14	1%	10%	Y	6501	6514	13	0%	10%	Y
	EB Right	108	106	-2	-2%	20%	Y	106	106	0	0%	20%	Y	85	88	3	4%	20%	Y	106	108	2	2%	20%	Y	405	408	3	1%	20%	Y
WB	WB Left	388	386	-2	-1%	20%	Y	314	321	7	2%	20%	Y	276	287	11	4%	20%	Y	295	289	-6	-2%	20%	Y	1273	1283	10	1%	10%	Y
	WB Through	2271	2157	-114	-5%	10%	Y	1976	1780	-196	-10%	10%	Y	1729	1856	127	7%	10%	Y	1859	2185	326	18%	10%	N	7835	7978	143	2%	10%	Y
	WB Right	43	43	0	0%	20%	Y	49	52	3	6%	20%	Y	53	55	2	4%	20%	Y	46	45	-1	-2%	20%	Y	191	195	4	2%	20%	Y
Route 3 at Carl D. Silver Parkway (Signalized)																															
NB	NB Left	8	7	-1	-13%	20%	Y	9	9	0	0%	20%	Y	11	10	-1	-9%	20%	Y	13	12	-1	-8%	20%	Y	41	38	-3	-7%	20%	Y
	NB Through	9	10	1	11%	20%	Y	12	12	0	0%	20%	Y	8	8	0	0%	20%	Y	6	8	2	33%	20%	N	35	38	3	9%	20%	Y
	NB Right	16	16	0	0%	20%	Y	15	15	0	0%	20%	Y	6	6	0	0%	20%	Y	4	3	-1	-25%	20%	N	41	40	-1	-2%	20%	Y
SB	SB Left	784	775	-9	-1%	20%	Y	818	807	-11	-1%	20%	Y	752	761	9	1%	20%	Y	722	723	1	0%	20%	Y	3076	3066	-10	0%	10%	Y
	SB Through	8	8	0	0%	20%	Y	9	10	1	11%	20%	Y	7	6	-1	-14%	20%	Y	8	8	0	0%	20%	Y	32	32	0	0%	20%	Y
	SB Right	285	288	3	1%	20%	Y	290	282	-8	-3%	20%	Y	276	276	0	0%	20%	Y	277	276	-1	0%	20%	Y	1128	1122	-6	-1%	10%	Y
EB	EB Left	235	240	5	2%	20%	Y	251	247	-4	-2%	20%	Y	245	235	-10	-4%	20%	Y	230	229	-1	0%	20%	Y	961	951	-10	-1%	20%	Y
	EB Through	1927	1936	9	0%	10%	Y	1996	1988	-8	0%	10%	Y	2129	2130	1	0%	10%	Y	1634	1649	15	1%	10%	Y	7686	7703	17	0%	10%	Y
	EB Right	3	3	0	0%	20%	Y	5	4	-1	-20%	20%	Y	6	7	1	17%	20%	Y	8	9	1	13%	20%	Y	22	23	1	5%	20%	Y
WB	WB Left	18	17	-1	-6%	20%	Y	17	17	0	0%	20%	Y	16	15	-1	-6%	20%	Y	27	24	-3	-11%	20%	Y	78	73	-5	-6%	20%	Y
	WB Through	2409	2319	-90	-4%	10%	Y	2040	1874	-166	-8%	10%	Y	1771	1891	120	7%	10%	Y	1910	2224	314	16%	10%	N	8130	8308	178	2%	10%	Y
	WB Right	847	844	-3	0%	20%	Y	925	911	-14	-2%	20%	Y	979	1010	31	3%	20%	Y	746	785	39	5%	20%	Y	3497	3550	53	2%	10%	Y
Route 3 at Gateway Boulevard (Signalized)																															
NB	NB Left	269	265	-4	-1%	20%	Y	295	293	-2	-1%	20%	Y	301	307	6	2%	20%	Y	312	315	3	1%	20%	Y	1177	1180	3	0%	10%	Y
	NB Through	0	0	0	0%	20%	Y	2	1	-1	-50%	20%	N	3	2	-1	-33%	20%	N	0	0	0	0%	20%	Y	5	3	-2	-40%	20%	N
	NB Right	180	177	-3	-2%	20%	Y	206	211	5	2%	20%	Y	199	197	-2	-1%	20%	Y	150	147	-3	-2%	20%	Y	735	732	-3	0%	20%	Y
SB	SB Left	10	9	-1	-10%	20%	Y	7	8	1	14%	20%	Y	14	13	-1	-7%	20%	Y	8	8	0	0%	20%	Y	39	38	-1	-3%	20%	Y
	SB Through	2	2	0	0%	20%	Y	7	6	-1	-14%	20%	Y	4	5	1	25%	20%	N	4	4	0	0%	20%	Y	17	17	0	0%	20%	Y
	SB Right	28	29	1	4%	20%	Y	22	23	1	5%	20%	Y	21	21	0	0%	20%	Y	8	8	0	0%	20%	Y	79	81	2	3%	20%	Y
EB	EB Left	35	36	1	3%	20%	Y	33	35	2	6%	20%	Y	36	34	-2	-6%	20%	Y	17	17	0	0%	20%	Y	121	122	1	1%	20%	Y
	EB Through	1550	1517	-33	-2%	10%	Y	1432	1372	-60	-4%	10%	Y	1543	1555	12	1%	10%	Y	1148	1283	135	12%	10%	N	5673	5727	54	1%	10%	Y
	EB Right	367	364	-3	-1%	20%	Y	385	397	12	3%	20%	Y	382	380	-2	-1%	20%	Y	331	343	12	4%	20%	Y	1465	1484	19	1%	10%	Y
WB	WB Left	152	151	-1	-1%	20%	Y	160	161	1	1%	20%	Y	214	215	1	0%	20%	Y	124	122	-2	-2%	20%	Y	650	649	-1	0%	20%	Y
	WB Through	1477	1484	7	0%	10%	Y	1580	1585	5	0%	10%	Y	1518	1514	-4	0%	10%	Y	1536	1528	-8	-1%	10%	Y	6111	6111	0	0%	10%	Y
	WB Right	4	4	0	0%	20%	Y	2	2	0	0%	20%	Y	8	8	0	0%	20%	Y	0	0	0	0%	20%	Y	14	14	0	0%	20%	Y
Route 17 at Falls Run Drive (Signalized)																															
NB	NB Left	10	11	1	10%	20%	Y	70	69	-1	-1%	20%	Y	63	61	-2	-3%	20%	Y	57	60	3	5%	20%	Y	200	201	1	1%	20%	Y
	NB Through	1	1	0	0%	20%	Y	2	2	0	0%	20%	Y	3	3	0	0%	20%	Y	3	3	0	0%	20%	Y	9	9	0	0%	20%	Y
	NB Right	34	33	-1	-3%	20%	Y	123	122	-1	-1%	20%	Y	132	132	0	0%	20%	Y	57	56	-1	-2%	20%	Y	346	343	-3	-1%	20%	Y
SB	SB Left	102	96	-6	-6%	20%	Y	117	117	0	0%	20%	Y	102	102	0	0%	20%	Y	74	72	-2	-3%	20%	Y	395	387	-8	-2%	20%	Y
	SB Through	0	0	0	0%	20%	Y	1	1	0	0%	20%	Y	1	1	0	0%	20%	Y	3	4	1	33%	20%	N	5	6	1	20%	20%	Y
	SB Right	51	56	5	10%	20%	Y	58	58	0	0%	20%	Y	66	65	-1	-2%	20%	Y	37	40	3	8%	20%	Y	212	219	7	3%	20%	Y
EB	EB Left	32	35	3	9%	20%	Y	29	29	0	0%	20%	Y	28	28	0	0%	20%	Y	19	19	0	0%	20%	Y	108	111	3	3%	20%	Y
	EB Through	1800	1807	7	0%	10%	Y	1841	1813	-28	-2%	10%	Y	1734	1761	27	2%	10%	Y	1562	1544	-18	-1%	10%	Y	6937	6925	-12	0%	10%	Y
	EB Right	1	1	0	0%	20%	Y	7	6	-1	-14%	20%	Y	11	13	2	18%	20%	Y	6	5	-1	-17%	20%	Y	25	25	0	0%	20%	Y
WB	WB Left	21	22	1	5%	20%	Y	57	53	-4	-7%	20%	Y	56	55	-1	-2%	20%	Y	38	41	3	8%	20%	Y	172	171	-1	-1%	20%	Y
	WB Through	1702	1697	-5	0%	10%	Y	1782	1715	-67	-4%	10%	Y	1722	1756	34	2%	10%	Y	1577	1627	50	3%	10%	Y	6783	6795	12	0%	10%	Y
	WB Right	32	33	1	3%	20%	Y	45	44	-1	-2%	20%	Y	42	43	1	2%	20%	Y	32	31	-1	-3%	20%	Y	151	151	0	0%	20%	Y
Route 17 at McLane Drive (Signalized)																															
NB	NB Left	12	11	-1	-8%	20%	Y	13	13	0	0%	20%	Y	10	10	0	0%	20%	Y	8	9	1	13%	20%	Y	43	43	0	0%	20%	Y
	NB Through	0	0	0	0%	20%	Y	1	1	0	0%	20%	Y	0	0	0	0%	20%	Y	2	1	-1	-50%	20%	N	3	2	-1	-33%	20%	N
	NB Right	5	6	1	20%	20%	Y	7	7	0	0%	20%	Y	7	8	1	14%	20%	Y	7	7	0	0%	20%	Y	26	28	2	8%	20%	Y
SB	SB Left	47	47	0	0%	20%	Y	44	44	0	0%	20%	Y	40	38	-2	-5%	20%	Y	44	45	1	2%	20%	Y	175	174	-1	-1%	20%	Y
	SB Through	2	3	1	50%	20%	N	3	4	1	33%	20%	N	1	2	1	100%	20%	N	6	6	0	0%	20%	Y	12	15	3	25%	20%	N
	SB Right	12	10	-2	-17%	20%	Y	10	10	0	0%	20%	Y	8	9	1	13%	20%	Y	7	6	-1	-14%	20%	Y	37	35	-2	-5%	20%	Y
EB	EB Left	2	3	1	50%	20%	N	2	3	1	50%	20%	N	0	0	0	0%	20%	Y	8	9	1	13%	20%	Y	12	15	3	25%	20%	N
	EB Through	1915	1918	3	0%	10%	Y	2059	2035	-24	-1%	10%	Y	1943	1964	21	1%	10%	Y	1666	1650	-16	-1%	10%	Y	7583	7567	-16	0%	10%	Y
	EB Right	19	18	-1	-5%	20%	Y	20	20	0	0%	20%	Y	25	27	2	8%	20%	Y	19	19	0	0%	20%	Y	83	84	1	1%	20%	Y
WB	WB Left	17	17	0	0%	20%	Y	3	3	0	0%	20%	Y	11	11	0	0%	20%	Y	8	9	1	13%	20%	Y	39	40	1	3%	20%	Y
	WB Through	1730	1698	-32	-2%	10%	Y	1861	1827	-34	-2%	10%	Y	1802	1798	-4	0%	10%	Y	1632	1719	87	5%	10%	Y	7025	7042	17	0%	10%	Y
	WB Right	22	23	1	5%	20%	Y	16	14	-2	-13%	20%	Y	25	27	2	8%	20%	Y	25	24	-1	-4%	20%	Y	88	88	0	0%	20%	Y

Approach	Movement	Existing 3-4 PM						Existing 4-5 PM						Existing 5-6 PM (Peak Hour)						Existing 6-7 PM						Existing 3-7 PM (Peak Period)					
		Volume Input	Volume Throughput	Diff.	Percent Diff.	vol allow diff	vol w/in allow?	Volume Input	Volume Throughput	Diff.	Percent Diff.	vol allow diff	vol w/in allow?	Volume Input	Volume Throughput	Diff.	Percent Diff.	vol allow diff	vol w/in allow?	Volume Input	Volume Throughput	Diff.	Percent Diff.	vol allow diff	vol w/in allow?	Volume Input	Volume Throughput	Diff.	Percent Diff.	vol allow diff	vol w/in allow?
Route 17 at Sanford Drive/ Gateway Drive (Signalized)																															
NB	NB Left	20	18	-2	-10%	20%	Y	31	26	-5	-16%	20%	Y	30	24	-6	-20%	20%	Y	42	44	2	5%	20%	Y	123	112	-11	-9%	20%	Y
	NB Through	16	16	0	0%	20%	Y	21	18	-3	-14%	20%	Y	14	14	0	0%	20%	Y	0	3	3	300%	20%	N	51	51	0	0%	20%	Y
	NB Right	230	237	7	3%	20%	Y	383	309	-74	-19%	20%	Y	317	251	-66	-21%	20%	N	167	233	66	40%	20%	N	1097	1030	-67	-6%	10%	Y
SB	SB Left	423	408	-15	-4%	20%	Y	428	433	5	1%	20%	Y	471	488	17	4%	20%	Y	367	354	-13	-4%	20%	Y	1689	1683	-6	0%	10%	Y
	SB Through	19	19	0	0%	20%	Y	23	23	0	0%	20%	Y	16	18	2	13%	20%	Y	38	37	-1	-3%	20%	Y	96	97	1	1%	20%	Y
	SB Right	92	86	-6	-7%	20%	Y	89	89	0	0%	20%	Y	100	98	-2	-2%	20%	Y	95	95	0	0%	20%	Y	376	368	-8	-2%	20%	Y
EB	EB Left	76	77	1	1%	20%	Y	80	77	-3	-4%	20%	Y	82	81	-1	-1%	20%	Y	101	98	-3	-3%	20%	Y	339	333	-6	-2%	20%	Y
	EB Through	1878	1841	-37	-2%	10%	Y	2006	2031	25	1%	10%	Y	1895	1871	-24	-1%	10%	Y	1616	1647	31	2%	10%	Y	7395	7390	-5	0%	10%	Y
	EB Right	13	11	-2	-15%	20%	Y	24	25	1	4%	20%	Y	13	12	-1	-8%	20%	Y	0	0	0	0%	20%	Y	50	48	-2	-4%	20%	Y
WB	WB Left	74	71	-3	-4%	20%	Y	97	98	1	1%	20%	Y	60	61	1	2%	20%	Y	63	68	5	8%	20%	Y	294	298	4	1%	20%	Y
	WB Through	1657	1637	-20	-1%	10%	Y	1760	1729	-31	-2%	10%	Y	1708	1709	1	0%	10%	Y	1528	1616	88	6%	10%	Y	6653	6691	38	1%	10%	Y
	WB Right	388	390	2	1%	20%	Y	360	359	-1	0%	20%	Y	358	367	9	3%	20%	Y	332	342	10	3%	20%	Y	1438	1458	20	1%	10%	Y
Route 17 Business at Short Street (Unsignalized)																															
NB	NB Left	92	92	0	0%	20%	Y	89	86	-3	-3%	20%	Y	89	89	0	0%	20%	Y	78	79	1	1%	20%	Y	348	346	-2	-1%	20%	Y
	NB Through	1	1	0	0%	20%	Y	1	1	0	0%	20%	Y	1	1	0	0%	20%	Y	6	6	0	0%	20%	Y	9	9	0	0%	20%	Y
	NB Right	12	12	0	0%	20%	Y	20	22	2	10%	20%	Y	18	20	2	11%	20%	Y	15	16	1	7%	20%	Y	65	70	5	8%	20%	Y
SB	SB Left	7	8	1	14%	20%	Y	9	9	0	0%	20%	Y	6	6	0	0%	20%	Y	2	2	0	0%	20%	Y	24	25	1	4%	20%	Y
	SB Through	1	1	0	0%	20%	Y	0	0	0	0%	20%	Y	0	0	0	0%	20%	Y	0	0	0	0%	20%	Y	1	1	0	0%	20%	Y
	SB Right	10	10	0	0%	20%	Y	7	7	0	0%	20%	Y	6	7	1	17%	20%	Y	10	9	-1	-10%	20%	Y	33	33	0	0%	20%	Y
EB	EB Left	6	6	0	0%	20%	Y	5	5	0	0%	20%	Y	7	7	0	0%	20%	Y	6	6	0	0%	20%	Y	24	24	0	0%	20%	Y
	EB Through	1494	1404	-90	-6%	10%	Y	1878	1792	-86	-5%	10%	Y	1722	1740	18	1%	10%	Y	1412	1530	118	8%	10%	Y	6506	6466	-40	-1%	10%	Y
	EB Right	95	97	2	2%	20%	Y	94	92	-2	-2%	20%	Y	133	123	-10	-8%	20%	Y	127	136	9	7%	20%	Y	449	448	-1	0%	20%	Y
WB	WB Left	12	12	0	0%	20%	Y	14	14	0	0%	20%	Y	21	22	1	5%	20%	Y	11	12	1	9%	20%	Y	58	60	2	3%	20%	Y
	WB Through	1094	1087	-7	-1%	10%	Y	1187	1185	-2	0%	10%	Y	1197	1200	3	0%	10%	Y	1039	1036	-3	0%	10%	Y	4517	4508	-9	0%	10%	Y
	WB Right	7	7	0	0%	20%	Y	6	6	0	0%	20%	Y	2	2	0	0%	20%	Y	2	2	0	0%	20%	Y	17	17	0	0%	20%	Y
Route 17 Business at Olde Forge Drive (Signalized)																															
NB	NB Left	1	1	0	0%	20%	Y	5	4	-1	-20%	20%	Y	9	10	1	11%	20%	Y	11	11	0	0%	20%	Y	26	26	0	0%	20%	Y
	NB Right	40	40	0	0%	20%	Y	42	43	1	2%	20%	Y	33	32	-1	-3%	20%	Y	39	40	1	3%	20%	Y	154	155	1	1%	20%	Y
EB	EB Through	1503	1427	-76	-5%	10%	Y	1887	1790	-97	-5%	10%	Y	1729	1753	24	1%	10%	Y	1415	1522	107	8%	10%	Y	6534	6492	-42	-1%	10%	Y
	EB Right	10	10	0	0%	20%	Y	20	24	4	20%	20%	Y	17	17	0	0%	20%	Y	14	15	1	7%	20%	Y	61	66	5	8%	20%	Y
WB	WB Left	32	33	1	3%	20%	Y	38	43	5	13%	20%	Y	51	48	-3	-6%	20%	Y	47	49	2	4%	20%	Y	168	173	5	3%	20%	Y
	WB Through	1112	1110	-2	0%	10%	Y	1202	1196	-6	0%	10%	Y	1211	1213	2	0%	10%	Y	1041	1039	-2	0%	10%	Y	4566	4558	-8	0%	10%	Y

Lowest 15 % of intersection movements not included in calibration thresholds

I-95 RAPPAHANNOCK RIVER CROSSING NORTHBOUND

Interchange Modification Report

Discussion of Model Scenarios for Northbound I-95 North of the Route 17

August 21, 2018; *Revised July 18, 2019*

Background

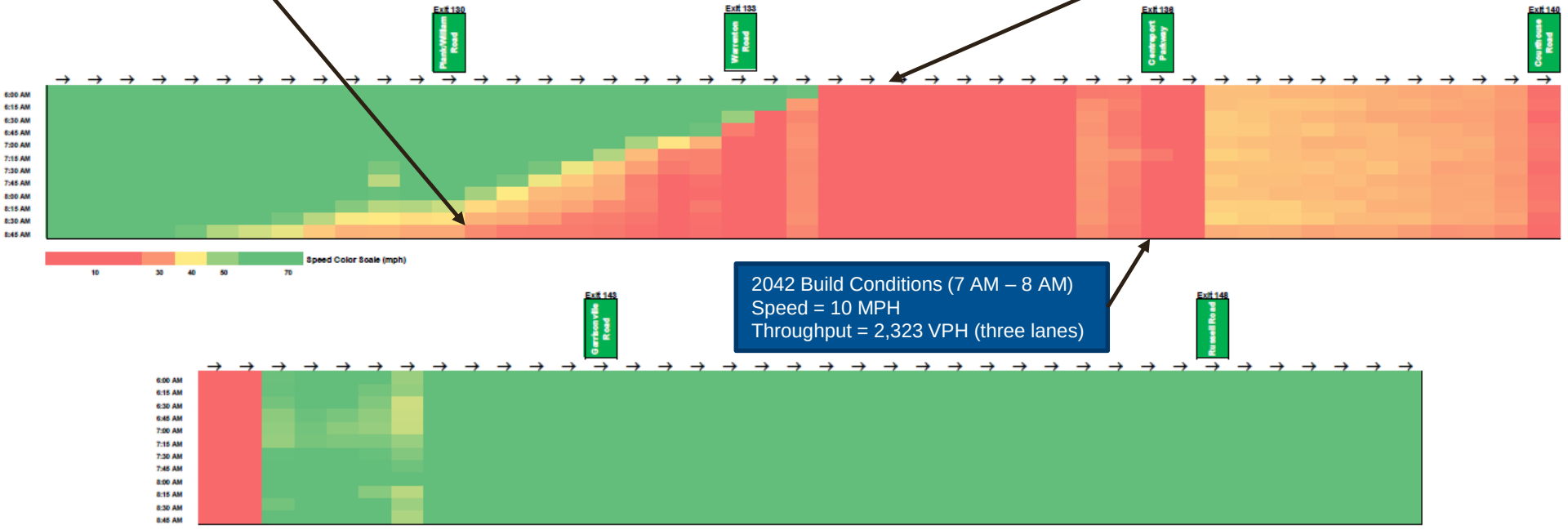
- **Challenge:** Uncongested operations along NB I-95 north of Route 17 are required in order to effectively test and compare alternatives for the I-95 RRC NB C-D lanes project including Route 17 interchange options
- **Purpose:** Identify the range of scenarios to be modeled along NB I-95 north of Route 17 as part of the IMR for future year conditions (AM peak)
  - 2022 No Build and Build
  - 2042 No Build and Build
- Fred Ex calibrated VISSIM models used as the starting point for the I-95 RRC NB IMR analysis
  - Northern VISSIM model limit for the I-95 RRC NB IMR was extended to north of the Centreport Parkway interchange
  - MOEs will be documented for the south-facing Centreport Parkway ramps (per IMR Framework Document)

NB I-95 General Purpose Lanes – 2042 Fred Ex Build Conditions (AM Peak)

Congestion extends through project limits of I-95 RRC NB project

Approx. location of merge between NB GP and C-D lanes

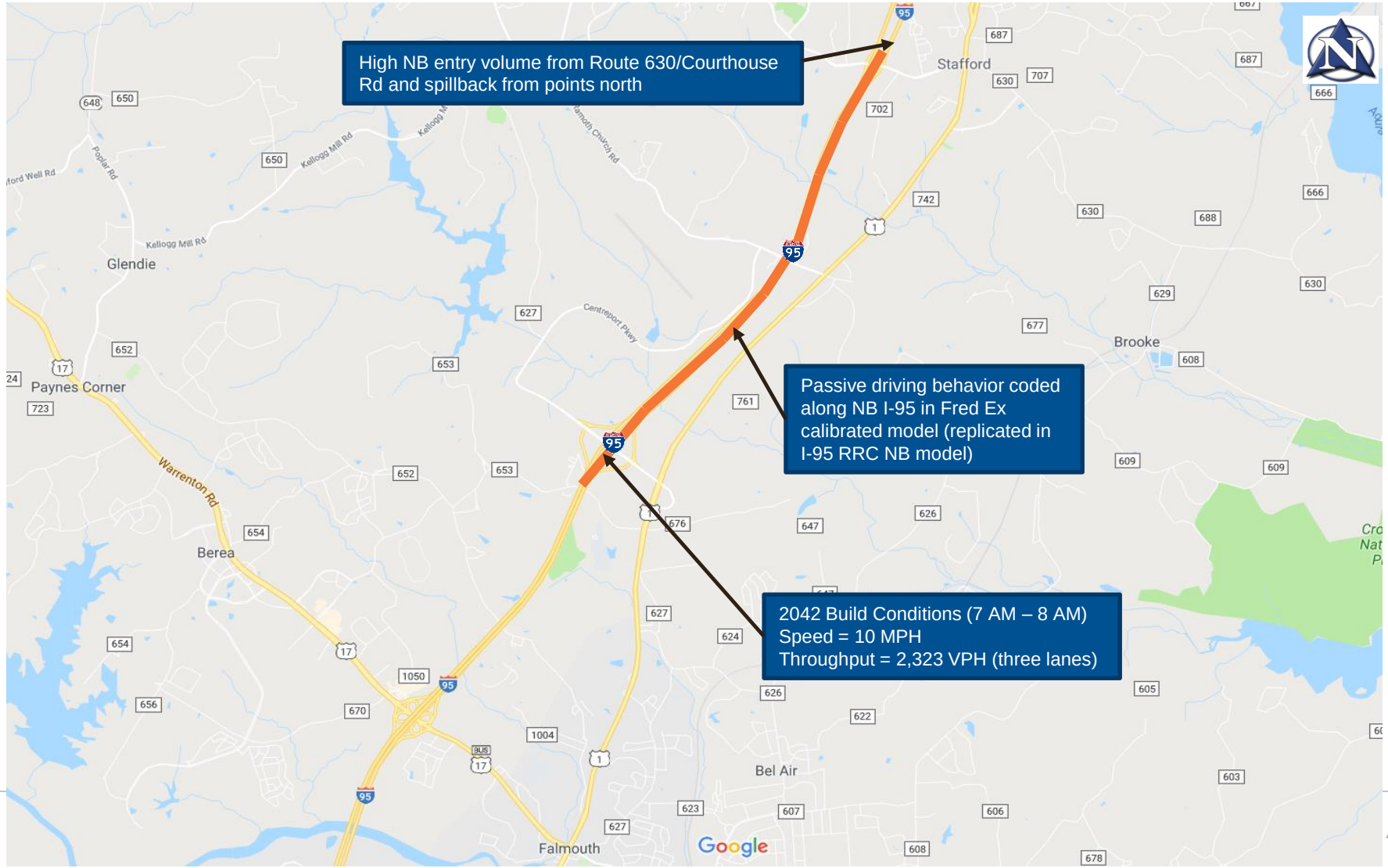
Figure 7-49: Build 2042 AM Period I-95 General Purpose Lane Speeds – Northbound



2042 Build Conditions (7 AM – 8 AM)
Speed = 10 MPH
Throughput = 2,323 VPH (three lanes)

Source: Fred Ex IJR

NB I-95 Sources of Congestion (2042 Fred Ex Build Conditions- AM Peak)



I-95 RRC NB VISSIM Model Development

- **To replicate the future congestion and reduced speeds along NB I-95 downstream of the Centreport Parkway interchange in the 2042 Design Year AM Peak Hour**
  - **"Reduced speed area" placed along northbound I-95 approximately 3.8 miles north of Centreport Parkway**
  - **Various "reduced speeds" tested to replicate hourly speeds and volume throughputs at the Centreport Pkwy interchange (as documented in the Fred Ex IJR)**
  - **2042 Build AM Peak Hour Results Comparison:**

Avg Speed (mph) at Centreport Pkwy interchange			
Fred Ex IJR	I-95 RRC NB IMR	Difference	
10	10.7	0.7	7%
Throughput (vehicles per hour) at Centreport Pkwy interchange			
Fred Ex IJR	I-95 RRC NB IMR	Difference	
2,323	2,359	36	2%

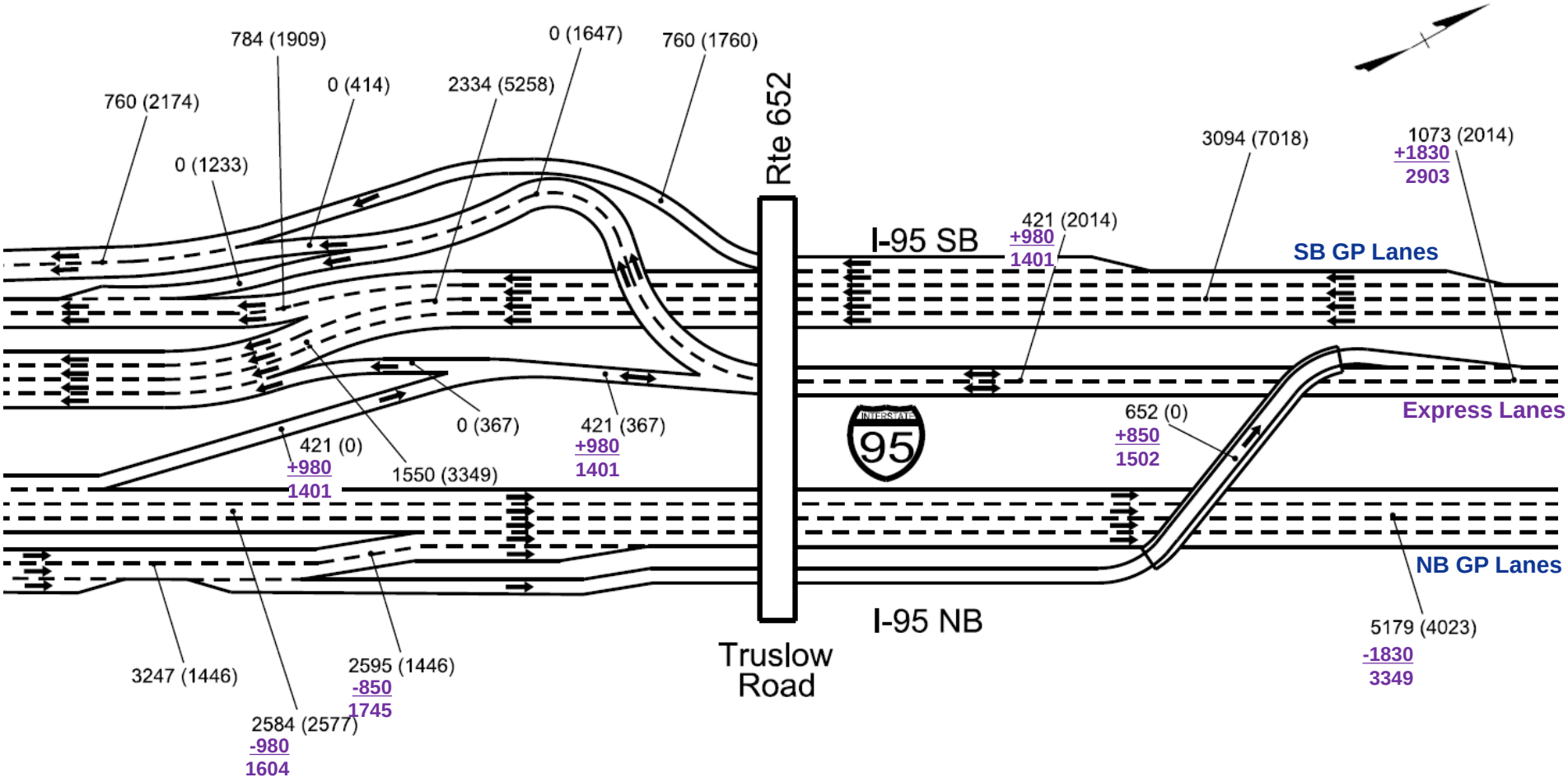
Potential Solutions to Reduce Congestion North of Route 17 to Effectively Test and Compare Alternatives for the I-95 RRC NB C-D Lanes Project

- **Option 1: Match current Fred Ex IJR model scenario**
  - ***Not recommended since congestion in the I-95 RRC NB IMR study area makes it impractical to compare alternatives under consideration for the C-D lanes and Route 17 interchange***
- **Option 2: Fully unconstrain capacity along NB I-95 GP lanes north of Route 17**
  - **Remove passive driving behaviors**
  - **Remove congestion generated by Courthouse Rd interchange and points north**
  - ***Not recommended since it requires modifications to calibration parameters from Fred Ex IJR***
- **Option 3: Add NB auxiliary lane between Courthouse Rd and Garrisonville Rd (sensitivity scenario included in Fred Ex IJR)**
  - ***Not recommended since it does not significantly improve congestion in I-95 RRC NB study area***

Potential Solutions to Reduce Congestion North of Route 17

- **Option 4: Increase demand for NB I-95 Express Lanes (shift traffic from NB I-95 GP Lanes into the Express Lanes)**
  - **Various traffic volume scenarios tested to maintain queues north of Route 17 (2042 Build AM Peak Hour)**
    - Add 980 peak hour vehicles (total 1,400 vehicles) on the Express Lanes entrance ramp from the NB I-95 mainline lanes to the Express Lanes (located south of the Route 17 interchange)
    - Add 850 peak hour vehicles (total 1,500 vehicles) on the Express Lanes entrance ramp from the C-D lanes to the Express Lanes (located north of the Route 17 interchange)
    - Results in 2,900 peak hour vehicles in Express Lanes compared to 1,100 (2042 AM Peak Hour Build forecast)
  - **Results in less vehicles in GP lanes merging with on-ramp vehicles from NB C-D Lanes and Centreport Pkwy and reduces congestion in the study area**
  - **Queues extend to just north of the C-D/GP Lanes merge north of Route 17**
  - ***Recommended since it maintains calibration parameters of Fred Ex IJR model and anticipated capacity constraints along NB I-95 GP lanes while relieving congestion north of Route 17 and balancing traffic volumes between GP and Express Lanes***

Option 4: Mainline and Express Lanes Volumes



XX(XX) AM (PM) Peak Hour 2042 Design Year

Recommendation

In order to evaluate 2042 Design Year AM Peak Hour conditions along NB I-95 north of Route 17 in the I-95 RRC NB IMR, implement *Option 4: Increase demand for NB I-95 Express Lanes (shift traffic from NB I-95 GP Lanes into the Express Lanes)*

- **Allows for an evaluation of functionality of NB I-95 C-D lanes and various Route 17 interchange options**
- **Maintains calibration parameters of the approved Fred Ex IJR model**

I-95 Express Lanes Fredericksburg Extension Study – Existing Conditions VISSIM Model Calibration

MEMORANDUM

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Date: **September 13, 2017 (Revised)**

To: **Virginia Department of Transportation**

From: **RK&K**

CC: **File**

Re: **I-95 Express Lanes Fredericksburg Extension Study - Existing Conditions VISSIM Model Calibration**

1. PURPOSE AND INTRODUCTION

VISSIM 8 was employed to analyze the operational performance of the Interstate 95 Express Lanes Fredericksburg Extension (FredEx) project. The proposed project improvements extend from just north of Exit 133 (US Route 17) to Exit 148 (Russell Road – MCB Quantico). However, the traffic modeling for this study included a larger study area to allow for testing of possible future transportation improvements in the area north of Exit 148. Additional information regarding the purpose of the study and the modeling is included in the IJR Framework Document for this project (dated September 12, 2017).

Therefore, RK&K developed VISSIM models for the larger study area, which includes approximately 34 miles of Interstate 95, which extends from Gordon Blvd (Exit 160) in Fairfax County to Plank Rd (Exit 130) in Fredericksburg, and 39 adjacent signalized intersections. A map of the overall VISSIM model area is shown in Figure 1. Both AM and PM period models have been developed. The AM period model covers traffic conditions from 6 AM to 9 AM with a two-hour seeding period, and the PM period model covers from 3 PM to 7 PM with a one-hour seeding period.

Microscopic simulation models must be calibrated before they can produce meaningful results. Model calibration is a process to ensures that the model replicates field conditions within acceptable tolerances. The purpose of this memorandum is to document the calibration procedures that were adopted and parameters that were changed for Interstate 95 Express Lanes Fredericksburg Extension VISSIM models.

2. VISSIM MODEL DEVELOPMENT

2.1. Model Input Data

The VDOT VISSIM User Guide (VUG version 1.0, November 2015) and The VDOT *Traffic Operations and Safety Analysis Manual, Version 1.0* (TOSAM, November 2015) describes specific VISSIM global parameters and inputs that must be coded into each model. These global parameters and their data sources are described below.

2.1.1. Seeding period

The VDOT VUG recommends seeding duration as "User travel time segments representing the average time it takes for a vehicle to travel from one end of the corridor to the other during the peak hour" for freeway projects. It is noted that the study corridor is highly congested for a long duration (more than an hour), a seeding duration of 7,200 seconds which is more than the recommended duration (field travel time for the peak direction is approximately 2,500 seconds) is used for AM models to build queues on I-95 Northbound. Unbalanced hourly field traffic counts were used for the seeding period. During PM peak period, peak direction travel time is about 2,300 seconds. Therefore, a 60-minute seeding period was identified as appropriate seeding time for PM peak period. The traffic volume for the first-hour interval of the PM peak hour is used for the entire seeding period during the PM peak period.

2.1.2. Vehicle Inputs

The balanced traffic volumes for the three 60-minute intervals of the AM peak period (6-9 AM) and four 60-minute intervals of the PM peak period (3-7 PM) are coded in the network. A two-hour seeding time for AM peak period and one-hour seeding time for PM peak period are coded to produce queue or traffic demand build-up. The "exact volume" arrival distribution is used for all the vehicle inputs. Three different sets of vehicle inputs were employed to represent general purpose lane cars, general purpose lane heavy vehicles, and HOT/HOV vehicles (using the I-95 Express Lanes) respectively.

2.1.3. Heavy Vehicle counts

The heavy vehicle counts are coded based on the field count data. The total heavy vehicle counts in the entire peak period were distributed to each hour evenly, which was consistent with available field counts.

2.1.4. Desired Speeds Distributions

A distribution ranging + 5 mph from the posted speed limit is used in the network. As recommended in the VDOT TOSAM, a distribution range of 7.5 - 15.5 mph is used for right turn speeds and 12.4 – 18.6 mph is used for the left-turns.

2.1.5. Vehicle Routings

The VISSIM static routes are set up based on the existing balanced traffic volumes for each hour. Two separate sets of static routes were input for general purpose lanes vehicles and HOT/HOV lane vehicles separately.

2.1.6. Car Following Model

The Wiedemann 99 car following model is employed to for the I-95 mainline and all ramps. The Wiedemann 74 car following model is employed along the included arterial street segments.

2.1.7. Simulation Period and Resolution

During the AM peak, a simulation period of 18,000 seconds including 7,200 seconds of seeding time and 10,800 seconds of recording time is used. During PM, an 18,000 second simulation period including 3,600 seconds of seeding time and 14,400 seconds of recording time is used. As recommended in VDOT VUG, a simulation resolution of 10 time steps/simulation second is used.

2.2. VISSIM Default Driver Behavior Parameters

The VISSIM 8.0 software models driver behavior based on the Wiedemann 74 and Wiedemann 99 car following models. The former model is recommended for modeling arterials or collector roadways and the latter model is recommended for modeling freeway and ramps. Table 1 below shows the default parameters of VISSIM 8.0.

Table 1: Default VISSIM 8.0 Driver Behavior Parameters

Wiedemann 74 Following Parameter	Unit	Default
Average Standstill Distance	ft	6.56
Additive part of safety distance		2.00
Multiplic. part of safety distance		3.00
Wiedemann 99 Following Parameter	**Unit**	**Default**
CC0 (Standstill Distance)	ft	4.92
CC1 (Headway Time)	sec	0.90
CC2 (Following Variation)	ft	13.12
CC3 (Threshold for Entering "Following")		-8.00
CC4 (Negative "Following" Threshold)		-0.35
CC5 (Positive "Following" Threshold)		0.35
CC6 (Speed Dependency Oscillation)		11.44
CC7 (Oscillation Acceleration)	ft/s^2	0.82
CC8 (Standstill Acceleration)	ft/s^2	11.48
CC9 (Acceleration at 50 mph)	ft/s^2	4.92
Wiedemann 74/99 Lane Change Parameter	**Unit**	**Default**
Minimum Headway (Front/Rear)	ft	1.64
Safety Distance Reduction Factor		0.60

2.3. Calibration Data Sources

Volume, travel time, travel speed and field observations were used to calibrate the existing conditions VISSIM models.

Vehicular tube counts along Interstate 95 mainline and ramps for all interchanges between Exit 133 and Exit 160 were collected from Tuesday, September 27 to Thursday, September 29, 2016. Supplemental data collection was performed at Exit 130 from Tuesday, November 15 to Wednesday, November 16, 2016. Additional data collection was performed at Exit 161 in December 2016. The hourly counts were balanced manually and are included in Attachment 1.

INRIX travel time and speed data were obtained for September 2016 and the data was aggregated hourly to use as a base condition against which to calibrate the VISSIM models. The processed outputs are included in Attachment 2.

Field observations were conducted in September and October 2016 to confirm that the model was accurately representing existing conditions. The data collection included the collection of queue data at key locations.

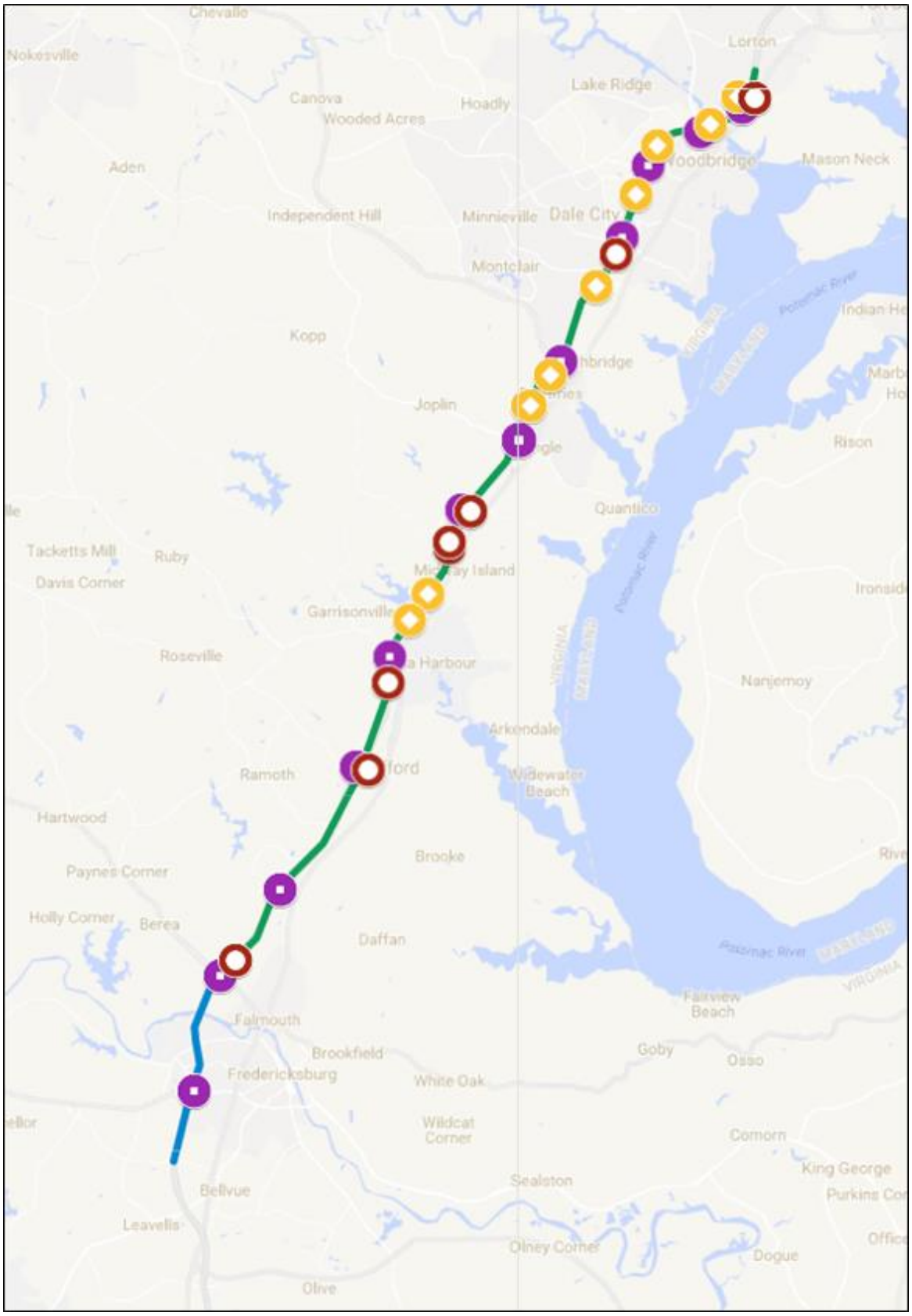


Figure 1: Study Limits

2.4. Number of Model Runs

A minimum number of model runs is required to produce accurate results. The VDOT TOSAM adopts the FHWA-developed statistical process for determining the appropriate number of simulation runs at a 95th percentile confidence level with a 10% tolerance.

Initially, ten initial model runs as recommended by VDOT TOSAM are performed to evaluate a critical measure of effectiveness (MOE) such as travel time or vehicular throughput. The initial model output is then evaluated using a standard statistical "t-test" to determine whether additional model runs are needed (up to 30) to meet confidence and tolerance requirements. The VDOT TOSAM provides a spreadsheet-based sample size determination tool which incorporates the FHWA methodology to determine the necessary number of model runs. Based on this evaluation, 10 simulation runs were determined to be sufficient to meet the requirements. Six examples of this evaluation are included in Attachment 3, which include three per peak. During AM peak hour (7-8 AM), I-95 northbound corridor travel time, corridor average speed, and VISSIM throughput at south of Centreport Pkwy (Exit 136) are included since I-95 northbound is the peak direction during AM peak. During PM peak hour (5-6 PM), I-95 southbound is the peak direction. Therefore, the calculations of I-95 southbound corridor travel time, corridor average speed, and VISSIM throughput at north of Warrenton Rd (Exit 133) are also included in Attachment 3. Based on the results of this evaluation, all results presented in this memo are based on the output from 10 runs.

3. VISSIM MODEL CALIBRATION RESULTS

3.1. Calibration Targets

The goal of the calibration effort is to replicate the existing real world condition in the simulation model with minimally acceptable differences. The VDOT *Traffic Operations and Safety Analysis Manual, Version 1.0* (TOSAM, November 2015) recommends the calibration thresholds (Table 5 of Section 5.3, TOSAM page 33) summarized in **Table 2**.

However, based on the project purpose, size of the model area, and the complex nature of traffic operations within the I-95 corridor, a set of project specific calibration thresholds were developed for this project. These revised thresholds were submitted for VDOT's review and concurrence in a memorandum dated August 28, 2017. This memorandum is included as Attachment 4. The VDOT District Traffic Engineer concurred with the revised thresholds, which are summarized in **Table 3**, on August 28, 2017.

Table 2: Microsimulation Model Calibration Thresholds Recommended by TOSAM (Table 5, TOSAM page 33)

<table>
<tr><th>Simulated Measure</th><th colspan="2">Calibration Threshold</th></tr>
<tr><td>Simulated Traffic Volume (vehicles per hour) The top 85% of the network links, based on link traffic volume, or a select number of critical links and/or movements, as determined by the RTE or his/her designee, shall meet the calibration thresholds. The traffic volumes identified in the calibration thresholds are actual traffic volumes as opposed to simulated traffic volumes.</td><td colspan="2">Within ± 20% for <100 vph
Within ± 15% for ≥100 vph to <300 vph
Within ± 10% for ≥300 vph to <1,000 vph
Within ± 5% for ≥1,000 vph</td></tr>
<tr><td>Simulated Average Speed (miles per hour) The top 85% of the network links, based on link traffic volume, or a select number of critical links and/or movements, as determined by the RTE or his/her designee, shall meet the calibration thresholds.</td><td colspan="2">Within ± 5 mph of average observed speeds on arterials
Within ± 7 mph of average observed speeds on freeways</td></tr>
<tr><td>Simulated Travel Time (seconds)
Eight-five percent (85%) of the travel time routes, or a select number of critical routes, as determined by the RTE or his/her designee, shall meet the calibration thresholds. Travel time routes should be determined in cooperation with the VDOT project manager based on project needs and goals.</td><td colspan="2">Within ± 30% for average observed travel times on arterials
Within ± 20% for average observed travel times on freeways
The travel time should be calibrated for segments and routes separately or as deemed appropriate by the VDOT project manager.</td></tr>
<tr><td rowspan="3">Simulated Queue Length (feet)
The top 85% of the network links, based on link traffic volume, or a select number of critical links and/or movements, as determined by the RTE or his/her designee, shall meet the calibration thresholds.</td><td rowspan="2">Undersaturated conditions (refer to Section 2.6 for guidance)</td><td>Average queue length on arterials:
Within ± 30% for movements ≤10 vph
Within ± 20% for movements >10 vph</td></tr>
<tr><td>Maximum queue length on arterials:
Within ± 25%</td></tr>
<tr><td rowspan="2">Oversaturated conditions (refer to Section 2.6 for guidance)</td><td>Average queue length:
Within ± 20% on arterials
Within ± 30% on freeways</td></tr>
<tr><td>Maximum queue length:
Within ± 20% on arterials
Within ± 35% on freeways</td></tr>
<tr><td colspan="3">Notes:
1. The calibration thresholds shall be used as minimum thresholds for calibration. The VDOT project manager may decide to use stricter thresholds based on the project needs. If the minimum thresholds cannot be achieved, a written justification shall be provided for review and approval by the RTE or his/her designee.
2. Field measurements should be made when there are no unusual traffic conditions, such as special events, crashes, incidents, etc. and preferably at the same time as the counts are conducted.
3. Critical links, movements, and/or routes in the network, if needed, shall be determined in coordination with the RTE or his/her designee.</td></tr>
<tr><td colspan="3">Recommendations for Selecting Simulated Measures Based on Type of Analysis:
▪ Intersection Analysis: simulated traffic volume and simulated queue length should be used for calibration.
▪ Arterial Analysis (no freeways): simulated traffic volume and simulated queue length should be used for calibration.
▪ Freeway Analysis (no arterials): simulated traffic volume and simulated average speed should be used for calibration. Simulated queue length at bottlenecks should also be checked, if present.
▪ Network Analysis (both freeways and arterials): simulated traffic volume and simulated travel time should be used for calibration.</td></tr>
</table>

Table 3: FredEx VISSIM Model Calibration Thresholds

Simulated Measure	Calibration Thresholds		
	Mainline I-95	**Ramps**	**Intersections**
Simulated Traffic Volume (vehicles per hour) vs. Field Measured Throughput Volumes	Overall Simulation Period: ±5% Peak Hour: ±5%[1] *Note: Mainline Volumes will be compared to the thresholds at two screenlines per direction, where high-quality throughput data is available.* I-95 NB, between Exit 133 and 136 I-95 SB, between Exit 133 and 136 I-95 NB, between Exit 158 and 160 I-95 SB, between Exit 158 and 160	Overall Simulation Period: Greater than 1,000 vph: ±5% Between 300 and 1,000 vph: ±10% Less than 300 vph: ±20%[2] Peak Hour: Greater than 1,000 vph: ±5% Between 300 and 1,000 vph: ±10% Less than 300 vph: ±20% *Note: Top 85% of ramp links will be evaluated.*	Overall Simulation Period (by Movement): Greater than 1,000 vph: ±10% Less than 1,000 vph: ±20% Peak Hour (by Movement): Greater than 1,000 vph: ±10% Less than 1,000 vph: ±20% *Note: Top 85% of intersection movements will be evaluated.*
Simulated Average Speed (mph) vs. Observed Average Travel Speeds	Overall Simulation Period: Corridor: ± 5 mph[3] Segments: ± 10 mph Individual Hours: Corridor: ± 5 mph Segments: ± 10 mph	n/a	n/a
Simulated Average Travel Time vs. Observed Average Travel Times	Overall Simulation Period: Corridor: ± 10% Segments: ± 20% Individual Hours: Corridor: +/- 15% Segments: +/- 25%	n/a	n/a
Simulated Queues vs. Observed Maximum Queues	Backups at Bottlenecks compared to congestion mapping and field observations (maximum backup lengths ±35%). Speed and travel time data also quantitatively confirms extent of backups.	n/a	Maximum Queue Lengths (feet): ±25% *Note: Quantitative Comparison will be conducted the for the following critical locations and movements:* *WB SR-3 at Carl D. Silver Pkwy* *SB I-95 Off-Ramp to Route 3* *SB US 17 at Gateway Center Blvd & I-95 Off-Ramp*

[1] Items in black text indicate thresholds as stipulated in the TOSAM.
[2] Items in red text indicate less stringent thresholds than stipulated in the TOSAM.
[3] Items in green text indicate more stringent thresholds than stipulated in the TOSAM.

			NB Route 1 at Garrisonville Road *EB Garrisonville Road at I-95 / US 1* *123 SB at Old Bridge Rd / Ramp to I-95 SB*

Table 3 provides calibration thresholds for both the overall simulation periods (6-9 AM, 3-7 PM) and for peak or individual hours (depending on the measure) within the simulation periods. Additionally, for speed and travel time calibration, separate thresholds are included for the overall corridor (34 miles) and for individual freeway segments (between each major interchange).

3.2. Calibration Parameter Range

Initial simulation runs conducted using default driver behavior parameters showed significant differences in travel time and volume outputs along I-95, indicating that default driver behavior parameters do not replicate field conditions with sufficient accuracy. Hence, driver behavior parameters were adjusted through an iterative process to achieve results within the calibration targets. Critical car following and lane changing parameters of Wiedemann 99 and Wiedemann 74 models were adjusted. VDOT TOSAM Appendix E suggests the following range (Table 4) for the car following models for Wiedemann 99 and Wiedemann 74 models.

Table 4: VISSIM Car Following Parameter Ranges Suggested by VDOT TOSAM

	Parameter		Default Value	Unit	Suggested Range	
					Basic Segment	Weave/Merge/ Diverge Segment
Wiedemann 99	CC0	Standstill distance	4.92	feet (ft)	4.5 to 5.5	>4.92
	CC1	Headway time	0.90	seconds (s)	0.85 to 1.05	0.90 to 1.50
	CC2	'Following' variation	13.12	ft	6.56 to 22.97	13.12 to 39.37
	CC3	Threshold for entering	-8	--	Use default	
	CC4	Negative 'following'	-0.35	--	Use default	
	CC5	Positive 'following'	0.35	--	Use default	
	CC6	Speed dependency of	11.44	--	Use default	
	CC7	Oscillation acceleration	0.82	ft/s^2	Use default	
	CC8	Standstill acceleration	11.48	ft/s^2	Use default	
	CC9	Acceleration at 50 mph	4.92	ft/s^2	Use default	
Wiedemann 74	Average standstill distance		6.56	feet (ft)	3.28 to 6.56	
	Additive part of safety distance		2.00	--	2.0 to 2.2	
	Multiplicative part of safety distance		3.00	--	2.8 to 3.3	

For arterials within the model, the Wiedemann 74 car following model is employed for both AM and PM models. To avoid unreasonable vehicle behavior in heavy weaving sections, an "aggressive lane change" driving behavior type was created for both AM and PM period. The "aggressive lane change" arterial

driving behavior type changes "Safety distance reduction factor" to 0.2 from the default value 0.6, and "Min. headway (front/rear)" from 1.64 to 1.41 feet.

3.3. AM Peak Period Calibration

3.3.1. Driver Behavior Parameter Modification

I-95 Northbound is the peak direction during AM peak period. INRIX data and field observations show that there are two congested sections within the I-95 northbound general purpose lanes. One bottleneck starts between Prince William Parkway (Exits 158) and Gordon Blvd (Exit 160) with congestion extending south towards Dale Boulevard (Exit 156). The other bottleneck begins at Garrisonville Rd (Exit 143) and congestion extends south towards Courthouse Road (Exit 140) and Centreport Parkway (Exit 136). Three different driving behaviors have been created to replicate field conditions.

First, the primary drive behavior type (Freeway 101) was adjusted to account for the overall corridor travel times. The resulting driving behavior is a Wiedemann 99 (Freeway) with a modified "Headway Time (CC1)" of 0.94 seconds and a reduced "Safety distance reduction factor" of 0.50.

Secondly, to avoid unreasonable vehicle behavior in the heavy weaving sections, an "Aggressive Lane Change" driving behavior type (Freeway 102) was created with a "Headway Time (CC1)" of 0.91 seconds, a "Following Variation (CC2)" of 14.12 feet, and a reduced "Safety distance reduction factor" of 0.45.

Thirdly, to replicate the congestion of I-95 northbound mainline south to Courthouse Road (Exit 140), a "Conservative Merging" driving behavior type (Freeway 103) was created with further conservative parameters.

Fourthly, driving behavior type "Conservative Merging II" (Freeway 104) was created to represent the driving behavior along I-95 northbound mainline north to Dale Boulevard (Exit 156). Table 5 summarizes the parameters for the four driving behavior types in AM model.

Table 5: Freeway Driving behavior AM Parameters (Wiedemann 99)

Parameter		Default Value	Unit	Freeway 101	Freeway 102	Freeway 103	Freeway 104
CC0	Standstill distance	4.92	feet	4.92	4.92	15.92	4.92
CC1	Headway time	0.90	seconds	0.94	0.91	1.50	1.35
CC2	'Following' variation	13.12	feet	13.12	14.12	38.12	28.12
Safety distance reduction factor		0.60	--	0.50	0.45	0.45	0.45

3.3.2. AM Model Calibration Results

3.3.2.1. *I-95 Mainline Results*

The VDOT Sample Size Determination Tool (Version 1.1) has been employed to determine the sample size based on hourly travel time. The tool is applied to the hourly travel time of each I-95 mainline section.

The results show that ten VISSIM runs can achieve the 95% confidence interval. Therefore, all the following results are based on ten VISSIM runs with random seeds from 1 to 10.

Table 6 presents the travel time calibration results of the AM peak period model. For most sections of both I-95 northbound and southbound during each individual hour, the difference between the INRIX travel time and VISSIM travel time are less than 10%, and all of them are less than 25%, which satisfies the calibration thresholds. At the corridor level, the travel time differences for I-95 northbound are 8%, -2%, and -5% for 6 AM, 7 AM and 8 AM hours respectively. For I-95 southbound, the differences are -6%, -2%, and 1% for each of the individual hours evaluated. A comparison of INRIX field speeds and hourly VISSIM model speed outputs is also illustrated in **Table 7** as a reference; this shows similar results to the travel time outputs, and the differences between the calculated INRIX speeds and VISSIM speeds all meet or exceed the project specific calibration targets (5 mph for the overall corridor, 10 mph for individual segments).

Table 8 compares the available I-95 mainline field measured vehicle throughputs (obtained through video counts) with VISSIM throughputs at the corresponding location. Mainline counts were collected at two locations on I-95 in the study area. One location is between Centreport Pkwy (Exit 136) and Warrenton Rd (Exit 133). The other location is between Gordon Blvd (Exit 160) and Prince Willian Pkwy (Exit 158). Table 8 shows that for the entire AM peak period (6-9 AM), all four VISSIM throughputs are within 5% of the measured throughputs. For the AM peak hour (7 AM), VISSIM throughput is 6% less than the actual counts of I-95 southbound at north of Warrenton Rd (Exit 133), which is highlighted in light red.

Table 9 illustrates the differences between the input demands (estimated based on the available count data) and VISSIM throughputs. Input demands versus VISSIM throughputs are not being used for calibration due to congestion along the corridor and the need to input additional demand to replicate congestion on the corridor. This table is provided for information only.

VISSIM is not explicitly able to accurately output existing mainline "queuing" data as specific speed and headway parameters need to be defined for queue counter data collection and the queuing behavior on freeways is substantially different than that on arterials. Mainline backups occur at two key locations: One bottleneck starts between Prince William Parkway (Exits 158) and Gordon Blvd (Exit 160) with congestion extending south towards Dale Boulevard (Exit 156). The other bottleneck begins at Garrisonville Rd (Exit 143) and congestion extends south towards Courthouse Road (Exit 140) and Centreport Parkway (Exit 136). As can be noted from Tables 6 and 7, substantially reduced speeds and increased travel times, consistent with the INRIX data, occur in the appropriate segments, with free flow conditions in the adjoining segments. Based on the highly consistent travel time, speed, and throughput data, it can be reasonably inferred that the mainline backups are well within the 35 percent threshold identified.

3.3.2.2. *Intersection and Ramp Results*

Attachment 5 and 6 presents the comparison between VISSIM input and output volumes at the study area ramps and intersections (by movements). With the exception of one location, which is along Garrisonville Road at Exit 143, the top 85 percent of ramp and intersection movements are within the identified thresholds.

At Exit 143, there is a deviation from the thresholds along eastbound Garrisonville Road. This is primarily due to spillback from the congestion on the mainline of northbound I-95 in this area. The relatively minor

deviation (50 to 100 vehicles per hour) from the identified threshold in this location is justified as increasing throughput at these arterial locations would require adjustments to the mainline operations and that negatively impact the calibration along the Interstate 95 mainline, which is the primary concern for this study.

Attachment 7 illustrates the queuing calibration results. During AM peak period, all the VISSIM maximum queues are within the identified calibration threshold (±25%) of the field observed queues.

In summary, the comparison of AM VISSIM travel times, travel speeds, volume throughputs, and queues with the corresponding field data for I-95 mainline, ramps, and intersections demonstrates that the AM VISSIM model replicates the field traffic condition within the targeted calibration thresholds.

Table 6: AM Calibration Travel Time Results (Seconds)

	I-95 Section		INRIX 2016			VISSIM			Diff.			Diff.(%)		
	From	To	6 AM	7 AM	8 AM	6 AM	7 AM	8 AM	6 AM	7 AM	8 AM	6 AM	7 AM	8 AM
I-95 NB	Rappahannock River	Warrenton Rd (Ex. 133)	97	104	99	96	97	96	-1	-7	-3	-1%	-7%	-3%
	Warrenton Rd (Ex. 133)	Washington Dr (Ex. 143)	1,007	1,012	645	1,110	980	647	103	-32	1	10%	-3%	0%
	Washington Dr (Ex. 143)	Russell Rd (Ex. 148)	278	270	257	251	250	249	-26	-20	-8	-9%	-7%	-3%
	Russell Rd (Ex. 148)	Joplin Rd (Ex. 150)	116	118	120	116	116	116	0	-2	-4	0%	-1%	-3%
	Joplin Rd (Ex. 150)	Dumfries Rd (Ex. 152)	133	134	135	129	129	129	-4	-5	-7	-3%	-4%	-5%
	Dumfries Rd (Ex. 152)	Opitz Blvd (Ex. 156)	228	242	236	216	215	214	-12	-27	-22	-5%	-11%	-9%
	Opitz Blvd (Ex. 156)	Gordon Blvd (Ex. 160)	550	623	458	678	674	411	128	51	-47	23%	8%	-10%
	Rappahannock River	**Gordon Blvd (Ex. 160)**	**2,409**	**2,503**	**1,951**	**2,597**	**2,460**	**1,862**	**188**	**-42**	**-89**	**8%**	**-2%**	**-5%**
I-95 SB	Gordon Blvd (Ex. 160)	SB Rest Area (Ex. 156)	319	271	269	277	283	284	-41	12	16	-13%	4%	6%
	SB Rest Area (Ex. 156)	Dumfries Rd (Ex. 152)	166	167	162	155	157	157	-11	-10	-6	-7%	-6%	-4%
	Dumfries Rd (Ex. 152)	Joplin Rd (Ex. 150)	132	131	129	128	131	131	-4	0	1	-3%	0%	1%
	Joplin Rd (Ex. 150)	Washington Dr (Ex. 143)	365	363	356	353	356	358	-11	-7	3	-3%	-2%	1%
	Washington Dr (Ex. 143)	Warrenton Rd (Ex. 133)	532	537	521	515	520	522	-16	-17	1	-3%	-3%	0%
	Gordon Blvd (Ex. 160)	**Warrenton Rd (Ex. 133)**	**1,512**	**1,470**	**1,436**	**1,429**	**1,447**	**1,451**	**-83**	**-23**	**15**	**-6%**	**-2%**	**1%**

Table 7: AM Calibration Speed Results (VISSIM Speeds vs. INRIX Speed, miles per hour)[4]

	I-95 Section		INRIX 2016			VISSIM			Diff.			Diff.(%)		
	From	To	6 AM	7 AM	8 AM	6 AM	7 AM	8 AM	6 AM	7 AM	8 AM	6 AM	7 AM	8 AM
I-95 NB	Rappahannock River	Warrenton Rd (Ex. 133)	68	64	67	69	69	69	1	5	2	1%	7%	3%
	Warrenton Rd (Ex. 133)	Washington Dr (Ex. 143)	34	34	54	31	35	54	-3	1	0	-9%	3%	0%
	Washington Dr (Ex. 143)	Russell Rd (Ex. 148)	59	61	64	66	66	66	6	5	2	10%	8%	3%
	Russell Rd (Ex. 148)	Joplin Rd (Ex. 150)	70	69	68	70	70	70	0	1	2	0%	1%	4%
	Joplin Rd (Ex. 150)	Dumfries Rd (Ex. 152)	67	66	66	69	69	69	2	3	3	3%	4%	5%
	Dumfries Rd (Ex. 152)	Opitz Blvd (Ex. 156)	61	57	59	64	64	65	3	7	6	5%	13%	10%
	Opitz Blvd (Ex. 156)	Gordon Blvd (Ex. 160)	25	22	31	21	21	34	-5	-2	3	-19%	-8%	11%
	Rappahannock River	**Gordon Blvd (Ex. 160)**	**43**	**41**	**53**	**40**	**42**	**55**	**-3**	**1**	**3**	**-7%**	**2%**	**5%**
I-95 SB	Gordon Blvd (Ex. 160)	SB Rest Area (Ex. 156)	55	64	65	63	62	61	8	-3	-4	15%	-4%	-5%
	SB Rest Area (Ex. 156)	Dumfries Rd (Ex. 152)	64	64	66	69	68	68	5	4	2	7%	7%	4%
	Dumfries Rd (Ex. 152)	Joplin Rd (Ex. 150)	66	66	67	68	66	67	2	0	-1	3%	0%	-1%
	Joplin Rd (Ex. 150)	Washington Dr (Ex. 143)	68	68	70	70	69	69	2	1	0	3%	2%	-1%
	Washington Dr (Ex. 143)	South of Ex. 133	68	67	70	70	70	69	2	2	0	3%	3%	0%
	Gordon Blvd (Ex. 160)	**Warrenton Rd (Ex. 133)**	**65**	**67**	**68**	**68**	**68**	**67**	**4**	**1**	**-1**	**6%**	**2%**	**-1%**

Table 8: AM Calibration Volume Results (VISSIM Throughputs vs. Tube counts, vehicle per hour) [5]

	Location	Tube counts				VISSIM				Diff.				Diff.(%)			
		6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM
I-95 NB	South of Centreport Pkwy(Ex.	4,021	3,563	2,932	**10,516**	4,005	3,543	2,920	**10,468**	-16	-20	-12	**-48**	0%	-1%	0%	**0%**
	South of Gordon Blvd (Ex. 160	5,072	5,022	4,882	**14,976**	5,225	5,275	5,179	**15,679**	153	253	297	**703**	3%	5%	6%	**5%**
I-95 SB	North of Prince William Pkwy	2,168	4,152	4,357	**10,677**	2,387	4,160	4,346	**10,893**	219	8	-11	**216**	10%	0%	0%	**2%**
	North of Warrenton Rd (Ex. 13	1,591	2,913	3,104	**7,608**	1,622	2,749	2,996	**7,367**	31	-164	-108	**-241**	2%	-6%	-3%	**-3%**

[4] The speeds are color coded based on the following range: red (<30 mph), orange (30-40 mph), yellow (40-50 mph), light green (50-60 mph), dark green (>60 mph).

[5] Values highlighted in RED exceed the project specific calibration thresholds.

Table 9: AM Calibration Volume Results (VISSIM Throughputs vs. Input Demands, vehicle per hour)

	Location	Input Volumes				VISSIM				Diff.				Diff.(%)			
		6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM
I-95 NB	South of Warrenton Rd (Ex. 13	4,500	4,680	3,919	**13,099**	4,539	4,593	3,941	**13,073**	39	-87	22	**-26**	1%	-2%	1%	**0%**
	South of Garrisonville Rd (Ex	3,490	3,153	3,155	**9,798**	3,350	3,383	3,171	**9,904**	-140	230	16	**106**	-4%	7%	1%	**1%**
	South of Russell Rd (Ex. 148)	5,065	4,432	4,550	**14,047**	4,550	4,628	4,620	**13,798**	-515	196	70	**-249**	-10%	4%	2%	**-2%**
	South of Joplin Rd (Ex. 150)	3,611	3,306	3,345	**10,262**	3,355	3,380	3,369	**10,104**	-256	74	24	**-158**	-7%	2%	1%	**-2%**
	South of Dumfries Rd (Ex. 152	4,265	3,858	3,714	**11,837**	4,009	3,920	3,733	**11,662**	-256	62	19	**-175**	-6%	2%	1%	**-1%**
	South of Dale Blvd (Ex. 156)	4,923	4,425	4,238	**13,586**	4,692	4,479	4,241	**13,412**	-231	54	3	**-174**	-5%	1%	0%	**-1%**
	North of Gordon Blvd (Ex. 160	6,701	6,066	5,603	**18,370**	6,368	6,204	5,983	**18,555**	-333	138	380	**185**	-5%	2%	7%	**1%**
I-95 SB	North of Gordon Blvd (Ex. 160	2,040	3,885	4,091	**10,016**	2,278	3,906	4,112	**10,296**	238	21	21	**280**	12%	1%	1%	**3%**
	North of Dale Blvd (Ex. 156)	2,154	3,998	3,988	**10,140**	2,312	3,967	3,992	**10,271**	158	-31	4	**131**	7%	-1%	0%	**1%**
	South of Dumfries Rd (Ex. 152	2,397	4,302	4,094	**10,793**	2,485	4,245	4,063	**10,793**	88	-57	-31	**0**	4%	-1%	-1%	**0%**
	South of Joplin Rd (Ex. 150)	2,038	3,471	3,840	**9,349**	2,099	3,475	3,812	**9,386**	61	4	-28	**37**	3%	0%	-1%	**0%**
	South of Garrisonville Rd (Ex	1,326	2,500	2,746	**6,572**	1,361	2,367	2,684	**6,412**	35	-133	-62	**-160**	3%	-5%	-2%	**-2%**
	South of Warrenton Rd (Ex. 13	1,792	3,073	3,220	**8,085**	1,869	2,956	3,124	**7,949**	77	-117	-96	**-136**	4%	-4%	-3%	**-2%**

3.4. PM Peak Hour Calibration

3.4.1. Driver Behavior Parameter Changes

I-95 Southbound is the peak direction during PM peak period. Field observations and the INRIX data show that there are three congested sections within the I-95 southbound general purpose lanes. One bottleneck starts at the lane reduction from four lanes to three lanes at Gordon Blvd (Exit 160) with congestion extending north towards Fairfax County Pkwy (Exit 166). The second bottleneck begins at Garrisonville Rd (Exit 143) and congestion extends north towards Russell Rd (Exit 148). The third bottleneck begins at Warrenton Rd (Exit 133) and congestion extends north towards Garrisonville Rd (Exit 143). Five different driving behaviors have been created to replicate field conditions.

First, the general driver behavior type (Freeway 101) was adjusted to account for the overall corridor travel times. The resulting driving behavior is a Wiedemann 99 (Freeway) with a "Standstill Distance (CC0)" of 7 feet and a modified "Headway Time (CC1)" of 1.05 seconds.

Second, to avoid unreasonable vehicle behavior in the heavy weaving sections, an "Aggressive Lane Change" driving behavior type (Freeway 102) was created with a "Headway Time (CC1)" of 0.9 seconds, and a reduced "Safety distance reduction factor" of 0.2.

Third, to replicate the three congested sections on the I-95 southbound mainline, three "Congested Merging/weaving" driving behavior types (Freeway 103, 104, and 105) were created with further conservative parameters. Table 10 summarizes the parameters for all five freeway driving behavior types for PM model.

Table 10: Freeway Driving behavior PM Parameters (Wiedemann 99)

Parameter		Default Value	Unit	Freeway 101	Freeway 102	Freeway 103	Freeway 203	Freeway 204
CC0	**Standstill distance**	4.92	feet	7.00	4.92	10.00	9.50	10.00
CC1	**Headway time**	0.90	seconds	1.05	0.90	1.33	1.32	1.45
CC2	**'Following' variation**	13.12	feet	13.12	13.12	19.17	31.00	35.00
Safety distance reduction factor		0.60	--	0.60	0.20	0.23	0.20	0.20

3.4.2. PM Model Calibration Results

3.4.2.1. *I-95 Mainline Results*

Table 11 presents the travel time calibration results of PM peak period model. For most sections (over 95%), the difference between the INRIX travel time and VISSIM travel time during individual hours for individual segments are less than 10%, and all of them are less than 25%, which satisfies the project-specific calibration targets. For the peak I-95 southbound direction, the travel time differences for the entire corridor are 1%, -3%, -3%, and -4% for 3PM, 4PM, 5 PM and 6 PM respectively. For the non-peak I-95 northbound, the differences are 2%, 1%, 4% and 2%. As a reference, the hourly average VISSIM speeds are also compared to available INRIX speed data in Table 12. Similar to the travel time data, the the INRIX and VISSIM speeds were very similar; all locations are within 10 mph of the observed field speeds during

the peak hour and over 95 percent of the individual segment speeds are within the 10 mph threshold for the remaining hours. Three outlier speeds (12, -12, + 16 mph, highlighted in light red) were noticed for individual segments towards the southern project limits during the shoulder hours (particularly 4 PM and 6 PM). Travel times within these segments satisfied the 25% requirement for individual hours, so the travel speed deviation is not considered a major concern.

The available I-95 mainline field measured vehicle throughputs (obtained through video counts) are compared with the corresponding VISSIM throughputs in Table 13. Mainline counts were collected at the same two locations as AM peak period in the study limits. For the entire PM peak period (3-7 PM), the VISSIM throughputs of both direction (southbound and northbound) are within 5% of the field-measured throughputs. Peak hour (5-6 PM) throughputs were also all within 5% of the field-measured throughputs for these locations. In several shoulder hours, the throughputs slightly exceed the 5% threshold; two of these instances are for the off-peak (northbound direction).

Table 14 illustrates the differences between the input demands (estimated based on the available count data) and VISSIM throughputs. Input demands versus VISSIM throughputs are not being used for calibration due to congestion along the corridor and the need to input additional demand at the entry points to replicate congestion on the corridor. This table is provided for information.

VISSIM is not explicitly able to accurately output existing mainline "queuing" data as specific speed and headway parameters need to be defined for queue counter data collection and the queuing behavior on freeways is substantially different than that on arterials. Mainline backups occur at three key locations: One bottleneck starts at the lane reduction from four lanes to three lanes at Gordon Blvd (Exit 160) with congestion extending north towards Fairfax County Pkwy (Exit 166). The second bottleneck begins at Garrisonville Rd (Exit 143) and congestion extends north towards Russell Rd (Exit 148). The third bottleneck begins at Warrenton Rd (Exit 133) and congestion extends north towards Garrisonville Rd (Exit 143). As can be noted from Tables 12 and 13, substantially reduced speeds and increased travel times, consistent with the INRIX data, occur in the appropriate segments, with free flow conditions in the adjoining segments. Based on the highly consistent travel time, speed, and throughput data, it can be reasonably inferred that the mainline backups are well within the 35 percent threshold identified.

3.4.2.2. *Intersection and Ramp Terminal Results*

Attachment 8 and 9 present the comparison between VISSIM input and output volumes at the study intersection and ramp terminals by movements during PM peak period. For the 4-hour PM peak period, all the ramps and intersection movements are within the calibration threshold. At several individual locations, individual hour volumes at a limited number of ramps or intersections deviate from the project-specific thresholds. Further calibration to adjust these limited number of locations was not considered prudent given the excellent volume, travel time, and travel speed calibration along the I-95 mainline. Generally, the volume differentials above the allowable deviation from the thresholds is on the order of 50 to 100 vehicles per hour, and these differences would have minimal impacts on operations along the I-95 corridor and the arterials themselves.

Attachment 10 shows the comparison between VISSIM average maximum queue and field observed queues. For most locations, the VISSIM queues are well within the project-specific calibration threshold. However, for the queue along westbound Route 3 at Carl D. Silver Parkway, VISSIM reports shorter queues than those observed in the field. The queue along westbound Route 3 is complex, with several intersections west of I-95 contributing to the overall queue. Based on field observations, the critical queue

begins two intersections west of the modeled area, where Route 3 westbound reduces from four through lanes to 3 through lanes. Additionally, the queuing along the off-ramp from I-95 SB to Route 3 (which is primarily a rolling queue throughout the peak period) could not be adequately captured using VISSIM evaluation measures. From visual inspection, the simulated queue on this off-ramp is also less than field observed conditions; this queue is influenced by the same factors as the queue along westbound Route 3. It is important to note that the primary purpose of this VISSIM model is to evaluate the impacts of the I-95 Express Lanes Fredericksburg Extension project; the project itself terminates north of Exit 133, and the project would not involve changes to the Route 3 corridor. Additionally, the I-95 / Route 3 Safety Improvements are currently under construction; these improvements will substantially modify the existing conditions at this interchange and efforts to further calibrate this specific location would have minimal benefits in terms of evaluating the I-95 Express Lanes Fredericksburg Extension project. Future studies could expand the model to the west if the intent of a future study is to evaluate operations along Route 3 in greater detail.

In summary, the comparison of PM VISSIM travel time data, vehicle throughputs, and queues with the corresponding field data for I-95 corridor, intersections, and ramp terminals demonstrates that the PM VISSIM model replicates the field traffic conditions within the targeted calibration goals.

Table 11: PM Calibration Travel Time Results

	I-95 Section		INRIX 2016				VISSIM				Diff.				Diff.(%)			
	From	To	3 PM	4 PM	5 PM	6 PM	3 PM	4 PM	5 PM	6 PM	3 PM	4 PM	5 PM	6 PM	3 PM	4 PM	5 PM	6 PM
I-95 NB	Rappahannock River	Warrenton Rd (Ex. 133)	96	98	95	98	96	96	96	96	1	-2	1	-2	1%	-2%	1%	-2%
	Warrenton Rd (Ex. 133)	Washington Dr (Ex. 143)	501	506	495	499	506	506	506	504	5	1	11	5	1%	0%	2%	1%
	Washington Dr (Ex. 143)	Russell Rd (Ex. 148)	239	243	236	238	242	242	241	240	2	-2	5	2	1%	-1%	2%	1%
	Russell Rd (Ex. 148)	Joplin Rd (Ex. 150)	117	121	115	117	120	121	120	119	3	0	5	2	3%	0%	4%	2%
	Joplin Rd (Ex. 150)	Dumfries Rd (Ex. 152)	133	137	129	131	131	132	130	129	-1	-5	2	-1	-1%	-4%	1%	-1%
	Dumfries Rd (Ex. 152)	Opitz Blvd (Ex. 156)	208	215	202	206	215	215	213	212	7	0	11	6	3%	0%	6%	3%
	Opitz Blvd (Ex. 156)	Gordon Blvd (Ex. 160)	212	215	211	208	232	232	231	229	20	17	20	21	10%	8%	10%	10%
	Rappahannock River	**Gordon Blvd (Ex. 160)**	**1,506**	**1,535**	**1,482**	**1,496**	**1,543**	**1,544**	**1,538**	**1,529**	**37**	**9**	**56**	**33**	**2%**	**1%**	**4%**	**2%**
I-95 SB	Gordon Blvd (Ex. 160)	SB Rest Area (Ex. 156)	281	289	300	287	297	299	299	298	16	10	0	11	6%	3%	0%	4%
	SB Rest Area (Ex. 156)	Dumfries Rd (Ex. 152)	162	161	164	161	158	159	159	159	-3	-2	-5	-2	-2%	-1%	-3%	-1%
	Dumfries Rd (Ex. 152)	Joplin Rd (Ex. 150)	129	129	129	128	130	131	131	130	1	2	2	2	1%	1%	1%	2%
	Joplin Rd (Ex. 150)	Washington Dr (Ex. 143)	411	580	503	369	380	454	568	451	-32	-126	66	83	-8%	-22%	13%	22%
	Washington Dr (Ex. 143)	Warrenton Rd (Ex. 133)	635	821	987	701	661	880	868	536	26	59	-119	-164	4%	7%	-12%	-23%
	Gordon Blvd (Ex. 160)	**Warrenton Rd (Ex. 133)**	**1,617**	**1,980**	**2,082**	**1,644**	**1,626**	**1,922**	**2,025**	**1,574**	**9**	**-58**	**-57**	**-70**	**1%**	**-3%**	**-3%**	**-4%**

Table 12: PM Calibration Speed Results (VISSIM Speeds vs. INRIX Speed, miles per hour) [6,7]

	I-95 Section		INRIX 2016				VISSIM				Diff.			
	From	To	3 PM	4 PM	5 PM	6 PM	3 PM	4 PM	5 PM	6 PM	3 PM	4 PM	5 PM	6 PM
I-95 NB	Rappahannock River	Warrenton Rd (Ex. 133)	69	68	70	68	69	69	69	69	-1	1	-1	1
	Warrenton Rd (Ex. 133)	Washington Dr (Ex. 143)	69	69	70	70	69	69	69	69	-1	0	-2	-1
	Washington Dr (Ex. 143)	Russell Rd (Ex. 148)	69	68	70	69	68	68	68	69	-1	0	-2	-1
	Russell Rd (Ex. 148)	Joplin Rd (Ex. 150)	69	67	71	69	67	67	68	68	-2	0	-3	-1
	Joplin Rd (Ex. 150)	Dumfries Rd (Ex. 152)	67	65	69	68	68	67	68	69	1	3	-1	1
	Dumfries Rd (Ex. 152)	Opitz Blvd (Ex. 156)	67	65	69	68	65	65	65	66	-2	0	-4	-2
	Opitz Blvd (Ex. 156)	Gordon Blvd (Ex. 160)	66	65	66	67	60	60	61	61	-6	-5	-6	-6
	Rappahannock River	**Gordon Blvd (Ex. 160)**	68	67	69	69	67	67	67	67	**-2**	**0**	**-3**	**-1**
I-95 SB	Gordon Blvd (Ex. 160)	SB Rest Area (Ex. 156)	62	60	58	61	59	58	58	59	-3	-2	0	-2
	SB Rest Area (Ex. 156)	Dumfries Rd (Ex. 152)	66	66	65	67	67	67	67	67	1	1	2	1
	Dumfries Rd (Ex. 152)	Joplin Rd (Ex. 150)	67	67	68	68	67	67	67	67	-1	-1	-1	-1
	Joplin Rd (Ex. 150)	Washington Dr (Ex. 143)	60	43	49	67	65	55	44	55	5	12	-6	-12
	Washington Dr (Ex. 143)	South of Ex. 133	57	44	37	52	55	41	42	68	-2	-3	5	16
	Gordon Blvd (Ex. 160)	**Warrenton Rd (Ex. 133)**	60	49	47	59	60	51	48	62	**0**	**1**	**1**	**3**

[6] The speeds are color coded based on the following range: red (<30 mph), orange (30-40 mph), yellow (40-50 mph), light green (50-60 mph), dark green (>60 mph).

[7] Values exceeding the project specific calibration thresholds are highlighted in RED.

Table 13: PM Calibration Volume Results (VISSIM Throughputs vs. Tube counts) [7]

	Location	Tube counts					VISSIM					Diff.					Diff.(%)				
		3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM
I-95 NB	South of Centreport Pkwy(Ex. 136)	3,561	3,582	3,405	3,119	**13,667**	3,613	3,594	3,451	3,203	**13,861**	52	12	46	84	**194**	1%	0%	1%	3%	**1%**
	South of Gordon Blvd (Ex. 160)	4,872	4,755	4,523	4,162	**18,312**	5,250	5,135	4,700	4,115	**19,200**	378	380	177	-47	**888**	8%	8%	4%	-1%	**5%**
I-95 SB	North of Prince William Pkwy (Ex. 158)	5,472	5,707	5,487	5,063	**21,729**	5,434	5,463	5,442	5,445	**21,784**	-38	-244	-45	382	**55**	-1%	-4%	-1%	8%	**0%**
	North of Warrenton Rd (Ex. 133)	4,853	4,890	4,327	3,792	**17,862**	5,168	5,060	4,537	3,886	**18,651**	315	170	210	94	**789**	6%	3%	5%	2%	**4%**

Table 14: PM Calibration Volume Results (VISSIM Throughputs vs. Input Demands)

	Location	Input Volumes					VISSIM					Diff.					Diff.(%)				
		3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM
I-95 NB	South of Warrenton Rd (Ex. 133)	3,995	3,979	3,876	3,547	**15,397**	4,023	3,916	3,742	3,539	**15,220**	28	-63	-134	-8	**-177**	1%	-2%	-3%	0%	**-1%**
	South of Garrisonville Rd (Ex. 143)	3,484	3,532	3,384	3,103	**13,503**	3,530	3,496	3,313	3,070	**13,408**	46	-36	-71	-33	**-95**	1%	-1%	-2%	-1%	**-1%**
	South of Russell Rd (Ex. 148)	3,549	3,583	3,500	3,242	**13,874**	3,577	3,600	3,424	3,204	**13,804**	28	17	-76	-38	**-70**	1%	0%	-2%	-1%	**-1%**
	South of Joplin Rd (Ex. 150)	4,202	4,480	4,121	3,534	**16,337**	4,335	4,376	3,906	3,518	**16,134**	133	-104	-215	-16	**-203**	3%	-2%	-5%	0%	**-1%**
	South of Dumfries Rd (Ex. 152)	4,712	5,129	4,679	3,799	**18,319**	4,908	5,008	4,346	3,780	**18,041**	196	-121	-333	-19	**-278**	4%	-2%	-7%	-1%	**-2%**
	South of Dale Blvd (Ex. 156)	4,531	4,829	4,475	3,711	**17,546**	4,650	4,729	4,236	3,710	**17,325**	119	-100	-239	-1	**-221**	3%	-2%	-5%	0%	**-1%**
	North of Gordon Blvd (Ex. 160)	5,260	5,144	4,757	4,134	**19,295**	5,142	4,971	4,646	4,168	**18,926**	-118	-173	-111	34	**-369**	-2%	-3%	-2%	1%	**-2%**
I-95 SB	North of Gordon Blvd (Ex. 160)	5,385	5,617	5,408	5,403	**21,813**	5,475	5,336	5,399	5,519	**21,729**	90	-281	-9	116	**-84**	2%	-5%	0%	2%	**0%**
	North of Dale Blvd (Ex. 156)	5,848	6,305	6,264	5,964	**24,381**	5,881	6,136	6,115	5,997	**24,129**	33	-169	-149	33	**-252**	1%	-3%	-2%	1%	**-1%**
	South of Dumfries Rd (Ex. 152)	3,928	4,067	4,237	3,804	**16,036**	3,890	4,079	3,981	3,828	**15,778**	-38	12	-256	24	**-258**	-1%	0%	-6%	1%	**-2%**
	South of Joplin Rd (Ex. 150)	3,615	3,891	3,929	3,700	**15,135**	3,654	3,852	3,769	3,725	**15,000**	39	-39	-160	25	**-135**	1%	-1%	-4%	1%	**-1%**
	South of Garrisonville Rd (Ex. 143)	4,974	5,406	4,851	3,871	**19,102**	5,033	4,979	4,611	3,958	**18,582**	59	-427	-240	88	**-520**	1%	-8%	-5%	2%	**-3%**
	South of Warrenton Rd (Ex. 133)	5,588	5,860	4,976	3,869	**20,292**	5,414	5,422	5,376	4,429	**20,640**	-173	-438	400	560	**349**	-3%	-7%	8%	14%	**2%**

[7] The speeds are color coded based on the following range: red (<30 mph), orange (30-40 mph), yellow (40-50 mph), light green (50-60 mph), dark green (>60 mph).
[7] Values exceeding the project specific calibration thresholds are highlighted in RED.

Attachment 1:
2016 Balanced Traffic Volumes

1

				R		346
				T		1,056
R	T	L		L		8
	VA-3 (Plank Road)			L	T	R
	128		L			
	2,832		T	8	0	10
	4		R			

Carl D Silver Pkwy / Mall Court

1303

2

				R		0
				T		892
R	T	L		L		86
	VA-3 (Plank Road)			L	T	R
	72		L			
	1,219		T	290	0	112
	208		R			

Ramseur St / Gateway Blvd

1304

Legend

x,xxx Weekday 6-7 AM Volume

NOT TO SCALE

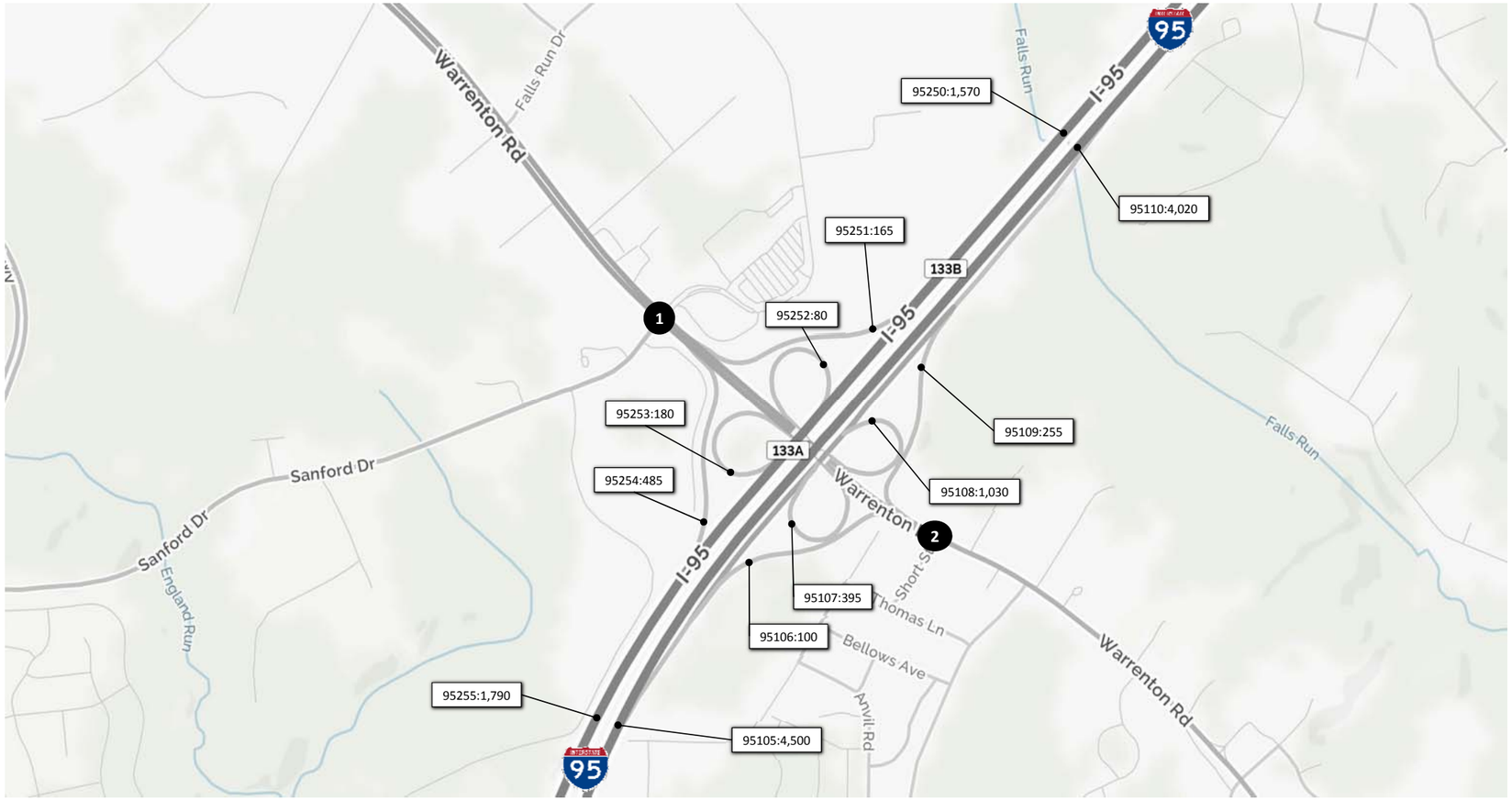
VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 6-7 AM Volumes I-95 Corridor

August 2017 | Figure A.1-1



1

						R		165
	15	0	172			T		1,549
	R	T	L			L		63
US-17 (Warrenton Rd)				*S Gateway Dr*				
	20	L				L	T	R
	1,006	T		*Sanford Dr*		10	10	58
	10	R						
								1333

2

						R		0
	0	2	2			T		838
	R	T	L	*Parking Lot*		L		3
US-17 BUS (Warrenton Rd)								
	0	L		*Short St*		L	T	R
	595	T				82	0	10
	43	R						
								1338

Legend

x,xxx Weekday 6-7 AM Volume

NOT TO SCALE

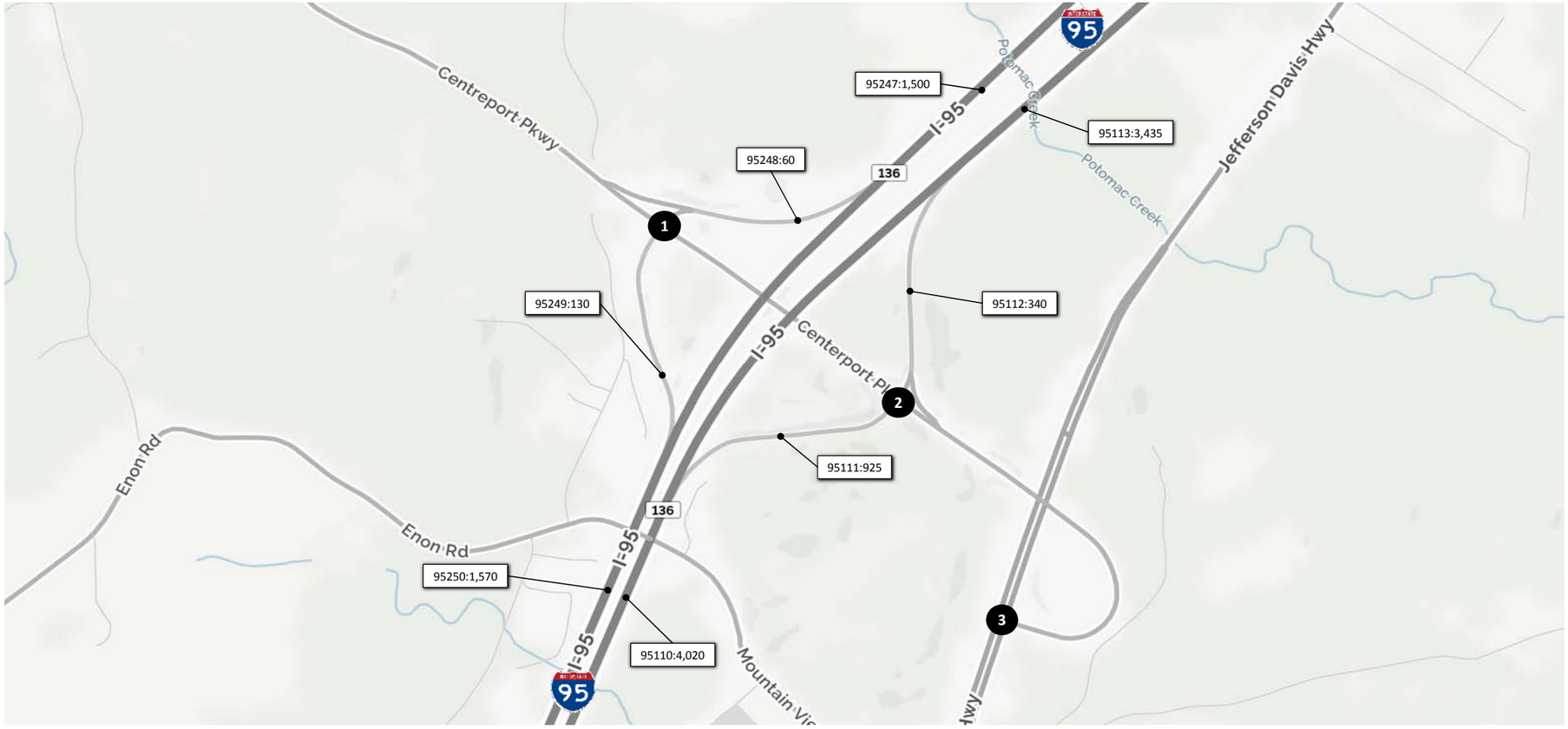
VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing
Weekday 6-7 AM Volumes
I-95 Corridor

August 2017 | Figure A.1-2



1

						I-95 SB Off-Ramp		
					T	649		
3	0	55		L	49			
R	T	L						
Centreport Pkwy								
						I-95 SB On-Ramp		
45		T						
82		R						
					1363			

2

						I-95 NB On-Ramp		
				R	331			
				T	238			
Centreport Pkwy								
3	L			L	T	R		
97	T		I-95 NB Off-Ramp	461	5	459		
					1366			

3

167	36						US-1	
T	L			R	428			
Centreport Pkwy				L	138			
					T	R	US-1	
				954	533			
					1368			

Legend

x,xxx Weekday 6-7 AM Volume

NOT TO SCALE

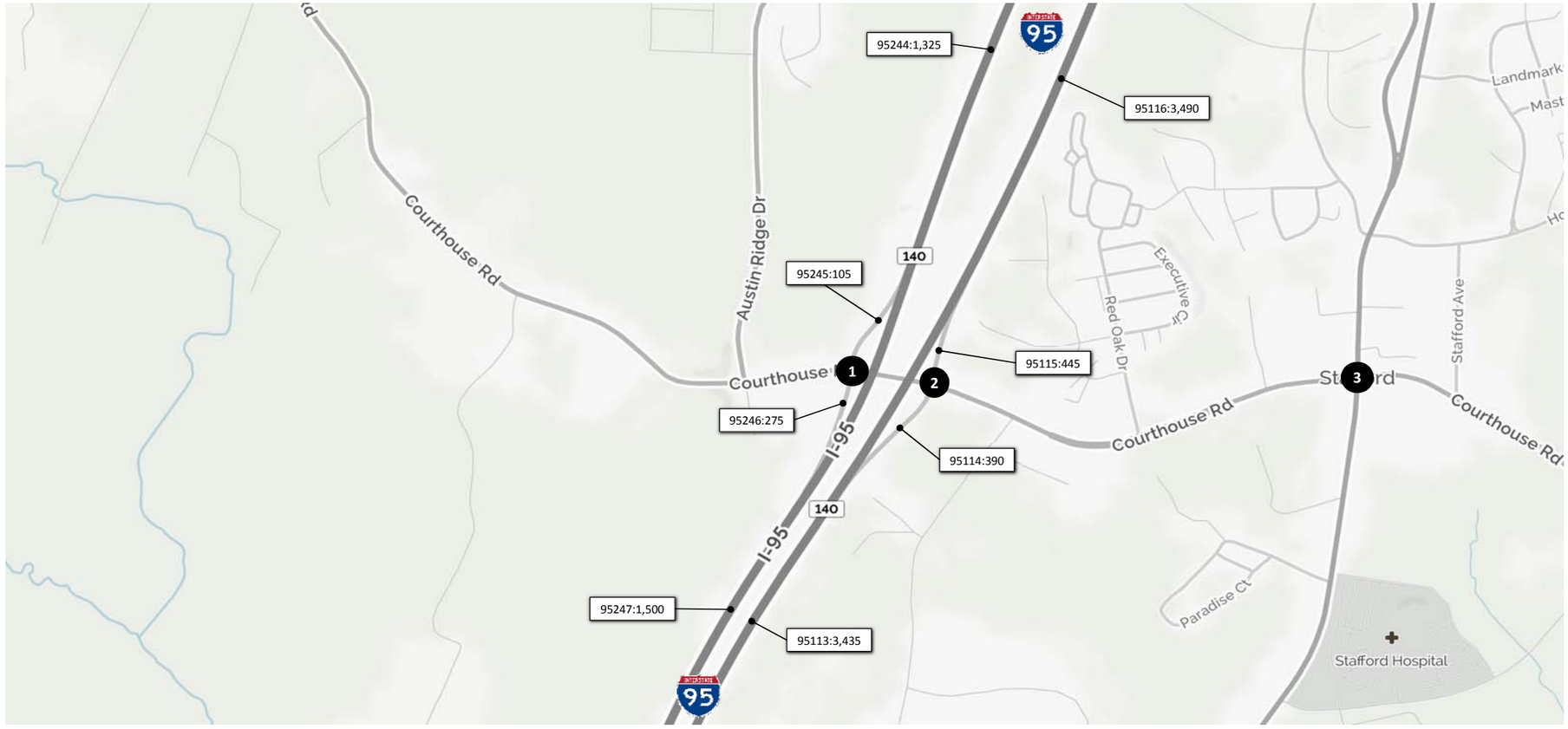
VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 6-7 AM Volumes I-95 Corridor

August 2017 | Figure A.1-3



1

				I-95 SB Off-Ramp		
					T	707
36	0	69			L	99
R	T	L				
Courthouse Road (630)			I-95 SB On-Ramp			
	251	T				
	179	R				
						1403

2

				I-95 NB On-Ramp		
					R	328
					T	544
Courthouse Road (630)			I-95 NB Off-Ramp			
104	L			L	T	R
216	T			262	15	115
						1406

3

				US-1		
					R	155
					T	209
304	105	65			L	15
R	T	L				
Courthouse Road (630)			US-1			
	120	L			L	T R
	105	T			359	427 12
	105	R				
						1408

Legend

x,xxx Weekday 6-7 AM Volume

NOT TO SCALE

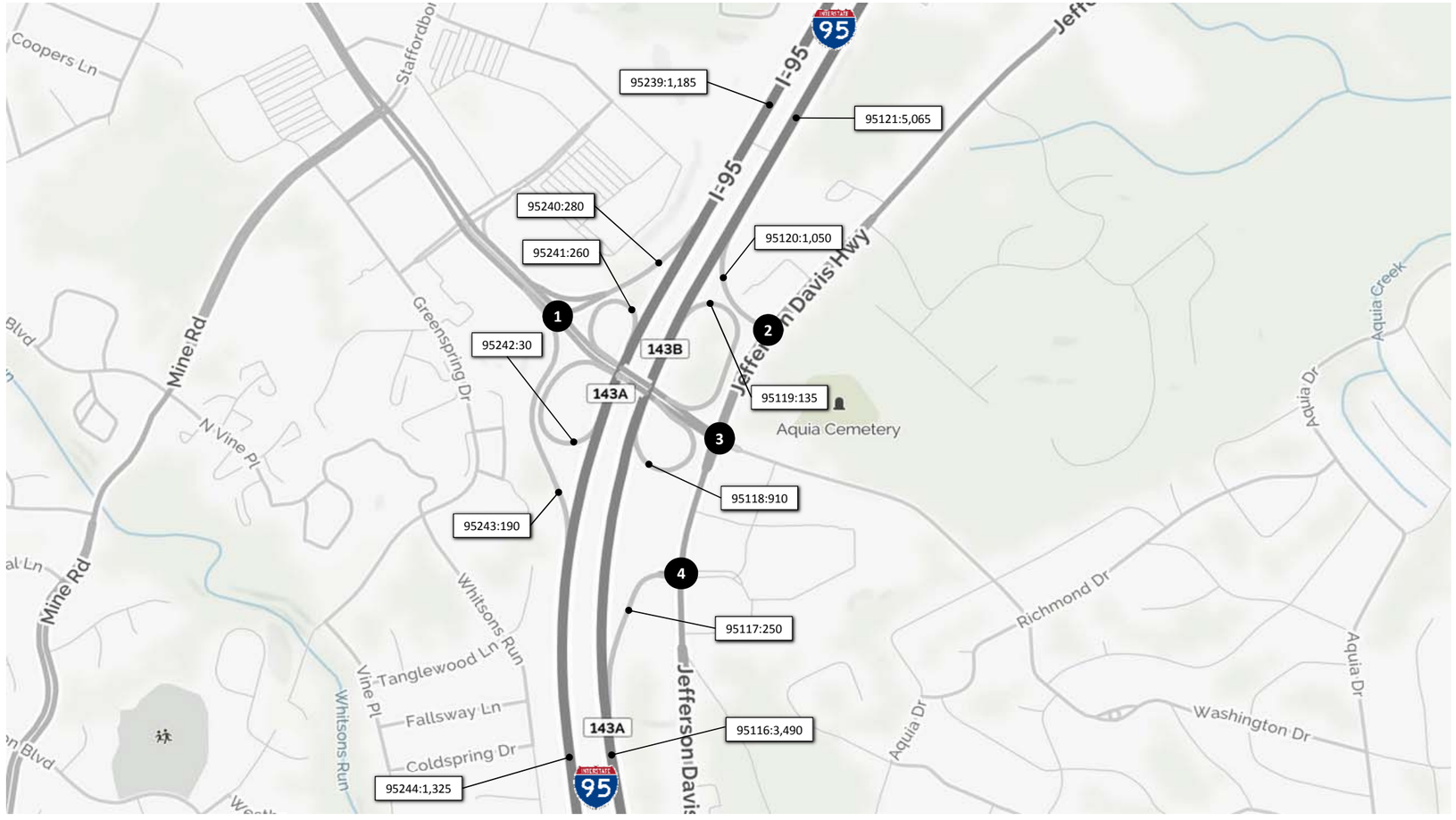
VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 6-7 AM Volumes I-95 Corridor

August 2017 | Figure A.1-4



1

I-95 SB Off-Ramp: 671 (T)

Garrisonville Road (610): 0 (R); 1,921 (T); 188 (R)

I-95 SB On-Ramp

1431

2

US-1: 60 (R), 646 (T); 988 (L), 1,387 (T)

I-95 NB On-Ramp

1434

3

US-1: 440 (R), 190 (T), 15 (L); 298 (R), 187 (T), 66 (L)

Garrisonville Road (610): 910 (L), 14 (T), 114 (R); 168 (L), 1,169 (T), 0 (R)

US-1

1438

4

US-1: 327 (T), 44 (L); 119 (R), 19 (L)

I-95 NB Off-Ramp: 163 (L), 81 (T), 5 (R); 1,055 (T), 58 (R)

US-1

1432

Legend

x,xxx Weekday 6-7 AM Volume

NOT TO SCALE

VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 6-7 AM Volumes I-95 Corridor

August 2017

Figure A.1-5

Legend

x,xxx Weekday 6-7 AM Volume

NOT TO SCALE

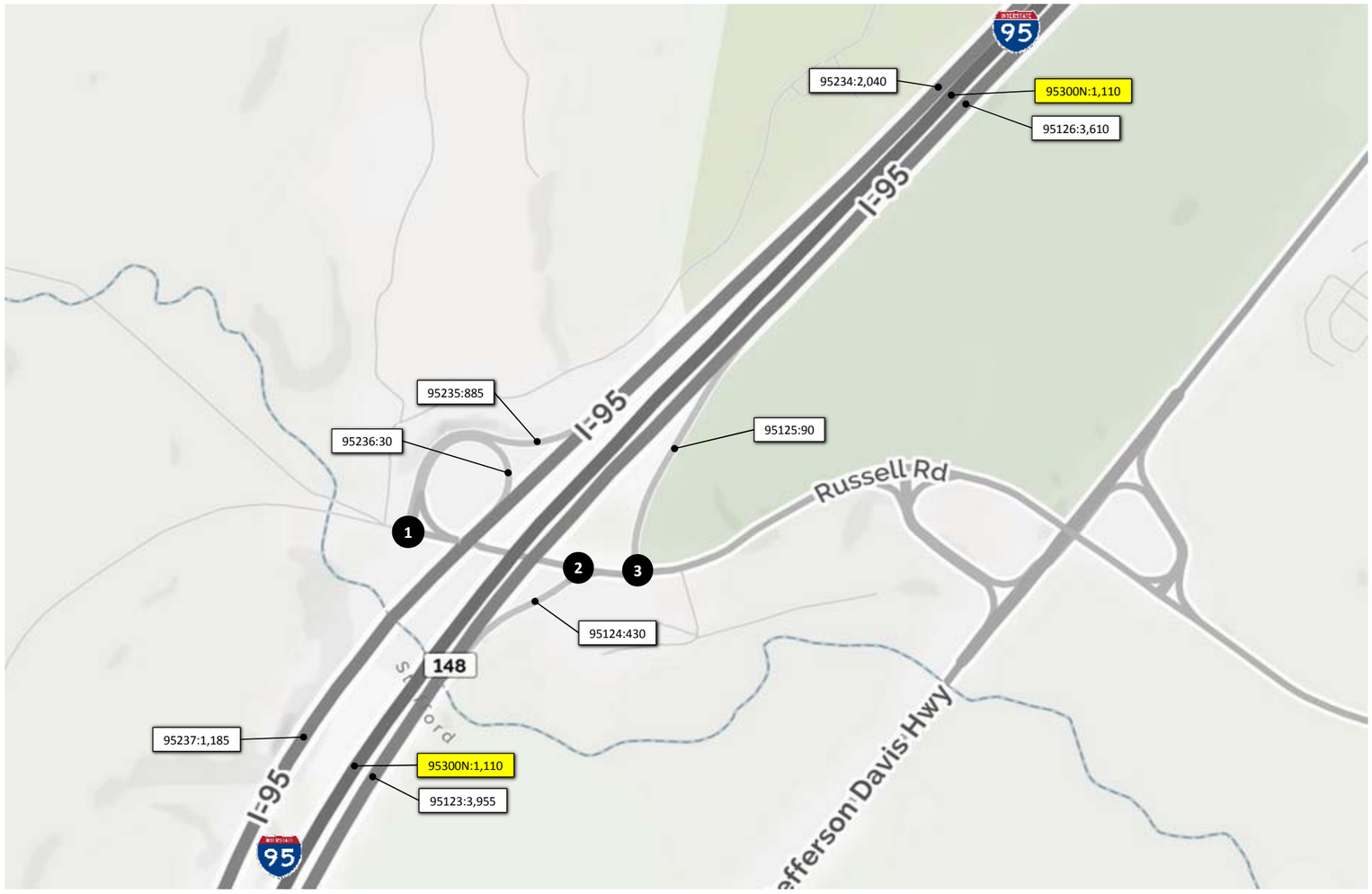
VDOT Virginia Department of Transportation

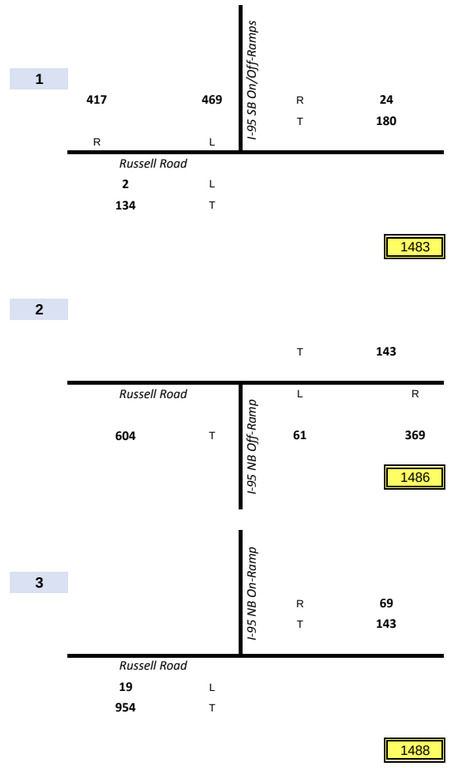
U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 6-7 AM Volumes I-95 Corridor

August 2017 | Figure A.1-6





Legend

x,xxx Weekday 6-7 AM Volume

NOT TO SCALE

VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 6-7 AM Volumes I-95 Corridor

August 2017 | Figure A.1-7

1

	41	2	313	R	410
				T	1,385
	R	T	L	L	13
	VA-3 (Plank Road)			L	T	R
	156		L			
	2,849		T	1	3	9
	4		R			

Carl D Silver Pkwy

Mall Court

1303

2

	15	2	5	R	7
				T	1,044
	R	T	L	L	104
	VA-3 (Plank Road)			L	T	R
	73		L			
	1,614		T	263	1	140
	271		R			

Ramseur St

Gateway Blvd

1304

Legend

x,xxx Weekday 7-8 AM Volume

NOT TO SCALE

VDOT Virginia Department of Transportation

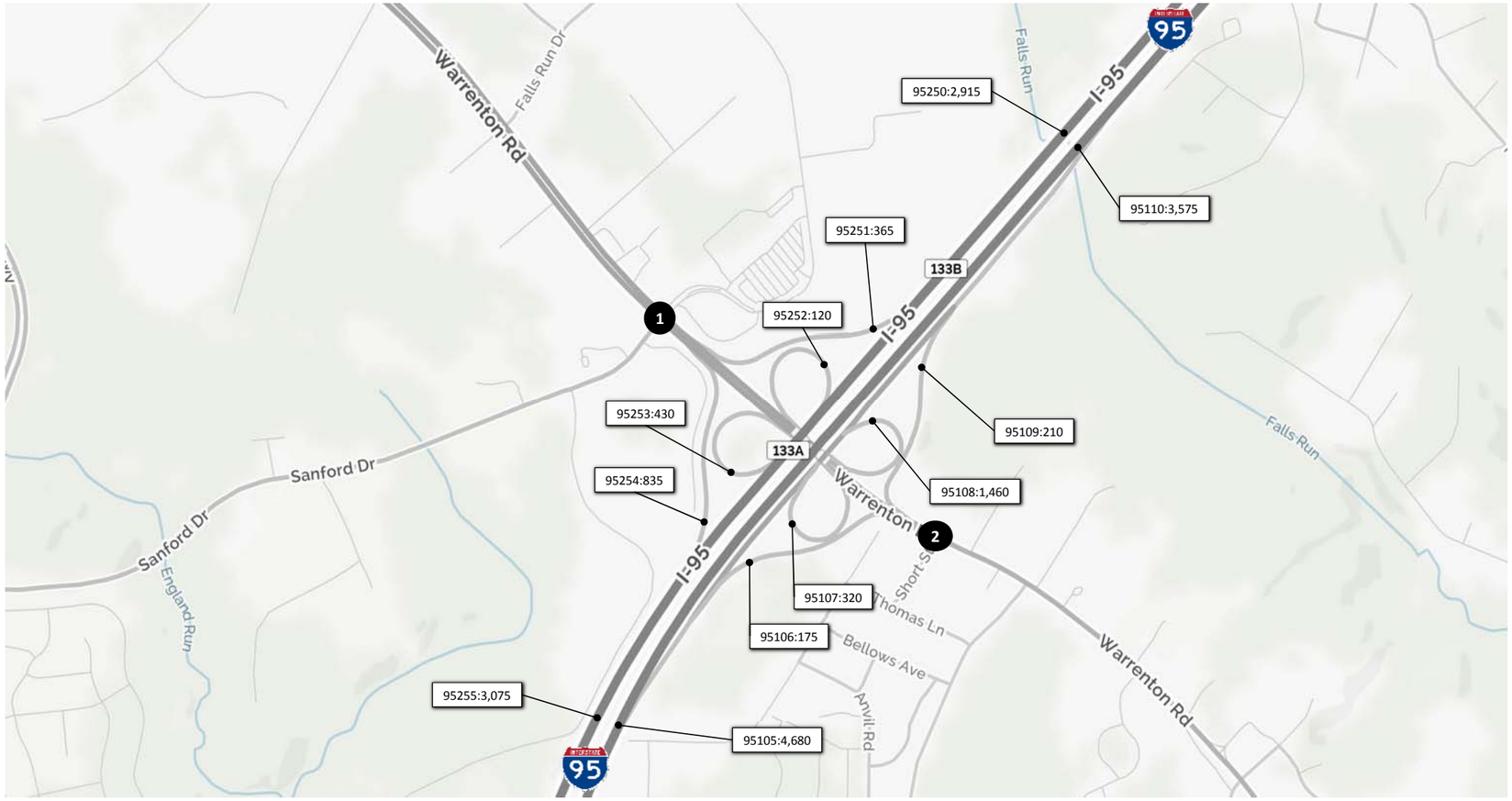
U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 7-8 AM Volumes I-95 Corridor

August 2017

Figure A.2-1



1

	36	27	286	R	337
				T	2,174
	R	T	L	L	289

S Gateway Dr

US-17 (Warrenton Rd)

				L	T	R
	53	L				
	1,380	T		29	19	114
	28	R				

Sanford Dr

1333

2

	6	0	3	R	2
				T	1,200
	R	T	L	L	5

Parking Lot

US-17 BUS (Warrenton Rd)

				L	T	R
	4	L				
	1,167	T		100	3	18
	60	R				

Short St

1338

Legend

x,xxx Weekday 7-8 AM Volume

NOT TO SCALE

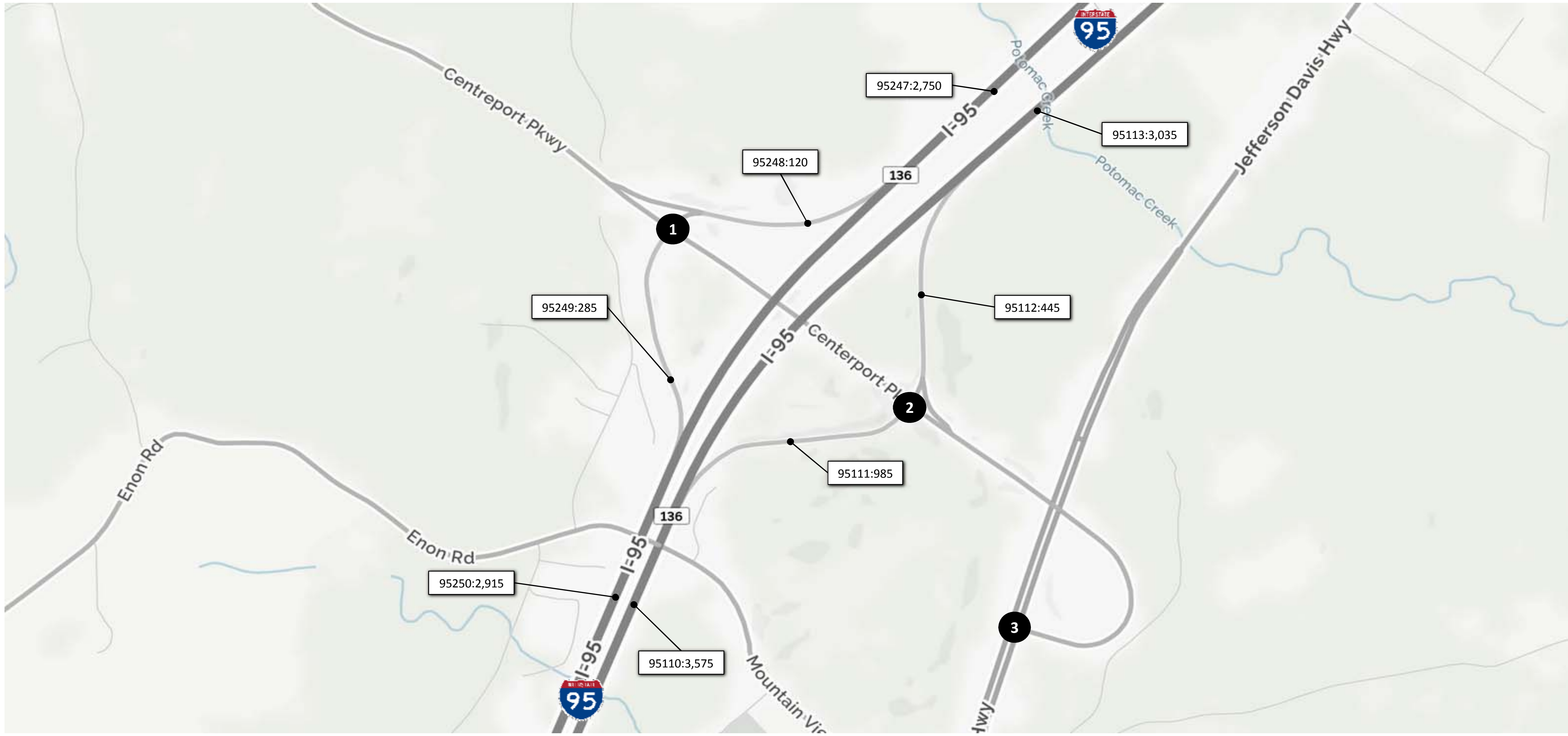
VDOT Virginia Department of Transportation

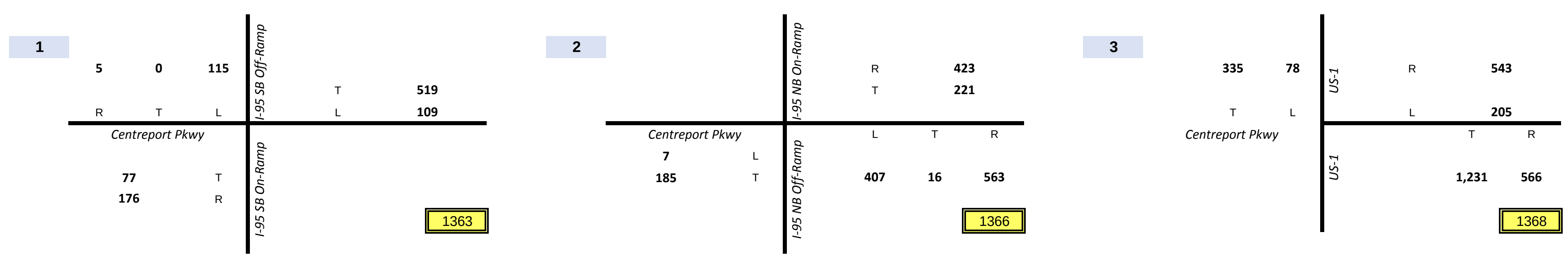
U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing
Weekday 7-8 AM Volumes
I-95 Corridor

August 2017 | Figure A.2-2





Legend

x,xxx Weekday 7-8 AM Volume

NOT TO SCALE

I-95 Express Lanes Fredericksburg Extension Study

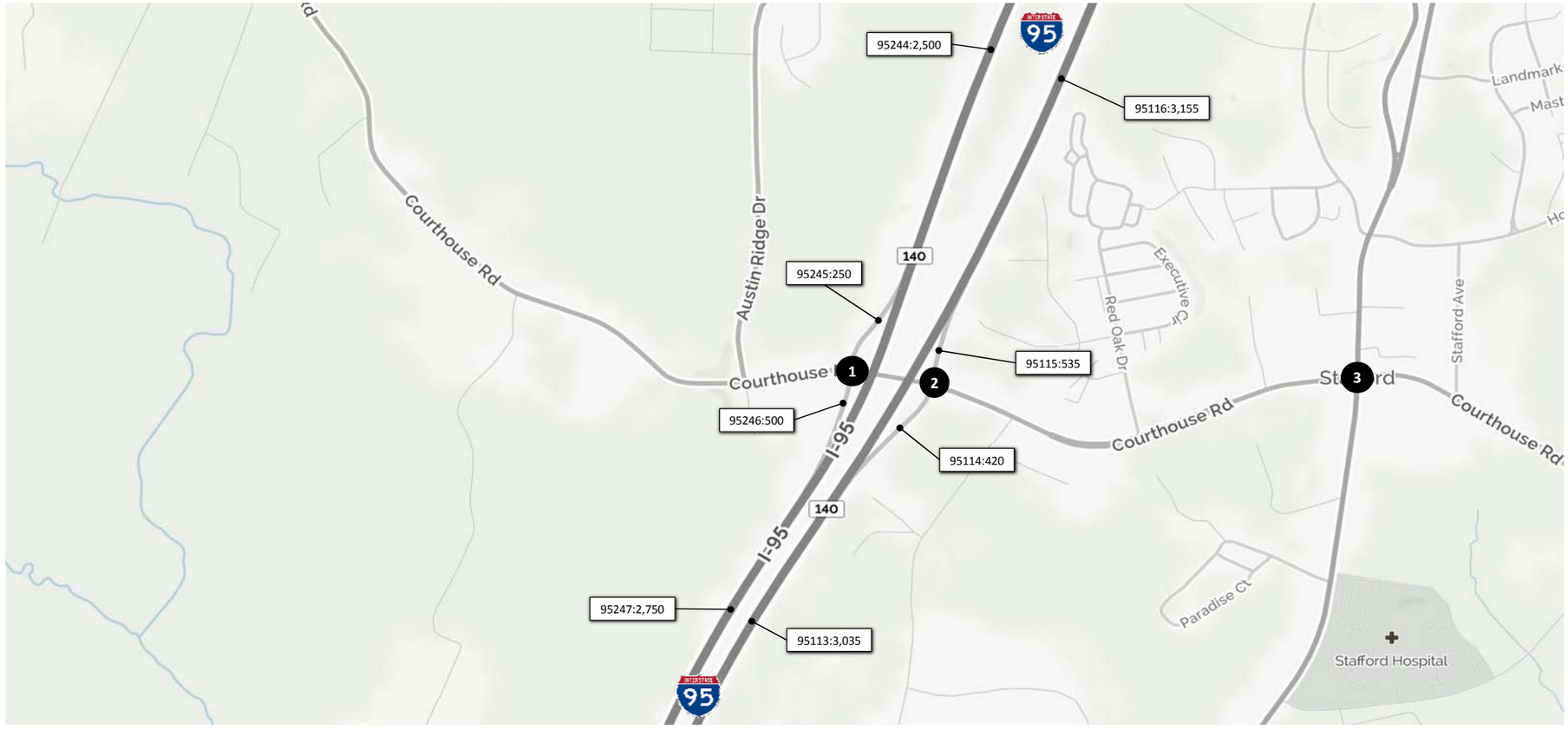
2016 Existing

Weekday 7-8 AM Volumes

I-95 Corridor

August 2017

Figure A.2-3



1

			I-95 SB Off-Ramp		
				T	766
86	0	164		L	94
R	T	L			
Courthouse Road (630)					
	488	T	I-95 SB On-Ramp		
	404	R			
					1403

2

			I-95 NB On-Ramp		
				R	365
				T	606
Courthouse Road (630)					
145	L		I-95 NB Off-Ramp	L	T	R
507	T			254	26	139
					1406

3

349	231	180	US-1		
				R	367
				T	321
R	T	L		L	18
Courthouse Road (630)					
227	L		US-1	L	T	R
98	T			301	340	16
321	R				
				1408	

Legend

x,xxx Weekday 7-8 AM Volume

NOT TO SCALE

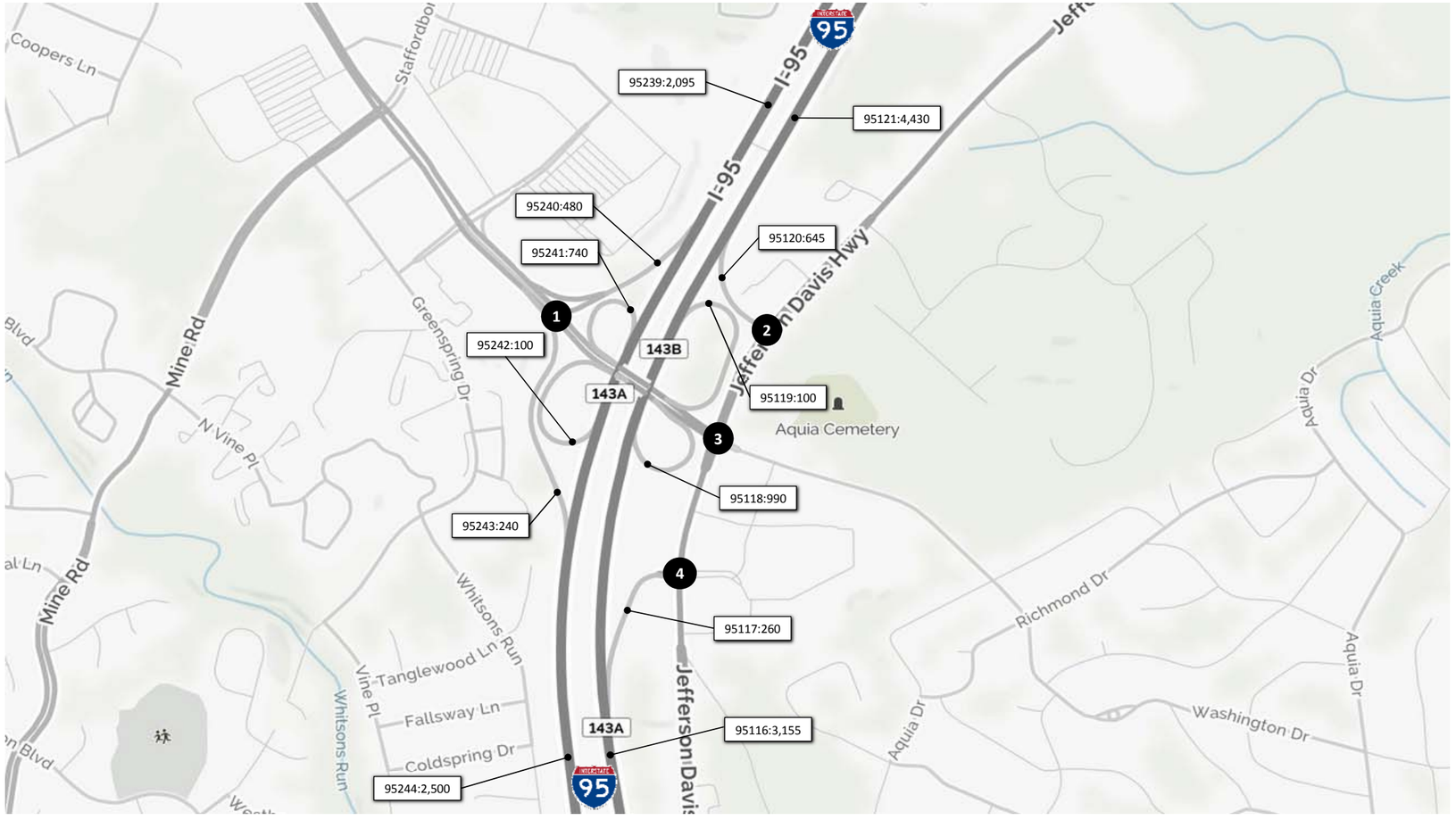
VDOT Virginia Department of Transportation

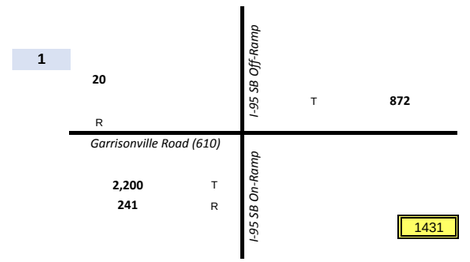
U.S. Department of Transportation Federal Highway Administration

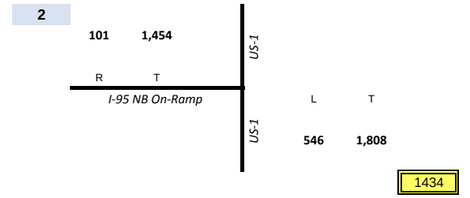
I-95 Express Lanes Fredericksburg Extension Study

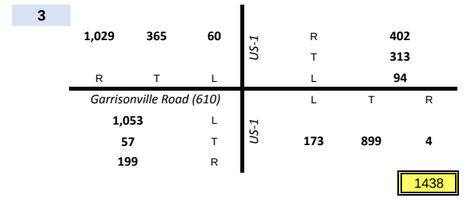
2016 Existing Weekday 7-8 AM Volumes I-95 Corridor

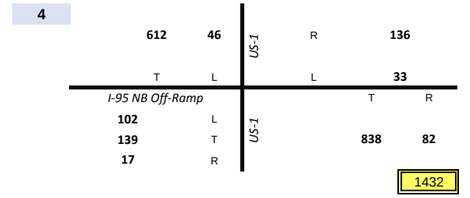
August 2017 | Figure A.2-4











Legend

x,xxx Weekday 7-8 AM Volume

NOT TO SCALE

VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 7-8 AM Volumes I-95 Corridor

August 2017

Figure A.2-5

Legend

x,xxx Weekday 7-8 AM Volume

NOT TO SCALE

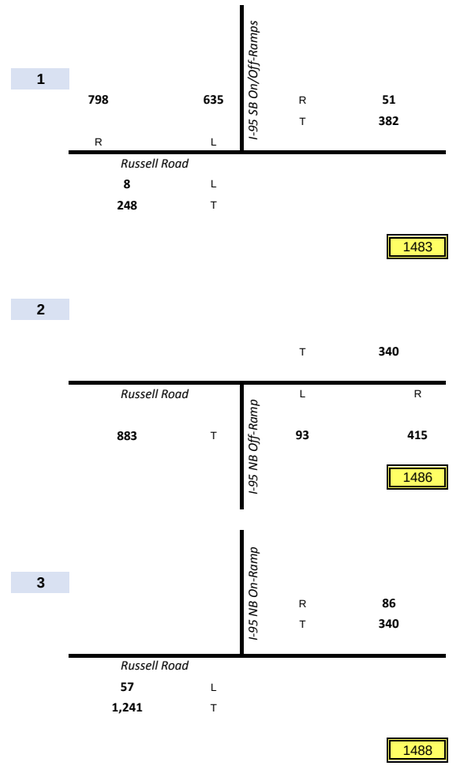
VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 7-8 AM Volumes I-95 Corridor

August 2017 | Figure A.2-6



Legend

x,xxx Weekday 7-8 AM Volume

NOT TO SCALE

VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 7-8 AM Volumes I-95 Corridor

August 2017 | Figure A.2-7

1

			Carl D Silver Pkwy			
82	10	308	R	609		
			T	1,383		
R	T	L	L	19		
VA-3 (Plank Road)				L	T	R
210		L				
2,302		T	*Mall Court*	7	6	12
2		R				

1303

2

			Ramseur St			
16	7	4	R	15		
			T	1,032		
R	T	L	L	132		
VA-3 (Plank Road)				L	T	R
27		L				
1,427		T	*Gateway Blvd*	253	1	173
299		R				

1304

Legend

x,xxx **Weekday 8-9 AM Volume**

NOT TO SCALE

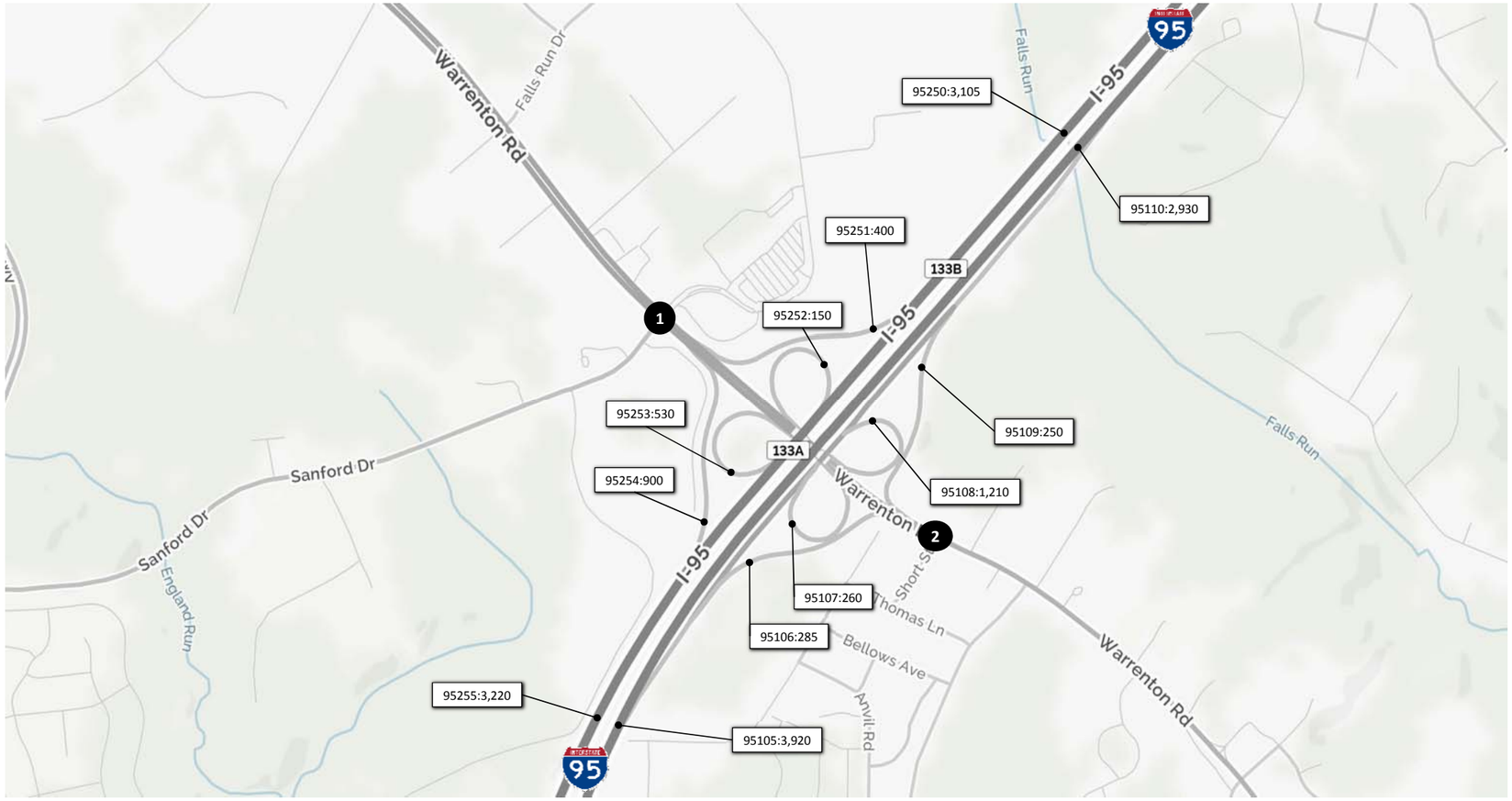
VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing
Weekday 8-9 AM Volumes
I-95 Corridor

August 2017 | Figure A.3-1



1

					S Gateway Dr		
83	59	273	R			354	
			T			1,913	
R	T	L	L			168	
US-17 (Warrenton Rd)					L	T	R
77		L					
1,448		T	Sanford Dr		28	12	137
28		R					
							1333

2

					Parking Lot		
7	0	5	R			2	
			T			1,108	
R	T	L	L			13	
US-17 BUS (Warrenton Rd)					L	T	R
5		L					
1,438		T	Short St		104	2	25
70		R					
							1338

Legend

x,xxx Weekday 8-9 AM Volume

NOT TO SCALE

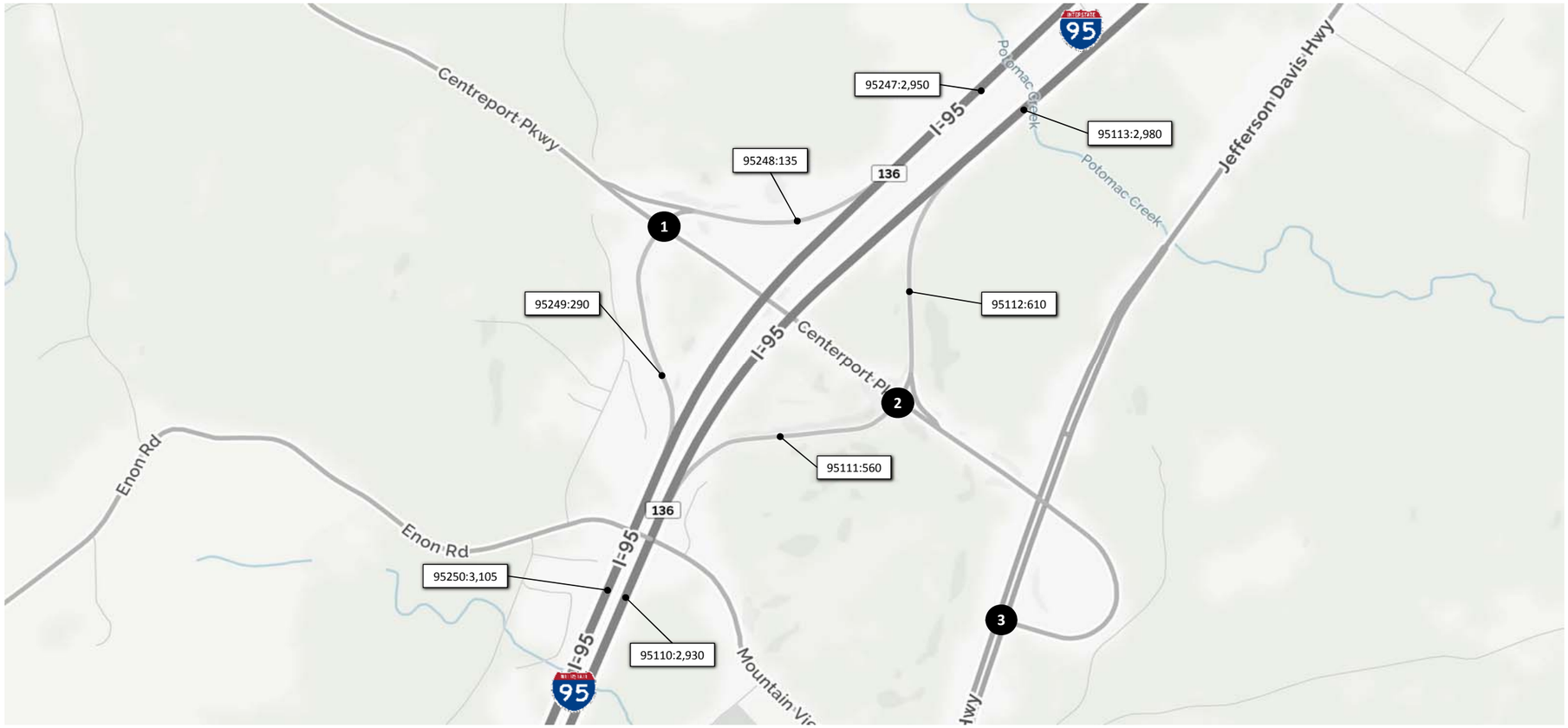
VDOT Virginia Department of Transportation

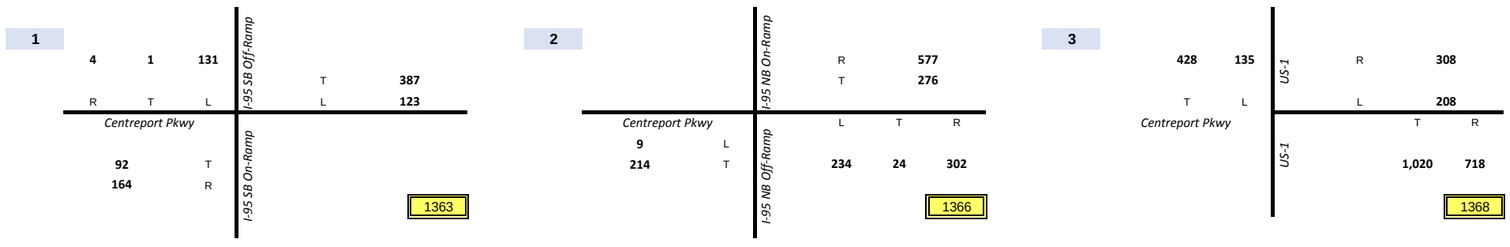
U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing
Weekday 8-9 AM Volumes
I-95 Corridor

August 2017 | Figure A.3-2





Legend

x,xxx Weekday 8-9 AM Volume

NOT TO SCALE

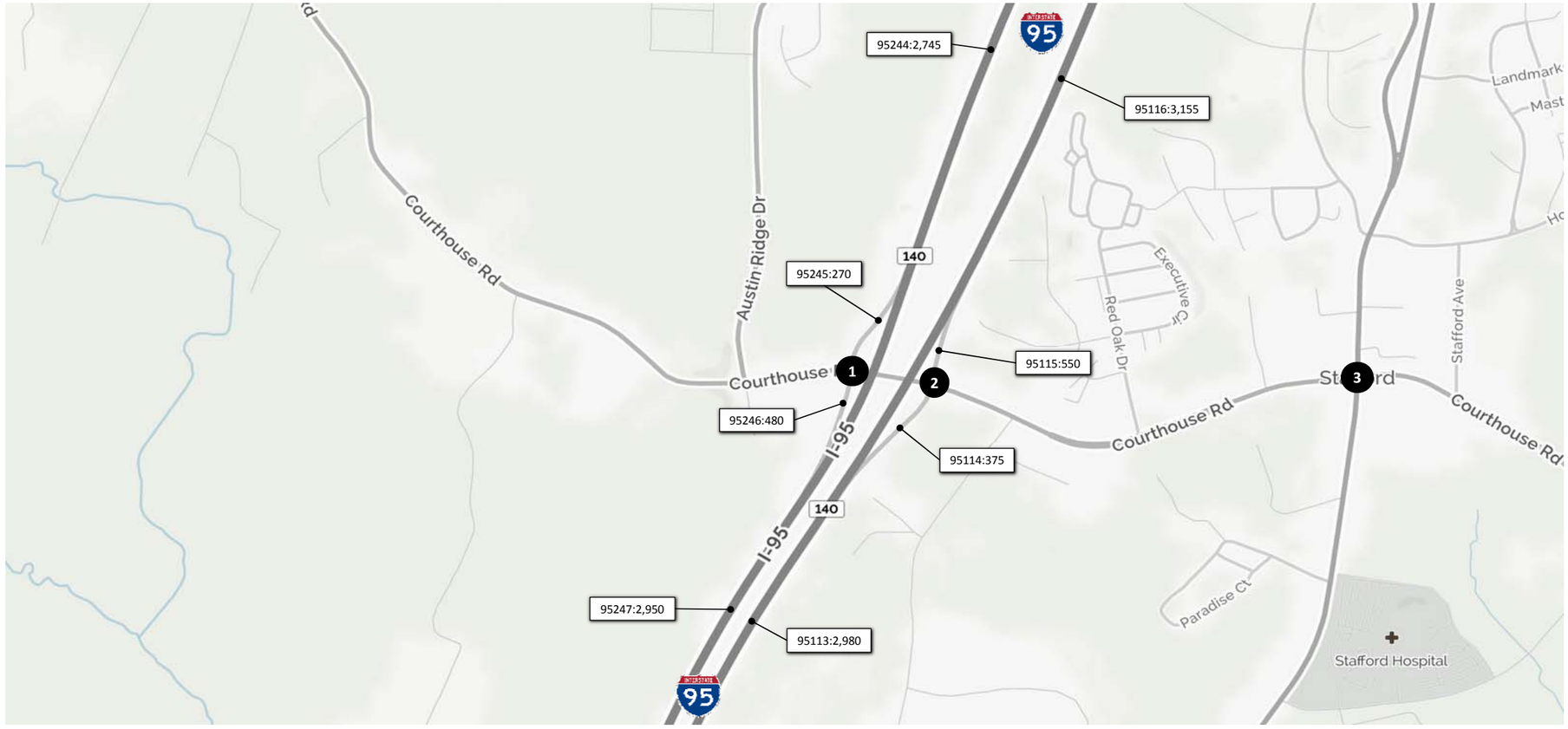
VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 8-9 AM Volumes I-95 Corridor

August 2017 | Figure A.3-3



1

	90	2	180		
	R	T	L		
Courthouse Road (630)				I-95 SB Off-Ramp	T 663
				I-95 SB On-Ramp	L 116
	538	T			
	360	R			

1403

2

				I-95 NB On-Ramp	R 358
					T 591
Courthouse Road (630)				I-95 NB Off-Ramp	L T R
	181	L			
	537	T			188 10 178

1406

3

	316	258	69	US-1	R 313
	R	T	L		T 287
Courthouse Road (630)					L 31
	256	L		US-1	L T R
	67	T			346 312 16
	392	R			

1408

Legend

x,xxx Weekday 8-9 AM Volume

NOT TO SCALE

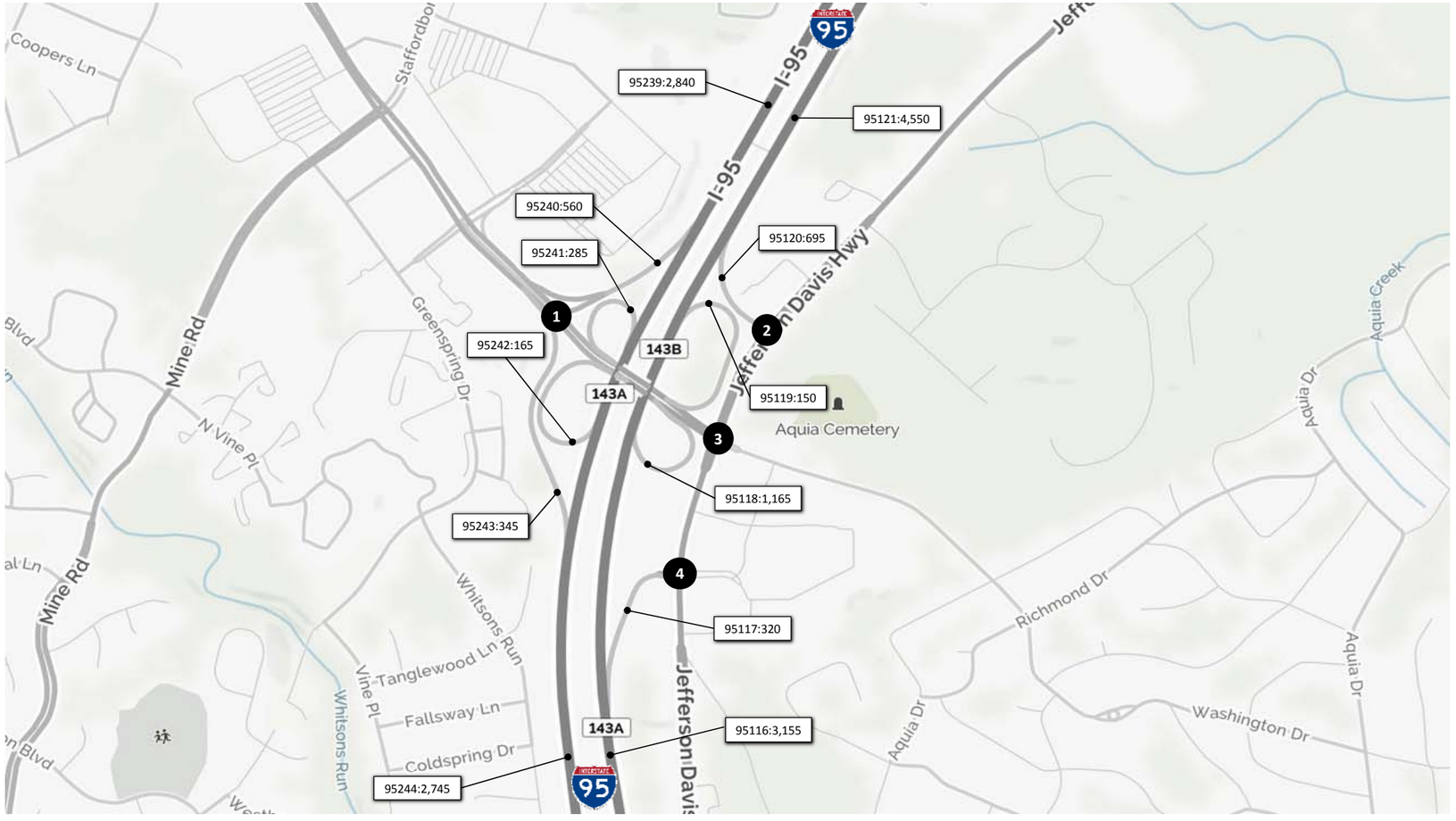
VDOT Virginia Department of Transportation

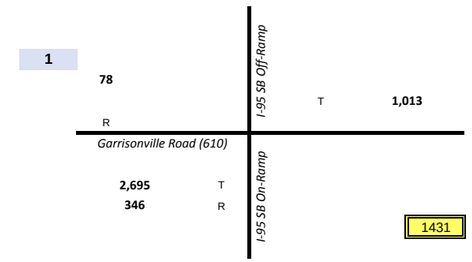
U.S. Department of Transportation Federal Highway Administration

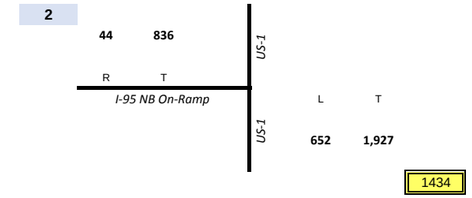
I-95 Express Lanes Fredericksburg Extension Study

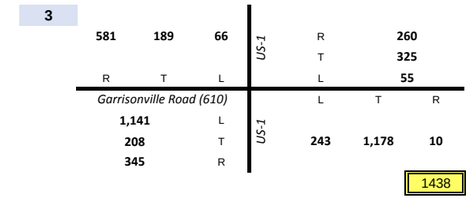
2016 Existing Weekday 8-9 AM Volumes I-95 Corridor

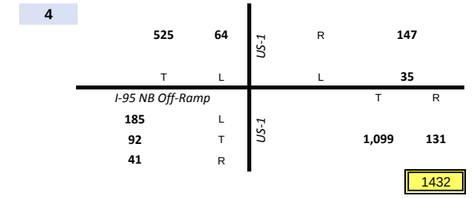
August 2017 | Figure A.3-4











Legend

x,xxx Weekday 8-9 AM Volume

NOT TO SCALE

VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 8-9 AM Volumes I-95 Corridor

August 2017

Figure A.3-5

Legend

x,xxx Weekday 8-9 AM Volume

NOT TO SCALE

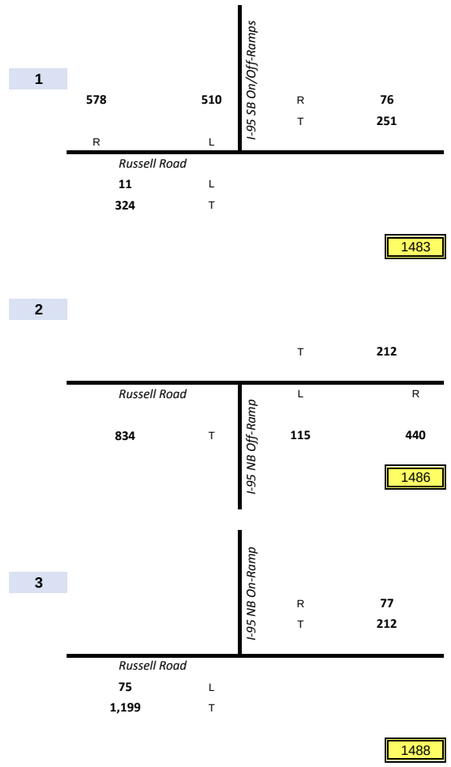
VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 8-9 AM Volumes I-95 Corridor

August 2017 | Figure A.3-6



Legend

x,xxx Weekday 8-9 AM Volume

NOT TO SCALE

VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 8-9 AM Volumes I-95 Corridor

August 2017 | Figure A.3-7

1

	285	8	784	R	847
				T	2,409
	R	T	L	L	18
	VA-3 (Plank Road)			L	T	R
	235		L			
	1,928		T	8	9	16
	3		R			

Carl D Silver Pkwy

Mall Court

1303

2

	28	2	10	R	4
				T	1,477
	R	T	L	L	152
	VA-3 (Plank Road)			L	T	R
	35		L			
	1,550		T	269	0	180
	367		R			

Ramseur St

Gateway Blvd

1304

Legend

x,xxx Weekday 3-4 PM Volume

NOT TO SCALE

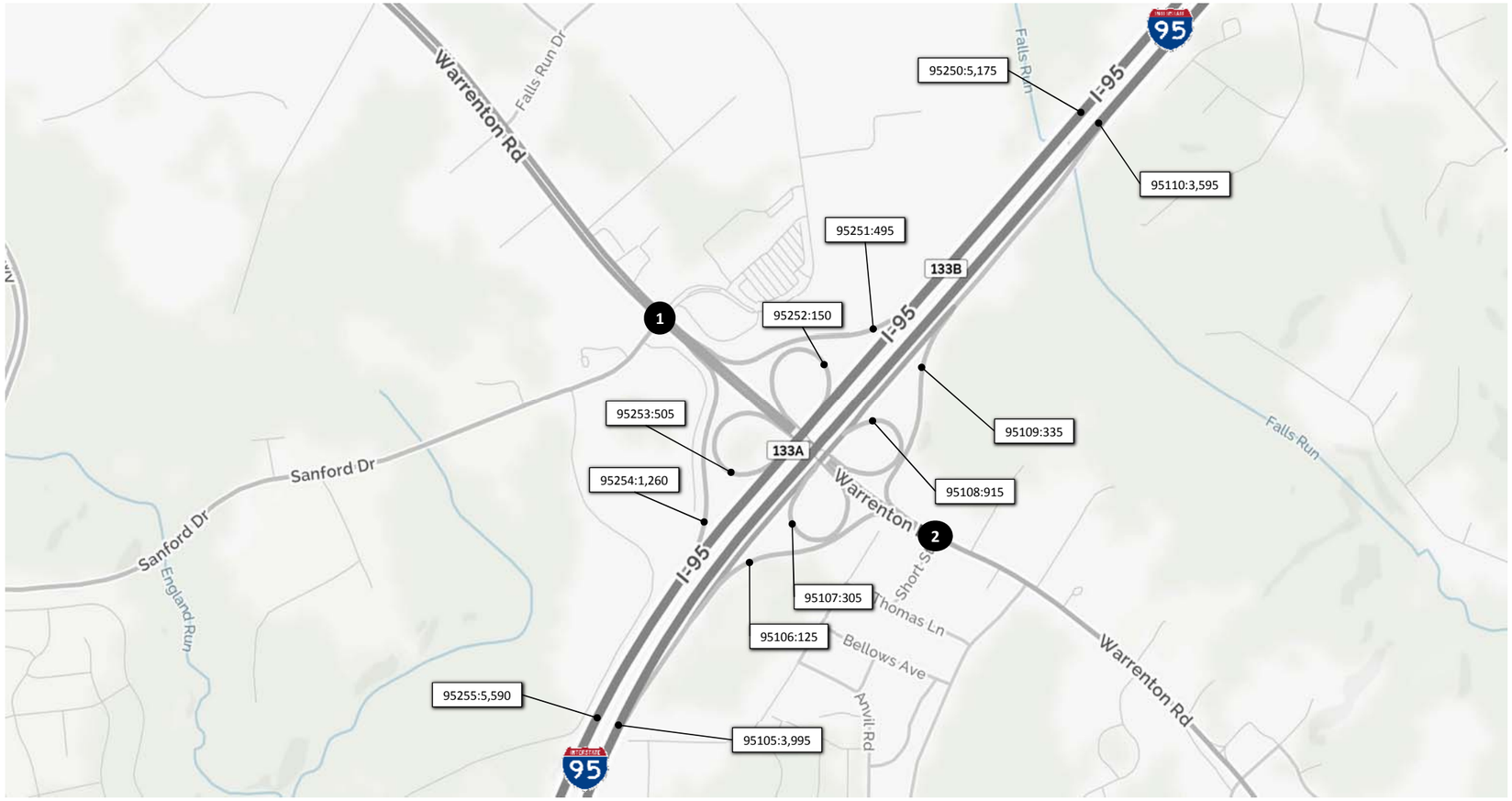
VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 3-4 PM Volumes I-95 Corridor

August 2017 | Figure A.4-1



1

				R		372
			S Gateway Dr	T		1,590
R	T	L		L		74
US-17 (Warrenton Rd)				L	T	R
76		L				
1,878		T	*Sanford Dr*	20	16	230
13		R				

1333

2

10	1	7		R		7
			Parking Lot	T		1,094
R	T	L		L		12
US-17 BUS (Warrenton Rd)				L	T	R
6		L				
1,494		T	*Short St*	92	1	12
95		R				

1338

Legend

x,xxx Weekday 3-4 PM Volume

NOT TO SCALE

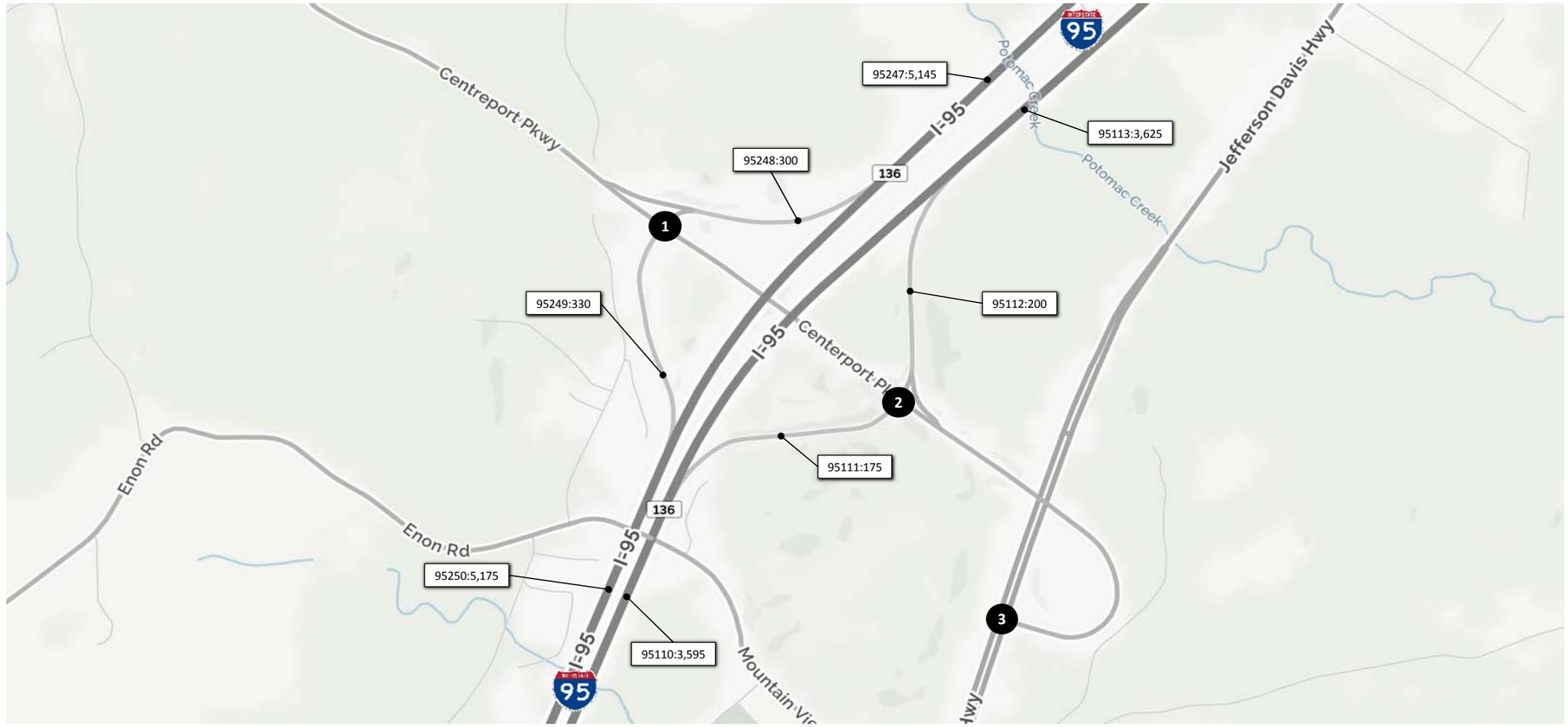
VDOT Virginia Department of Transportation

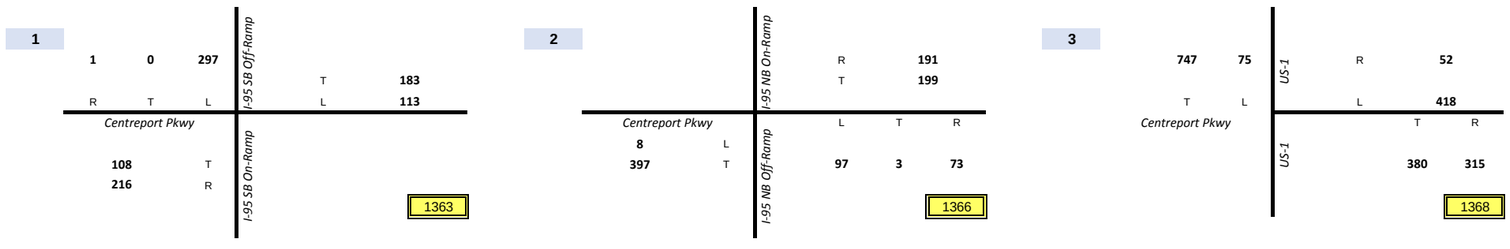
U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing
Weekday 3-4 PM Volumes
I-95 Corridor

August 2017 | Figure A.4-2





Legend

x,xxx Weekday 3-4 PM Volume

NOT TO SCALE

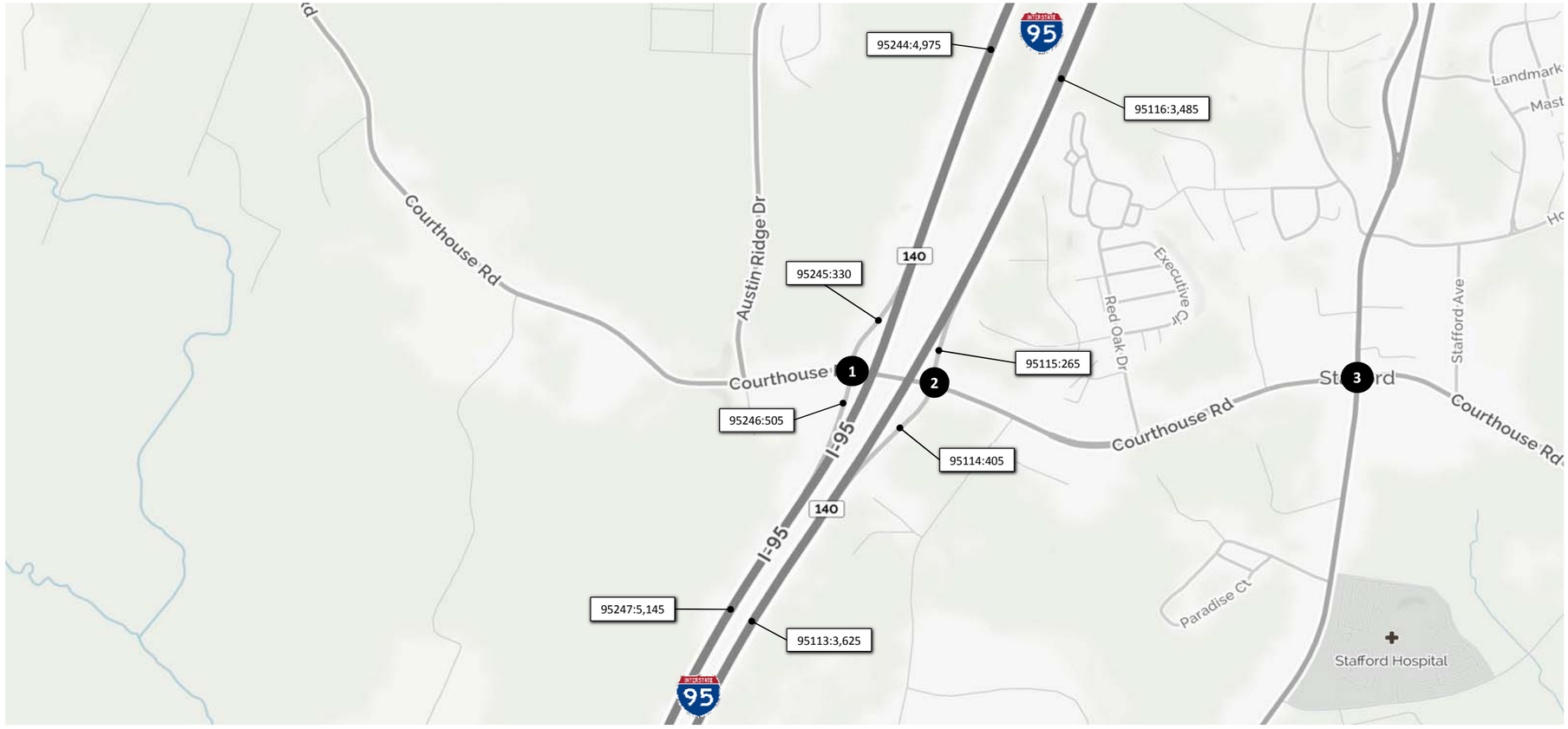
VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 3-4 PM Volumes I-95 Corridor

August 2017 | Figure A.4-3



1

				I-95 SB Off-Ramp		
					T	515
116	0	216			L	227
R	T	L				
Courthouse Road (630)			I-95 SB On-Ramp			
	422	T				
	276	R				
						1403

2

				I-95 NB On-Ramp		
				R		160
				T		521
Courthouse Road (630)			I-95 NB Off-Ramp	L	T	R
100	L					
538	T			221	4	181
						1406

3

				US-1		
				R		101
				T		217
249	490	128		L		31
R	T	L				
Courthouse Road (630)			US-1			
	216	L		L	T	R
	183	T		215	237	22
	320	R				
						1408

Legend

x,xxx Weekday 3-4 PM Volume

NOT TO SCALE

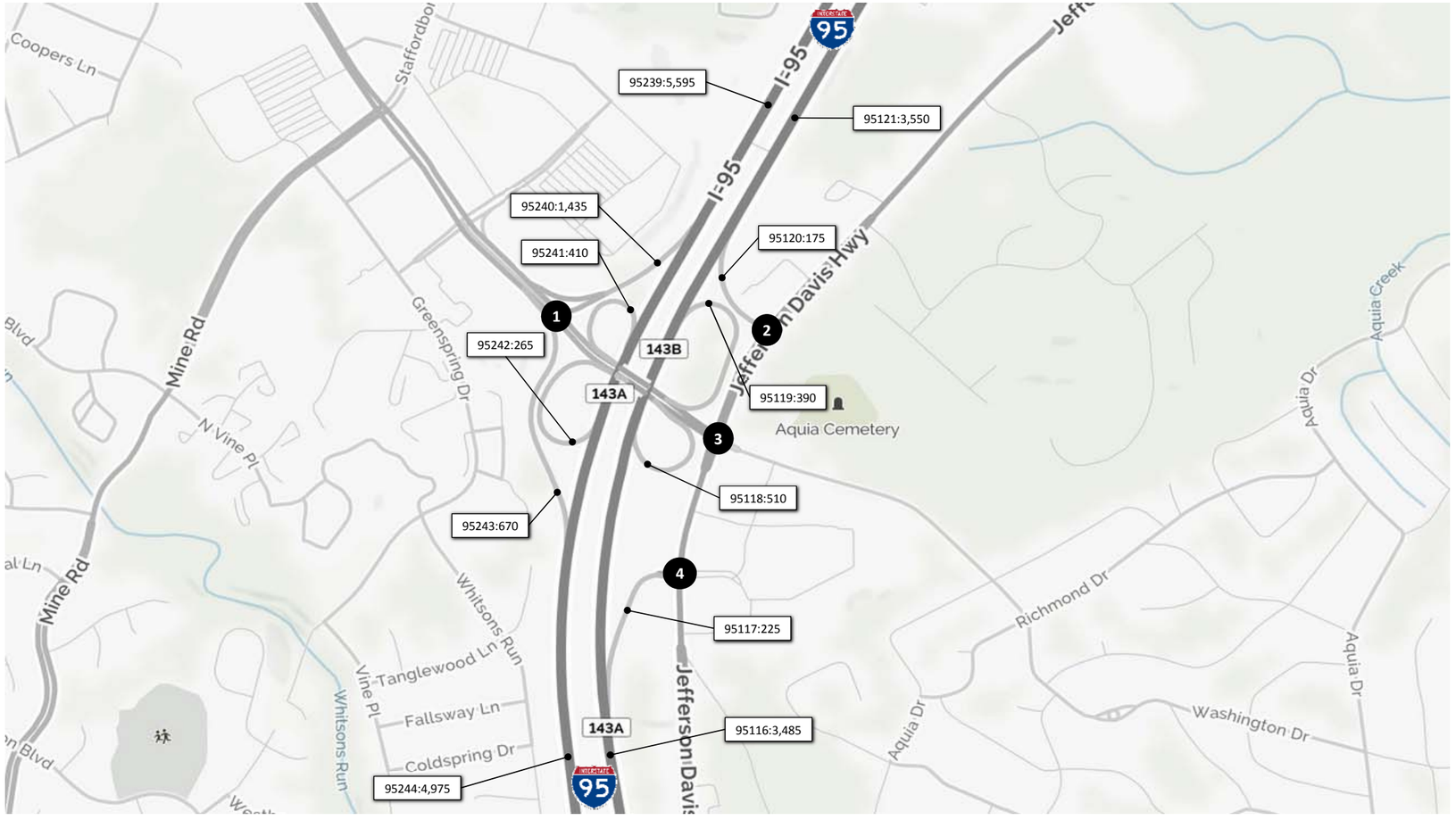
VDOT Virginia Department of Transportation

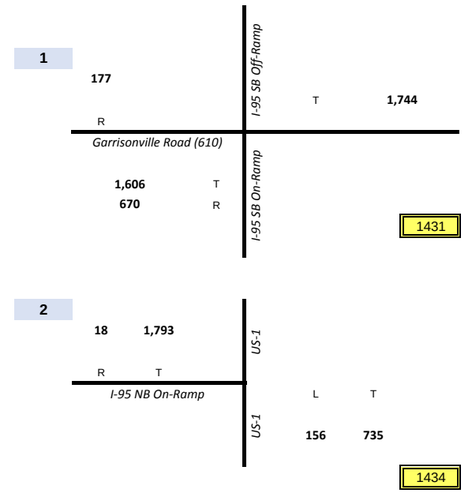
U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 3-4 PM Volumes I-95 Corridor

August 2017 | Figure A.4-4





Legend

x,xxx Weekday 3-4 PM Volume

NOT TO SCALE

VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 3-4 PM Volumes I-95 Corridor

August 2017

Figure A.4-5

Legend

x,xxx Weekday 3-4 PM Volume

NOT TO SCALE

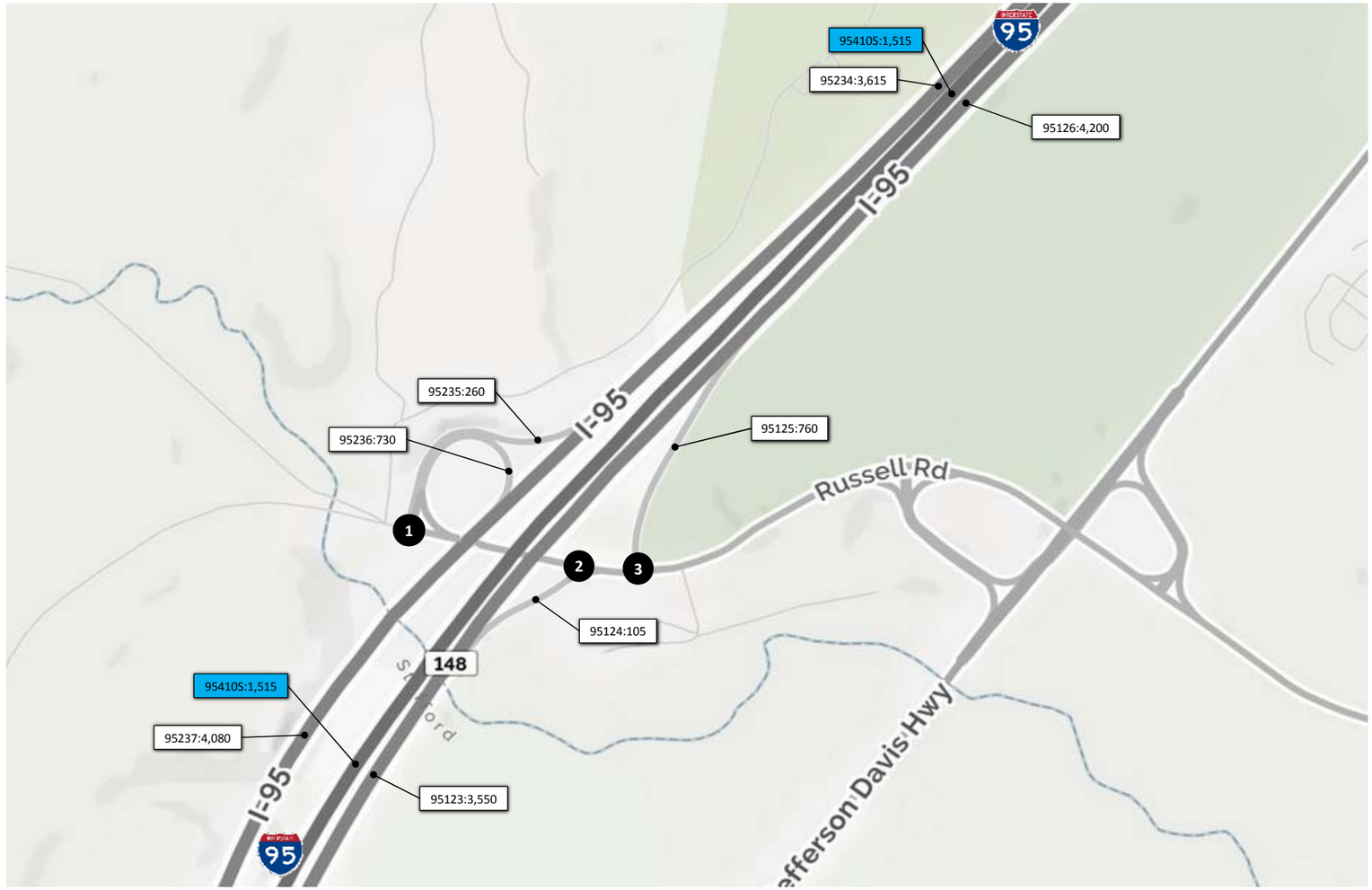
VDOT Virginia Department of Transportation

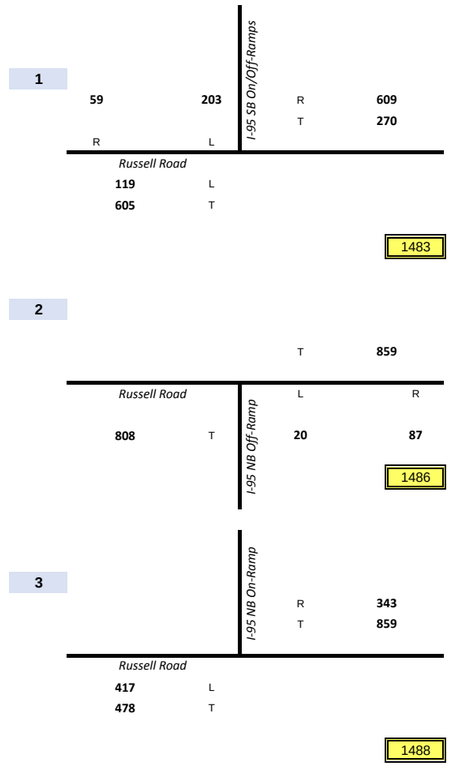
U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing
Weekday 3-4 PM Volumes
I-95 Corridor

August 2017 | Figure A.4-6





Legend

x,xxx Weekday 3-4 PM Volume

NOT TO SCALE

VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 3-4 PM Volumes I-95 Corridor

August 2017 | Figure A.4-7

1

	290	9	818	R	925
				T	2,040
	R	T	L	L	17

Carl D Silver Pkwy

VA-3 (Plank Road)

	251	L			
	1,996	T			
	5	R			

L	T	R
9	12	15

Mall Court

1303

2

	22	7	7	R	2
				T	1,580
	R	T	L	L	160

Ramseur St

VA-3 (Plank Road)

	33	L			
	1,432	T			
	385	R			

L	T	R
295	2	206

Gateway Blvd

1304

Legend

x,xxx Weekday 4-5 PM Volume

NOT TO SCALE

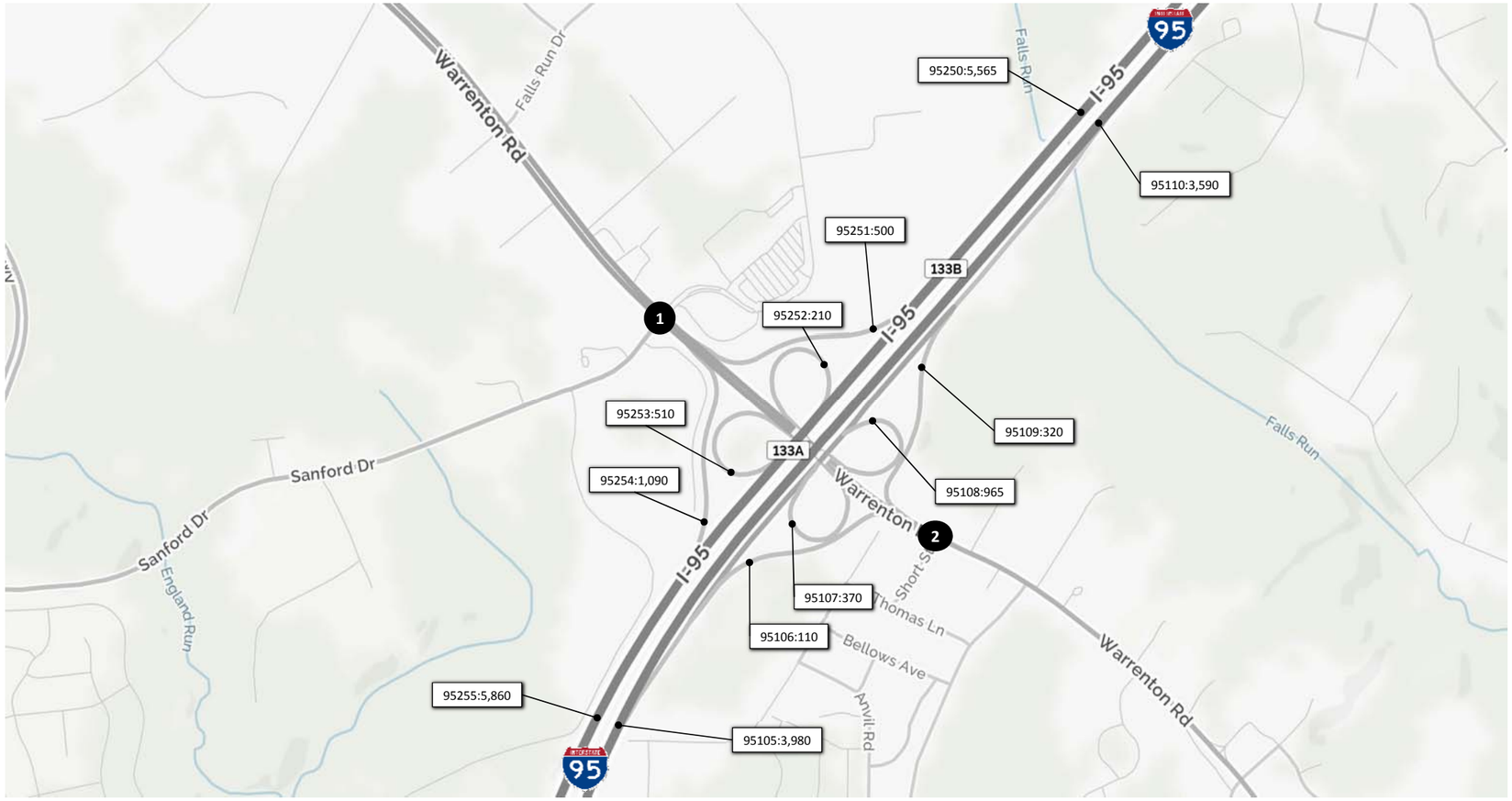
VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 4-5 PM Volumes I-95 Corridor

August 2017 | Figure A.5-1



1

	89	23	428	R	360	
				T	1,760	
R	T	L		L	97	
US-17 (Warrenton Rd)			*S Gateway Dr*			
	80	L		L	T	R
	2,006	T	*Sanford Dr*	31	21	383
	24	R				
						1333

2

	7	0	9	R	6	
				T	1,187	
R	T	L	*Parking Lot*	L	14	
US-17 BUS (Warrenton Rd)						
	5	L	*Short St*	L	T	R
	1,878	T		89	1	20
	94	R				
						1338

Legend

x,xxx Weekday 4-5 PM Volume

NOT TO SCALE

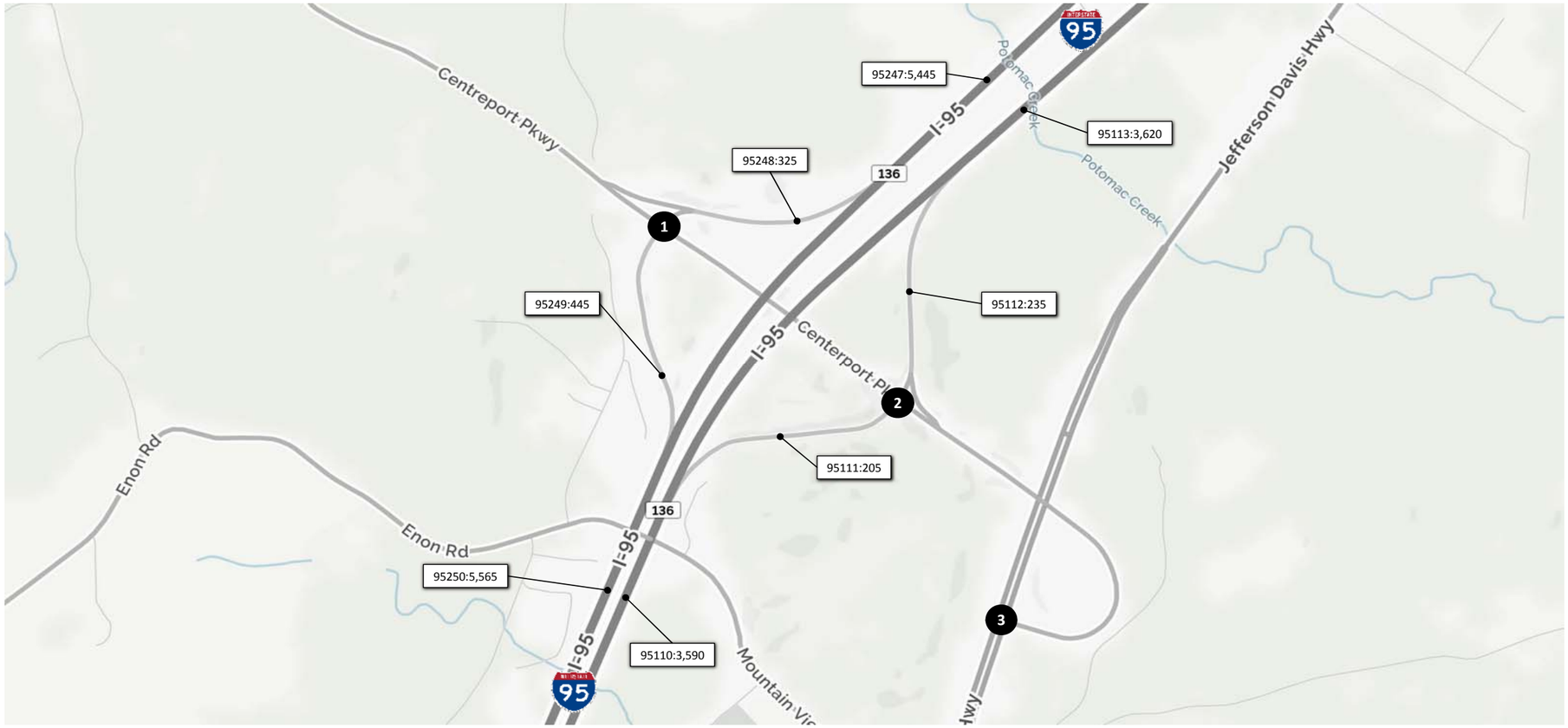
VDOT Virginia Department of Transportation

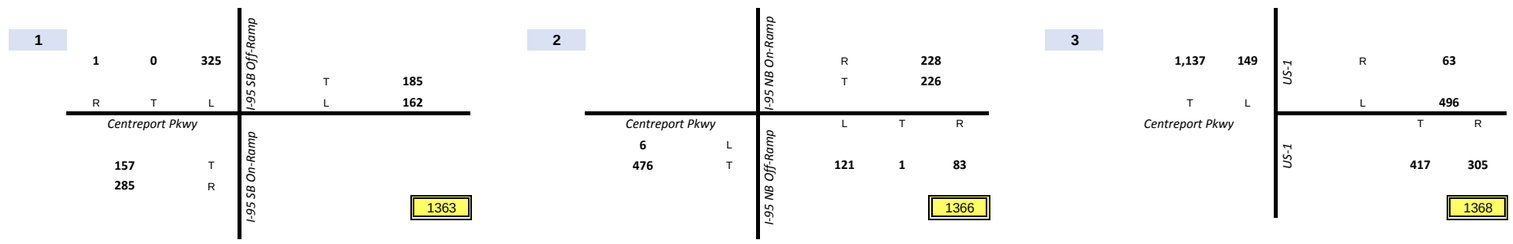
U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing
Weekday 4-5 PM Volumes
I-95 Corridor

August 2017 | Figure A.5-2





Legend

x,xxx Weekday 4-5 PM Volume

NOT TO SCALE

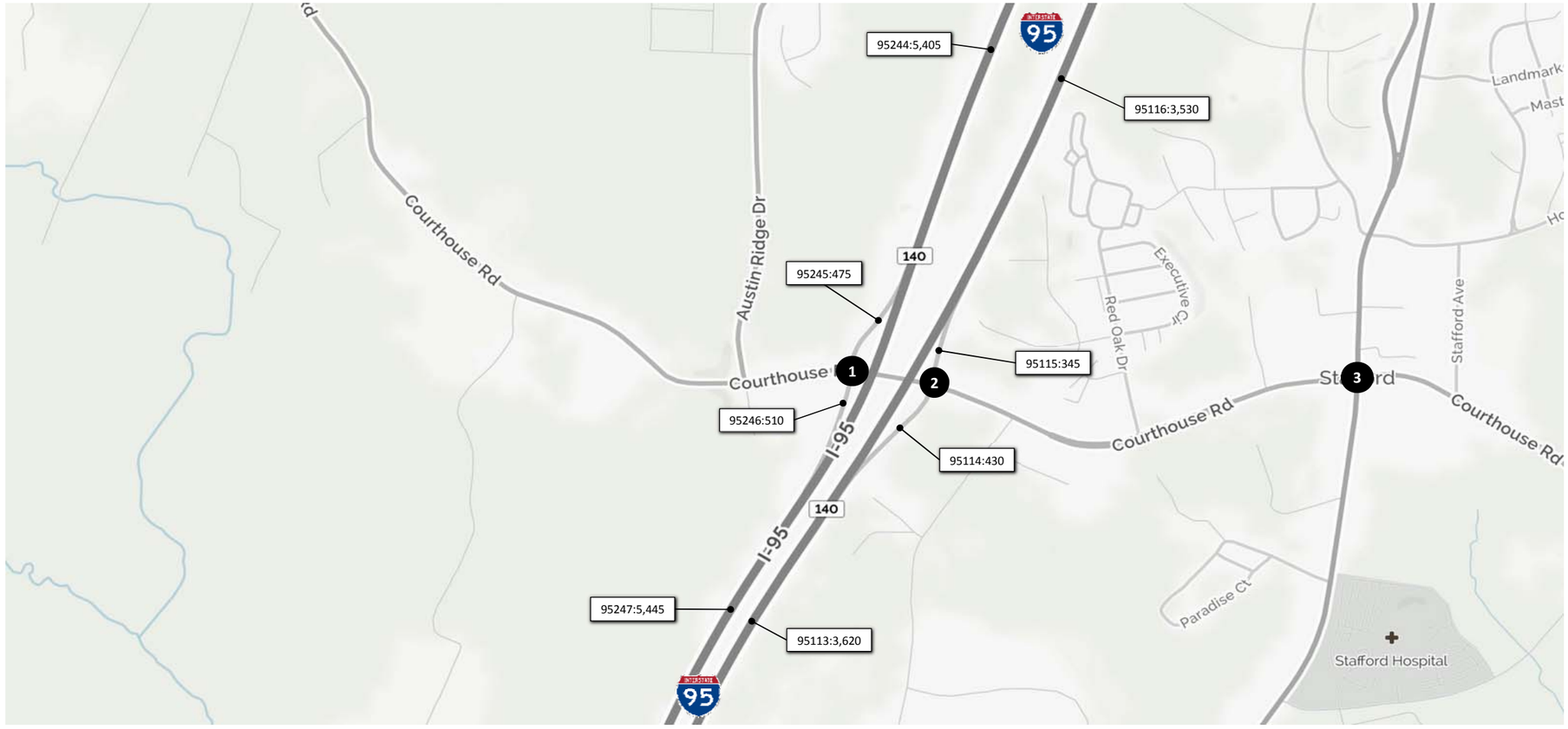
VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 4-5 PM Volumes I-95 Corridor

August 2017 | Figure A.5-3



1

					I-95 SB Off-Ramp	
				T	L	646
188	1	285				188
R	T	L				
Courthouse Road (630)						
	562	T				
	323	R				
			I-95 SB On-Ramp			

1403

2

				R	222	
				T	555	
			I-95 NB On-Ramp			
Courthouse Road (630)				L	T	R
119	L					
728	T					
			I-95 NB Off-Ramp	279	2	150

1406

3

				R	143	
				T	251	
265	639	144	US-1	L	50	
R	T	L				
Courthouse Road (630)						
	176	L		L	T	R
	190	T	US-1	261	255	31
	512	R				

1408

Legend

x,xxx Weekday 4-5 PM Volume

NOT TO SCALE

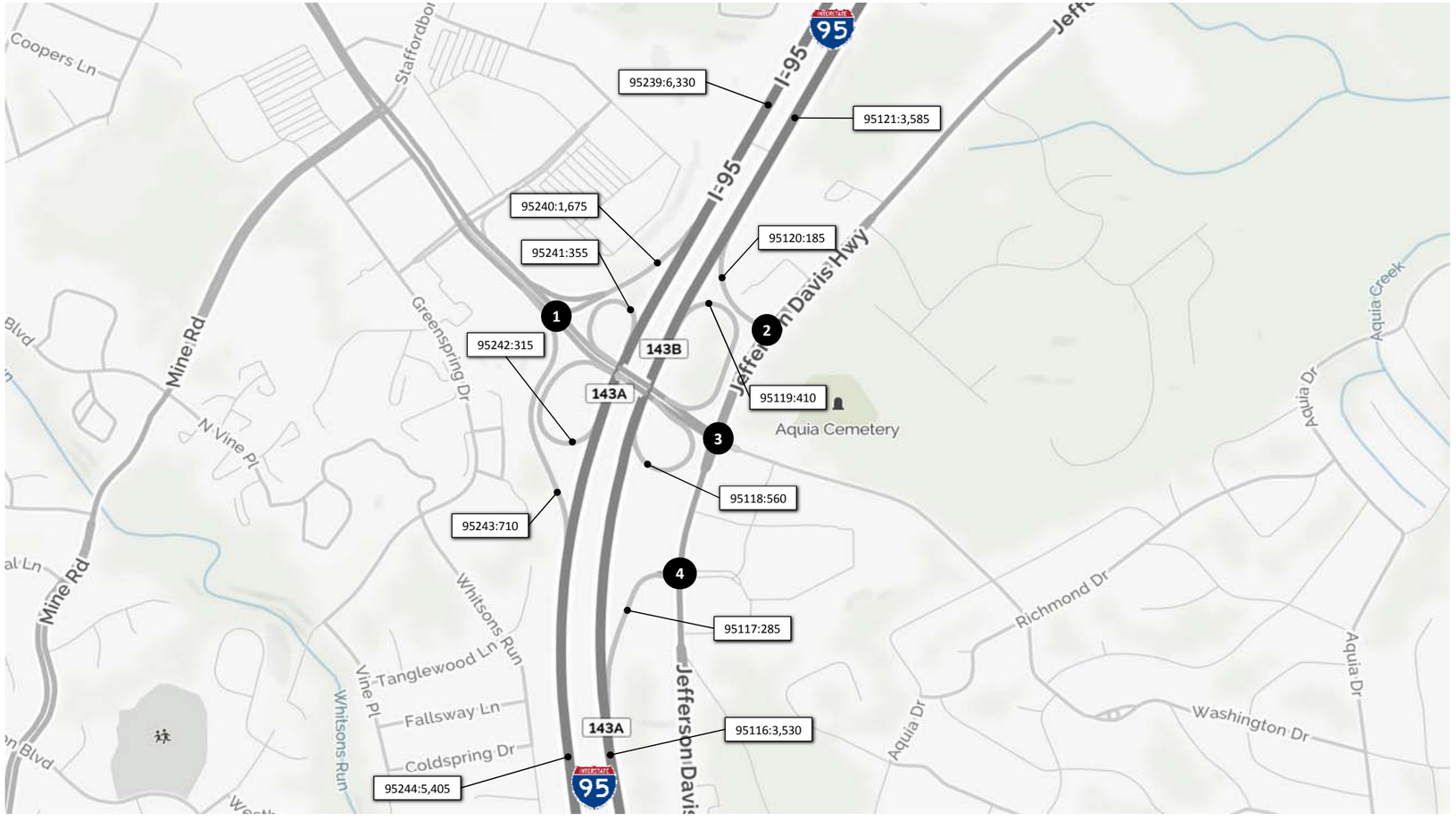
VDOT Virginia Department of Transportation

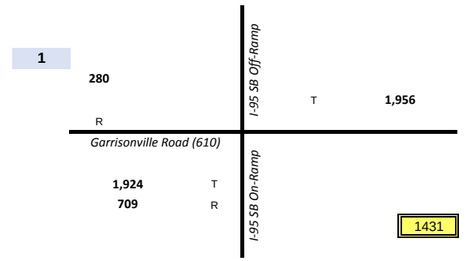
U.S. Department of Transportation Federal Highway Administration

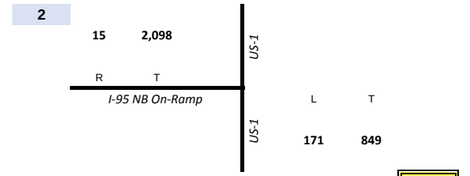
I-95 Express Lanes Fredericksburg Extension Study

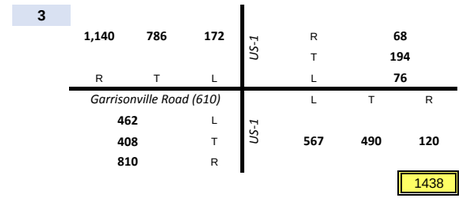
2016 Existing Weekday 4-5 PM Volumes I-95 Corridor

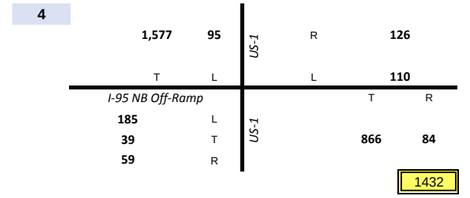
August 2017 | Figure A.5-4











Legend

x,xxx Weekday 4-5 PM Volume

NOT TO SCALE

VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 4-5 PM Volumes I-95 Corridor

August 2017

Figure A.5-5

Legend

x,xxx Weekday 4-5 PM Volume

NOT TO SCALE

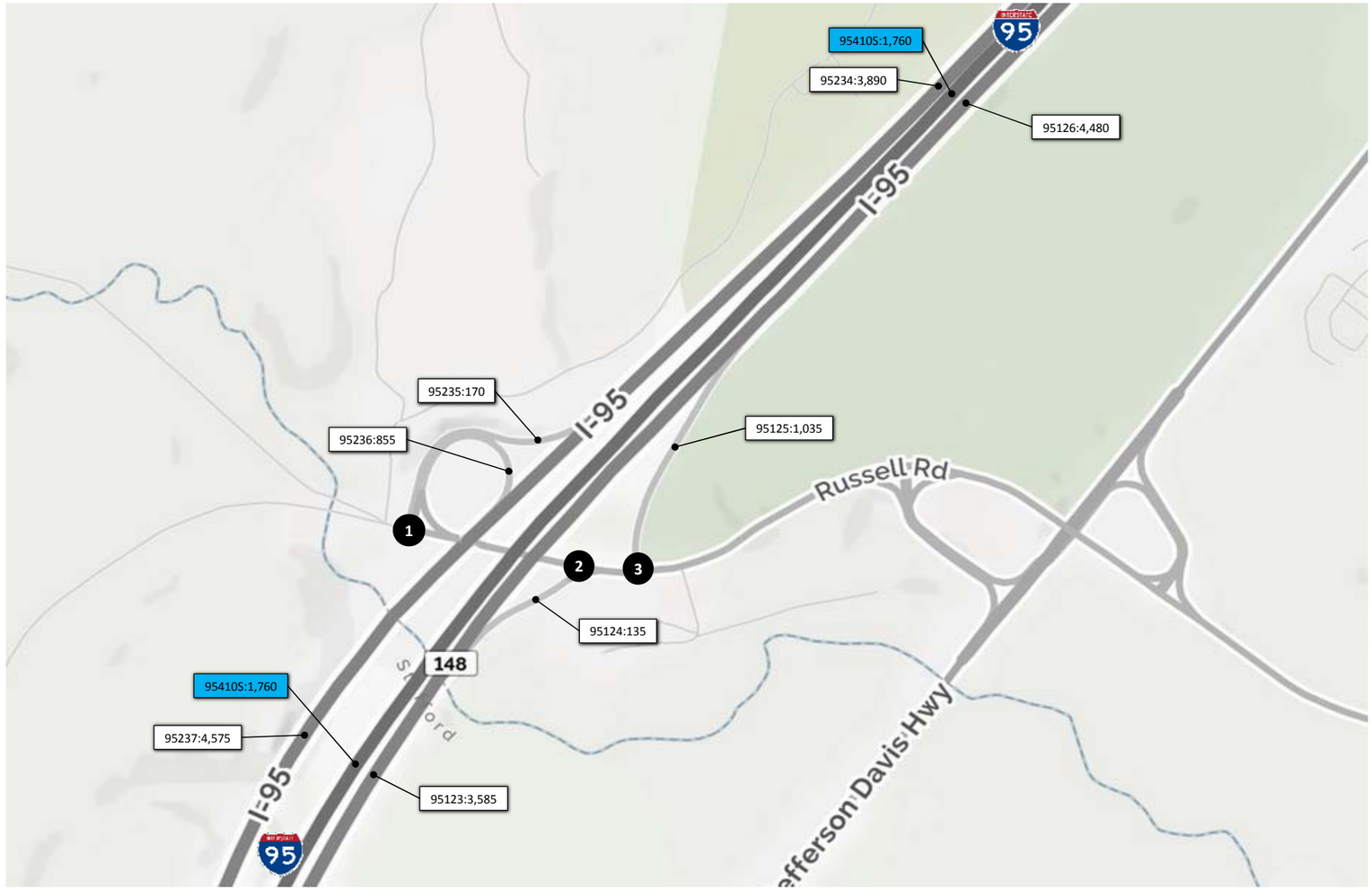
VDOT Virginia Department of Transportation

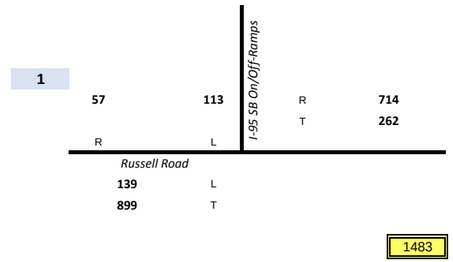
U.S. Department of Transportation Federal Highway Administration

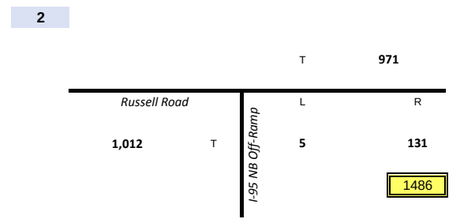
I-95 Express Lanes Fredericksburg Extension Study

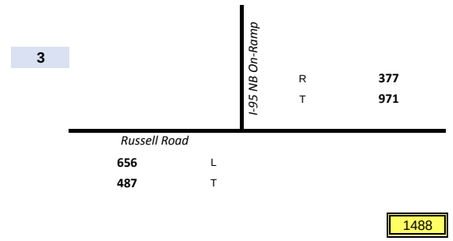
2016 Existing Weekday 4-5 PM Volumes I-95 Corridor

August 2017 | Figure A.5-6









Legend

x,xxx Weekday 4-5 PM Volume

NOT TO SCALE

VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing
Weekday 4-5 PM Volumes
I-95 Corridor

August 2017 | Figure A.5-7

1

			Carl D Silver Pkwy			
276	7	752	R	980		
			T	1,771		
R	T	L	L	16		
VA-3 (Plank Road)			*Mall Court*	L	T	R
245		L				
2,129		T		11	8	6
6		R				

1303

2

			Ramseur St			
21	4	14	R	8		
			T	1,518		
R	T	L	L	214		
VA-3 (Plank Road)			*Gateway Blvd*	L	T	R
36		L				
1,631		T		301	3	199
404		R				

1304

Legend

x,xxx **Weekday 5-6 PM Volume**

NOT TO SCALE

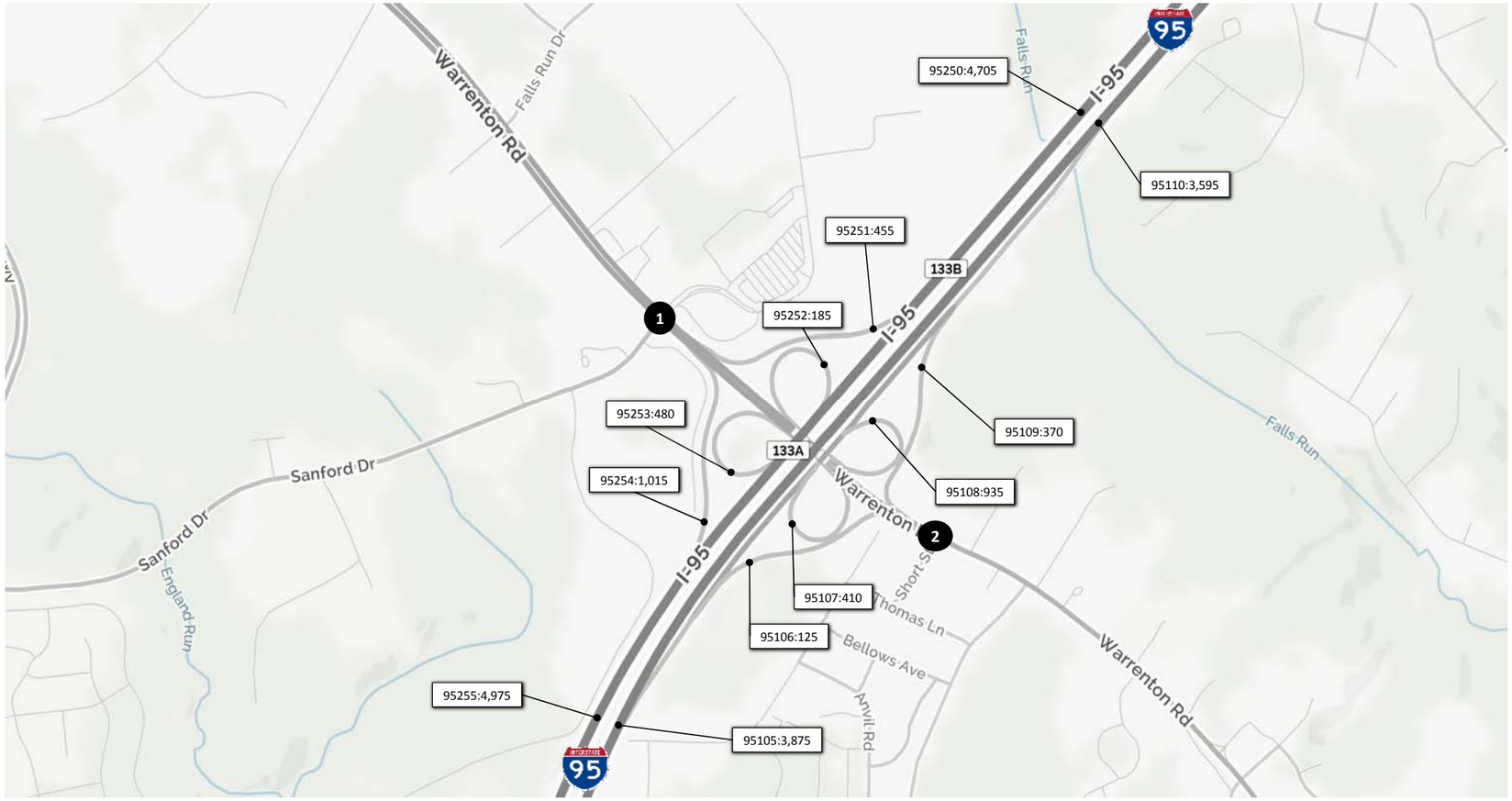
VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing
Weekday 5-6 PM Volumes
I-95 Corridor

August 2017 | Figure A.6-1



1

					S Gateway Dr		
100	16	471	R			358	
			T			1,709	
R	T	L	L			60	
US-17 (Warrenton Rd)					L	T	R
82		L					
1,895		T	Sanford Dr		30	14	317
13		R					
							1333

2

					Parking Lot		
6	0	6	R			2	
			T			1,197	
R	T	L	L			21	
US-17 BUS (Warrenton Rd)					L	T	R
7		L					
1,884		T	Short St		89	1	18
115		R					
							1338

Legend

x,xxx Weekday 5-6 PM Volume

NOT TO SCALE

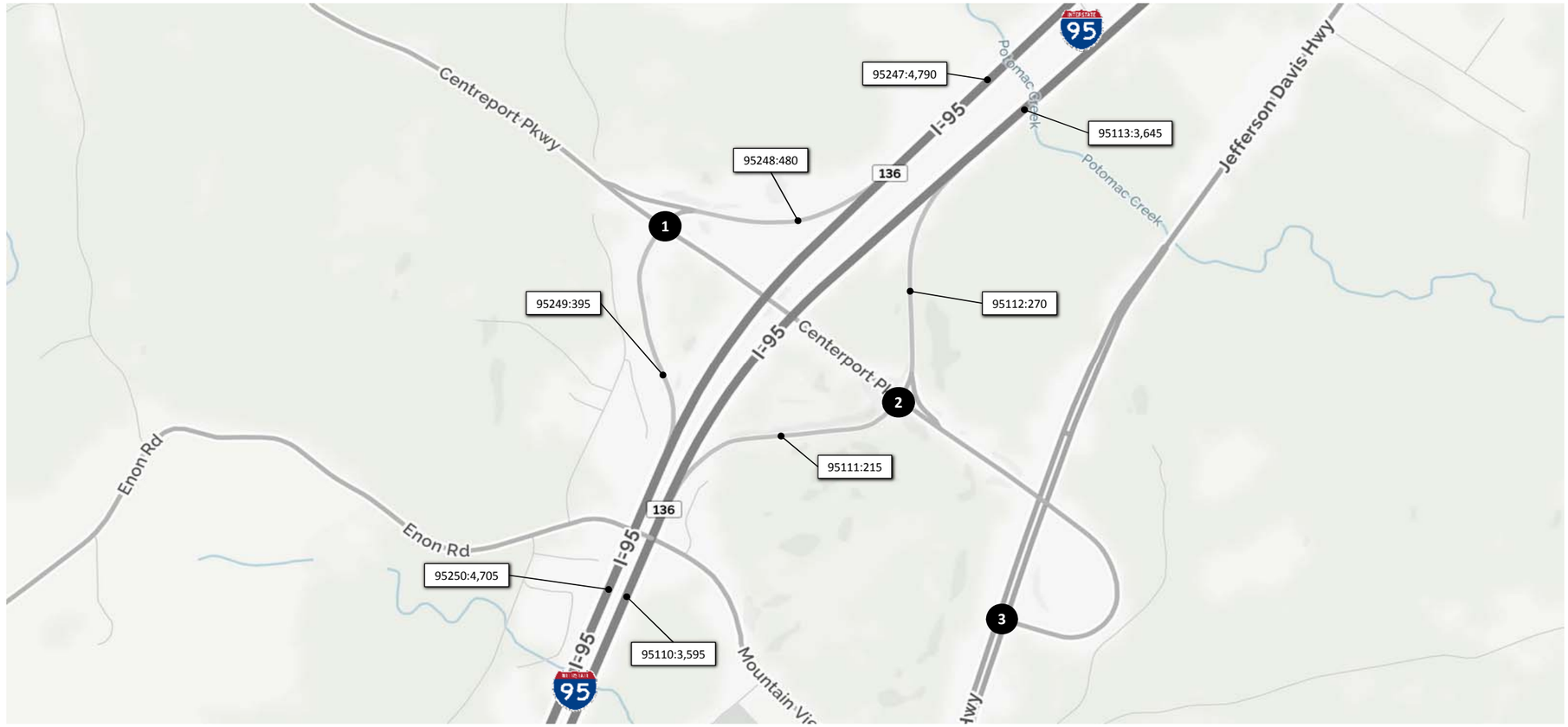
VDOT Virginia Department of Transportation

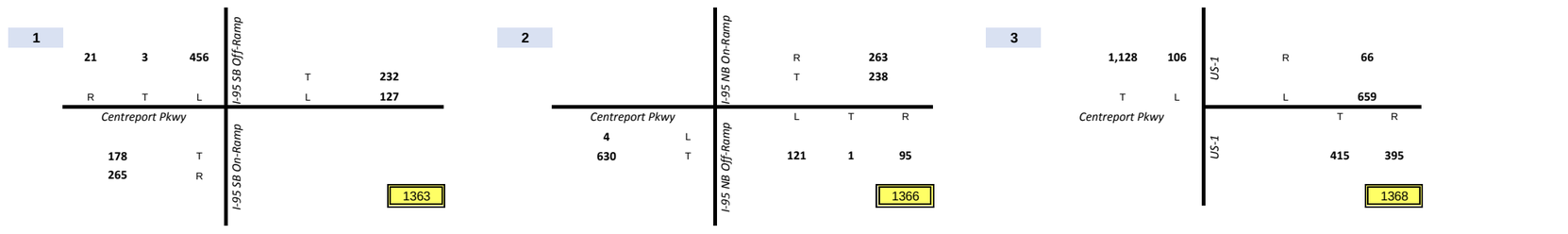
U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing
Weekday 5-6 PM Volumes
I-95 Corridor

August 2017 | Figure A.6-2





Legend

x,xxx Weekday 5-6 PM Volume

NOT TO SCALE

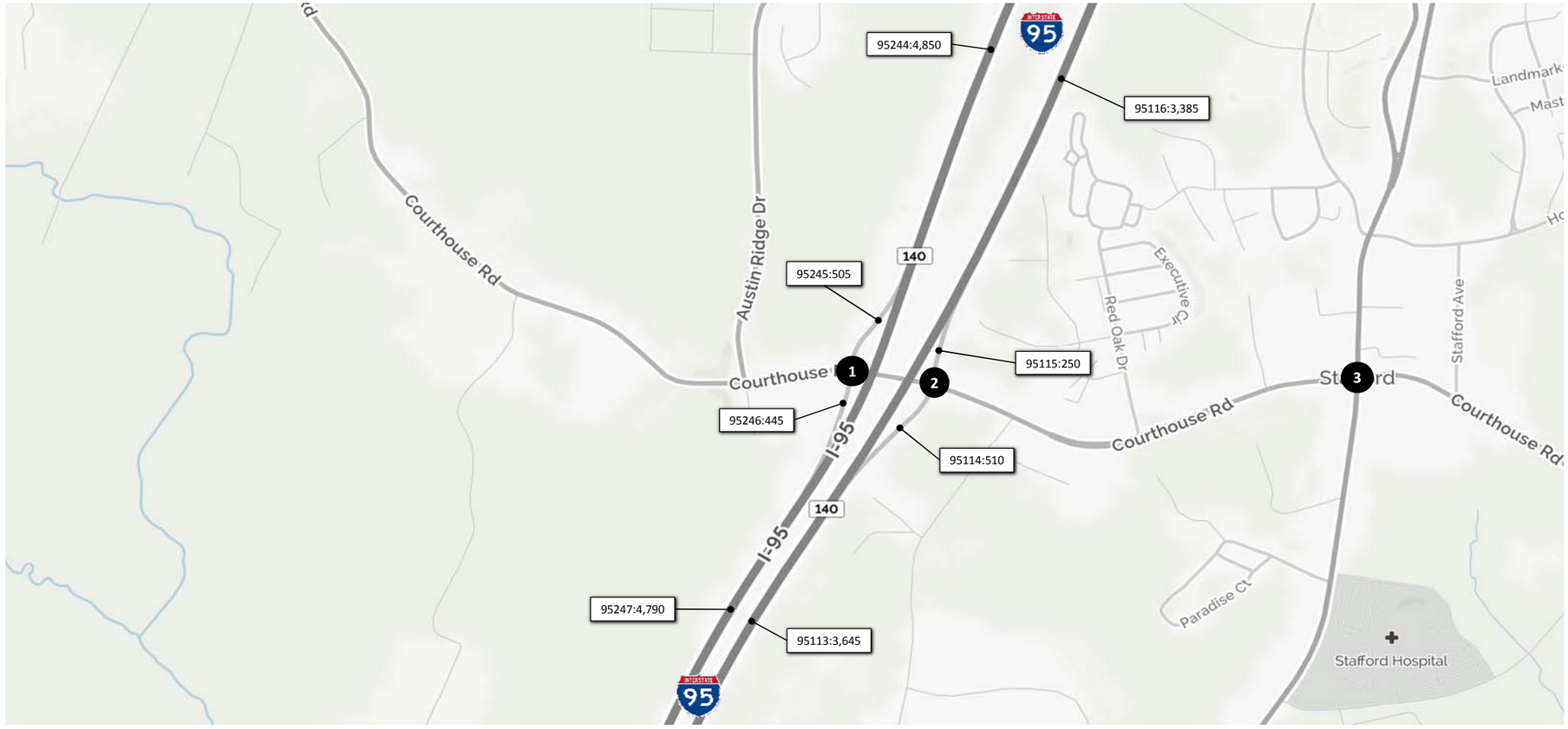
VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 5-6 PM Volumes I-95 Corridor

August 2017 | Figure A.6-3



1

				I-95 SB Off-Ramp		
					T	736
200	0	304			L	113
R	T	L				
Courthouse Road (630)			I-95 SB On-Ramp			
	592	T				
	332	R				
						1403

2

				I-95 NB On-Ramp		
				R		146
				T		509
Courthouse Road (630)			I-95 NB Off-Ramp	L	T	R
103	L					
793	T			340	0	169
						1406

3

				US-1		
				R		124
				T		203
241	722	138		L		32
R	T	L				
Courthouse Road (630)			US-1			
223	L			L	T	R
186	T			211	258	19
553	R					
						1408

Legend

x,xxx Weekday 5-6 PM Volume

NOT TO SCALE

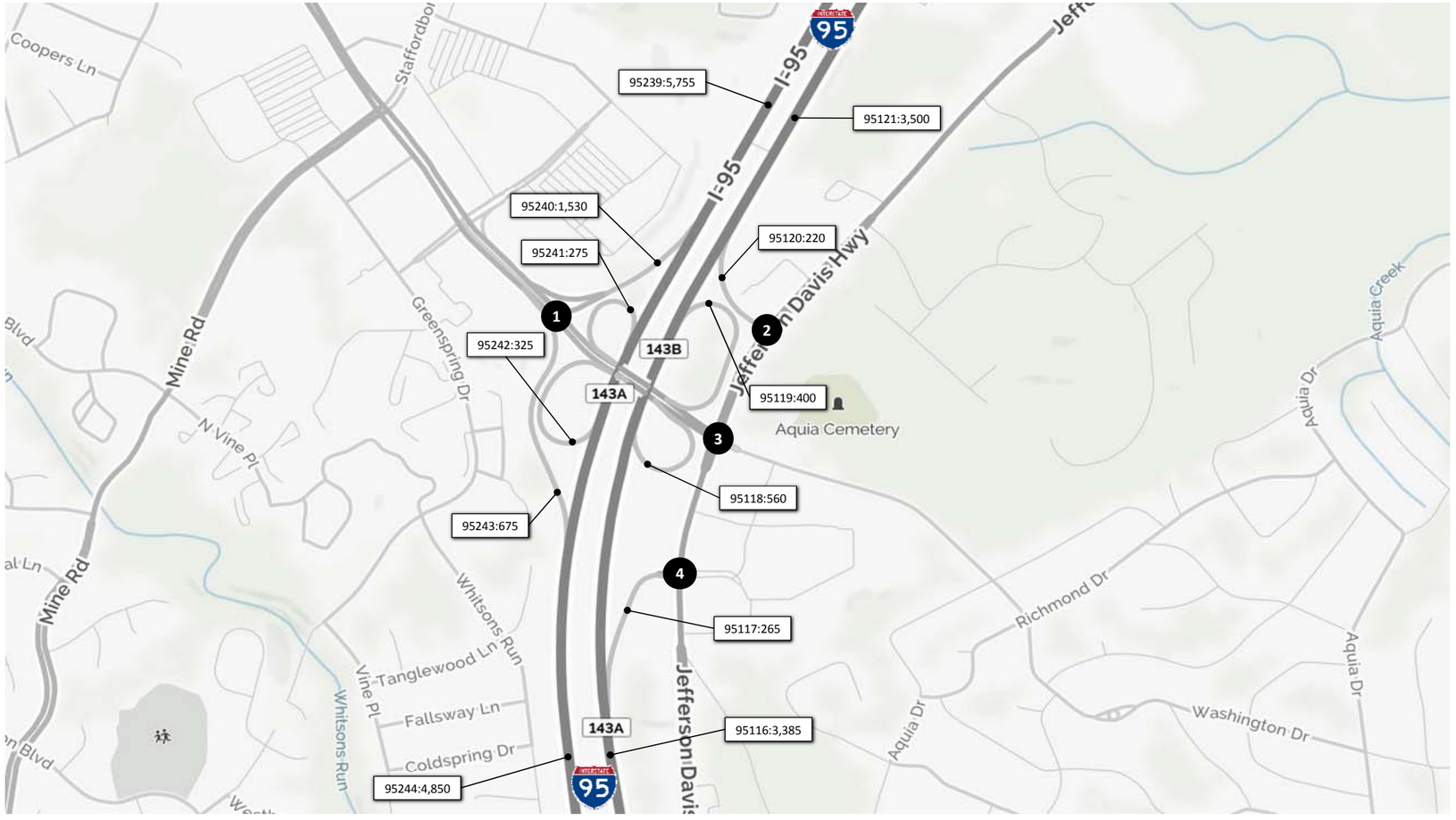
VDOT Virginia Department of Transportation

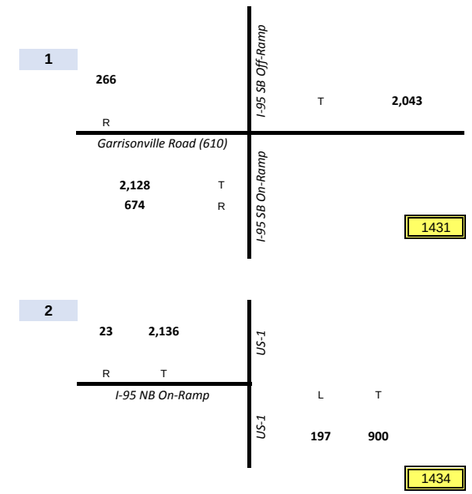
U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 5-6 PM Volumes I-95 Corridor

August 2017 | Figure A.6-4





Legend

x,xxx Weekday 5-6 PM Volume

NOT TO SCALE

VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 5-6 PM Volumes I-95 Corridor

August 2017

Figure A.6-5

Legend

x,xxx Weekday 5-6 PM Volume

NOT TO SCALE

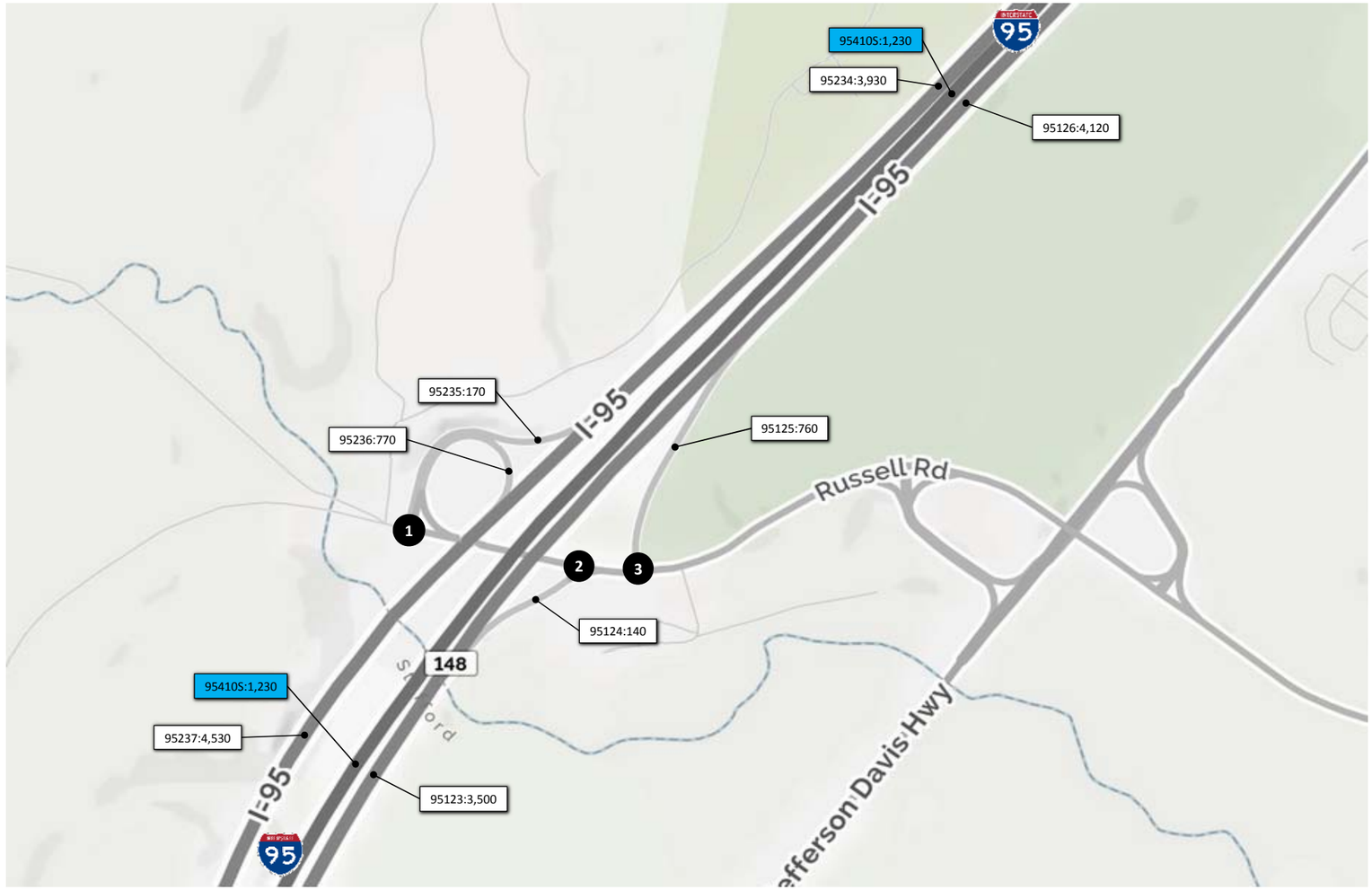
VDOT Virginia Department of Transportation

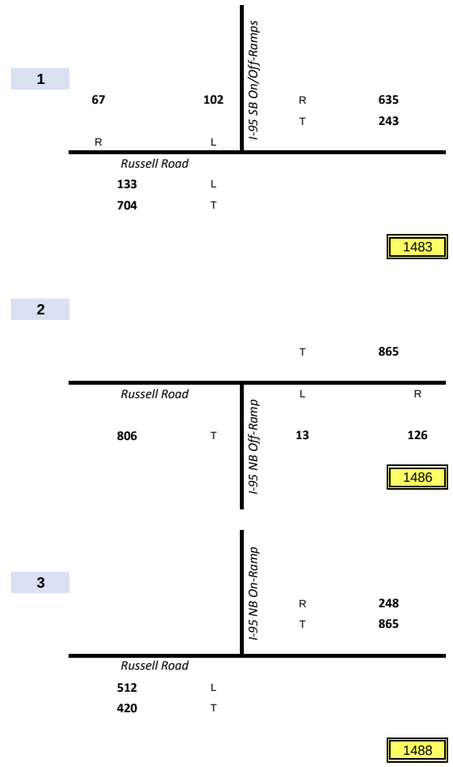
U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing
Weekday 5-6 PM Volumes
I-95 Corridor

August 2017 | Figure A.6-6





Legend

x,xxx Weekday 5-6 PM Volume

NOT TO SCALE

VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 5-6 PM Volumes I-95 Corridor

August 2017 | Figure A.6-7

1

	277	8	722	R	746
				T	1,910
	R	T	L	L	27
VA-3 (Plank Road)				L	T	R
	230	L				
	1,634	T		13	6	4
	8	R				

Carl D Silver Pkwy / *Mall Court*

1303

2

	8	4	8	R	0
				T	1,536
	R	T	L	L	124
VA-3 (Plank Road)				L	T	R
	17	L				
	1,148	T		312	0	150
	331	R				

Ramseur St / *Gateway Blvd*

1304

Legend

x,xxx Weekday 6-7 PM Volume

NOT TO SCALE

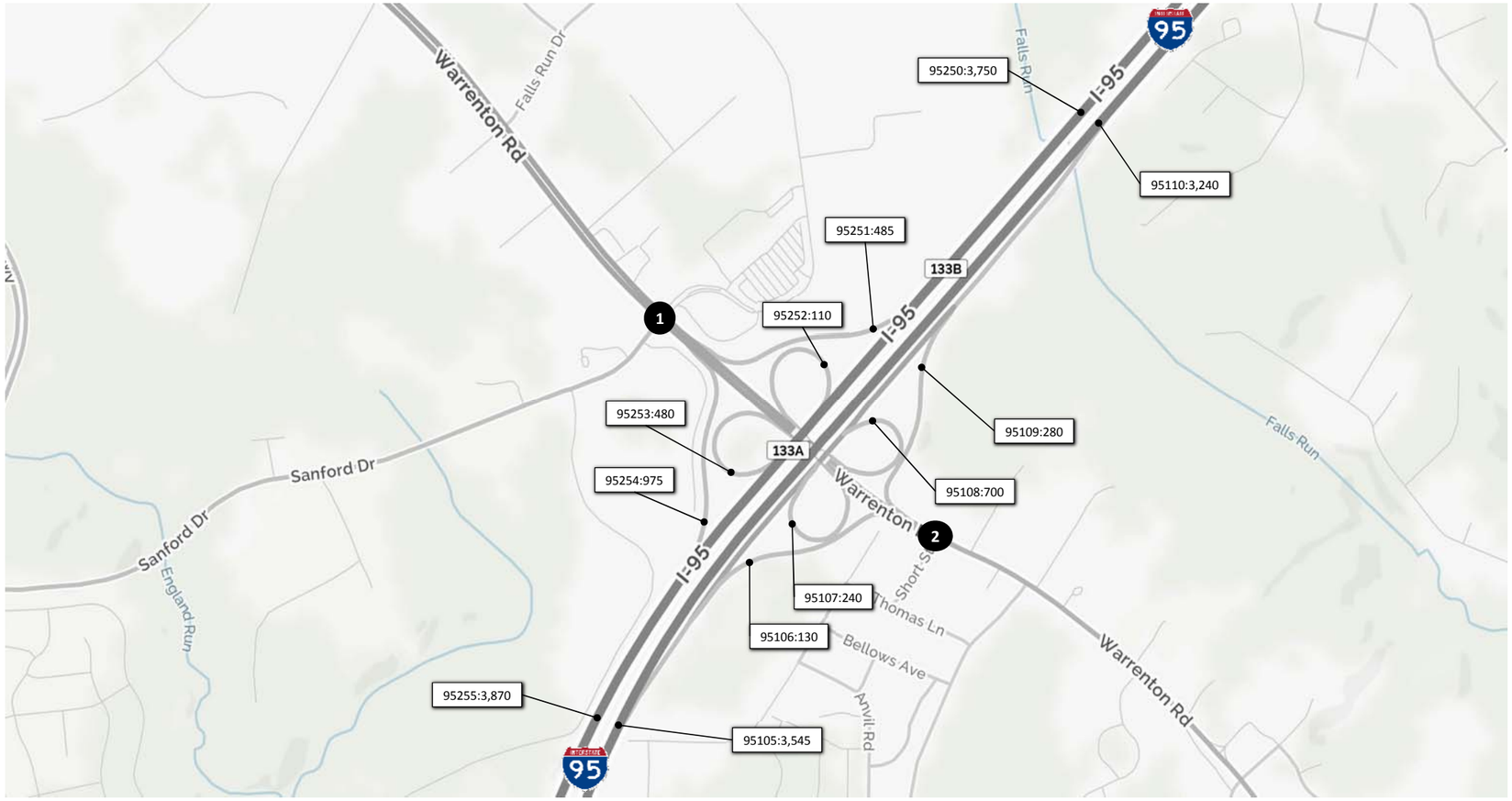
VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 6-7 PM Volumes I-95 Corridor

August 2017 | Figure A.7-1



1

	95	38	367	R		333	S Gateway Dr	
				T		1,528		
R	T	L		L		63		
US-17 (Warrenton Rd)				L	T	R		
	101	L					Sanford Dr	
	1,616	T		42	0	167		
	0	R						
						1333		

2

	10	0	2	R		2	Parking Lot	
				T		1,039		
R	T	L		L		11		
US-17 BUS (Warrenton Rd)				L	T	R		
	6	L					Short St	
	1,412	T		78	6	15		
	127	R						
						1338		

Legend

x,xxx Weekday 6-7 PM Volume

NOT TO SCALE

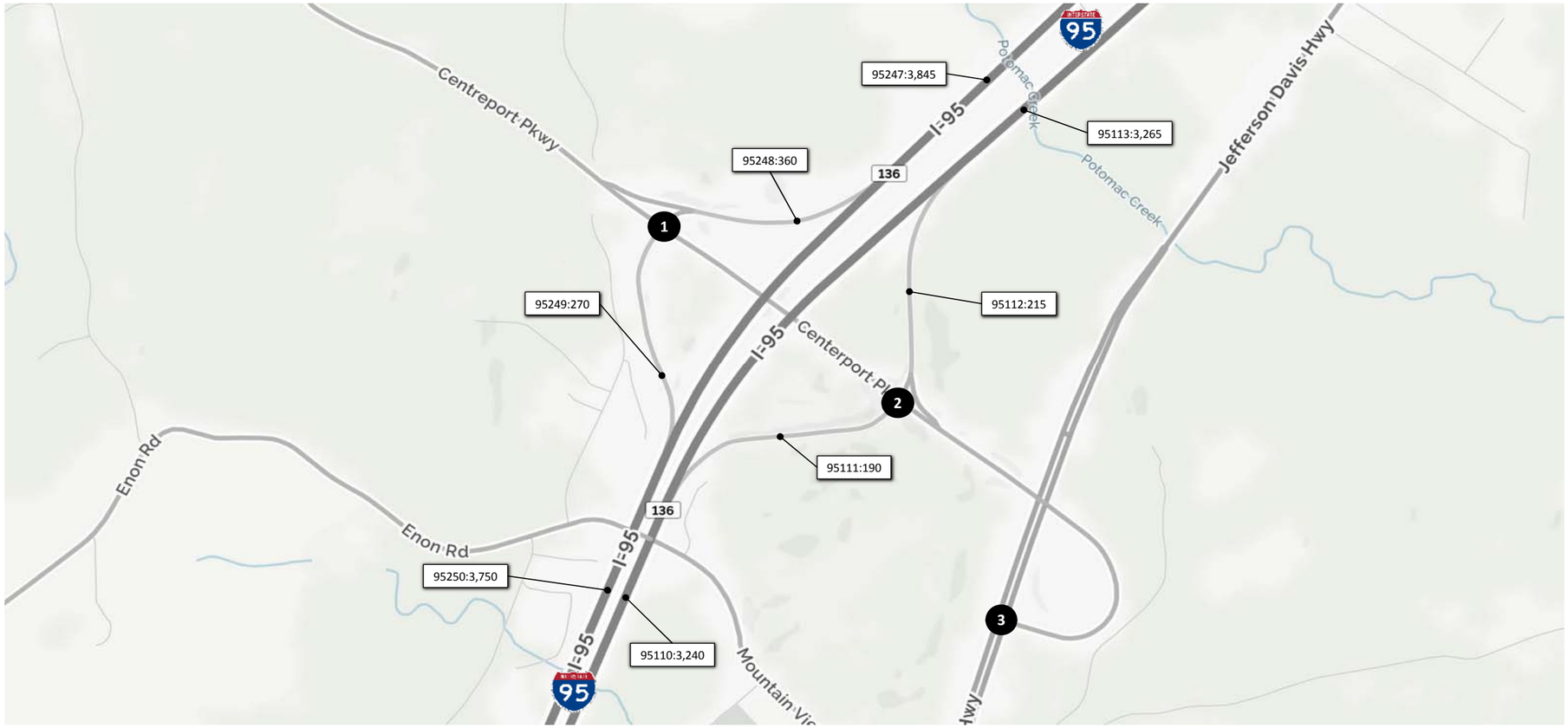
VDOT Virginia Department of Transportation

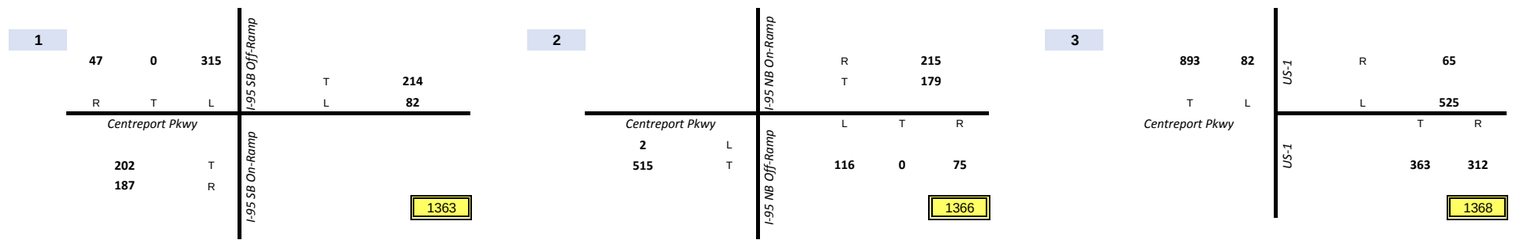
U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing
Weekday 6-7 PM Volumes
I-95 Corridor

August 2017 | Figure A.7-2





Legend

x,xxx Weekday 6-7 PM Volume

NOT TO SCALE

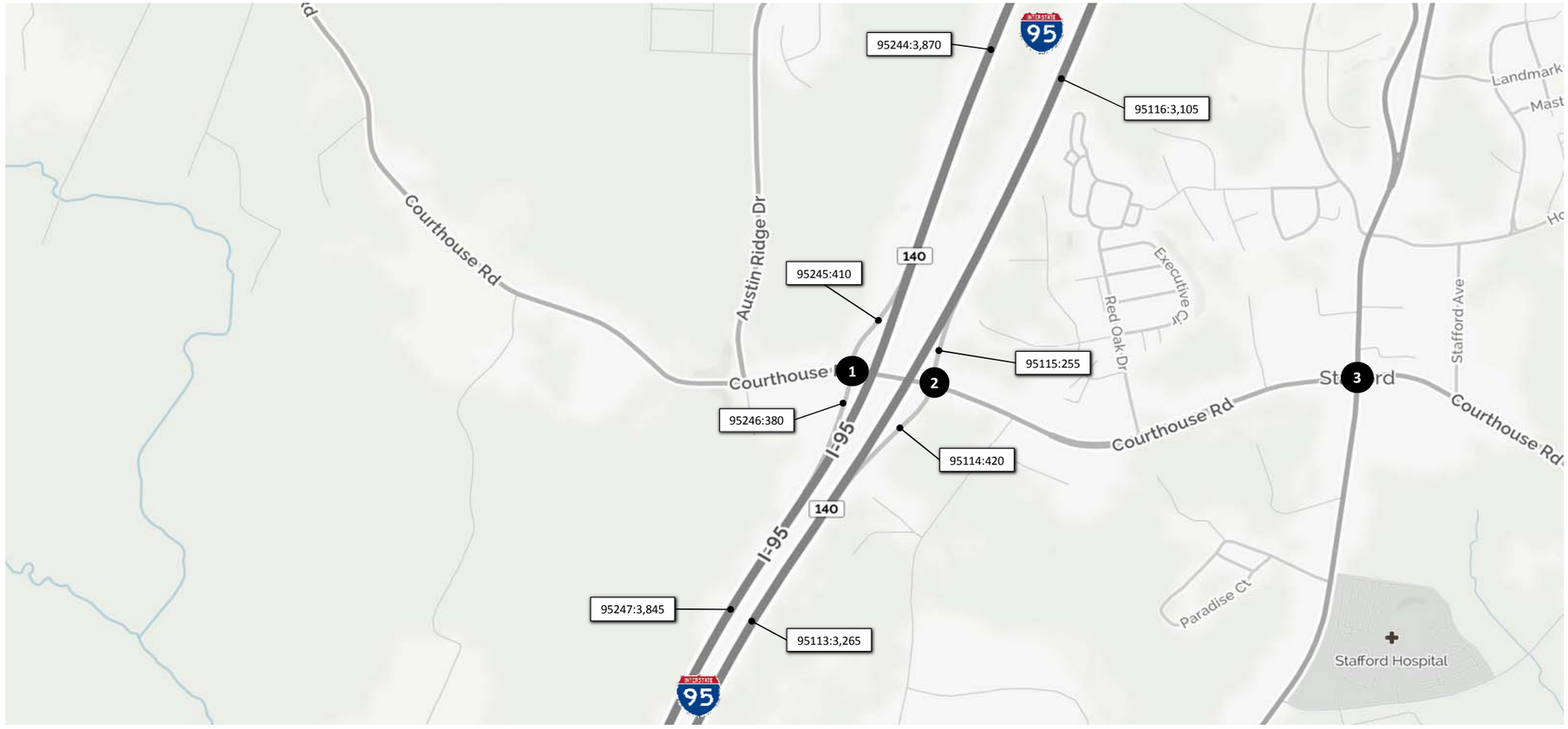
VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 6-7 PM Volumes I-95 Corridor

August 2017 | Figure A.7-3



1

					T	640
146	0	262			L	114
R	T	L				
Courthouse Road (630)			*I-95 SB Off-Ramp*			
	458	T	*I-95 SB On-Ramp*			
	268	R				
						1403

2

					R	168
					T	494
Courthouse Road (630)			*I-95 NB On-Ramp*			
89	L				L	T	R
631	T		*I-95 NB Off-Ramp*	260	0	158
						1406

3

230	536	84	*US-1*		R	127
R	T	L			T	201
Courthouse Road (630)					L	30
205	L		*US-1*		L	T	R
214	T			231	219	19
370	R					
						1408

Legend

x,xxx Weekday 6-7 PM Volume

NOT TO SCALE

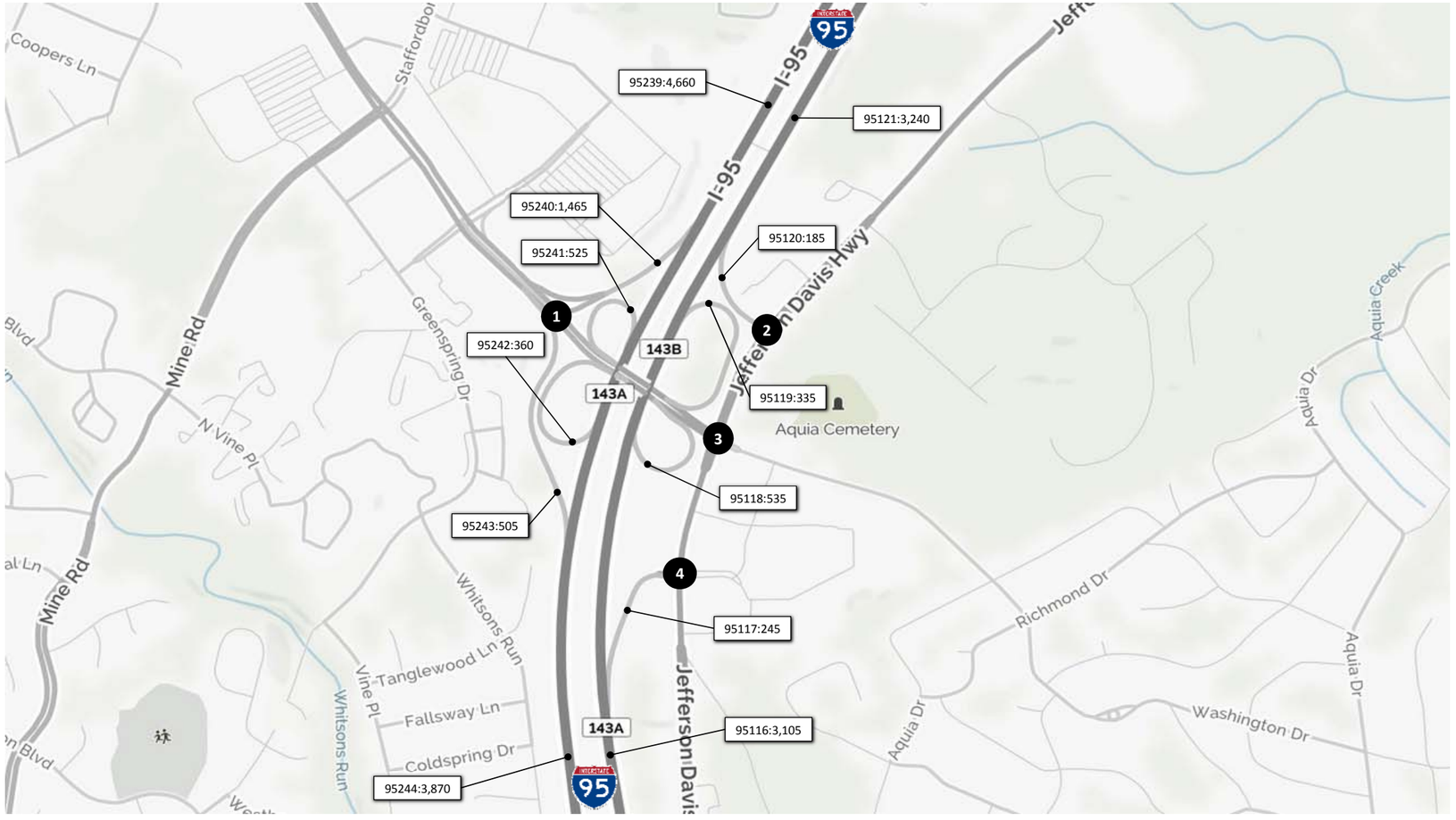
VDOT Virginia Department of Transportation

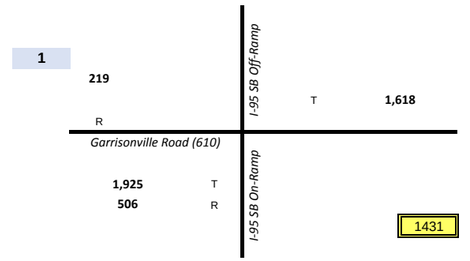
U.S. Department of Transportation Federal Highway Administration

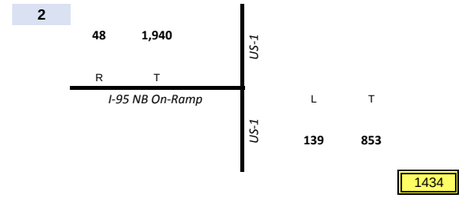
I-95 Express Lanes Fredericksburg Extension Study

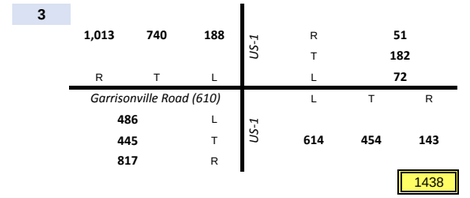
2016 Existing Weekday 6-7 PM Volumes I-95 Corridor

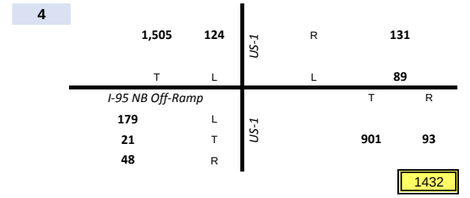
August 2017 | Figure A.7-4











Legend

x,xxx Weekday 6-7 PM Volume

NOT TO SCALE

VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 6-7 PM Volumes I-95 Corridor

August 2017 | Figure A.7-5

Legend

x,xxx Weekday 6-7 PM Volume

NOT TO SCALE

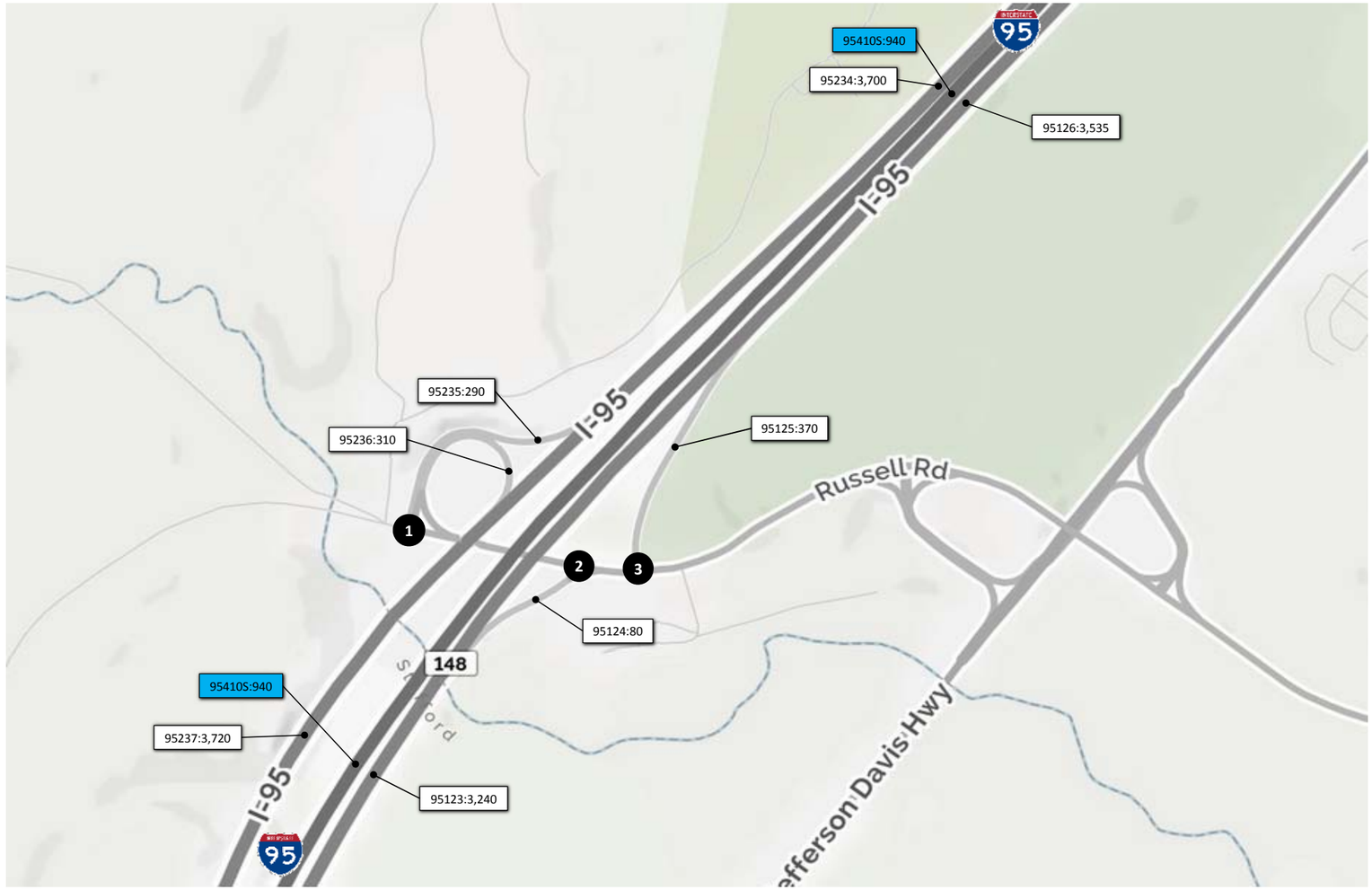
VDOT Virginia Department of Transportation

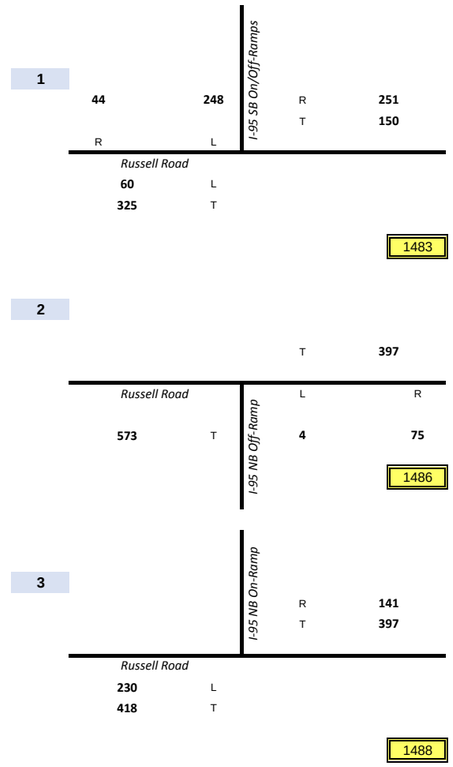
U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 6-7 PM Volumes I-95 Corridor

August 2017 | Figure A.7-6





Legend

x,xxx Weekday 6-7 PM Volume

NOT TO SCALE

VDOT Virginia Department of Transportation

U.S. Department of Transportation Federal Highway Administration

I-95 Express Lanes Fredericksburg Extension Study

2016 Existing Weekday 6-7 PM Volumes I-95 Corridor

August 2017 | Figure A.7-7

Attachment 2:
INRIX Travel Time Data

	I-95 Section		INRIX 2016 September Travel Time (seconds)						
	From	To	6 AM	7 AM	8 AM	3 PM	4 PM	5 PM	6 PM
I-95 NB	Rappahannock River	Warrenton Rd (Ex. 133)	97	104	99	96	98	95	98
	Warrenton Rd (Ex. 133)	Washington Dr (Ex. 143)	1,007	1,012	645	501	506	495	499
	Washington Dr (Ex. 143)	Russell Rd (Ex. 148)	278	270	257	239	243	236	238
	Russell Rd (Ex. 148)	Joplin Rd (Ex. 150)	116	118	120	117	121	115	117
	Joplin Rd (Ex. 150)	Dumfries Rd (Ex. 152)	133	134	135	133	137	129	131
	Dumfries Rd (Ex. 152)	Opitz Blvd (Ex. 156)	228	242	236	208	215	202	206
	Opitz Blvd (Ex. 156)	Gordon Blvd (Ex. 160)	550	623	458	212	215	211	208
	Rappahannock River	**Gordon Blvd (Ex. 160)**	**2,409**	**2,503**	**1,951**	**1,506**	**1,535**	**1,482**	**1,496**
I-95 SB	Gordon Blvd (Ex. 160)	SB Rest Area (Ex. 156)	319	271	269	281	289	300	287
	SB Rest Area (Ex. 156)	Dumfries Rd (Ex. 152)	166	167	162	162	161	164	161
	Dumfries Rd (Ex. 152)	Joplin Rd (Ex. 150)	132	131	129	129	129	129	128
	Joplin Rd (Ex. 150)	Washington Dr (Ex. 143)	365	363	356	411	580	503	369
	Washington Dr (Ex. 143)	South of Ex. 133	532	537	521	635	821	987	701
	Gordon Blvd (Ex. 160)	**Warrenton Rd (Ex. 133)**	**1,512**	**1,470**	**1,436**	**1,617**	**1,980**	**2,082**	**1,644**

Attachment 3:
Sample Size Determination Tool Samples

Sample Size Determination Tool, Version 1.1

Virginia Department of Transportation

User Inputs	Sample Size (N) = Number of Model Runs
Constants	Sample Mean (X_s) = (1/N) (X_1 + X_2 + X_3 … + X_N)
Outputs	Sample Standard Deviation (S_s) = √[(Σ(X-X_s)^2)/(N-1)]
	Sampling Error = Z (S_s/√N)
	Confidence Level = X_s ± Z (S_s/√N)
	% of Sample Mean (E) = % Tolerance * X_s
	Sample Size Needed = [(Z)^2 * (S_s)^2] / (E)^2

Model Iterations

Measure of Effectiveness (MOE):	Travel Time
Confidence Interval:	95%
Tolerance Error:	10%
Number of Model Runs:	10

Run Number	*Travel Time*
1	2421.045
2	2472.615
3	2388.395
4	2350.892
5	2409.176
6	2548.71
7	2378.218
8	2499.826
9	2521.788
10	2610.529
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Sample Size Outputs

N	=	10.0
X_s	=	2460.1
S_s	=	84.3
E	=	246.0
Z	=	1.96

Sampling Error	=	52.23		
95% Confidence Interval	=	2407.9	to	2512.4
Percentage of Mean	=	2.1%		**Good**
Sample Size Needed	=	**10**		

Z is the number of standard deviations away from the mean corresponding to the required confidence level in a normal distribution.

Sample Size Determination Tool, Version 1.1

Virginia Department of Transportation

User Inputs	Sample Size (N) = Number of Model Runs
Constants	Sample Mean (X_s) = (1/N) ($X_1 + X_2 + X_3 \ldots + X_N$)
Outputs	Sample Standard Deviation (S_s) = $\sqrt{[(\Sigma(X-X_s)^2)/(N-1)]}$
	Sampling Error = $Z\ (S_s/\sqrt{N})$
	Confidence Level = $X_s \pm Z\ (S_s/\sqrt{N})$
	% of Sample Mean (E) = % Tolerance * X_s
	Sample Size Needed = $[(Z)^2 * (S_s)^2] / (E)^2$

Model Iterations

Measure of Effectiveness (MOE):	Speed
Confidence Interval:	95%
Tolerance Error:	10%
Number of Model Runs:	10

Run Number	*Speed*
1	42.43034
2	41.54539
3	43.01036
4	43.69651
5	42.63937
6	40.305
7	43.19442
8	41.09316
9	40.73528
10	39.35055
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Sample Size Outputs

N	=	10.0
X_s	=	41.8
S_s	=	1.4
E	=	4.2
Z	=	1.96

Sampling Error	=	0.88		
95% Confidence Interval	=	40.9	to	42.7
Percentage of Mean	=	2.1%		**Good**
Sample Size Needed	=	**10**		

Z is the number of standard deviations away from the mean corresponding to the required confidence level in a normal distribution.

Sample Size Determination Tool, Version 1.1

Virginia Department of Transportation

User Inputs	Sample Size (N) = Number of Model Runs
Constants	Sample Mean (X_s) = (1/N) ($X_1 + X_2 + X_3 \ldots + X_N$)
Outputs	Sample Standard Deviation (S_s) = $\sqrt{[(\Sigma(X-X_s)^2)/(N-1)]}$
	Sampling Error = $Z\ (S_s/\sqrt{N})$
	Confidence Level = $X_s \pm Z\ (S_s/\sqrt{N})$
	% of Sample Mean (E) = % Tolerance * X_s
	Sample Size Needed = $[(Z)^2 * (S_s)^2] / (E)^2$

Model Iterations

Measure of Effectiveness (MOE):	Throughput
Confidence Interval:	95%
Tolerance Error:	10%
Number of Model Runs:	10

Run Number	*Throughput*
1	3438
2	3538
3	3582
4	3606
5	3508
6	3546
7	3485
8	3586
9	3665
10	3480
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Sample Size Outputs

N	=	10.0
X_s	=	3543.4
S_s	=	68.2
E	=	354.3
Z	=	1.96

Sampling Error	=	42.26		
95% Confidence Interval	=	3501.1	to	3585.7
Percentage of Mean	=	1.2%		**Good**
Sample Size Needed	=	**10**		

Z is the number of standard deviations away from the mean corresponding to the required confidence level in a normal distribution.

Sample Size Determination Tool, Version 1.1

Virginia Department of Transportation

User Inputs	Sample Size (N) = Number of Model Runs
Constants	Sample Mean (X_s) = (1/N) (X_1 + X_2 + X_3 … + X_N)
Outputs	Sample Standard Deviation (S_s) = √[(Σ(X-X_s)^2)/(N-1)]
	Sampling Error = Z (S_s/√N)
	Confidence Level = X_s ± Z (S_s/√N)
	% of Sample Mean (E) = % Tolerance * X_s
	Sample Size Needed = [(Z)^2 * (S_s)^2] / (E)^2

Model Iterations

Measure of Effectiveness (MOE):	Travel Time
Confidence Interval:	95%
Tolerance Error:	10%
Number of Model Runs:	10

Run Number	*Travel Time*
1	2189.988
2	2011.46
3	1962.792
4	1915.034
5	1982.567
6	2232.339
7	1986.254
8	1976.561
9	1875.853
10	2118.285
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Sample Size Outputs

N	=	10.0
X_s	=	2025.1
S_s	=	116.9
E	=	202.5
Z	=	1.96

Sampling Error	=	72.44		
95% Confidence Interval	=	1952.7	to	2097.6
Percentage of Mean	=	3.6%		**Good**
Sample Size Needed	=	**10**		

Z is the number of standard deviations away from the mean corresponding to the required confidence level in a normal distribution.

Sample Size Determination Tool, Version 1.1

Virginia Department of Transportation

User Inputs	Sample Size (N) = Number of Model Runs
Constants	Sample Mean (X_s) = (1/N) (X_1 + X_2 + X_3 … + X_N)
Outputs	Sample Standard Deviation (S_s) = √[(Σ(X-X_s)^2)/(N-1)]
	Sampling Error = Z (S_s/√N)
	Confidence Level = X_s ± Z (S_s/√N)
	% of Sample Mean (E) = % Tolerance * X_s
	Sample Size Needed = [(Z)^2 * (S_s)^2] / (E)^2

Model Iterations

Measure of Effectiveness (MOE):	Speed
Confidence Interval:	95%
Tolerance Error:	10%
Number of Model Runs:	10

Run Number	*Speed*
1	44.65619
2	48.61967
3	49.82521
4	51.06778
5	49.32823
6	43.80901
7	49.23668
8	49.47814
9	52.13444
10	46.16779
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Sample Size Outputs

N	=	10.0
X_s	=	48.4
S_s	=	2.7
E	=	4.8
Z	=	1.96

Sampling Error	=	1.68		
95% Confidence Interval	=	46.8	to	50.1
Percentage of Mean	=	3.5%		**Good**
Sample Size Needed	=	**10**		

Z is the number of standard deviations away from the mean corresponding to the required confidence level in a normal distribution.

Sample Size Determination Tool, Version 1.1

Virginia Department of Transportation

User Inputs	Sample Size (N) = Number of Model Runs
Constants	Sample Mean (X_s) = (1/N) (X_1 + X_2 + X_3 … + X_N)
Outputs	Sample Standard Deviation (S_s) = √[(Σ(X-X_s)^2)/(N-1)]
	Sampling Error = Z (S_s/√N)
	Confidence Level = X_s ± Z (S_s/√N)
	% of Sample Mean (E) = % Tolerance * X_s
	Sample Size Needed = [(Z)^2 * (S_s)^2] / (E)^2

Model Iterations

Measure of Effectiveness (MOE):	Throughput
Confidence Interval:	95%
Tolerance Error:	10%
Number of Model Runs:	10

Run Number	*Throughput*
1	4587
2	4513
3	4594
4	4431
5	4543
6	4636
7	4585
8	4443
9	4454
10	4588
11	
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Sample Size Outputs

N	=	10.0
X_s	=	4537.4
S_s	=	73.0
E	=	453.7
Z	=	1.96

Sampling Error	=	45.28		
95% Confidence Interval	=	4492.1	to	4582.7
Percentage of Mean	=	1.0%		**Good**
Sample Size Needed	=	**10**		

Z is the number of standard deviations away from the mean corresponding to the required confidence level in a normal distribution.

Attachment 4:
Project Specific Calibration Threshold Justification

MEMORANDUM

2100 E. Cary Street
Suite 309
Richmond, VA 23223
Phone 804.782.1903
Fax 804.782.2142
www.rkk.com

Date: August 28, 2017

To: VDOT Traffic Engineering

From: RK&K

CC: File

Re: I-95 Express Lanes Fredericksburg Extension – VISSIM Calibration Thresholds

---

The I-95 Express Lanes Fredericksburg Extension project is proposed to extend the existing I-95 Express Lanes 10 miles further south to a new terminus at Exit 133 (US 17, Warrenton Road). The proposed I-95 Express Lanes Fredericksburg Extension improvements primarily consist of extending two reversible high-occupancy toll lanes an additional 10 miles south of the current terminus of the Express Lanes. New slip ramps and flyover ramps connecting the high-occupancy toll lanes to the general purpose lanes are proposed at multiple locations, along with one direct ramp connection between the HOT lanes and an arterial street at Old Courthouse Road.

For this project, a VISSIM model has been developed for an extended segment of I-95, beginning at approximately Mile Marker 128 (south of Exit 130 – Plank Road) and continuing north to approximately Mile Marker 162 (north of Exit 161 – US 1). This extended model was intended to evaluate the I-95 Express Lanes Fredericksburg Extension project area in Stafford County, as well as test to potential improvements (modifications to the Express Lanes system or GP lane improvements) along the I-95 corridor in Prince William County and southern Fairfax County. The modeled time periods are 6 – 9 AM with a 2-hour seeding period in the AM peak and from 3 – 7 PM with a 1-hour seeding period in the PM peak. The operational analysis for this study is supporting both the NEPA Environmental Assessment (EA) and the Interchange Justification Report (IJR) for the changes in access proposed along the I-95 corridor.

The purpose of this memorandum is document the calibration thresholds proposed for the VISSIM model for this project and request VDOT concurrence with their use.

Calibration Thresholds:

VDOT's Traffic Operation and Safety Analysis Manual (TOSAM) establishes the requirements for operational analysis, including microsimulation, for VDOT projects. The TOSAM provides calibration thresholds for microsimulation analysis, which are summarized in Table 1 below.

Table 1: Microsimulation Model Calibration Thresholds Recommended by TOSAM (Table 5, TOSAM page 33)

<table>
<tr><th>Simulated Measure</th><th colspan="2">Calibration Threshold</th></tr>
<tr><td>Simulated Traffic Volume (vehicles per hour) The top 85% of the network links, based on link traffic volume, or a select number of critical links and/or movements, as determined by the RTE or his/her designee, shall meet the calibration thresholds. The traffic volumes identified in the calibration thresholds are actual traffic volumes as opposed to simulated traffic volumes.</td><td colspan="2">Within ± 20% for <100 vph
Within ± 15% for ≥100 vph to <300 vph
Within ± 10% for ≥300 vph to <1,000 vph
Within ± 5% for ≥1,000 vph</td></tr>
<tr><td>Simulated Average Speed (miles per hour) The top 85% of the network links, based on link traffic volume, or a select number of critical links and/or movements, as determined by the RTE or his/her designee, shall meet the calibration thresholds.</td><td colspan="2">Within ± 5 mph of average observed speeds on arterials
Within ± 7 mph of average observed speeds on freeways</td></tr>
<tr><td>Simulated Travel Time (seconds)
Eight-five percent (85%) of the travel time routes, or a select number of critical routes, as determined by the RTE or his/her designee, shall meet the calibration thresholds. Travel time routes should be determined in cooperation with the VDOT project manager based on project needs and goals.</td><td colspan="2">Within ± 30% for average observed travel times on arterials
Within ± 20% for average observed travel times on freeways
The travel time should be calibrated for segments and routes separately or as deemed appropriate by the VDOT project manager.</td></tr>
<tr><td rowspan="4">Simulated Queue Length (feet)
The top 85% of the network links, based on link traffic volume, or a select number of critical links and/or movements, as determined by the RTE or his/her designee, shall meet the calibration thresholds.</td><td rowspan="2">Undersaturated conditions (refer to Section 2.6 for guidance)</td><td>Average queue length on arterials:
Within ± 30% for movements ≤10 vph
Within ± 20% for movements >10 vph</td></tr>
<tr><td>Maximum queue length on arterials:
Within ± 25%</td></tr>
<tr><td rowspan="2">Oversaturated conditions (refer to Section 2.6 for guidance)</td><td>Average queue length:
Within ± 20% on arterials
Within ± 30% on freeways</td></tr>
<tr><td>Maximum queue length:
Within ± 20% on arterials
Within ± 35% on freeways</td></tr>
<tr><td colspan="3">Notes:
1. The calibration thresholds shall be used as minimum thresholds for calibration. The VDOT project manager may decide to use stricter thresholds based on the project needs. If the minimum thresholds cannot be achieved, written justification shall be provided for review and approval by the RTE or his/her designee.
2. Field measurements should be made when there are no unusual traffic conditions, such as special events, crashes, incidents, etc. and preferably at the same time as the counts are conducted.
3. Critical links, movements, and/or routes in the network, if needed, shall be determined in coordination with the RTE or his/her designee.</td></tr>
<tr><td colspan="3">Recommendations for Selecting Simulated Measures Based on Type of Analysis:
▪ Intersection Analysis: simulated traffic volume and simulated queue length should be used for calibration.
▪ Arterial Analysis (no freeways): simulated traffic volume and simulated queue length should be used for calibration.
▪ Freeway Analysis (no arterials): simulated traffic volume and simulated average speed should be used for calibration. Simulated queue length at bottlenecks should also be checked, if present.
▪ Network Analysis (both freeways and arterials): simulated traffic volume and simulated travel time should be used for calibration.</td></tr>
</table>

Deviations, to better match the analysis purpose and project goals, from the specific calibration thresholds identified in the TOSAM, are permitted with approval by the VDOT District Engineer overseeing the analysis. Based on a review of the model area and the analysis approach for the I-95 Fredericksburg Extension project, RK&K proposes the project specific calibration thresholds identified in Table 2 for the VISSIM modeling for this project.

Table 2. Project Calibration Thresholds

Simulated Measure	Calibration Thresholds		
	Mainline I-95	**Ramps**	**Intersections**
Simulated Traffic Volume (vehicles per hour) vs. Field Measured Throughput Volumes	Overall Simulation Period: ±5% Peak Hour: ±5% *Note: Mainline Volumes will be compared to the thresholds at two screenlines per direction, where high-quality throughput data is available:* *I-95 NB, between Exit 133 and 136* *I-95 SB, between Exit 133 and 136* *I-95 NB, between Exit 158 and 160* *I-95 SB, between Exit 158 and 160*	Overall Simulation Period: Greater than 1,000 vph: ±5% Between 300 and 1,000 vph: ±10% Less than 300 vph: ±20% Peak Hour: Greater than 1,000 vph: ±5% Between 300 and 1,000 vph: ±10% Less than 300 vph: ±20% *Note: Top 85% of ramp links will be evaluated.*	Overall Simulation Period (by Movement): Greater than 1,000 vph: ±10% Less than 1,000 vph: ±20% Peak Hour (by Movement): Greater than 1,000 vph: ±10% Less than 1,000 vph: ±20% *Note: Top 85% of intersection movements will be evaluated.*
Simulated Average Speed (mph) vs. Observed Average Travel Speeds	Overall Simulation Period: Corridor: ± 5 mph Segments: ± 10 mph Individual Hours: Corridor: ± 5 mph Segments: ± 10 mph	n/a	n/a
Simulated Average Travel Time vs. Observed Average Travel Times	Overall Simulation Period: Corridor: ± 10% Segments: ± 20% Individual Hours: Corridor: +/- 15% Segments: +/- 25%	n/a	n/a
Simulated Queues vs. Observed Maximum Queues	Backups at Bottlenecks compared to congestion mapping and field observations (maximum backup lengths ±35%). Speed and travel time data also quantitatively confirms extent of backups.	See calibration thresholds for intersections.	Maximum Queue Lengths (feet): ±25% *Note: Quantitative Comparison will be conducted the for the following critical locations and movements:* *WB SR-3 at Carl D. Silver Pkwy* *SB I-95 Off-Ramp to Route 3* *SB US 17 at Gateway Center Blvd & I-95 Off-Ramp*

			NB Route 1 at Garrisonville Road *EB Garrisonville Road at I-95 / US 1* *123 SB at Old Bridge Rd / Ramp to I-95 SB*

Notes:

1. Items in green text indicate more stringent thresholds than stipulated in the TOSAM.
2. Items in red text indicate less stringent thresholds than stipulated in the TOSAM.
3. Items in black text indicate thresholds as stipulated in the TOSAM.

Table 2 provides proposed calibration thresholds for both the overall simulation periods (6-9 AM, 3-7 PM) and for peak or individual hours (depending on the measure) within the simulation periods. Additionally, for speed and travel time calibration, separate thresholds are recommended for the overall corridor (34 miles) and for individual freeway segments (between each major interchange). Thresholds which are more stringent than those specified in the TOSAM are marked in green; thresholds which are less stringent from the specific guidance in the TOSAM are marked in red; thresholds matching the TOSAM are shown in black.

Justification for Proposed Project-Specific Thresholds:

Analysis Purpose: The purpose of this analysis is to assess the impacts of the extended reversible HOT lanes in the median of I-95. All but 1 of the proposed new access points are either slip ramps or flyover ramps between the HOT lanes and the I-95 General Purpose Lanes. Therefore, the primary calibration focus is on I-95 freeway operations to ensure that existing throughputs, travel times, and speeds accurately reflect existing conditions. The proposed thresholds for overall the overall simulation period and peak hour for volumes, corridor speeds, and corridor and segment travel times for both northbound and southbound I-95 in the AM and PM peak periods meet or exceed the thresholds identified in the TOSAM.

For ramps and arterials, the primary calibration tool will be simulated volume versus input volume, as well as queues at selected key locations. This will ensure that sufficient volume is entering the I-95 corridor at each access point to accurately reflect existing conditions. Detailed calibration of travel times, travel speeds, and queues along short segments of arterial cross streets (typically ½-mile or less) is not necessary to achieve the goals of the analysis. As noted in Table 2, queues at key locations along arterial streets will be compared to field observed conditions; this will include confirming that queue impacts along southbound US 17 due to downstream congestion along the ramp to southbound I-95 is captured in the VISSIM model.

Oversaturated Conditions: There are existing oversaturated conditions along the I-95 corridor (northbound during the AM peak and southbound during the PM peak). Because of this, field-collected traffic counts provide accurate throughput values but may not fully capture the volume demand for a particular segment. Therefore, to generate the appropriate level of congestion, it was necessary to develop demand volumes for the corridor which were input to VISSIM; the input volumes are based off measured throughputs at key locations, combined with upstream ramp and freeway volumes to estimate overall demand for each segment. It should be understood that the full input (demand) volume in a particular segment may not be served during each time period; unserved demand results in queued traffic and reduced speeds and travel times and is necessary to model this corridor. Over the course of the 3 or 4-hour simulation periods, unserved demand from a previous hour may be served as downstream congestion begins to alleviate. At several locations, estimated ramp demand volumes may exceed actual throughputs due to downstream bottlenecks. Because of this approach, simulated hourly volumes may fluctuate by greater amounts compared to input volumes. Field measured throughputs at two mainline I-95

general purpose lane locations (as specified in Table 2) will be compared to modeled throughputs for both the overall simulation periods and the peak hour. Generally, ramp and intersection thresholds are proposed to match the TOSAM for high-volume (over 1,000 vehicles) locations, but less restrictive thresholds are recommended for lower volume locations (less than 300 vehicles).

Corridor Length & Simulation Duration: As noted above, the VISSIM model for this project, extends approximately 34 miles from MP 128 to MP 162 along I-95. The simulation periods extend from 6 – 9 AM and from 3 – 7 PM. There are bottlenecks within the simulated peak periods in both directions:

- AM Peak
    - NB approaching Garrisonville Road (Exit 143)
    - NB approaching Gordon Blvd (Exit 160)
- PM Peak
    - SB approaching Gordon Blvd (Exit 160) – 4 lane to 3 lane reduction in GP lanes
    - SB approaching Garrisonville Road (Exit 143)
    - SB approaching Warrenton Road (Exit 133)

With multiple bottlenecks occurring over an extended period, traffic conditions can change markedly at the same location within the model based on the impacts from upstream or downstream bottlenecks. This means that exact calibration of each freeway segment for volume, speed and travel times or each ramp and intersection volume is extremely challenging. Because of this, the most stringent thresholds for various parameters are recommended for the overall peak period and/or the peak hour during each period. During shoulder hours, less stringent thresholds are recommended. This is reflected in the proposed calibration thresholds. Use of more stringent thresholds for all time periods will require additional effort, with potentially minimal additional benefit to understanding the operational impacts of the proposed project.

Next Steps:

Project specific calibration thresholds, which deviate in some cases from the thresholds presented in the TOSAM, are proposed for the VISSIM model developed for the I-95 Express Lanes Fredericksburg Extension project. RK&K is requesting concurrence from VDOT with the use of these project-specific thresholds. Upon approval, a revised calibration memo documenting that the specific calibration targets have been achieved will be submitted, along with the calibrated VISSIM files, for VDOT review.

Attachment 5:
AM Intersection Volume Comparison (VISSIM Throughputs vs. Input Demands)

AM Peak			Approach	Turn			Demands				Outputs				Diff.				Diff. (%)			
Arterial	Cross street	Count ID					6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM
Gordon Rlvd	Old Bridge Rd	160-T3	NB	L	16031	1	1,042	1,017	829	2,888	1,025	1,006	817	2,848	-17	-11	-12	-40	-2%	-1%	-1%	-1%
			NB	R	16031	3	2,129	2,013	1,652	5,794	2,132	1,945	1,676	5,753	3	-68	24	-41	0%	-3%	1%	-1%
			EB	T	16033	2	924	1,208	1,171	3,303	952	1,195	1,163	3,310	28	-13	-8	7	3%	-1%	-1%	0%
			EB	R	16033	3	114	151	223	488	129	165	221	515	15	14	-2	27	13%	9%	-1%	6%
			WB	L	16034	1	209	341	371	921	210	351	393	954	1	10	22	33	0%	3%	6%	4%
			WB	T	16034	2	840	809	904	2,553	798	854	944	2,596	-42	45	40	43	-5%	6%	4%	2%
	Jefferson Davis Hwy	160-T1	NB	L	16041	1	410	370	336	1,116	402	364	332	1,098	-8	-6	-4	-18	-2%	-2%	-1%	-2%
			NB	T	16041	2	1,343	1,609	1,284	4,236	1,387	1,552	1,289	4,228	44	-57	5	-8	3%	-4%	0%	0%
			SB	T	16042	2	224	407	508	1,139	239	383	458	1,080	15	-24	-50	-59	7%	-6%	-10%	-5%
			SB	R	16042	3	61	120	85	266	71	119	82	272	10	-1	-3	6	16%	-1%	-4%	2%
			EB	L	16043	1	660	569	328	1,557	638	551	330	1,519	-22	-18	2	-38	-3%	-3%	1%	-2%
			EB	R	16043	3	83	154	143	380	85	154	145	384	2	0	2	4	2%	0%	1%	1%
Prince William Pkwy	Horner Road Commuter Parking Lot Exit	158-T1	SB	L	15832	1	27	26	16	69	38	26	18	82	11	0	2	13	41%	0%	13%	19%
			SB	R	15832	3	34	29	16	79	32	28	15	75	-2	-1	-1	-4	-6%	-3%	-6%	-5%
			EB	L	15833	1	916	731	430	2,077	873	680	427	1,980	-43	-51	-3	-97	-5%	-7%	-1%	-5%
			EB	T	15833	2	1,420	1,965	1,714	5,099	1,512	1,943	1,703	5,158	92	-22	-11	59	6%	-1%	-1%	1%
			EB	R	15833	3	196	376	362	934	229	374	372	975	33	-2	10	41	17%	-1%	3%	4%
			WB	L	15834	1	136	198	152	486	146	188	155	489	10	-10	3	3	7%	-5%	2%	1%
			WB	T	15834	2	876	1,476	1,854	4,206	930	1,554	1,847	4,331	54	78	-7	125	6%	5%	0%	3%
			WB	R	15834	3	350	273	108	731	340	251	103	694	-10	-22	-5	-37	-3%	-8%	-5%	-5%
	C-D to Gen	158-5	NB	L	15821	1	326	382	422	1,130	311	417	423	1,151	-15	35	1	21	-5%	9%	0%	2%
			NB	T	15821	2	426	0	105	531	345	8	104	457	-81	8	-1	-74	-19%	-	-1%	-14%
			NB	R	15821	3	269	381	347	997	267	390	350	1,007	-2	9	3	10	-1%	2%	1%	1%
			EB	L	15823	1	596	850	928	2,374	620	855	873	2,348	24	5	-55	-26	4%	1%	-6%	-1%
			EB	T	15823	2	878	1,218	888	2,984	949	1,211	927	3,087	71	-7	39	103	8%	-1%	4%	3%
			WB	T	15824	2	707	908	889	2,504	747	903	885	2,535	40	-5	-4	31	6%	-1%	0%	1%
			WB	R	15824	3	175	177	137	489	171	169	140	480	-4	-8	3	-9	-2%	-5%	2%	-2%
Rippon Blvd	Jefferson Davis Hwy	156-T1	NB	L	15681	1	838	825	747	2,410	849	806	746	2,401	11	-19	-1	-9	1%	-2%	0%	0%
			NB	T	15681	2	785	1,059	927	2,771	820	1,041	920	2,781	35	-18	-7	10	4%	-2%	-1%	0%
			NB	R	15681	3	133	111	71	315	131	106	68	305	-2	-5	-3	-10	-2%	-5%	-4%	-3%
			SB	L	15682	1	20	31	26	77	20	31	25	76	0	0	-1	-1	0%	0%	-4%	-1%
			SB	T	15682	2	158	307	330	795	179	301	329	809	21	-6	-1	14	13%	-2%	0%	2%
			SB	R	15682	3	144	199	162	505	153	198	160	511	9	-1	-2	6	6%	-1%	-1%	1%
			EB	L	15683	1	102	153	153	408	106	157	161	424	4	4	8	16	4%	3%	5%	4%
			EB	T	15683	2	215	380	331	926	222	363	337	922	7	-17	6	-4	3%	-4%	2%	0%
			EB	R	15683	3	146	247	322	715	157	264	317	738	11	17	-5	23	8%	7%	-2%	3%

AM Peak			Approach	Turn			Demands				Outputs				Diff.				Diff. (%)			
Arterial	Cross street	Count ID					6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM
			WB	L	15684	1	46	107	114	267	51	113	116	280	5	6	2	13	11%	6%	2%	5%
			WB	T	15684	2	493	539	417	1,449	510	517	416	1,443	17	-22	-1	-6	3%	-4%	0%	0%
			WB	R	15684	3	85	108	104	297	89	105	100	294	4	-3	-4	-3	5%	-3%	-4%	-1%
Chapel Parking LOT	Potomac Mills Rd	156-T3	NB	L	15681	1	838	825	747	2,410	849	806	746	2,401	11	-19	-1	-9	1%	-2%	0%	0%
			NB	T	15681	2	785	1,059	927	2,771	820	1,041	920	2,781	35	-18	-7	10	4%	-2%	-1%	0%
			NB	R	15681	3	133	111	71	315	131	106	68	305	-2	-5	-3	-10	-2%	-5%	-4%	-3%
			SB	L	15682	1	20	31	26	77	20	31	25	76	0	0	-1	-1	0%	0%	-4%	-1%
			SB	T	15682	2	158	307	330	795	179	301	329	809	21	-6	-1	14	13%	-2%	0%	2%
			SB	R	15682	3	144	199	162	505	153	198	160	511	9	-1	-2	6	6%	-1%	-1%	1%
			EB	L	15683	1	102	153	153	408	106	157	161	424	4	4	8	16	4%	3%	5%	4%
			EB	T	15683	2	215	380	331	926	222	363	337	922	7	-17	6	-4	3%	-4%	2%	0%
			EB	R	15683	3	146	247	322	715	157	264	317	738	11	17	-5	23	8%	7%	-2%	3%
			WB	L	15684	1	46	107	114	267	51	113	116	280	5	6	2	13	11%	6%	2%	5%
			WB	T	15684	2	493	539	417	1,449	510	517	416	1,443	17	-22	-1	-6	3%	-4%	0%	0%
			WB	R	15684	3	85	108	104	297	89	105	100	294	4	-3	-4	-3	5%	-3%	-4%	-1%
Dumfries Rd	Jefferson Davis Hwy	152-T3	NB	L	15261	1	585	512	418	1,515	576	498	403	1,477	-9	-14	-15	-38	-2%	-3%	-4%	-3%
			NB	T	15261	2	430	544	580	1,554	451	547	592	1,590	21	3	12	36	5%	1%	2%	2%
			SB	T	15262	2	255	543	414	1,212	299	516	412	1,227	44	-27	-2	15	17%	-5%	0%	1%
			SB	R	15262	3	712	997	874	2,583	751	987	885	2,623	39	-10	11	40	5%	-1%	1%	2%
			EB	L	15263	1	516	793	575	1,884	530	780	562	1,872	14	-13	-13	-12	3%	-2%	-2%	-1%
			EB	R	15263	3	384	361	395	1,140	373	369	404	1,146	-11	8	9	6	-3%	2%	2%	1%
Joplin Rd/Fuller Rd	Jefferson Davis Hwy	150-T3	NB	L	15061	1	438	458	386	1,282	450	448	385	1,283	12	-10	-1	1	3%	-2%	0%	0%
			NB	T	15061	2	400	395	418	1,213	393	399	415	1,207	-7	4	-3	-6	-2%	1%	-1%	0%
			NB	R	15061	3	177	237	206	620	186	231	205	622	9	-6	-1	2	5%	-3%	0%	0%
			SB	L	15062	1	204	286	306	796	221	292	307	820	17	6	1	24	8%	2%	0%	3%
			SB	T	15062	2	178	395	293	866	210	370	295	875	32	-25	2	9	18%	-6%	1%	1%
			SB	R	15062	3	180	139	121	440	173	141	117	431	-7	2	-4	-9	-4%	1%	-3%	-2%
			EB	L	15063	1	27	163	216	406	33	170	221	424	6	7	5	18	22%	4%	2%	4%
			EB	T	15063	2	624	584	558	1,766	585	572	559	1,716	-39	-12	1	-50	-6%	-2%	0%	-3%
			EB	R	15063	3	219	633	272	1,124	252	567	269	1,088	33	-66	-3	-36	15%	-10%	-1%	-3%
			WB	L	15064	1	29	64	75	168	35	63	72	170	6	-1	-3	2	21%	-2%	-4%	1%
			WB	T	15064	2	377	343	329	1,049	368	344	334	1,046	-9	1	5	-3	-2%	0%	2%	0%
			WB	R	15064	3	51	35	66	152	52	41	64	157	1	6	-2	5	2%	17%	-3%	3%
Russell Rd	I 95 SB Off-Ramp	148-T2	SB	L	14832	1	469	635	510	1,614	467	605	513	1,585	-2	-30	3	-29	0%	-5%	1%	-2%
			SB	R	14832	3	416	798	578	1,792	428	747	565	1,740	12	-51	-13	-52	3%	-6%	-2%	-3%
			EB	T	14833	2	134	248	324	706	153	257	327	737	19	9	3	31	14%	4%	1%	4%
			WB	T	14834	2	180	382	251	813	197	361	242	800	17	-21	-9	-13	9%	-5%	-4%	-2%
			WB	R	14834	3	24	51	76	151	26	58	83	167	2	7	7	16	8%	14%	9%	11%
Russell Rd	I 95 NB Off-Ramp	148-T1a	NB	L	14861	1	61	93	115	269	55	95	111	261	-6	2	-4	-8	-10%	2%	-3%	-3%
			NB	R	14861	3	369	415	440	1,224	351	407	420	1,178	-18	-8	-20	-46	-5%	-2%	-5%	-4%
			EB	T	14863	2	604	883	834	2,321	616	848	838	2,302	12	-35	4	-19	2%	-4%	0%	-1%

AM Peak			Approach	Turn			Demands				Outputs				Diff.				Diff. (%)			
Arterial	Cross street	Count ID					6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM
			WB	T	14864	2	143	340	212	695	168	324	214	706	25	-16	2	11	17%	-5%	1%	2%
Russell Rd	I 95 NB On-Ramp	148-T1b	EB	L	14883	1	19	57	75	151	23	57	75	155	4	0	0	4	21%	0%	0%	3%
			EB	T	14883	2	954	1,241	1,199	3,394	955	1,214	1,198	3,367	1	-27	-1	-27	0%	-2%	0%	-1%
			WB	T	14884	2	143	340	212	695	170	320	213	703	27	-20	1	8	19%	-6%	0%	1%
			WB	R	14884	3	69	86	77	232	74	85	75	234	5	-1	-2	2	7%	-1%	-3%	1%
Garrisonville Rd	I 95 SB Ramps	143-T2	SB	L	14312	1	28	98	165	291	29	95	164	288	1	-3	-1	-3	4%	-3%	-1%	-1%
			SB	R	14312	3	279	482	559	1,320	274	454	551	1,279	-5	-28	-8	-41	-2%	-6%	-1%	-3%
			EB	T	14313	2	1,921	2,200	2,695	6,816	1,701	1,892	2,226	5,819	-220	-308	-469	-997	-11%	-14%	-17%	-15%
			EB	R	14313	3	188	241	346	775	162	201	264	627	-26	-40	-82	-148	-14%	-17%	-24%	-19%
			WB	L	14314	1	261	742	285	1,288	334	663	284	1,281	73	-79	-1	-7	28%	-11%	0%	-1%
			WB	T	14314	2	671	872	1,013	2,556	699	904	1,027	2,630	28	32	14	74	4%	4%	1%	3%
I 95 NB Off-ramp (Ex. 143A)	Jefferson Davis Hwy	143-T1	NB	T	143821	2	1,055	838	1,099	2,992	866	877	1,096	2,839	-189	39	-3	-153	-18%	5%	0%	-5%
			NB	R	143821	3	58	82	131	271	63	89	132	284	5	7	1	13	9%	9%	1%	5%
			SB	L	143822	1	44	46	64	154	43	47	57	147	-1	1	-7	-7	-2%	2%	-11%	-5%
			SB	T	143822	2	326	612	525	1,463	343	571	474	1,388	17	-41	-51	-75	5%	-7%	-10%	-5%
			EB	T	143823	2	81	139	92	312	80	151	92	323	-1	12	0	11	-1%	9%	0%	4%
			EB	R	143823	3	5	17	41	63	5	20	44	69	0	3	3	6	0%	18%	7%	10%
			WB	L	143824	1	19	33	35	87	19	32	36	87	0	-1	1	0	0%	-3%	3%	0%
			WB	R	143824	3	119	136	147	402	124	139	146	409	5	3	-1	7	4%	2%	-1%	2%
Washington Dr	Jefferson Davis Hwy	143-T3	NB	L	14381	1	168	173	243	584	172	186	246	604	4	13	3	20	2%	8%	1%	3%
			NB	T	14381	2	1,169	899	1,178	3,246	970	936	1,177	3,083	-199	37	-1	-163	-17%	4%	0%	-5%
			SB	L	14382	1	15	60	66	141	18	61	71	150	3	1	5	9	20%	2%	8%	6%
			SB	T	14382	2	190	365	189	744	220	345	189	754	30	-20	0	10	16%	-5%	0%	1%
			SB	R	14382	3	440	1,029	581	2,050	535	953	570	2,058	95	-76	-11	8	22%	-7%	-2%	0%
			EB	L	14383	1	910	1,053	1,141	3,104	847	881	887	2,615	-63	-172	-254	-489	-7%	-16%	-22%	-16%
			EB	T	14383	2	14	57	208	279	13	62	185	260	-1	5	-23	-19	-7%	9%	-11%	-7%
			EB	R	14383	3	114	199	345	658	104	174	284	562	-10	-25	-61	-96	-9%	-13%	-18%	-15%
			WB	L	14384	1	66	94	55	215	75	92	56	223	9	-2	1	8	14%	-2%	2%	4%
			WB	T	14384	2	187	313	325	825	204	314	324	842	17	1	-1	17	9%	0%	0%	2%
			WB	R	14384	3	298	402	260	960	311	376	261	948	13	-26	1	-12	4%	-6%	0%	-1%
Courthouse Rd	I 95 SB Ramps	140-T1	SB	L	14032	1	69	164	180	413	72	152	177	401	3	-12	-3	-12	4%	-7%	-2%	-3%
			SB	R	14032	3	36	86	90	212	33	85	88	206	-3	-1	-2	-6	-8%	-1%	-2%	-3%
			EB	T	14033	2	251	488	538	1,277	286	492	532	1,310	35	4	-6	33	14%	1%	-1%	3%
			EB	R	14033	3	178	404	360	942	216	398	369	983	38	-6	9	41	21%	-1%	3%	4%
			WB	L	14034	1	99	94	116	309	94	94	112	300	-5	0	-4	-9	-5%	0%	-3%	-3%
			WB	T	14034	2	707	766	663	2,136	725	755	666	2,146	18	-11	3	10	3%	-1%	0%	0%
Courthouse Rd	I 95 NB Ramps	140-T2	NB	L	14061	1	262	254	188	704	267	248	191	706	5	-6	3	2	2%	-2%	2%	0%
			NB	R	14061	3	115	139	178	432	113	142	172	427	-2	3	-6	-5	-2%	2%	-3%	-1%
			EB	L	14063	1	104	145	181	430	107	149	183	439	3	4	2	9	3%	3%	1%	2%
			EB	T	14063	2	216	507	537	1,260	251	495	526	1,272	35	-12	-11	12	16%	-2%	-2%	1%
			WB	T	14064	2	544	606	591	1,741	551	602	587	1,740	7	-4	-4	-1	1%	-1%	-1%	0%
			WB	R	14064	3	328	365	358	1,051	335	365	362	1,062	7	0	4	11	2%	0%	1%	1%

AM Peak			Approach	Turn			Demands				Outputs				Diff.				Diff. (%)			
Arterial	Cross street	Count ID					6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM
Centreport Pkwy	I 95 SB Ramps	136-T1	NB	T	13681	2	954	1,231	1,020	3,205	995	1,185	1,030	3,210	41	-46	10	5	4%	-4%	1%	0%
			NB	R	13681	3	533	566	718	1,817	541	597	712	1,850	8	31	-6	33	2%	5%	-1%	2%
			SB	L	13682	1	36	78	135	249	39	85	131	255	3	7	-4	6	8%	9%	-3%	2%
			SB	T	13682	2	167	335	428	930	198	352	432	982	31	17	4	52	19%	5%	1%	6%
			WB	L	13684	1	138	205	208	551	137	202	205	544	-1	-3	-3	-7	-1%	-1%	-1%	-1%
			WB	R	13684	3	428	543	308	1,279	424	538	314	1,276	-4	-5	6	-3	-1%	-1%	2%	0%
Centreport Pkwy	I 95 NB Ramps	136-T2	SB	L	13632	1	55	115	131	301	59	113	128	300	4	-2	-3	-1	7%	-2%	-2%	0%
			EB	T	13633	2	45	77	92	214	50	82	95	227	5	5	3	13	11%	6%	3%	6%
			EB	R	13633	3	82	176	164	422	96	171	160	427	14	-5	-4	5	17%	-3%	-2%	1%
			WB	L	13634	1	49	109	123	281	54	119	112	285	5	10	-11	4	10%	9%	-9%	1%
			WB	T	13634	2	649	519	387	1,555	620	501	389	1,510	-29	-18	2	-45	-4%	-3%	1%	-3%
Centreport Pkwy	Jefferson Davis Hwy	136-T3	NB	L	13661	1	461	407	234	1,102	445	392	230	1,067	-16	-15	-4	-35	-3%	-4%	-2%	-3%
			NB	R	13661	3	459	563	302	1,324	462	552	303	1,317	3	-11	1	-7	1%	-2%	0%	-1%
			EB	T	13663	2	97	185	214	496	104	186	215	505	7	1	1	9	7%	1%	0%	2%
			WB	T	13664	2	238	221	276	735	229	228	269	726	-9	7	-7	-9	-4%	3%	-3%	-1%
			WB	R	13664	3	331	423	577	1,331	348	447	578	1,373	17	24	1	42	5%	6%	0%	3%
Warrenton Rd	S Gateway Dr	133-T1	NB	L	13331	1	10	29	28	67	12	25	25	62	2	-4	-3	-5	20%	-14%	-11%	-7%
			NB	R	13331	3	58	114	137	309	68	115	139	322	10	1	2	13	17%	1%	1%	4%
			SB	L	13332	1	172	286	273	731	188	284	269	741	16	-2	-4	10	9%	-1%	-1%	1%
			SB	T	13332	2	0	27	59	86	5	29	59	93	5	2	0	7	-	7%	0%	8%
			SB	R	13332	3	15	36	83	134	21	45	83	149	6	9	0	15	40%	25%	0%	11%
			EB	L	13333	1	20	53	77	150	44	51	68	163	24	-2	-9	13	120%	-4%	-12%	9%
			EB	T	13333	2	1,006	1,380	1,448	3,834	1,055	1,401	1,453	3,909	49	21	5	75	5%	2%	0%	2%
			EB	R	13333	3	10	28	28	66	12	29	29	70	2	1	1	4	20%	4%	4%	6%
			WB	L	13334	1	63	289	168	520	85	270	177	532	22	-19	9	12	35%	-7%	5%	2%
			WB	T	13334	2	1,549	2,174	1,913	5,636	1,573	2,127	1,917	5,617	24	-47	4	-19	2%	-2%	0%	0%
			WB	R	13334	3	165	337	354	856	184	339	357	880	19	2	3	24	12%	1%	1%	3%
Warrenton Rd	Short St	133-T2	NB	L	13381	1	82	100	104	286	84	100	100	284	2	0	-4	-2	2%	0%	-4%	-1%
			NB	R	13381	3	10	18	25	53	12	20	26	58	2	2	1	5	20%	11%	4%	9%
			EB	T	13383	2	595	1,167	1,438	3,200	650	1,155	1,436	3,241	55	-12	-2	41	9%	-1%	0%	1%
			EB	R	13383	3	42	60	70	172	45	59	68	172	3	-1	-2	0	7%	-2%	-3%	0%
			WB	T	13384	2	838	1,200	1,108	3,146	894	1,187	1,107	3,188	56	-13	-1	42	7%	-1%	0%	1%
Plank Rd	Carl D. Silver Parkway	130-T1	SB	L	13032	1	276	313	308	897	287	308	316	911	11	-5	8	14	4%	-2%	3%	2%
			SB	R	13032	3	30	41	82	153	32	46	80	158	2	5	-2	5	7%	12%	-2%	3%
			EB	L	13033	1	128	156	210	494	134	161	198	493	6	5	-12	-1	5%	3%	-6%	0%
			EB	T	13033	2	2,832	2,849	2,302	7,983	2,818	2,778	2,286	7,882	-14	-71	-16	-101	0%	-2%	-1%	-1%
			WB	T	13034	2	1,056	1,385	1,383	3,824	1,064	1,384	1,374	3,822	8	-1	-9	-2	1%	0%	-1%	0%
			WB	R	13034	3	346	410	609	1,365	350	434	593	1,377	4	24	-16	12	1%	6%	-3%	1%
Plank Rd	Gateway Blvd	130-T2	NB	L	13041	1	290	263	253	806	289	260	252	801	-1	-3	-1	-5	0%	-1%	0%	-1%
			NB	R	13041	3	112	140	173	425	118	149	169	436	6	9	-4	11	5%	6%	-2%	3%
			EB	L	13043	1	72	73	27	172	70	65	27	162	-2	-8	0	-10	-3%	-11%	0%	-6%
			EB	T	13043	2	1,219	1,614	1,427	4,260	1,233	1,634	1,417	4,284	14	20	-10	24	1%	1%	-1%	1%

AM Peak			Approach	Turn			Demands				Outputs				Diff.				Diff. (%)			
Arterial	Cross street	Count ID					6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM
			EB	R	13043	3	208	271	299	778	259	225	305	789	51	-46	6	11	25%	-17%	2%	1%
			WB	L	13044	1	86	104	132	322	87	107	133	327	1	3	1	5	1%	3%	1%	2%
			WB	T	13044	2	892	1,044	1,032	2,968	917	1,039	1,024	2,980	25	-5	-8	12	3%	0%	-1%	0%

Attachment 6:
AM Ramp Volume Comparison (VISSIM Throughputs vs. Input Demands)

	AM Peak		Demands				Outputs				Diff.				Diff. (%)			
	Ex. #	Count ID	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM
I-95 NB	130	130-8	221	278	274	773	225	290	269	784	4	12	-5	11	2%	4%	-2%	1%
		130-6	1,798	1,525	1,127	4,450	1,767	1,452	1,135	4,354	-31	-73	8	-96	-2%	-5%	1%	-2%
		130-4	396	438	425	1,259	390	443	422	1,255	-6	5	-3	-4	-2%	1%	-1%	0%
		130-2	611	587	483	1,681	633	593	504	1,730	22	6	21	49	4%	1%	4%	3%
	133	133-5	101	176	286	563	108	190	299	597	7	14	13	34	7%	8%	5%	6%
		133-6	394	321	262	977	382	313	256	951	-12	-8	-6	-26	-3%	-2%	-2%	-3%
		133-7	1,028	1,460	1,212	3,700	1,065	1,441	1,225	3,731	37	-19	13	31	4%	-1%	1%	1%
		133-8	256	210	249	715	256	225	242	723	0	15	-7	8	0%	7%	-3%	1%
	136	136-3	925	986	560	2,471	906	928	529	2,363	-19	-58	-31	-108	-2%	-6%	-6%	-4%
		136-4	339	446	610	1,395	352	455	585	1,392	13	9	-25	-3	4%	2%	-4%	0%
	140	140-3	392	419	376	1,187	378	389	360	1,127	-14	-30	-16	-60	-4%	-7%	-4%	-5%
		140-4	447	537	549	1,533	417	486	516	1,419	-30	-51	-33	-114	-7%	-9%	-6%	-7%
	143	143-6	249	258	318	825	239	295	325	859	-10	37	7	34	-4%	14%	2%	4%
		143-5	912	989	1,166	3,067	801	855	1,052	2,708	-111	-134	-114	-359	-12%	-14%	-10%	-12%
		143-7	136	99	149	384	133	111	171	415	-3	12	22	31	-2%	12%	15%	8%
		143-8	1,048	647	696	2,391	785	604	655	2,044	-263	-43	-41	-347	-25%	-7%	-6%	-15%
	NB GP to HOT	PT 2	1,112	761	802	2,675	898	855	818	2,571	-214	94	16	-104	-19%	12%	2%	-4%
	148	148-3	430	508	555	1,493	416	525	552	1,493	-14	17	-3	0	-3%	3%	-1%	0%
	150	150-5/4	141	195	285	621	122	172	246	540	-19	-23	-39	-81	-13%	-12%	-14%	-13%
		150-6	795	747	654	2,196	792	739	655	2,186	-3	-8	1	-10	0%	-1%	0%	0%
	NB GP to HOT	PT 4	207	189	127	523	198	196	131	525	-9	7	4	2	-4%	4%	3%	0%
	152	152-4	134	210	177	521	136	208	178	522	2	-2	1	1	1%	-1%	1%	0%
		152-5	400	527	427	1,354	400	516	432	1,348	0	-11	5	-6	0%	-2%	1%	0%
		152-6	1,399	1,493	1,255	4,147	1,371	1,444	1,207	4,022	-28	-49	-48	-125	-2%	-3%	-4%	-3%
	Truck Reset Area NB		105	150	207	462	111	160	206	477	6	10	-1	15	6%	7%	0%	3%
	NB GP to HOT	PT 5	842	710	438	1,990	812	704	432	1,948	-30	-6	-6	-42	-4%	-1%	-1%	-2%
	156	156-A4	236	435	428	1,099	253	448	441	1,142	17	13	13	43	7%	3%	3%	4%
		156-A5	944	922	775	2,641	940	903	783	2,626	-4	-19	8	-15	0%	-2%	1%	-1%
		156-A6	177	407	426	1,010	213	423	422	1,058	36	16	-4	48	20%	4%	-1%	5%
		156-A7	1,036	950	739	2,725	1,044	910	748	2,702	8	-40	9	-23	1%	-4%	1%	-1%
		156B-3	109	175	139	423	119	168	139	426	10	-7	0	3	9%	-4%	0%	1%
		156B-2	432	354	273	1,059	423	338	275	1,036	-9	-16	2	-23	-2%	-5%	1%	-2%
	NB GP to HOT	PT 8	1,169	968	723	2,860	1,145	941	724	2,810	-24	-27	1	-50	-2%	-3%	0%	-2%
	NB HOT to GP	PT 10	409	490	437	1,336	387	531	436	1,354	-22	41	-1	18	-5%	8%	0%	1%
	158	158-4	269	381	347	997	269	386	353	1,008	0	5	6	11	0%	1%	2%	1%
		158-5	596	850	928	2,374	623	854	873	2,350	27	4	-55	-24	5%	0%	-6%	-1%
		158-6	326	382	422	1,130	311	412	425	1,148	-15	30	3	18	-5%	8%	1%	2%
		158-7	175	177	137	489	171	169	140	480	-4	-8	3	-9	-2%	-5%	2%	-2%
	160	160-5	1,585	1,416	1,335	4,336	1,560	1,394	1,355	4,309	-25	-22	20	-27	-2%	-2%	1%	-1%
		160-7	779	682	675	2,136	720	718	722	2,160	-59	36	47	24	-8%	5%	7%	1%

	AM Peak		Demands				Outputs				Diff.				Diff. (%)			
	Ex. #	Count ID	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM	6 AM	7 AM	8 AM	6-9 AM
		160-6	370	352	183	905	375	328	174	877	5	-24	-9	-28	1%	-7%	-5%	-3%
I-95 SB	160	160-1	262	465	471	1,198	284	477	480	1,241	22	12	9	43	8%	3%	2%	4%
		160-3	359	658	669	1,686	394	652	661	1,707	35	-6	-8	21	10%	-1%	-1%	1%
	158	158-1	329	657	803	1,789	360	673	797	1,830	31	16	-6	41	9%	2%	-1%	2%
		158-3	342	580	520	1,442	383	567	533	1,483	41	-13	13	41	12%	-2%	3%	3%
	156	156-B1	351	523	570	1,444	366	522	587	1,475	15	-1	17	31	4%	0%	3%	2%
		156-A2	249	361	264	874	269	351	259	879	20	-10	-5	5	8%	-3%	-2%	1%
		156-A1	220	344	374	938	232	341	372	945	12	-3	-2	7	5%	-1%	-1%	1%
		156-A3	213	269	301	783	225	271	295	791	12	2	-6	8	6%	1%	-2%	1%
	Truck Reset Area SB	Off ramp	201	198	235	634	192	191	228	611	-9	-7	-7	-23	-4%	-4%	-3%	-4%
		On ramp	201	198	235	634	199	202	235	636	-2	4	0	2	-1%	2%	0%	0%
	152	152-1	213	270	334	817	204	281	327	812	-9	11	-7	-5	-4%	4%	-2%	-1%
		152-2	228	307	298	833	223	313	294	830	-5	6	-4	-3	-2%	2%	-1%	0%
		152-3	793	1,118	1,117	3,028	830	1,114	1,109	3,053	37	-4	-8	25	5%	0%	-1%	1%
	150	150-3	644	1,050	622	2,316	640	974	622	2,236	-4	-76	0	-80	-1%	-7%	0%	-3%
	148	150-2	178	213	238	629	185	221	236	642	7	8	-2	13	4%	4%	-1%	2%
		148-1	886	1,433	1,088	3,407	901	1,356	1,076	3,333	15	-77	-12	-74	2%	-5%	-1%	-2%
	143	143-1	279	482	559	1,320	273	453	551	1,277	-6	-29	-8	-43	-2%	-6%	-1%	-3%
		143-2	261	742	285	1,288	327	668	282	1,277	66	-74	-3	-11	25%	-10%	-1%	-1%
		143-4	188	241	346	775	158	196	287	641	-30	-45	-59	-134	-16%	-19%	-17%	-17%
	140	140-1	104	250	272	626	105	238	267	610	1	-12	-5	-16	1%	-5%	-2%	-3%
		140-2	277	498	478	1,253	290	460	450	1,200	13	-38	-28	-53	5%	-8%	-6%	-4%
	136	136-2	131	285	288	704	149	288	273	710	18	3	-15	6	14%	1%	-5%	1%
	133	133-1	163	366	401	930	169	341	388	898	6	-25	-13	-32	4%	-7%	-3%	-3%
		133-3	181	432	532	1,145	190	413	526	1,129	9	-19	-6	-16	5%	-4%	-1%	-1%
		133-4	486	836	901	2,223	533	857	910	2,300	47	21	9	77	10%	3%	1%	3%
	130	130-1	556	813	920	2,289	559	782	894	2,235	3	-31	-26	-54	1%	-4%	-3%	-2%
		130-3	125	178	152	455	84	118	104	306	-41	-60	-48	-149	-33%	-34%	-32%	-33%
		130-5	279	432	394	1,105	293	414	388	1,095	14	-18	-6	-10	5%	-4%	-2%	-1%
		130-7	321	398	410	1,129	327	401	419	1,147	6	3	9	18	2%	1%	2%	2%

Attachment 7:
AM Calibration Arterial Queue Results (VISSIM Average Maximum Queue vs. Field Observed Queue, feet)

Maximum Queue Length in Feet										
VISSIM Queue Counter #	Study Movement	2016 Field Observations			VISSIM			Diff.(%)		
		6 AM	7 AM	8 AM	6 AM	7 AM	8 AM	6 AM	7 AM	8 AM
1	Westbound Route 3 (Plank Rd) at Carl D. Silver Pkwy	275	300	300	231	249	310	-16%	-17%	3%
2	Southbound I-95 Off-Ramp at Route 3	0	0	0	0	0	0	n/a	n/a	n/a
3	Southbound Route 17 (Warrenton Rd) at S Gateway Dr	475	675	675	505	674	681	6%	0%	1%
4	Northbound Route 1 (Jefferson Davis Hwy) at Route 610 (Garrisonville Rd)	800	900	1000	653	729	1043	-18%	-19%	4%
5	Eastbound Route 610 at Route 1	1800	1900	1850	2214	2218	2210	23%	17%	19%
6	Southbound Route 123 (Gordon Blvd) at I-95S Off-Ramp	775	975	1175	756	1028	1046	-3%	5%	-11%

Attachment 8:
PM Intersection Volume Comparison (VISSIM Throughputs vs. Input Demands)

PM Peak			Approach	Turn	Demands					Outputs					Diff.					Diff. (%)				
Arterial	Cross street	Count ID			3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM
Gordon Rlvd	Old Bridge Rd	160-T3	NB	L	308	309	338	298	1,253	310	319	313	306	1,248	2	10	-25	8	-5	1%	3%	-7%	3%	0%
			NB	R	555	553	638	585	2,331	540	597	623	586	2,346	-15	44	-15	1	15	-3%	8%	-2%	0%	1%
			EB	T	1,347	1,506	1,592	1,328	5,773	1,392	1,496	1,444	1,296	5,628	45	-10	-148	-32	-145	3%	-1%	-9%	-2%	-3%
			EB	R	647	747	704	542	2,640	690	692	684	636	2,702	43	-55	-20	94	62	7%	-7%	-3%	17%	2%
			WB	L	1,475	1,588	1,735	1,404	6,202	1,510	1,596	1,598	1,434	6,138	35	8	-137	30	-64	2%	1%	-8%	2%	-1%
			WB	T	831	1,251	1,007	999	4,088	1,041	1,101	1,027	1,008	4,177	210	-150	20	9	89	25%	-12%	2%	1%	2%
	Jefferson Davis Hwy	160-T1	NB	L	194	212	215	163	784	202	210	188	160	760	8	-2	-27	-3	-24	4%	-1%	-13%	-2%	-3%
			NB	T	516	538	550	467	2,071	523	542	514	466	2,045	7	4	-36	-1	-26	1%	1%	-7%	0%	-1%
			SB	T	1,302	1,328	1,274	1,024	4,928	1,410	1,341	1,175	1,039	4,965	108	13	-99	15	37	8%	1%	-8%	1%	1%
			SB	R	489	627	565	414	2,095	545	600	491	415	2,051	56	-27	-74	1	-44	11%	-4%	-13%	0%	-2%
			EB	L	154	110	202	78	544	130	148	147	82	507	-24	38	-55	4	-37	-16%	35%	-27%	5%	-7%
			EB	R	339	505	539	352	1,735	405	504	457	357	1,723	66	-1	-82	5	-12	19%	0%	-15%	1%	-1%
Prince William Pkwy	Horner Road Commuter Parking Lot Exit	158-T1	SB	L	124	195	219	112	650	154	202	169	117	642	30	7	-50	5	-8	24%	4%	-23%	4%	-1%
			SB	T	124	276	264	114	778	195	271	187	115	768	71	-5	-77	1	-10	57%	-2%	-29%	1%	-1%
			SB	R	555	823	938	680	2,996	688	898	819	676	3,081	133	75	-119	-4	85	24%	9%	-13%	-1%	3%
			EB	T	1,521	1,618	1,681	1,657	6,477	1,565	1,645	1,691	1,654	6,555	44	27	10	-3	78	3%	2%	1%	0%	1%
			EB	R	472	509	592	529	2,102	457	535	550	521	2,063	-15	26	-42	-8	-39	-3%	5%	-7%	-2%	-2%
			WB	L	194	221	225	226	866	202	211	219	234	866	8	-10	-6	8	0	4%	-5%	-3%	4%	0%
			WB	T	2,575	2,780	2,716	2,696	10,767	2,642	2,733	2,751	2,692	10,818	67	-47	35	-4	51	3%	-2%	1%	0%	0%
			WB	R	32	36	40	25	133	31	42	33	24	130	-1	6	-7	-1	-3	-3%	17%	-18%	-4%	-2%
	C-D to Gen	158-5	NB	L	451	499	531	425	1,906	470	524	503	424	1,921	19	25	-28	-1	15	4%	5%	-5%	0%	1%
			NB	T	12	32	43	72	159	17	36	61	69	183	5	4	18	-3	24	42%	13%	42%	-4%	15%
			NB	R	252	249	320	253	1,074	252	294	291	251	1,088	0	45	-29	-2	14	0%	18%	-9%	-1%	1%
			EB	L	698	749	737	638	2,822	669	675	657	608	2,609	-29	-74	-80	-30	-213	-4%	-10%	-11%	-5%	-8%
			EB	T	1,044	1,195	1,307	1,226	4,772	1,166	1,301	1,323	1,267	5,057	122	106	16	41	285	12%	9%	1%	3%	6%
			WB	T	1,252	1,345	1,316	1,438	5,351	1,297	1,333	1,362	1,447	5,439	45	-12	46	9	88	4%	-1%	3%	1%	2%
			WB	R	89	93	79	72	333	89	86	80	71	326	0	-7	1	-1	-7	0%	-8%	1%	-1%	-2%
Rippon Blvd	Jefferson Davis Hwy	156-T1	NB	L	510	519	561	505	2,095	503	541	529	506	2,079	-7	22	-32	1	-16	-1%	4%	-6%	0%	-1%
			NB	T	480	471	502	395	1,848	485	483	454	396	1,818	5	12	-48	1	-30	1%	3%	-10%	0%	-2%
			NB	R	43	65	51	49	208	51	57	49	48	205	8	-8	-2	-1	-3	19%	-12%	-4%	-2%	-1%
			SB	L	79	86	107	91	363	79	96	97	93	365	0	10	-10	2	2	0%	12%	-9%	2%	1%
			SB	T	734	810	1,028	923	3,495	765	911	977	921	3,574	31	101	-51	-2	79	4%	12%	-5%	0%	2%
			SB	R	292	297	394	426	1,409	297	348	404	429	1,478	5	51	10	3	69	2%	17%	3%	1%	5%
			EB	L	131	140	145	109	525	133	145	129	116	523	2	5	-16	7	-2	2%	4%	-11%	6%	0%
			EB	T	407	434	436	478	1,755	413	408	448	482	1,751	6	-26	12	4	-4	1%	-6%	3%	1%	0%
			EB	R	719	871	1,259	1,004	3,853	758	1,013	1,158	963	3,892	39	142	-101	-41	39	5%	16%	-8%	-4%	1%

PM Peak			Approach	Turn	Demands					Outputs					Diff.					Diff. (%)				
Arterial	Cross street	Count ID			3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM
			WB	L	100	138	180	141	559	121	161	163	141	586	21	23	-17	0	27	21%	17%	-9%	0%	5%
			WB	T	297	344	376	319	1,336	321	352	343	318	1,334	24	8	-33	-1	-2	8%	2%	-9%	0%	0%
			WB	R	56	71	58	70	255	63	66	66	70	265	7	-5	8	0	10	13%	-7%	14%	0%	4%
Chapel Parking LOT	Potomac Mills Rd	156-T3	NB	L	510	519	561	505	2,095	503	541	529	506	2,079	-7	22	-32	1	-16	-1%	4%	-6%	0%	-1%
			NB	T	480	471	502	395	1,848	485	483	454	396	1,818	5	12	-48	1	-30	1%	3%	-10%	0%	-2%
			NB	R	43	65	51	49	208	51	57	49	48	205	8	-8	-2	-1	-3	19%	-12%	-4%	-2%	-1%
			SB	L	79	86	107	91	363	79	96	97	93	365	0	10	-10	2	2	0%	12%	-9%	2%	1%
			SB	T	734	810	1,028	923	3,495	765	911	977	921	3,574	31	101	-51	-2	79	4%	12%	-5%	0%	2%
			SB	R	292	297	394	426	1,409	297	348	404	429	1,478	5	51	10	3	69	2%	17%	3%	1%	5%
			EB	L	131	140	145	109	525	133	145	129	116	523	2	5	-16	7	-2	2%	4%	-11%	6%	0%
			EB	T	407	434	436	478	1,755	413	408	448	482	1,751	6	-26	12	4	-4	1%	-6%	3%	1%	0%
			EB	R	719	871	1,259	1,004	3,853	758	1,013	1,158	963	3,892	39	142	-101	-41	39	5%	16%	-8%	-4%	1%
			WB	L	100	138	180	141	559	121	161	163	141	586	21	23	-17	0	27	21%	17%	-9%	0%	5%
			WB	T	297	344	376	319	1,336	321	352	343	318	1,334	24	8	-33	-1	-2	8%	2%	-9%	0%	0%
			WB	R	56	71	58	70	255	63	66	66	70	265	7	-5	8	0	10	13%	-7%	14%	0%	4%
Dumfries Rd	Jefferson Davis Hwy	152-T3	NB	L	376	547	536	360	1,819	414	472	466	400	1,752	38	-75	-70	40	-67	10%	-14%	-13%	11%	-4%
			NB	T	609	630	693	602	2,534	599	591	709	649	2,548	-10	-39	16	47	14	-2%	-6%	2%	8%	1%
			SB	L	14	23	49	25	111	18	35	34	24	111	4	12	-15	-1	0	29%	52%	-31%	-4%	0%
			SB	T	674	762	798	638	2,872	701	770	715	640	2,826	27	8	-83	2	-46	4%	1%	-10%	0%	-2%
			SB	R	771	858	862	758	3,249	825	860	811	764	3,260	54	2	-51	6	11	7%	0%	-6%	1%	0%
			EB	L	791	950	990	946	3,677	849	957	975	963	3,744	58	7	-15	17	67	7%	1%	-2%	2%	2%
			EB	R	498	508	479	526	2,011	493	497	515	523	2,028	-5	-11	36	-3	17	-1%	-2%	8%	-1%	1%
			WB	T	13	30	48	28	119	22	40	41	28	131	9	10	-7	0	12	69%	33%	-15%	0%	10%
Joplin Rd/Fuller Rd	Jefferson Davis Hwy	150-T3	NB	L	283	403	306	180	1,172	341	364	253	174	1,132	58	-39	-53	-6	-40	20%	-10%	-17%	-3%	-3%
			NB	T	300	393	365	234	1,292	346	383	296	230	1,255	46	-10	-69	-4	-37	15%	-3%	-19%	-2%	-3%
			NB	R	73	118	122	80	393	95	111	106	79	391	22	-7	-16	-1	-2	30%	-6%	-13%	-1%	-1%
			SB	L	108	149	212	118	587	126	183	169	117	595	18	34	-43	-1	8	17%	23%	-20%	-1%	1%
			SB	T	492	557	538	390	1,977	521	553	459	390	1,923	29	-4	-79	0	-54	6%	-1%	-15%	0%	-3%
			SB	R	121	189	184	112	606	156	182	154	107	599	35	-7	-30	-5	-7	29%	-4%	-16%	-4%	-1%
			EB	L	132	168	202	129	631	140	189	173	133	635	8	21	-29	4	4	6%	13%	-14%	3%	1%
			EB	T	274	395	396	325	1,390	319	388	377	328	1,412	45	-7	-19	3	22	16%	-2%	-5%	1%	2%
			EB	R	766	650	770	393	2,579	706	682	610	394	2,392	-60	32	-160	1	-187	-8%	5%	-21%	0%	-7%
			WB	L	213	206	188	131	738	202	203	164	134	703	-11	-3	-24	3	-35	-5%	-1%	-13%	2%	-5%
			WB	T	634	695	672	435	2,436	668	687	560	437	2,352	34	-8	-112	2	-84	5%	-1%	-17%	0%	-3%
			WB	R	175	167	160	158	660	168	159	154	158	639	-7	-8	-6	0	-21	-4%	-5%	-4%	0%	-3%
Russell Rd	I 95 SB Off-Ramp	148-T2	SB	L	203	113	102	248	666	164	107	167	247	685	-39	-6	65	-1	19	-19%	-5%	64%	0%	3%
			SB	R	59	57	67	44	227	56	58	53	44	211	-3	1	-14	0	-16	-5%	2%	-21%	0%	-7%
			EB	L	434	462	509	486	1,891	440	472	508	490	1,910	6	10	-1	4	19	1%	2%	0%	1%	1%
			EB	T	299	408	520	445	1,672	340	460	481	449	1,730	41	52	-39	4	58	14%	13%	-8%	1%	3%
			WB	T	183	194	225	182	784	188	207	203	180	778	5	13	-22	-2	-6	3%	7%	-10%	-1%	-1%
			WB	R	72	68	74	51	265	66	74	61	51	252	-6	6	-13	0	-13	-8%	9%	-18%	0%	-5%

PM Peak			Approach	Turn	Demands					Outputs					Diff.					Diff. (%)				
Arterial	Cross street	Count ID			3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM
Russell Rd	I 95 NB Off-Ramp	148-T1a	NB	R	87	131	126	75	419	99	127	100	69	395	12	-4	-26	-6	-24	14%	-3%	-21%	-8%	-6%
			EB	T	808	1,012	806	573	3,199	905	924	683	574	3,086	97	-88	-123	1	-113	12%	-9%	-15%	0%	-4%
			WB	T	859	971	865	397	3,092	927	932	652	404	2,915	68	-39	-213	7	-177	8%	-4%	-25%	2%	-6%
Russell Rd	I 95 NB On-Ramp	148-T1b	EB	L	417	656	512	230	1,815	519	601	379	234	1,733	102	-55	-133	4	-82	24%	-8%	-26%	2%	-5%
			EB	T	478	487	420	418	1,803	482	458	412	414	1,766	4	-29	-8	-4	-37	1%	-6%	-2%	-1%	-2%
			WB	T	859	971	865	397	3,092	916	920	639	400	2,875	57	-51	-226	3	-217	7%	-5%	-26%	1%	-7%
			WB	R	343	377	248	141	1,109	355	313	192	142	1,002	12	-64	-56	1	-107	3%	-17%	-23%	1%	-10%
Garrisonville Rd	I 95 SB Ramps	143-T2	SB	L	267	316	325	358	1,266	261	297	347	381	1,286	-6	-19	22	23	20	-2%	-6%	7%	6%	2%
			SB	R	1,437	1,676	1,528	1,463	6,104	1,440	1,518	1,540	1,512	6,010	3	-158	12	49	-94	0%	-9%	1%	3%	-2%
			EB	T	1,606	1,924	2,128	1,925	7,583	1,757	2,025	1,980	1,890	7,652	151	101	-148	-35	69	9%	5%	-7%	-2%	1%
			EB	R	670	709	674	506	2,559	685	689	558	494	2,426	15	-20	-116	-12	-133	2%	-3%	-17%	-2%	-5%
			WB	L	411	357	273	526	1,567	396	311	381	518	1,606	-15	-46	108	-8	39	-4%	-13%	40%	-2%	2%
			WB	T	1,744	1,956	2,043	1,618	7,361	1,806	1,989	1,877	1,602	7,274	62	33	-166	-16	-87	4%	2%	-8%	-1%	-1%
I 95 NB Off-ramp (Ex. 143A)	Jefferson Davis Hwy	143-T2	NB	T	753	866	908	900	3,427	808	888	897	909	3,502	55	22	-11	9	75	7%	3%	-1%	1%	2%
			NB	R	86	84	85	93	348	90	84	86	92	352	4	0	1	-1	4	5%	0%	1%	-1%	1%
			SB	L	79	95	117	124	415	88	100	115	130	433	9	5	-2	6	18	11%	5%	-2%	5%	4%
			SB	T	1,246	1,577	1,695	1,505	6,023	1,374	1,597	1,583	1,481	6,035	128	20	-112	-24	12	10%	1%	-7%	-2%	0%
			EB	T	35	39	42	21	137	34	42	35	22	133	-1	3	-7	1	-4	-3%	8%	-17%	5%	-3%
			EB	R	51	59	41	48	199	55	54	42	48	199	4	-5	1	0	0	8%	-8%	2%	0%	0%
			WB	L	83	110	104	89	386	94	109	98	89	390	11	-1	-6	0	4	13%	-1%	-6%	0%	1%
			WB	R	135	126	169	131	561	129	149	145	131	554	-6	23	-24	0	-7	-4%	18%	-14%	0%	-1%
Washington Dr	Jefferson Davis Hwy	143-T3	NB	L	540	567	608	614	2,329	549	573	608	608	2,338	9	6	0	-6	9	2%	1%	0%	-1%	0%
			NB	T	385	490	514	454	1,843	427	497	477	449	1,850	42	7	-37	-5	7	11%	1%	-7%	-1%	0%
			NB	R	102	120	138	142	502	110	129	139	145	523	8	9	1	3	21	8%	8%	1%	2%	4%
			SB	L	121	172	197	188	678	144	190	190	185	709	23	18	-7	-3	31	19%	10%	-4%	-2%	5%
			SB	T	632	786	854	740	3,012	711	826	805	742	3,084	79	40	-49	2	72	13%	5%	-6%	0%	2%
			SB	R	1,040	1,140	1,085	1,013	4,278	1,069	1,106	1,063	1,000	4,238	29	-34	-22	-13	-40	3%	-3%	-2%	-1%	-1%
			EB	L	434	462	509	486	1,891	439	470	497	481	1,887	5	8	-12	-5	-4	1%	2%	-2%	-1%	0%
			EB	T	299	408	520	445	1,672	340	456	471	437	1,704	41	48	-49	-8	32	14%	12%	-9%	-2%	2%
			EB	R	632	810	864	817	3,123	684	788	807	803	3,082	52	-22	-57	-14	-41	8%	-3%	-7%	-2%	-1%
			WB	L	61	76	94	72	303	71	83	85	70	309	10	7	-9	-2	6	16%	9%	-10%	-3%	2%
			WB	T	183	194	225	182	784	188	207	203	180	778	5	13	-22	-2	-6	3%	7%	-10%	-1%	-1%
			WB	R	72	68	74	51	265	67	74	62	50	253	-5	6	-12	-1	-12	-7%	9%	-16%	-2%	-5%
Courthouse Rd	I 95 SB Ramps	140-T1	SB	L	216	285	304	262	1,067	240	284	298	278	1,100	24	-1	-6	16	33	11%	0%	-2%	6%	3%
			SB	R	116	188	200	146	650	142	189	181	150	662	26	1	-19	4	12	22%	1%	-10%	3%	2%
			EB	T	422	562	592	458	2,034	489	561	479	410	1,939	67	-1	-113	-48	-95	16%	0%	-19%	-10%	-5%
			EB	R	276	323	332	268	1,199	297	331	300	279	1,207	21	8	-32	11	8	8%	2%	-10%	4%	1%
			WB	L	227	188	113	114	642	208	151	109	114	582	-19	-37	-4	0	-60	-8%	-20%	-4%	0%	-9%
			WB	T	515	646	736	640	2,537	580	666	710	634	2,590	65	20	-26	-6	53	13%	3%	-4%	-1%	2%
Courthouse Rd	I 95 NB Ramps	140-T2	NB	L	221	279	340	260	1,100	256	283	315	261	1,115	35	4	-25	1	15	16%	1%	-7%	0%	1%

PM Peak			Approach	Turn	Demands					Outputs					Diff.					Diff. (%)				
Arterial	Cross street	Count ID			3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM
			NB	R	181	150	169	158	658	161	148	167	158	634	-20	-2	-2	0	-24	-11%	-1%	-1%	0%	-4%
			EB	L	100	119	103	89	411	106	111	94	91	402	6	-8	-9	2	-9	6%	-7%	-9%	2%	-2%
			EB	T	538	728	793	631	2,690	611	760	726	629	2,726	73	32	-67	-2	36	14%	4%	-8%	0%	1%
			WB	T	521	555	509	494	2,079	534	533	502	488	2,057	13	-22	-7	-6	-22	2%	-4%	-1%	-1%	-1%
			WB	R	160	222	146	168	696	189	189	159	170	707	29	-33	13	2	11	18%	-15%	9%	1%	2%
Centreport Pkwy	I 95 SB Ramps	136-T1	NB	T	380	417	415	363	1,575	395	413	389	368	1,565	15	-4	-26	5	-10	4%	-1%	-6%	1%	-1%
			NB	R	315	305	395	312	1,327	310	357	354	310	1,331	-5	52	-41	-2	4	-2%	17%	-10%	-1%	0%
			SB	L	75	149	106	82	412	112	125	97	84	418	37	-24	-9	2	6	49%	-16%	-8%	2%	1%
			SB	T	747	1,137	1,128	893	3,905	933	1,130	1,020	896	3,979	186	-7	-108	3	74	25%	-1%	-10%	0%	2%
			WB	L	418	496	659	525	2,098	452	542	654	526	2,174	34	46	-5	1	76	8%	9%	-1%	0%	4%
			WB	R	52	63	66	65	246	55	63	67	65	250	3	0	1	0	4	6%	0%	2%	0%	2%
Centreport Pkwy	I 95 NB Ramps	136-T2	SB	L	297	325	456	315	1,393	303	373	433	322	1,431	6	48	-23	7	38	2%	15%	-5%	2%	3%
			EB	T	108	157	178	202	645	136	168	196	196	696	28	11	18	-6	51	26%	7%	10%	-3%	8%
			EB	R	216	285	265	187	953	247	268	225	195	935	31	-17	-40	8	-18	14%	-6%	-15%	4%	-2%
			WB	L	113	162	127	82	484	134	142	108	82	466	21	-20	-19	0	-18	19%	-12%	-15%	0%	-4%
			WB	T	183	185	232	214	814	182	204	222	209	817	-1	19	-10	-5	3	-1%	10%	-4%	-2%	0%
Centreport Pkwy	Jefferson Davis Hwy	136-T3	NB	L	97	121	121	116	455	106	116	120	115	457	9	-5	-1	-1	2	9%	-4%	-1%	-1%	0%
			NB	R	73	83	95	75	326	76	84	84	74	318	3	1	-11	-1	-8	4%	1%	-12%	-1%	-2%
			EB	T	397	476	630	515	2,018	432	534	628	516	2,110	35	58	-2	1	92	9%	12%	0%	0%	5%
			WB	T	199	226	238	179	842	210	231	206	176	823	11	5	-32	-3	-19	6%	2%	-13%	-2%	-2%
			WB	R	191	228	263	215	897	210	251	244	218	923	19	23	-19	3	26	10%	10%	-7%	1%	3%
Warrenton Rd	S Gateway Dr	133-T1	NB	L	20	31	30	42	123	21	28	33	40	122	1	-3	3	-2	-1	5%	-10%	10%	-5%	-1%
			NB	R	230	383	317	167	1,097	288	335	251	164	1,038	58	-48	-66	-3	-59	25%	-13%	-21%	-2%	-5%
			SB	L	423	428	471	367	1,689	431	431	436	365	1,663	8	3	-35	-2	-26	2%	1%	-7%	-1%	-2%
			SB	R	92	89	100	95	376	86	88	85	88	347	-6	-1	-15	-7	-29	-7%	-1%	-15%	-7%	-8%
			EB	L	76	80	82	101	339	65	71	84	90	310	-11	-9	2	-11	-29	-14%	-11%	2%	-11%	-9%
			EB	T	1,878	2,006	1,895	1,616	7,395	1,923	1,973	1,758	1,616	7,270	45	-33	-137	0	-125	2%	-2%	-7%	0%	-2%
			WB	L	74	97	60	63	294	81	83	63	67	294	7	-14	3	4	0	9%	-14%	5%	6%	0%
			WB	T	1,590	1,760	1,709	1,528	6,587	1,674	1,692	1,584	1,471	6,421	84	-68	-125	-57	-166	5%	-4%	-7%	-4%	-3%
			WB	R	372	360	358	332	1,422	374	356	355	346	1,431	2	-4	-3	14	9	1%	-1%	-1%	4%	1%
Warrenton Rd	Short St	133-T2	NB	L	92	89	89	78	348	91	86	85	77	339	-1	-3	-4	-1	-9	-1%	-3%	-4%	-1%	-3%
			EB	T	1,544	1,778	1,584	1,112	6,018	1,578	1,564	1,354	1,194	5,690	34	-214	-230	82	-328	2%	-12%	-15%	7%	-5%
			EB	R	95	94	115	127	431	96	96	118	139	449	1	2	3	12	18	1%	2%	3%	9%	4%
			WB	T	1,094	1,187	1,197	1,039	4,517	1,137	1,194	1,118	1,041	4,490	43	7	-79	2	-27	4%	1%	-7%	0%	-1%
Plank Rd	Carl D. Silver Parkway	130-T1	SB	L	784	818	752	722	3,076	784	796	733	716	3,029	0	-22	-19	-6	-47	0%	-3%	-3%	-1%	-2%
			SB	R	285	290	276	277	1,128	289	277	274	275	1,115	4	-13	-2	-2	-13	1%	-4%	-1%	-1%	-1%
			EB	L	235	251	245	230	961	242	241	226	225	934	7	-10	-19	-5	-27	3%	-4%	-8%	-2%	-3%
			EB	T	1,928	1,996	2,129	1,634	7,687	1,980	2,071	1,886	1,626	7,563	52	75	-243	-8	-124	3%	4%	-11%	0%	-2%
			WB	T	2,409	2,040	1,771	1,910	8,130	2,201	1,867	2,050	1,972	8,090	-208	-173	279	62	-40	-9%	-8%	16%	3%	0%
			WB	R	847	925	980	746	3,498	887	921	901	772	3,481	40	-4	-79	26	-17	5%	0%	-8%	3%	0%
Plank Rd	Gateway Blvd	130-T2	NB	L	269	295	301	312	1,177	279	297	312	313	1,201	10	2	11	1	24	4%	1%	4%	0%	2%
			NB	R	180	206	199	150	735	191	206	179	142	718	11	0	-20	-8	-17	6%	0%	-10%	-5%	-2%
			EB	L	35	33	36	17	121	33	36	26	16	111	-2	3	-10	-1	-10	-6%	9%	-28%	-6%	-8%

PM Peak			Approach	Turn	Demands					Outputs					Diff.					Diff. (%)				
Arterial	Cross street	Count ID			3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM
			EB	T	1,550	1,432	1,631	1,148	5,761	1,463	1,475	1,427	1,152	5,517	-87	43	-204	4	-244	-6%	3%	-13%	0%	-4%
			EB	R	367	385	404	331	1,487	372	395	358	338	1,463	5	10	-46	7	-24	1%	3%	-11%	2%	-2%
			WB	L	152	160	214	124	650	150	185	165	119	619	-2	25	-49	-5	-31	-1%	16%	-23%	-4%	-5%
			WB	T	1,477	1,580	1,518	1,536	6,111	1,522	1,551	1,525	1,520	6,118	45	-29	7	-16	7	3%	-2%	0%	-1%	0%

Attachment 9:
PM Ramp Volume Comparison (VISSIM Throughputs vs. Input Demands)

PM Peak					Demands					Outputs					Diff.					Diff. (%)				
	Exit #	Count ID			3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM
I-95 NB	130	130-8	13021	3	198	204	228	151	781	202	217	191	158	768	4	13	-37	7	-13	2%	6%	-16%	5%	-2%
		130-6	13023	1	905	1013	942	811	3671	964	972	889	806	3631	59	-41	-53	-5	-40	7%	-4%	-6%	-1%	-1%
		130-4	13021	1	276	213	147	102	738	237	188	127	107	659	-39	-25	-20	5	-79	-14%	-12%	-14%	5%	-11%
		130-2	13024	3	414	489	411	328	1642	464	456	367	326	1613	50	-33	-44	-2	-29	12%	-7%	-11%	-1%	-2%
	133	133-5	13361	3	123	111	127	130	491	113	118	128	132	491	-10	7	1	2	0	-8%	6%	1%	2%	0%
		133-6	13363	1	306	369	411	240	1326	325	382	327	226	1260	19	13	-84	-14	-66	6%	4%	-20%	-6%	-5%
		133-7	13361	1	914	965	935	699	3513	941	944	844	710	3439	27	-21	-91	11	-74	3%	-2%	-10%	2%	-2%
		133-8	13364	3	333	318	368	280	1299	318	347	329	276	1270	-15	29	-39	-4	-29	-5%	9%	-11%	-1%	-2%
	136	136-3	13641	3	173	205	217	191	786	183	199	204	188	774	10	-6	-13	-3	-12	6%	-3%	-6%	-2%	-2%
		136-4	13624	3	202	235	268	217	922	217	255	247	220	939	15	20	-21	3	17	7%	9%	-8%	1%	2%
	140	140-3	14041	3	406	431	509	418	1764	415	447	471	417	1750	9	16	-38	-1	-14	2%	4%	-7%	0%	-1%
		140-4	14024	3	264	343	249	257	1113	281	284	239	248	1052	17	-59	-10	-9	-61	6%	-17%	-4%	-4%	-5%
	143	143-6	143811	3	225	283	266	247	1021	248	282	264	242	1036	23	-1	-2	-5	15	10%	0%	-1%	-2%	1%
		143-5	14363	1	508	560	560	535	2163	543	573	550	540	2206	35	13	-10	5	43	7%	2%	-2%	1%	2%
		143-7	14361	1	392	412	398	335	1537	399	411	383	334	1527	7	-1	-15	-1	-10	2%	0%	-4%	0%	-1%
		143-8	14324	3	174	186	220	186	766	172	211	204	187	774	-2	25	-16	1	8	-1%	13%	-7%	1%	1%
	148	148-4	14824	3	760	1033	760	371	2924	874	916	572	375	2737	114	-117	-188	4	-187	15%	-11%	-25%	1%	-6%
	150	150-5/4	15081	3	255	288	326	233	1102	239	266	252	206	963	-16	-22	-74	-27	-139	-6%	-8%	-23%	-12%	-13%
		150-6	15124	3	765	937	884	498	3084	857	918	711	499	2985	92	-19	-173	1	-99	12%	-2%	-20%	0%	-3%
	NB GP to HOT	152-4	15221	3	164	185	180	171	700	178	186	180	171	715	14	1	0	0	15	9%	1%	0%	0%	2%
		152-5	15221	1	708	885	829	584	3006	788	874	740	575	2977	80	-11	-89	-9	-29	11%	-1%	-11%	-2%	-1%
		152-6	15284	3	691	770	805	667	2933	716	745	726	671	2858	25	-25	-79	4	-75	4%	-3%	-10%	1%	-3%
	Truck Reset Area NB		15321	3	241	218	207	226	892	233	221	225	228	907	-8	3	18	2	15	-3%	1%	9%	1%	2%
	156	156-A4	15661	3	331	409	439	380	1559	375	442	432	389	1638	44	33	-7	9	79	13%	8%	-2%	2%	5%
		156-A5	15663	1	324	347	333	363	1367	337	342	351	361	1391	13	-5	18	-2	24	4%	-1%	5%	-1%	2%
		156-A6	15661	1	336	362	345	330	1373	352	370	352	336	1410	16	8	7	6	37	5%	2%	2%	2%	3%
		156-A7	15664	3	450	388	399	375	1612	417	384	382	372	1555	-33	-4	-17	-3	-57	-7%	-1%	-4%	-1%	-4%
		156B-3	15623	1	295	239	220	174	928	263	232	204	168	867	-32	-7	-16	-6	-61	-11%	-3%	-7%	-3%	-7%
		156B-2	15624	3	209	232	259	179	879	227	242	227	174	870	18	10	-32	-5	-9	9%	4%	-12%	-3%	-1%
	158	158-4	15821	3	252	249	320	253	1074	252	294	291	251	1088	0	45	-29	-2	14	0%	18%	-9%	-1%	1%
		158-5	15823	1	698	749	737	638	2822	669	675	657	608	2609	-29	-74	-80	-30	-213	-4%	-10%	-11%	-5%	-8%
		158-6	15821	1	451	499	531	425	1906	470	524	503	424	1921	19	25	-28	-1	15	4%	5%	-5%	0%	1%
	160	160-5	16023	1	531	554	589	625	2299	531	555	633	638	2357	0	1	44	13	58	0%	0%	7%	2%	3%
		160-7	16021	1	544	782	718	635	2679	654	752	702	622	2730	110	-30	-16	-13	51	20%	-4%	-2%	-2%	2%
I-95 SB	160	160-1	16012	3	1040	1180	1216	1176	4612	1118	1106	1190	1223	4637	78	-74	-26	47	25	8%	-6%	-2%	4%	1%
		160-2	16014	1	117	194	207	145	663	154	198	174	145	671	37	4	-33	0	8	32%	2%	-16%	0%	1%
		160-3	16013	3	1010	1076	1088	1041	4215	1010	1066	1032	968	4076	0	-10	-56	-73	-139	0%	-1%	-5%	-7%	-3%
	158	158-1	15812	3	1098	1193	1134	1084	4509	1116	1128	1131	1079	4454	18	-65	-3	-5	-55	2%	-5%	0%	0%	-1%
		158-2	15812	1	97	131	144	95	467	114	125	123	101	463	17	-6	-21	6	-4	18%	-5%	-15%	6%	-1%
		158-3	15853	3	790	1006	1081	869	3746	853	1011	957	868	3689	63	5	-124	-1	-57	8%	0%	-11%	0%	-2%

PM Peak					Demands					Outputs					Diff.					Diff. (%)				
Exit #	Count ID			3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM	3 PM	4 PM	5 PM	6 PM	3-7 PM
SB HOT to GP	PT 9	15702	3	781	916	974	861	3532	837	947	952	868	3604	56	31	-22	7	72	7%	3%	-2%	1%	2%
156	156-B1	15612	3	1252	1319	1592	1336	5499	1256	1402	1476	1323	5457	4	83	-116	-13	-42	0%	6%	-7%	-1%	-1%
SB GP to HOT	PT 7	15672	1	926	1036	1401	1194	4557	936	1173	1324	1193	4626	10	137	-77	-1	69	1%	13%	-5%	0%	2%
156	156-A2	15674	1	364	323	470	418	1575	346	392	449	427	1614	-18	69	-21	9	39	-5%	21%	-4%	2%	2%
	156-A1	15672	1	926	1036	1401	1194	4557	936	1173	1324	1193	4626	10	137	-77	-1	69	1%	13%	-5%	0%	2%
	156-A3	15673	3	429	430	483	446	1788	431	454	459	447	1791	2	24	-24	1	3	0%	6%	-5%	0%	0%
SB HOT to GP	PT 6	15502	3	367	517	875	645	2404	426	688	784	635	2533	59	171	-91	-10	129	16%	33%	-10%	-2%	5%
Truck Reset Area SB	Off ramp	15412	3	250	243	174	175	842	232	203	171	184	790	-18	-40	-3	9	-52	-7%	-16%	-2%	5%	-6%
	On ramp	15313	3	250	243	174	175	842	245	208	175	172	800	-5	-35	1	-3	-42	-2%	-14%	1%	-2%	-5%
152	152-1	15212	3	686	810	710	812	3018	722	741	756	813	3032	36	-69	46	1	14	5%	-9%	6%	0%	0%
	152-2	15212	1	588	699	629	786	2702	628	666	733	792	2819	40	-33	104	6	117	7%	-5%	17%	1%	4%
	152-3	15253	3	600	607	627	637	2471	587	612	622	640	2461	-13	5	-5	3	-10	-2%	1%	-1%	0%	0%
SB HOT to GP	PT 3	15102	3	162	186	230	165	743	169	198	208	165	740	7	12	-22	0	-3	4%	6%	-10%	0%	0%
150	150-3	15012	1	802	824	944	538	3108	793	860	770	539	2962	-9	36	-174	1	-146	-1%	4%	-18%	0%	-5%
	150-2	15013	3	229	292	266	168	955	264	281	217	170	932	35	-11	-49	2	-23	15%	-4%	-18%	1%	-2%
148	148-1	14812	3	262	170	169	292	893	218	164	225	290	897	-44	-6	56	-2	4	-17%	-4%	33%	-1%	0%
	148-2	14813	3	728	853	768	311	2660	782	811	550	314	2457	54	-42	-218	3	-203	7%	-5%	-28%	1%	-8%
143	143-1	14312	3	1437	1676	1528	1463	6104	1437	1521	1519	1527	6004	0	-155	-9	64	-100	0%	-9%	-1%	4%	-2%
	143-2	14314	1	411	357	273	526	1567	387	297	373	521	1578	-24	-60	100	-5	11	-6%	-17%	37%	-1%	1%
	143-3	14312	1	267	316	325	358	1266	259	299	342	384	1284	-8	-17	17	26	18	-3%	-5%	5%	7%	1%
	143-4	14313	3	670	709	674	506	2559	685	692	575	510	2462	15	-17	-99	4	-97	2%	-2%	-15%	1%	-4%
140	140-1	14012	3	332	474	504	409	1719	378	477	476	430	1761	46	3	-28	21	42	14%	1%	-6%	5%	2%
	140-2	14053	3	503	512	445	382	1842	478	453	382	370	1683	-25	-59	-63	-12	-159	-5%	-12%	-14%	-3%	-9%
136	136-1	13612	3	298	326	480	362	1466	307	384	459	379	1529	9	58	-21	17	63	3%	18%	-4%	5%	4%
	136-2	13653	3	329	447	395	269	1440	378	413	333	278	1402	49	-34	-62	9	-38	15%	-8%	-16%	3%	-3%
133	133-1	13312	3	493	498	454	486	1931	475	442	511	522	1950	-18	-56	57	36	19	-4%	-11%	13%	7%	1%
	133-2	13314	1	151	211	236	209	807	181	219	220	212	832	30	8	-16	3	25	20%	4%	-7%	1%	3%
	133-3	13312	1	506	508	479	480	1973	457	470	558	509	1994	-49	-38	79	29	21	-10%	-7%	16%	6%	1%
	133-4	13313	3	1209	1190	1415	1275	5089	1200	1295	1316	1222	5033	-9	105	-99	-53	-56	-1%	9%	-7%	-4%	-1%
130	130-1	13012	3	1888	1641	1521	1221	6271	1690	1482	1593	1302	6067	-198	-159	72	81	-204	-10%	-10%	5%	7%	-3%
	130-3	13014	1	250	280	330	167	1027	230	280	238	155	903	-20	0	-92	-12	-124	-8%	0%	-28%	-7%	-12%
	130-5	13012	1	557	508	368	254	1687	507	414	381	269	1571	-50	-94	13	15	-116	-9%	-19%	4%	6%	-7%
	130-7	13013	3	626	678	580	459	2343	647	639	522	462	2270	21	-39	-58	3	-73	3%	-6%	-10%	1%	-3%

Attachment 10:
PM Calibration Arterial Queue Results (VISSIM Average Maximum Queue vs. Field Observed Queue, feet)

Maximum Queue Length in Feet													
VISSIM Queue Counter #	Study Movement	2016 Field Observations				VISSIM				Diff.(%)			
		3 PM	4 PM	5 PM	6 PM	3 PM	4 PM	5 PM	6 PM	3 PM	4 PM	5 PM	6 PM
1	Westbound Route 3 (Plank Rd) at Carl D. Silver Pkwy	825	900	1300	950	753	566	671	556	-9%	-37%	-48%	-41%
2	Southbound I-95 Off-Ramp at Route 3**	375	525	1200	1100	-	-	-	-	-	-	-	-
3	Southbound Route 17 (Warrenton Rd) at S Gateway Dr*	800	800	800	800	785	835	826	783	-2%	4%	3%	-2%
4	Northbound Route 1 (Jefferson Davis Hwy) at Route 610 (Garrisonville Rd)	500	600	600	600	438	526	639	583	-12%	-12%	6%	-3%
5	Eastbound Route 610 at Route 1	450	675	975	575	508	676	756	650	13%	0%	-23%	13%
6	Southbound Route 123 (Gordon Blvd) at I-95S Off-Ramp	1575	2600	2650	2200	1428	2157	2330	1684	-9%	-17%	-12%	-23%

*Queuing extends beyond model area (800' to upstream signal)

**Field observations indicated rolling queue along off-ramp. VISSIM is not able to explicitly capture queue lengths in this scenario.