



To: Donn Hart
Virginia Properties, Inc.

From: Michael R. Pinkoske, PTP
John A. Schick

Re: Patriot's Crossing (Stafford Parcel 20-12)
Operational Analysis
Stafford County, Virginia

Date: June 2, 2016

INTRODUCTION

This memorandum provides the operational analysis requested by VDOT at joint meeting with the Applicant and Stafford County staff in response to their review of the proposed proffer amendment for the proposed Patriot's Crossing (Stafford Parcel 20-12) development held on May 19th, 2016. The site is located on the south side of Garrisonville Road (VA 610), between Wolverine Way/Joyce Street and Parkway Boulevard. The property is located just east of the North Stafford High School. The general site location is depicted on Figure 1.

The site was previously approved for a Sports Center with commercial space including retail space, a full service or fast food restaurant, and general office. The site is now proposed to be developed with a modified program and requires a Proffer Amendment. As proposed, the site would be developed with a combination of commercial uses, including retail space, a fast food restaurant, a car wash, and general office (See Figure 2). Given the configuration of the property, a larger portion of the property will be used for general office. For purpose of the analysis it is assumed that Parcels 1 through 4 would be complete by 2018 and Parcels 5 through 9 would be complete by 2020.

Access to the site is proposed via one (1) limited access (left-in, right-in, right-out) driveway located approximately 470 feet east of the Wolverine Way/Joyce Street intersection with a median break on Garrisonville Road to facilitate left turns into the property. The new left turn lane would be constructed to include 200 feet of storage and a 100 foot taper.



This analysis evaluates the operations of the planned access on Garrisonville Road (VA 610) that would serve the property and the adjacent signalized intersections. Specifically, it evaluates the operations of the adjacent signalized intersections with and without the proposed limited accessed median break (serving left-turns into the property) on Garrisonville Road at the site driveway. As an alternative to the proposed access, a scenario is evaluated herein without left-turns in (right-in, right-out only). Additionally, each of the aforementioned scenarios has been evaluated with a proffered inter-parcel connection to Wolverine Way (private) to the west.

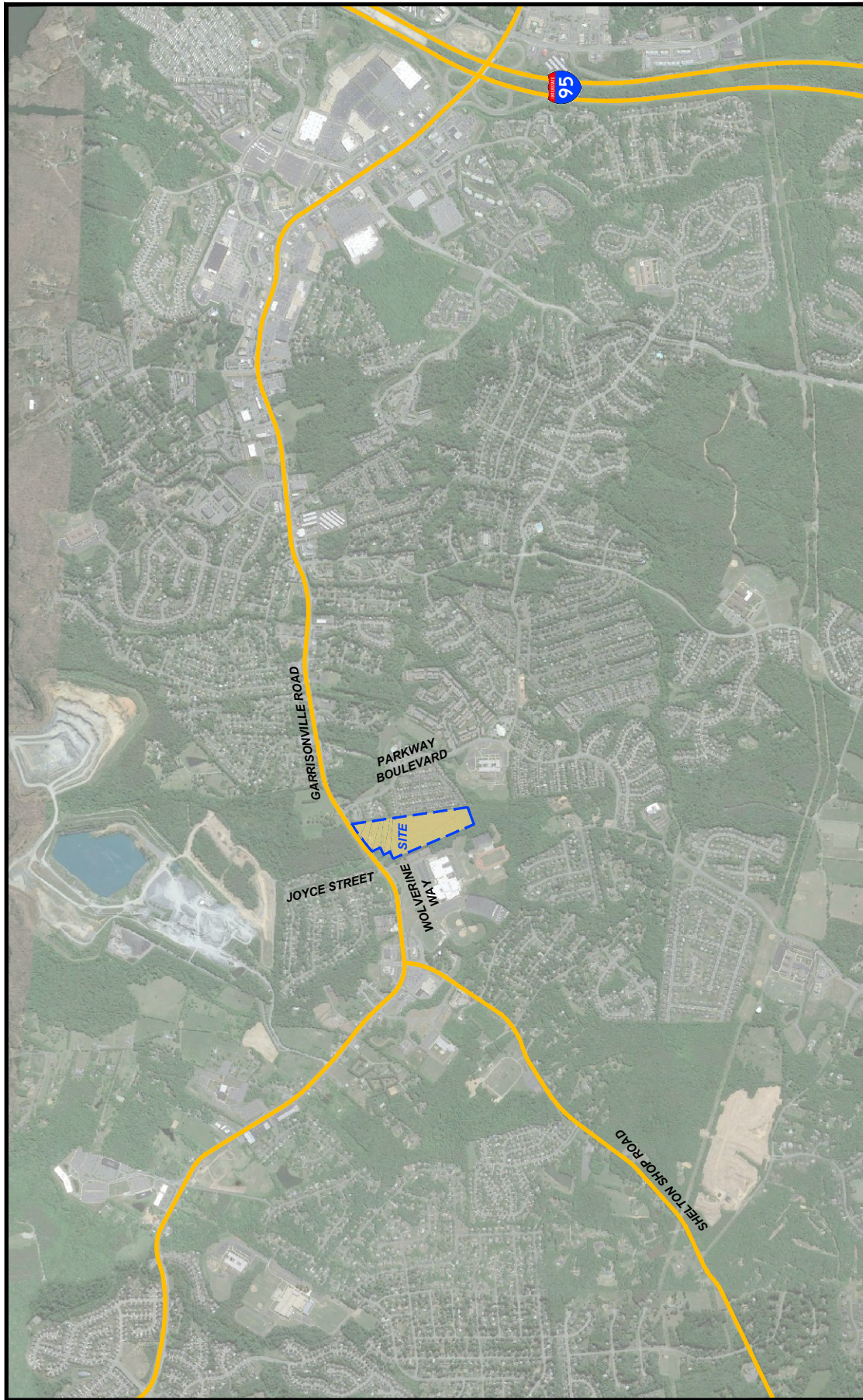


Figure 1
Site Location

Patriot's Crossing
Stafford County, VA

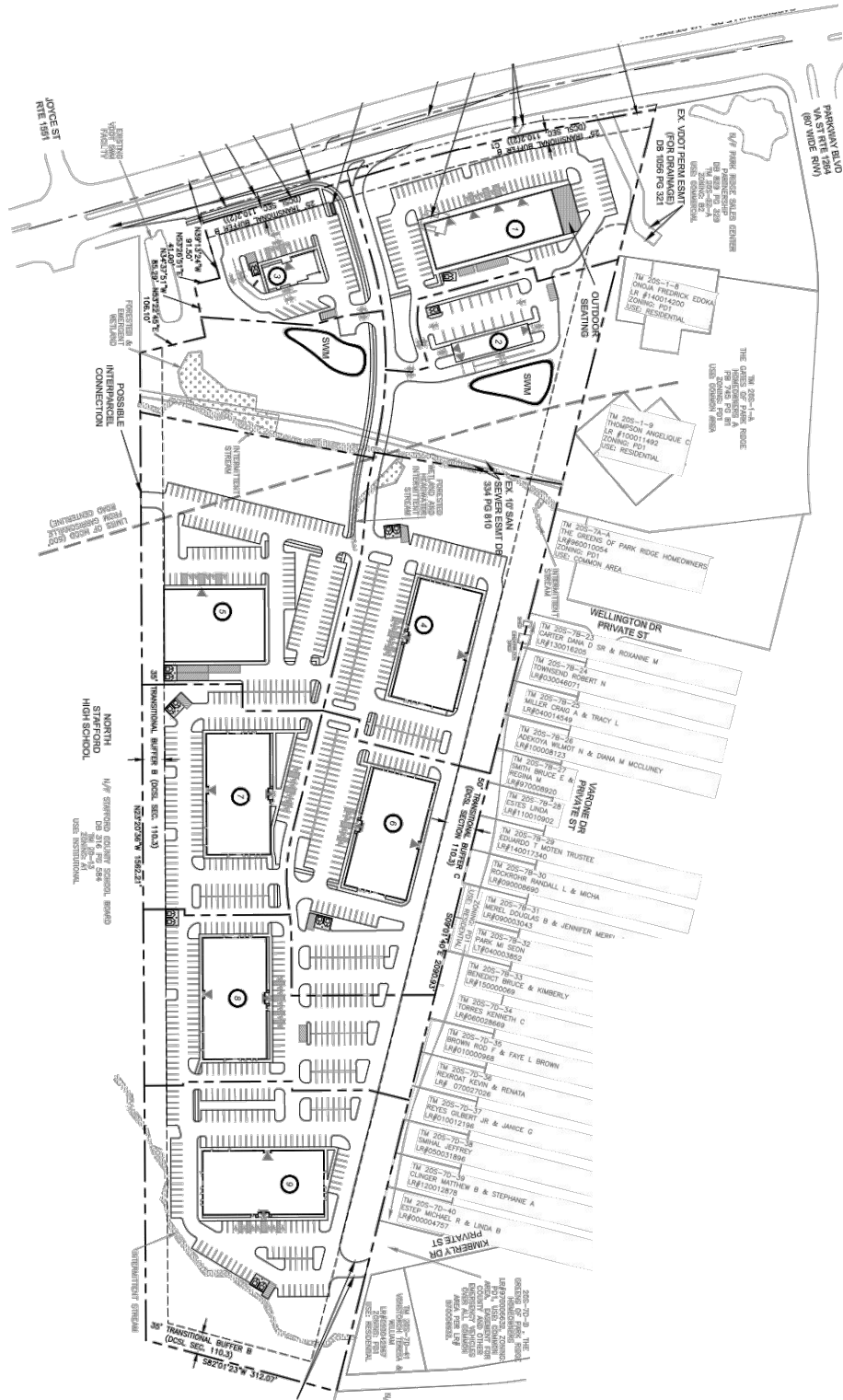


Figure 2
Site Plan (Reduced)

Patriot's Crossing
Stafford County, VA



EXISTING CONDITIONS

Peak hour traffic volume data was collected in March 2015 was provided by VDOT for the signalized intersections of Garrisonville Road/Wolverine Way/Joyce Street and Garrisonville Road/Parkway Boulevard. Based on a review of the data provided, the peak hours of the Garrisonville Road in the vicinity of the site occur between 7:00 to 8:00 AM and 4:00 to 5:00 PM. The peak hour traffic counts provided by VDOT were reviewed and balanced to account for differences between intersections greater than 10%. As such, the traffic data at the Garrisonville Road/Parkway Boulevard intersection was increased using the Garrisonville Road/Wolverine Way/Joyce Street intersection. The existing lane use and traffic controls as well as peak hour traffic counts are shown on Figure 3. As shown on Figure 3, 65% of the AM peak hour traffic on Garrisonville Road is traveling eastbound towards Interstate 95. Conversely, during the PM peak hour, 60% of traffic on Garrisonville Road is travelling westbound.

Operational Analysis

The existing levels of service (LOS) were calculated for the AM and PM peak hours based on the peak hour traffic data provided by VDOT, the existing lane use and traffic controls, the traffic signal phasing/timings provided by VDOT, and the Highway Capacity Manual 2000 (HCM) methodologies for signalized and unsignalized intersections using Synchro 9.1. The peak hour queuing analysis was conducted using SimTraffic 9. The Synchro and SimTraffic analysis was completed based on the standard input parameters and assumptions contained in the VDOT Traffic Operations and Safety Analysis Manual (TOSAM), Version 1.0, dated November 2015.

The peak hour LOS and estimated queues as reported by Synchro and SimTraffic are summarized in Tables 1 and 2. The Synchro and SimTraffic summary sheets are also provided in Appendix A.

Levels of Service. As shown in Table 1, the intersections along Garrisonville Road at Wolverine Way/ Joyce Street and Parkway Boulevard currently operate at an overall LOS “D” or better during both the AM and PM peak hours. The minor street approaches and left turns from Garrisonville Road at Wolverine Way/Joyce Street currently operate at LOS “E” during peak periods primarily due the amount of green time allocated to the mainline in order to move through traffic, the protected left turns phasing along the mainline, and the split phasing of minor street approaches. Since left turns on Garrisonville Road are not permitted without a green arrow and the minor street approaches each get separate green lights (split phased) all add incrementally to the overall delay at the intersection.

All lane groups and approached at the intersection of Garrisonville Road/Parkway Boulevard currently operate at LOS “D” or better during peak periods.

Queues. The 50th and 95th percentile and maximum queues of existing conditions are used to establish a datum against which to compare future conditions. The results of the SimTraffic analysis are the average of ten (10) 60 minute simulations, with a ten (10) minute seed.

The 50th percentile (or average) queue is defined as the maximum back of queue associated with a typical signal cycle. The 95th percentile queue is defined as the maximum back of queue with 95th percentile traffic volumes. The 95th percentile queue is not necessarily ever observed, it is simply based on statistical calculations. The maximum queue is the maximum back of queue observed for the entire analysis interval. This is a simple maximum; no averaging is performed and is calculated by lane.¹ The existing storage length provided in the VDOT Synchro files was reviewed and confirmed using Google Earth imagery.

As shown on Table 2, the turn lane storage (plus half the available taper) provided at study intersections are sufficient to accommodate the average AM and PM peak hour queue. Based on the simulations the maximum queue would exceed this storage by approximately one (1) vehicle (25 feet or less) at the below locations in the remaining portion of the taper.

- Garrisonville Road eastbound right turn at Wolverine Way (AM peak)
- Garrisonville Road westbound left turn at Wolverine Way (AM peak)
- Garrisonville Road westbound right turn at Wolverine Way (PM peak)
- Garrisonville Road eastbound right turn at Parkway Boulevard (AM & PM peak)
- Garrisonville Road westbound left turn at Parkway Boulevard (AM peak)

¹ Synchro Studio 9, Traffic Signal Software – User Guide



Figure 3
Existing Lane Use, Peak Hour Volumes, & Levels of Service

Patriot's Crossing
Stafford County, VA

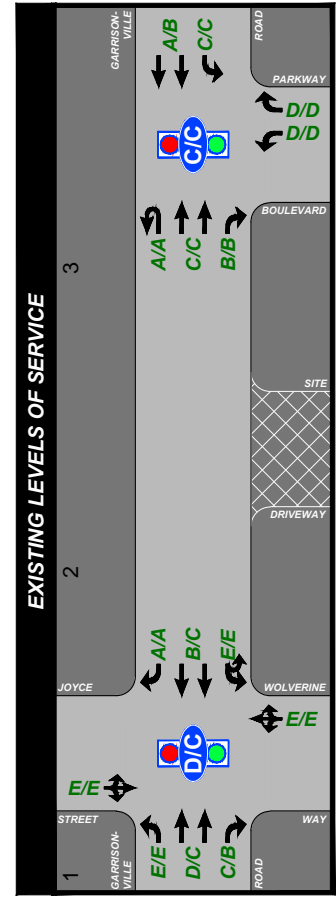
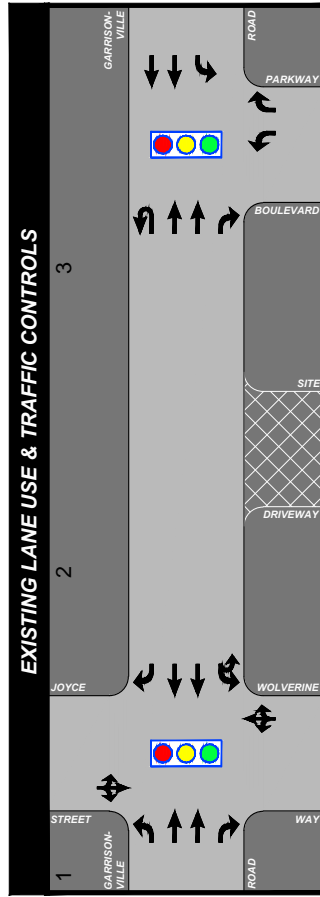
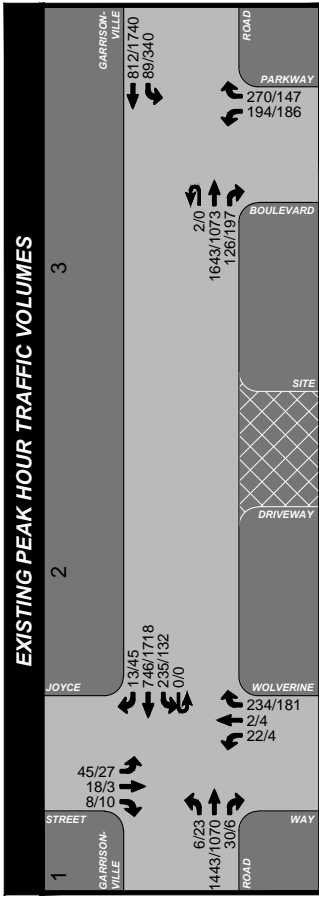


Table 1
Patriot's Crossing
Intersection Level of Service ¹

			Existing Conditions				Background Conditions (2018)				Background Conditions (2020)							
		Lane	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour					
Intersection	Control	Group	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
(1) Garrisonville Road/ Wolverine Way/ Joyce Street	Signalized	EBL	E	75.3	E	64.1	E	75.3	E	64.2	E	75.3	E	64.2				
		EBT	D	43.2	C	20.1	D	48.6	C	21.0	D	50.2	C	21.3				
		EBR	C	20.3	B	13.2	C	20.3	B	13.2	C	20.3	B	13.3				
		WBLU	E	69.5	E	59.3	E	69.5	E	59.6	E	69.5	E	59.4				
		WBT	B	12.2	C	21.0	B	12.4	C	23.5	B	12.4	C	24.1				
		WBR	A	9.3	A	8.7	A	9.3	A	8.7	A	9.3	A	8.7				
		NBLTR	E	67.4	E	59.3	E	67.4	E	59.3	E	67.4	E	59.3				
		SBLTR	E	66.4	E	61.7	E	66.4	E	61.7	E	66.4	E	61.9				
		Overall	D	39.6	C	25.1	D	42.2	C	26.6	D	43.0	C	27.0				
(2) Garrisonville Road/ Site Driveway (Future)			Future Intersection		Future Intersection		Future Intersection		Future Intersection		Future Intersection		Future Intersection					
(3) Garrisonville Road/ Parkway Boulevard	Signalized	EBLU	A	8.1	-	-	B	10.5	-	-	B	10.6	-	-				
		EBT	C	23.4	C	28.5	D	36.0	D	44.3	D	37.8	D	44.6				
		EBR	B	10.1	B	19.2	B	13.1	C	27.7	B	13.1	C	27.7				
		WBL	C	20.7	C	32.7	D	36.4	E	74.7	D	37.1	E	77.9				
		WBT	A	9.0	B	10.6	A	9.9	B	13.6	A	9.9	B	13.8				
		NBL	D	43.9	D	43.9	D	48.4	F	86.8	D	48.4	F	89.5				
		NBR	D	36.8	D	37.2	D	38.2	D	42.1	D	38.2	D	42.3				
		Overall	C	21.5	C	21.1	C	29.9	D	38.0	C	30.9	D	38.8				
					Total Future - Scenario 1 (2018)				Total Future - Scenario 2 (2018)				Total Future - Scenario 1A (2018)				Total Future - Scenario 2A (2018)	
		Lane	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
Intersection	Control	Group	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
(1) Garrisonville Road/ Wolverine Way Joyce Street	Signalized	EBL	E	76.1	E	64.2	E	79.5	E	64.4	F	85.2	E	73.4	F	85.9	E	73.7
		EBT	E	57.9	C	22.2	E	75.9	C	25.9	F	102.9	D	35.1	F	109.3	D	38.0
		EBR	C	20.8	B	13.6	C	23.8	B	15.8	C	27.9	C	21.3	C	28.7	C	22.8
		WBLU	E	70.3	E	59.5	E	79.6	E	59.5	F	84.8	E	68.3	F	99.0	E	68.3
		WBT	B	12.4	C	25.8	B	12.0	C	25.7	B	17.6	D	43.1	B	16.6	D	42.9
		WBR	A	9.2	A	8.7	A	8.9	A	8.7	B	13.3	B	14.1	B	12.4	B	13.5
		NBLTR	E	68.1	E	59.3	E	71.7	E	59.5	F	86.8	E	73.9	F	86.1	E	73.4
		SBLTR	E	67.2	E	61.7	E	71.0	E	61.9	E	76.1	E	70.9	E	3.8	E	71.2
		Overall	D	47.2	C	28.2	E	58.3	C	29.9	E	75.9	D	44.0	F	80.1	D	45.0
(2) Garrisonville Road/ Site Driveway (Future)	Stop	EBTR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		WBL	C	21.4	B	13.8	-	-	-	-	C	20.3	B	13.0	-	-	-	-
		WBT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		NBR	B	12.7	B	11.5	B	12.4	B	11.7	B	11.6	B	10.9	B	11.6	B	11.3
(3) Garrisonville Road/ Parkway Boulevard	Signalized	EBLU	B	10.0	C	30.1	A	10.0	C	27.7	B	10.5	C	24.1	B	10.5	C	24.1
		EBT	D	45.7	D	51.9	D	45.4	D	49.8	D	40.5	D	45.4	D	40.5	D	45.4
		EBR	B	13.4	C	27.5	B	13.4	C	27.3	B	13.1	C	26.5	B	13.1	C	26.5
		WBL	C	34.7	F	80.3	C	34.8	F	83.9	D	37.0	F	94.4	D	37.0	F	94.4
		WBT	B	12.1	C	30.7	B	12.0	C	26.6	B	10.3	B	19.9	B	10.3	B	19.9
		NBL	D	46.2	F	91.8	D	46.2	F	95.3	D	48.4	F	105.8	D	48.4	F	105.8
		NBR	D	36.9	D	43.2	D	36.9	D	43.8	D	38.2	D	45.9	D	38.2	D	45.9
		Overall	C	34.3	D	47.8	C	34.1	D	46.3	C	31.8	D	44.6	C	31.8	D	44.6
					Total Future - Scenario 1 (2020)				Total Future - Scenario 2 (2020)				Total Future - Scenario 1A (2020)				Total Future - Scenario 2A (2020)	
		Lane	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
Intersection	Control	Group	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
(1) Garrisonville Road/ Wolverine Way Joyce Street	Signalized	EBL	E	77.2	E	64.2	F	81.3	E	65.0	F	87.9	E	75.6	F	87.2	E	76.9
		EBT	F	82.1	C	22.8	F	110.3	C	27.9	F	149.0	D	40.4	F	143.8	D	45.8
		EBR	C	21.7	B	13.8	C	25.1	B	16.7	C	30.6	C	23.8	C	30.0	C	26.3
		WBLU	E	72.6	E	59.4	F	218.7	E	60.1	F	109.1	E	71.4	F	265.0	E	73.7
		WBT	B	12.4	C	29.8	B	13.4	C	29.2	B	18.5	E	56.4	B	17.9	E	57.8
		WBR	A	9.1	A	8.7	A	9.9	A	8.6	B	13.9	B	15.7	B	13.4	B	15.5
		NBLTR	E	69.2	E	59.3	E	74.9	E	60.0	F	97.6	F	97.1	F	93.0	F	95.1
		SBLTR	E	68.2	E	61.9	E	72.6	E	62.5	E	79.1	E	73.3	E	78.3	E	74.6
		Overall	E	60.6	C	30.5	F	97.1	C	32.6	F	103.9	E	55.2	F	123.1	E	57.8
(2) Garrisonville Road/ Site Driveway (Future)	Stop	EBTR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		WBL	F	83.2	B	14.6	-	-	-	-	E	44.4	B	13.5	-	-	-	-
		WBT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		NBR	B	13.3	B	14.8	B	12.8	C	15.3	B	11.7	B	12.6	B	11.8	B	13.4
(3) Garrisonville Road/ Parkway Boulevard	Signalized	EBLU	B	10.3	D	52.3	B	10.4	D	36.4	B	10.7	C	25.4	B	10.7	C	25.4
		EBT	E	56.0	E	72.3	D	52.1	E	72.3	D	45.9	E	64.3	D	45.9	E	64.1
		EBR	B	13.7	C	27.8	B	13.5	C	27.8	B	13.1	C	27.3	B	13.1	C	27.3
		WBL	C	33.6	F	83.2	C	34.8	F	83.2	D	37.4	F	90.3	D	37.4	F	90.3
		WBT	B	14.2	D	36.3	B	13.1	C	34.6	B	11.2	C	23.8	B	11.2	C	23.8
		NBL	D	45.1	F	93.8	D	46.4	F	93.8	D	48.7	F	101.4	D	48.7	F	101.4
		NBR	D	36.2	D	43.2	D	37.0	D	43.2	D	38.2	D	44.6	D	38.2	D	44.6
		Overall	D	38.7	E	57.1	D	36.8	E	56.1	C	33.8	D	51.1	C	33.8	D	51.0
					Total Future - Scenario 1 (2020) Garrisonville Road 6 Lanes				Total Future - Scenario 2 (2020) Garrisonville Road 6 Lanes				Total Future - Scenario 1A (2020) Garrisonville Road 6 Lanes				Total Future - Scenario 2A (2020) Garrisonville Road 6 Lanes	
		Lane	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
Intersection	Control	Group	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
(1) Garrisonville Road/ Wolverine Way Joyce Street	Signalized	EBL	E	75.3	E	56.3	F	80.3	E	56.9	F	87.4	E	69.0	F	87.2	E	70.5
		EBT	D	35.4	C	21.3	D	41.1	C	25.3	D	50.0	D	35.7	F	143.8	D	38.7
		EBR	C	22.1	B	15.7	C	25.5	B	18.5	C	30.8	C	26.1	C	30.0	C	28.3
		WBLU	E	69.0	D	48.2	F	209.4	D	48.0	F	105.5	E	62.2	F	265.0	E	64.8
		WBT	B	11.3	B	17.1	B	12.1	B	17.0	B	16.8	C	29.5	B	16.1	C	29.1
		WBR	A	9.3	A	9.6	A	9.9	A	9.5	B	13.9	B	17.3	B	13.4	B	16.9
		NBLTR	E	67.4	D	50.9	E	73.8	D	51.6	F	95.8	E	69.4	F	93.0	E	70.1
		SBLTR	E	66.4	D	53.5	E	71.4	D	54.3	E	78.7	E	66.4	E	78.3	E	67.9
		Overall	D	35.1	C	22.2	E	61.1	C	24.0	D	52.2	D	37.2	F	122.7	D	38.4
(2) Garrisonville Road/ Site Driveway (Future)	Stop	EBTR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		WBL	D	25.7	B	12.5	-	-	-	-	C	17.9	B	11.6	-	-	-	-
		WBT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		NBR	B	10.7	B	12.7	B	10.8	B	12.9	B	10.5	B	11.0	B	11.5	B	11.4
(3) Garrisonville Road/ Parkway Boulevard	Signalized	EBLU	A	9.7	D	36.5	B	10.0	C	25.7	B	10.6	C	22.0	B	10.6	C	22.0
		EBT	C	21.3	D													

Table 2
Patriot's Crossing
SimTraffic Queuing Summary ¹

				Existing Conditions						Background Conditions (2018)						Background Conditions (2020)											
Intersection	Control	Lane Group	Storage ²	AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour								
				Max	Ave	95th	Max	Ave	95th	Max	Ave	95th	Max	Ave	95th	Max	Ave	95th	Max	Ave	95th						
(1) Garrisonville Road/ Wolverine Way Joyce Street	Signalized	EBL	310	172	10	93	52	13	39	271	14	112	89	14	54	274	16	124	107	15	75						
		EBT	-	1203	844	1367	357	174	324	1413	1055	1690	406	198	361	1357	974	1555	406	200	368						
		EBR	260	285	59	230	53	5	52	285	46	202	102	5	52	285	54	221	101	6	60						
		WBLU	290	314	190	306	290	103	231	307	186	294	314	120	266	294	172	278	314	113	251						
		WBT	-	400	122	279	497	236	462	324	129	247	503	256	506	327	125	257	522	248	480						
		WBR	165	93	6	44	177	26	122	92	6	44	190	27	121	93	5	43	190	27	120						
		NBLTR	-	269	153	261	182	76	141	264	145	252	189	82	157	261	151	257	211	90	175						
		SBLTR	-	146	62	122	87	28	67	157	62	128	90	30	69	154	60	122	96	29	69						
(2) Garrisonville Road/ Site Driveway (Future)				Future Intersection			Future Intersection			Future Intersection			Future Intersection			Future Intersection			Future Intersection								
(3) Garrisonville Road/ Parkway Boulevard	Signalized	EBLU	295	82	4	47	-	-	-	50	3	35	-	-	-	111	4	57	-	-	-						
		EBT	-	675	357	604	490	234	422	711	518	781	577	344	550	732	543	830	642	370	601						
		EBR	250	275	99	281	275	98	267	275	165	362	275	163	350	275	170	367	275	181	364						
		WBL	295	135	54	103	313	151	263	188	90	152	320	264	371	179	84	149	320	276	370						
		WBT	-	217	99	185	541	189	421	205	94	173	829	339	668	203	98	171	621	336	576						
		NBL	-	204	105	179	231	118	201	275	137	231	628	397	663	263	131	224	641	430	703						
		NBR	-	207	107	184	141	48	102	250	131	222	339	102	376	250	134	227	399	132	476						
				Total Future - Scenario 1 (2018)						Total Future - Scenario 2 (2018)						Total Future - Scenario 1A (2018)						Total Future - Scenario 2A (2018)					
Intersection	Control	Lane Group		AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour		
				Max	Ave	95th	Max	Ave	95th	Max	Ave	95th	Max	Ave	95th	Max	Ave	95th	Max	Ave	95th	Max	Ave	95th	Max	Ave	95th
(1) Garrisonville Road/ Wolverine Way Joyce Street	Signalized	EBL	310	239	11	99	80	12	50	146	9	86	157	16	81	146	9	86	227	23	113	180	9	86	246	19	108
		EBT	-	1554	1206	1720	418	210	388	1573	1335	1817	458	263	439	1568	1309	1753	499	288	470	1570	1338	1834	484	306	470
		EBR	260	285	51	220	105	8	74	285	42	197	154	8	69	285	57	229	234	19	124	285	72	263	233	15	110
		WBLU	290	311	207	320	314	125	264	315	280	360	314	173	322	308	211	316	315	169	331	315	278	363	315	191	336
		WBT	-	370	131	302	452	239	463	450	289	551	455	274	488	379	150	333	464	345	530	455	275	541	459	335	542
		WBR	165	75	4	37	189	23	111	74	5	39	164	23	107	103	6	51	190	32	134	28	3	18	190	31	133
		NBLTR	-	264	153	265	189	82	156	268	160	270	199	81	156	275	189	294	276	172	288	270	183	296	259	158	268
		SBLTR	-	146	59	120	85	29	69	149	62	126	88	30	70	148	63	122	97	33	75	147	63	121	108	34	81
(2) Garrisonville Road/ Site Driveway (Future)	Stop	EBT	-	283	49	207	119	15	87	125	11	65	70	5	39	235	33	165	241	41	202	142	12	70	155	26	137
		EBR	250	126	9	93	15	1	8	-	-	-	-	-	-	96	4	61	124	9	88	-	-	-	59	3	51
		WBL	300	129	55	114	118	48	96	-	-	-	-	-	-	125	49	102	164	45	103	-	-	-	-	-	-
		WBT	-	25	2	24	240	24	125	280	64	288	266	34	167	76	4	42	333	71	246	268	63	279	393	76	269
		NBR	-	158	71	151	206	130	221	154	61	120	203	117	204	118	45	96	198	84	175	118	45	95	195	89	170
(3) Garrisonville Road/ Parkway Boulevard	Signalized	EBLU	295	319	54	210	320	142	339	319	42	183	320	101	284	118	7	69	149	16	96	151	8	70	264	27	147
		EBT	-	654	514	732	643	482	682	646	451	684	635	437	639	658	482	721	656	472	725	646	437	679	647	491	713
		EBR	250	275	166	361	275	212	379	275	141	338	275	200	375	275	155	353	275	197	375	275	126	320	275	199	376
		WBL	295	210	90	160	320	308	362	164	89	146	320	298	370	185	91	156	320	284	369	207	88	155	320	286	369
		WBT	-	281	136	238	1028	551	868	237	123	209	967	475	833	245	120	207	1145	382	780	254	115	203	956	385	741
		NBL	-	250	139	234	621	458	717	293	140	244	642	472	743	266	141	237	600	458	718	261	132	226	617	446	725
		NBR	-	273	132	229	424	172	557	240	133	223	514	203	628	267	130	225	450	179	582	262	129	219	351	158	530
				Total Future - Scenario 1 (2020)						Total Future - Scenario 2 (2020)						Total Future - Scenario 1A (2020)						Total Future - Scenario 2A (2020)					
Intersection	Control	Lane Group		AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour		
				Max	Ave	95th	Max	Ave	95th	Max	Ave	95th	Max	Ave	95th	Max	Ave	95th	Max	Ave	95th	Max	Ave	95th	Max	Ave	95th
(1) Garrisonville Road/ Wolverine Way Joyce Street	Signalized	EBL	310	208	8	85	168	16	83	146	6	70	191	21	114	144	6	70	275	28	140	143	7	70	225	26	129
		EBT	-	1573	1329	1837	440	239	424	1587	1453	1774	478	285	470	1579	1442	1829	518	320	487	1575	1443	1777	557	352	534
		EBR	260	285	50	217	206	9	84	285	40	189	233	11	95	285	61	238	233	15	99	285	73	262	184	15	107
		WBLU	290	313	225	335	314	127	270	315	313	318	314	205	343	315	295	360	314	195	353	315	313	319	315	235	368
		WBT	-	409	163	368	455	276	489	471	444	453	456	305	509	457	351	584	467	384	549	470	441	493	466	385	546
		WBR	165	124	8	62	190	25	116	78	4	37	176	24	113	90	6	44	190	35	145	106	6	54	189	33	137
		NBLTR	-	269	166	277	190	91	167	266	157	255	215	100	183	277	209	316	287	247	313	273	193	304	280	230	316
		SBLTR	-	141	60	120	88	31	71	155	59	124	92	31	71	145	60	124	95	32	72	175	68	141	99	33	78
(2) Garrisonville Road/ Site Driveway (Future)	Stop	EBT	-	183	23	129	238	37	163	3	0	3	145	17	113	102	8	56	407	114	321	60	4	30	319	88	280
		EBR	250	64																							

FUTURE CONDITIONS WITHOUT DEVELOPMENT (2018 and 2020)

Future traffic conditions without the proposed development at study intersections were analyzed based on the projected future peak hour traffic forecasts without the development. The future peak hour traffic forecasts without the development include a regional growth factor of 0.5 percent, compounded annually and the approved, but unbuilt 610 Parkridge development located in the southeast quadrant of the Garrisonville Road/Parkway Boulevard intersection.

As directed by VDOT, the regional growth rate was established by reviewing published VDOT average annual daily traffic (AADT) volumes for both Garrisonville Road and Parkway Boulevard for the most recent five (5) year period. Based on a review of the AADT data both Garrisonville Road and Parkway Boulevard experienced little or no growth in traffic from 2011 to 2015. Therefore, a regional growth rate of 0.5 percent was assumed herein and is summarized on Figure 4 for years 2018 and 2020.

While the timeframe for the redevelopment of adjacent pipeline development (610 Parkridge) is unclear and in order to provide a more conservative analysis, the peak hour trips associated with the approved development have been assumed herein and are summarized on Figure 5 for years 2018 and 2020.

Based on the above assumptions, the background peak hour traffic forecasts which add regional growth and the 610 Parkridge development to the existing peak traffic counts is summarized on Figure for years 2018 and 2020. The estimated levels of service for years 2018 and 2020 without development are also summarized on Figure 6 and will be discussed in detail below.

Operational Analysis

The future LOS without development in 2018 and 2020 were calculated for the AM and PM peak hours based on the peak hour traffic data provided by VDOT, the existing lane use and traffic controls, the traffic signal phasing/timings provided by VDOT, and the Highway Capacity Manual 2000 (HCM) methodologies for signalized and unsignalized intersections using Synchro 9.1. The peak hour queuing result were reported using SimTraffic 9.

The peak hour LOS and estimated queues as reported by Synchro and SimTraffic, respectively, are summarized in Tables 1 and 2. Additionally, the Synchro and SimTraffic summary sheets are also provided in Appendix B.

2018 Levels of Service. As shown in Table 1 with the addition of regional growth and the planned 610 Parkridge development, the intersections along Garrisonville Road

at Wolverine Way/ Joyce Street and Parkway Boulevard would continue to operate at an overall LOS “D” or better during both the AM and PM peak hours. The minor street approaches and left turns from Garrisonville Road at Wolverine Way/Joyce Street would continue to operate at LOS “E” during peak periods. As mentioned previously, this is primarily due the amount of green time allocated to the mainline in order to move through traffic as well as protected left turn phasing along the mainline and the split phasing of minor street approaches. With the addition of regional growth and the 610 Parkridge development the westbound left turn on Garrisonville Road and the northbound left turn on Parkway Boulevard would operate at LOS “E” and “F”, respectively during the PM peak hour.

2018 Queues without Development. As shown on Table 2, with the addition of regional growth and the planned 610 Parkridge development the turn lane storage provided at study intersections would continue to be sufficient to accommodate the average AM and PM peak hour queue. Based on the simulations the maximum queue would continue exceed storage at the locations mentioned previously, consistent with existing conditions. Additionally, the maximum westbound left turn on Garrisonville Road at Parkway Boulevard would exceed the full width storage by approximately 25 feet (or one vehicle) during the PM peak with the additional 610 Parkridge development traffic.

2020 Levels of Service with Development. As shown in Table 1, the intersections along Garrisonville Road at Wolverine Way/Joyce Street and Parkway Boulevard would continue to operate at levels of service consistent with 2018 conditions without development with two (2) additional years of regional growth.

2020 Queues without Development. Similar to LOS results above the estimated peak hour queues (maximum queue) would increase marginally when compared to 2018 condition without development with two (2) years of additional growth. The results of the SimTraffic analysis are summarized in Table 2.

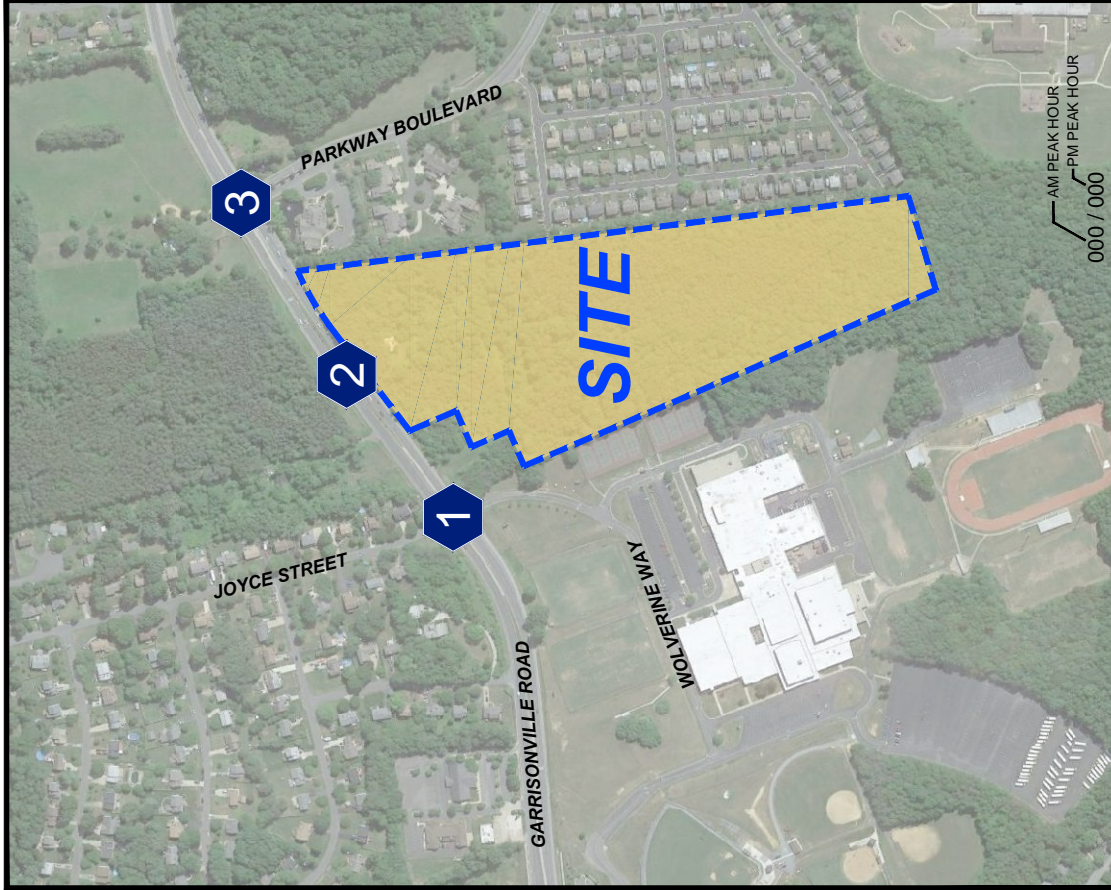
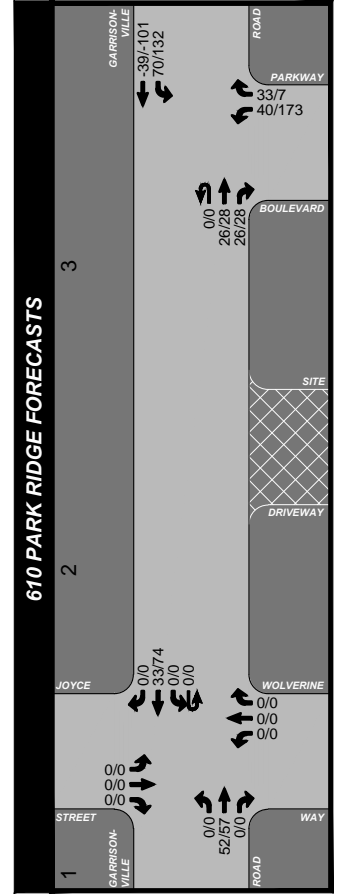
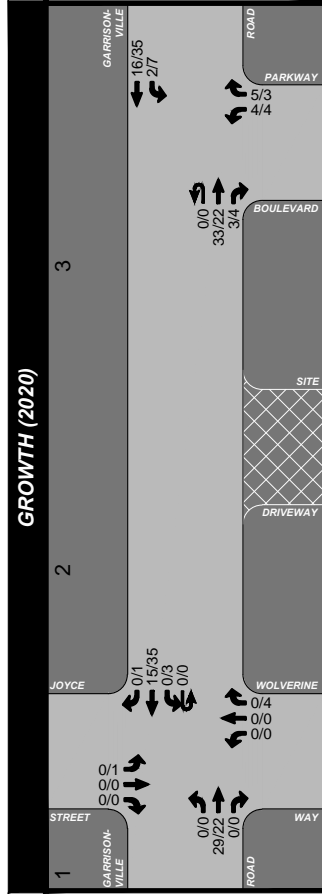
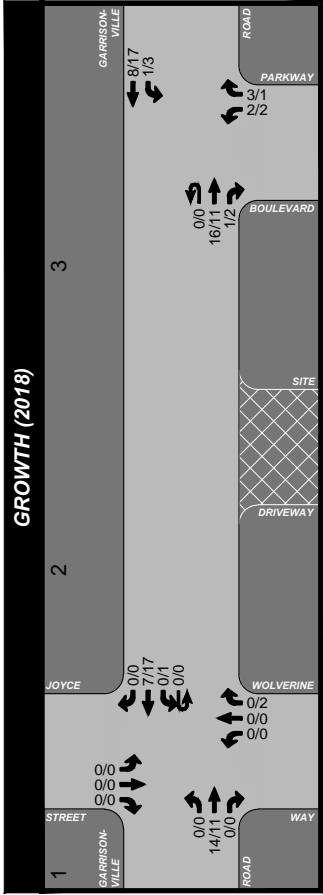


Figure 4
Regional Traffic Growth and 610 Park Ridge Peak Hour Forecasts

Patriot's Crossing
Stafford County, VA



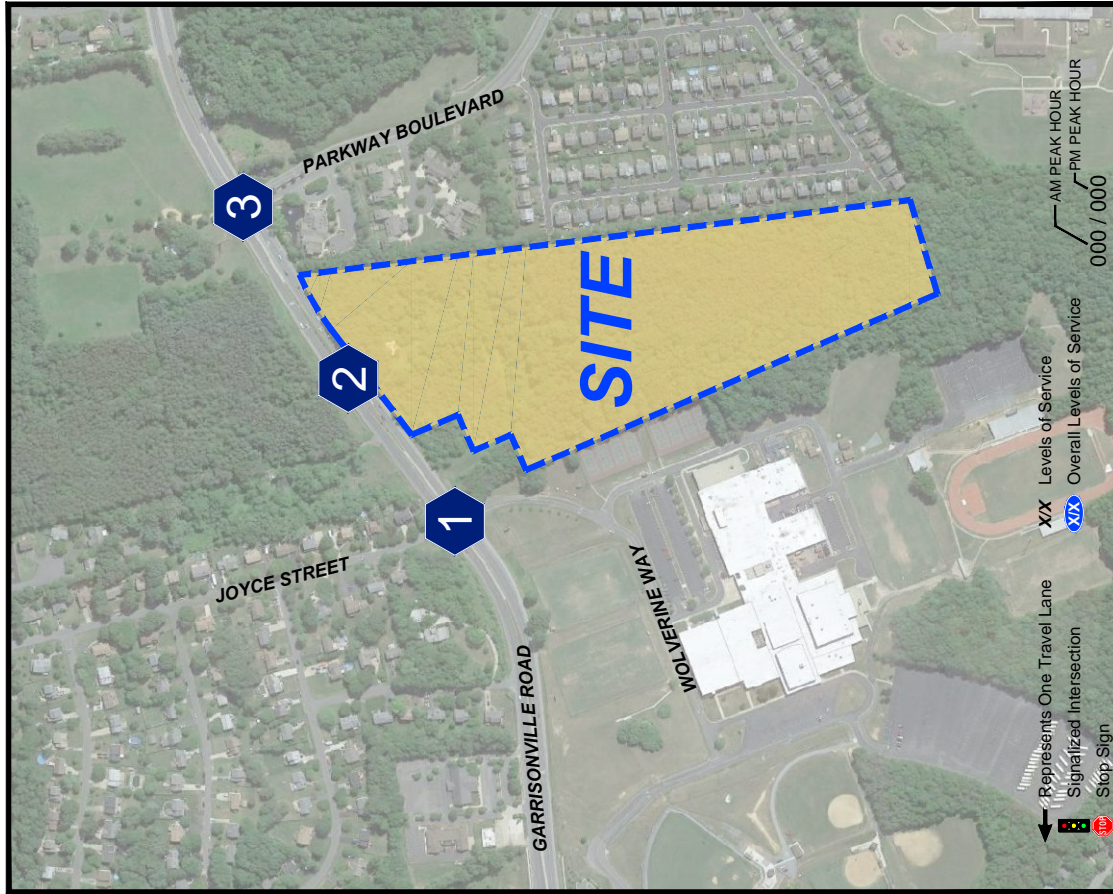
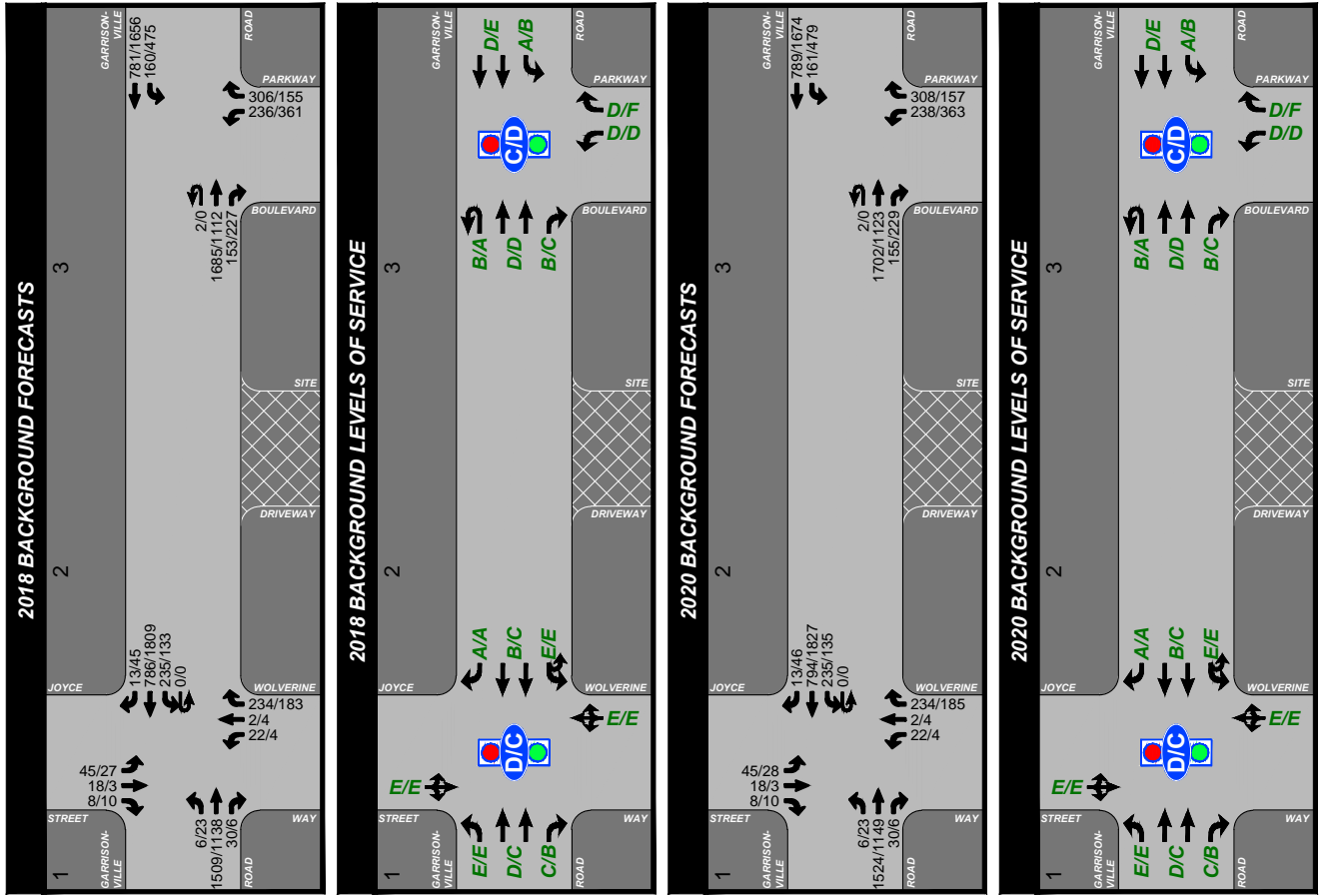


Figure 5
Background Peak Hour Traffic Forecasts, & Levels of Service

Patriot's Crossing
Stafford County, VA



SITE TRIP GENERATION and ACCESS SCENARIOS

Trip Generation Estimates. Based on plans provided by Fairbanks & Franklin, the site is proposed to be developed with a combination of commercial uses, including retail space, restaurants, car wash, pharmacy, and general office (See Figure 2).

A trip generation analysis is provided on Table 3 that reflects the currently proposed development plan for Pads 1 through 4, which is assumed as the Phase I. Based on the Institute of Transportation Engineer's (ITE) Trip Generation Manual, 9th Edition rates and equations the site is expected to generate 215 new AM peak hour trips (147 in and 68 out), 29 new PM peak hour trips (106 in and 189 out), and 2,922 daily weekday trips. This assumes a 40 percent pass-by reduction for the fast food restaurant and carwash, and a 25 percent pass-by reduction for the other retail uses.

As shown in Table 3, upon full-buildout (Pads 1 through 9) the site is expected to generate 479 new AM peak hour trips (379 in and 100 out), 493 new PM peak hour trips (140 in and 353 out), and 4,632 daily weekday trips.

Site Access. As shown on Figure 7 multiple access scenarios have been evaluated at the request of VDOT. Scenario 1, the proposed access, includes a new median break on Garrisonville Road which would allow for westbound left turns into the site as well as right-in, right-out turning movements along eastbound Garrisonville Road. The proposed access would reduce the frequency of U-turn movements at the Wolverine Way/Joyce Street intersection west of the site. Scenario 2, removes the left-in access and would result in all traffic approaching the site from the east to make a U-turn the Wolverine Way/Joyce Street intersection. Scenarios 1A and 2A are similar to the scenarios describe previously, but also include the addition of a proffered inter-parcel connection between the proposed development and the High School via Wolverine Way. While the inter-parcel connection is proffered it would require an agreement with the High School to implement since the connection would be on the school's property reduces security and results in an increase in traffic on Wolverine Way a privately maintained road.

Table 3
Patriot's Crossing
ITE Trip Generation Analysis ¹

	ITE Land Use	AM Peak Hour			PM Peak Hour			Weekday
		In	Out	Total	In	Out	Total	
Pads 1 through 4 (2018)								
Fast Food with Drive-Thru	934	74	71	145	54	50	104	1,588
Automated Carwash	948	0	0	0	27	26	53	530
Subtotal		74	71	145	81	76	157	2,118
<u>40% Pass-By Adjustment</u>		<u>-30</u>	<u>-28</u>	<u>-58</u>	<u>-32</u>	<u>-30</u>	<u>-62</u>	<u>-847</u>
Fast Food + Carwash Primary Trips		44	43	87	49	46	95	1,271
Shopping Center	820	31	19	50	84	90	174	2,043
<u>25% Pass-By Adjustment</u>		<u>-8</u>	<u>-5</u>	<u>-13</u>	<u>-21</u>	<u>-23</u>	<u>-44</u>	<u>-511</u>
Fast Food + Carwash Primary Trips		23	14	37	63	67	130	1,532
General Office Building	710	80	11	91	21	102	123	649
Total Phase 1 Trips		185	101	286	159	242	401	4,280
<u>Total Pass-By Adjustment</u>		<u>-38</u>	<u>-33</u>	<u>-71</u>	<u>-53</u>	<u>-53</u>	<u>-106</u>	<u>-1,358</u>
Net New Primary Phase 1 Trips		147	68	215	106	189	295	2,922
Pads 1 through 9 (2020)								
Fast Food with Drive-Thru	934	74	71	145	54	50	104	1,588
Automated Carwash	948	0	0	0	27	26	53	530
Subtotal		74	71	145	81	76	157	2,118
<u>40% Pass-By Adjustment</u>		<u>-30</u>	<u>-28</u>	<u>-58</u>	<u>-32</u>	<u>-30</u>	<u>-62</u>	<u>-847</u>
Fast Food + Carwash Primary Trips		44	43	87	49	46	95	1,271
Shopping Center	820	31	19	50	84	90	174	2,043
<u>25% Pass-By Adjustment</u>		<u>-8</u>	<u>-5</u>	<u>-13</u>	<u>-21</u>	<u>-23</u>	<u>-44</u>	<u>-511</u>
Fast Food + Carwash Primary Trips		23	14	37	63	67	130	1,532
General Office Building	710	312	43	355	55	266	321	2,359
Total Phase 1 Trips		417	133	550	193	406	599	5,990
<u>Total Pass-By Adjustment</u>		<u>-38</u>	<u>-33</u>	<u>-71</u>	<u>-53</u>	<u>-53</u>	<u>-106</u>	<u>-1,358</u>
Net New Primary Phase 1 Trips		379	100	479	140	353	493	4,632

Notes:

1. Traffic estimates based on Institute of Transportation Engineers (ITE) Trip Generation Manual, Ninth Edition.

JCP

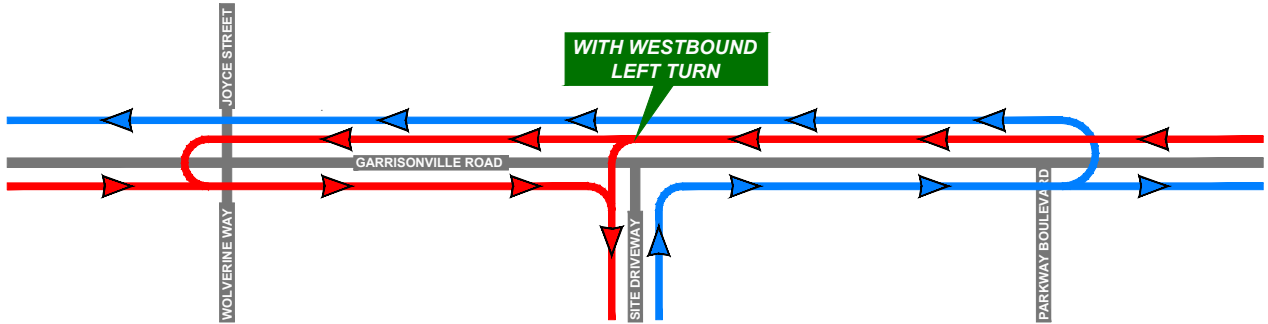
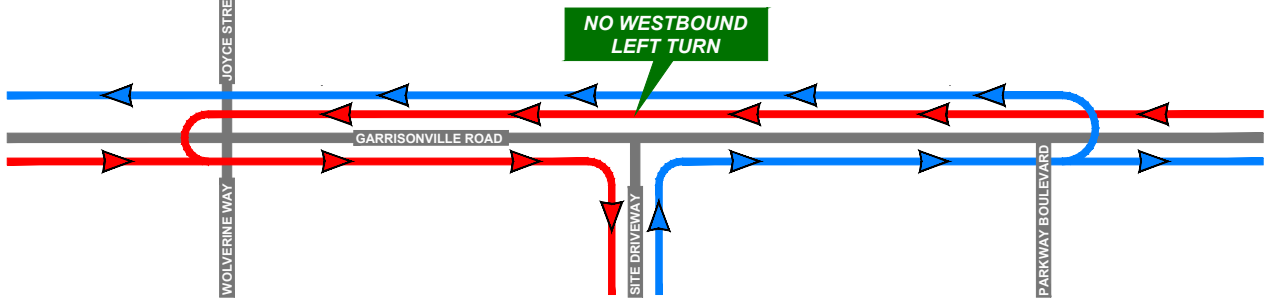
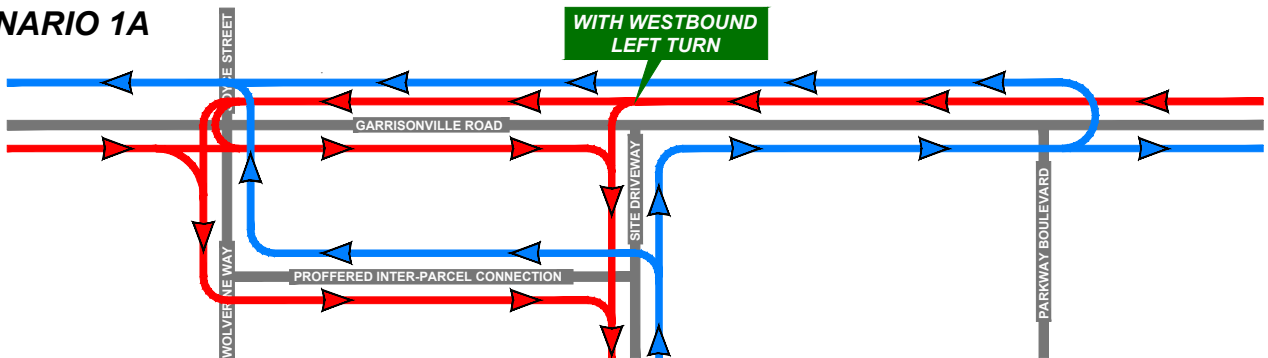
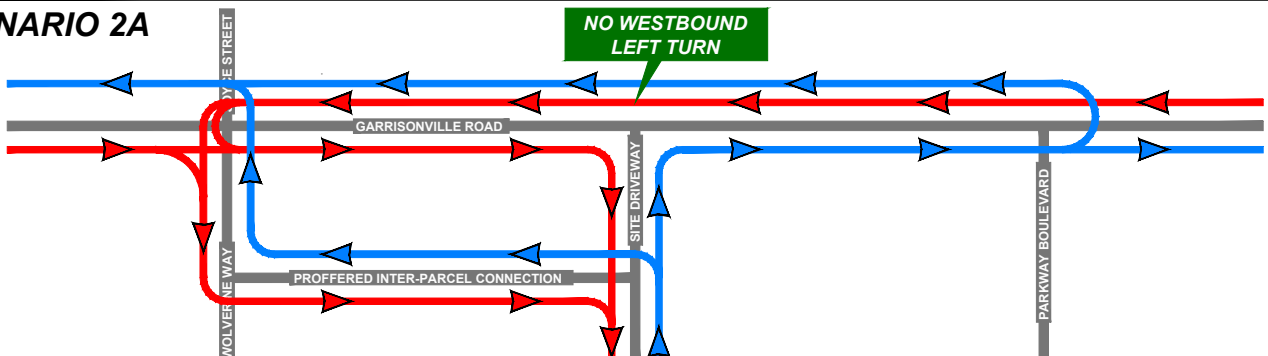
SCENARIO 1**SCENARIO 2****SCENARIO 1A****SCENARIO 2A**

Figure 6
Circulation / Access Scenarios

Patriot's Crossing
Stafford County, VA

INBOUND TRAFFIC
OUTBOUND TRAFFIC



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FUTURE CONDITIONS WITH DEVELOPMENT (2018 and 2020)

The site generated traffic assignments for the proposed development were added to future traffic forecasts without the development to yield future peak hour traffic forecasts with the proposed development and are shown on Figures 7 through 15. Future LOS and queue estimates with the development were calculated for the AM and PM peak hours based on future peak hour traffic forecasts with the development, future lane use and traffic controls, signal phasing/timings consistent with existing conditions, and the Highway Capacity Manual 2000 (HCM) methodologies for signalized and unsignalized intersections. The level of service results are shown on Figures 7 through 10 for the respective Scenarios in 2018, Figure 11 through 14 for the respective Scenarios in 2020 and on Figure 15 for 2020 conditions with Garrisonville Road widened to six (6) lanes. The level of service results are also summarized in Table 1. The SimTraffic queuing results are summarized in Table 2. The Synchro and SimTraffic summary sheets are also provided in Appendix C. The results of the operational analysis of future condition with development are summarized below.

Levels of Service (2018 and 2020)

Scenario 1 (Proposed Access). As shown in Table 1 with the proposed median break and the buildout of Pads 1 through 4 the signalized intersection of Garrisonville Road/Wolverine Way/Joyce Street and Garrisonville Road/Parkway Boulevard would continue to operate at acceptable levels of service, LOS “D” or better during both the AM and PM peak hours. When compared to future conditions without development the overall delay per vehicle at the signalized study intersections would increase by five (5) seconds or less during the AM peak hour and by 10 seconds or less during the PM peak hour.

The estimated delay per vehicle for westbound left turns on Garrisonville Road at Wolverine Way/Joyce Street would remain consistent with future conditions without development. The eastbound left U-turn on Garrisonville Road at Parkway Boulevard would operate at LOS “C” or better during peak periods.

The proposed westbound left turn on Garrisonville Road at the future site driveway would operate at LOS “C” during the critical AM peak hour and LOS “B” during the PM peak hour. Egress from the site (right-out only) would operate at LOS “B” during the AM and PM peak hours.

Scenario 2 (No Median Break). As shown in Table 1 without the proposed median break and the buildout of Pads 1 through 4 the signalized intersection of Garrisonville Road/Wolverine Way/Joyce Street and Garrisonville Road/Parkway Boulevard would continue to operate at acceptable levels of service, LOS “D” or

better during both the AM and PM peak hours with the exception of the AM peak hour at the Wolverine Way/Joyce Street intersection which would degrade to LOS “E”. When compared to Scenario 1 (proposed access) above, overall delay per vehicle at the signalized study intersections of Garrisonville Road/Wolverine Way/Joyce Street would increase by approximately 29 seconds during the AM peak hour and 16 seconds during the PM peak hour. This is directly attributable to the increase in the number of westbound left U-turns at Wolverine Way/Joyce Street.

Egress from the site (right-out only) would operate at LOS “B” during the AM and PM peak hours.

Scenario 1A (Proposed Access & Connection to Wolverine Way). As shown in Table 1 with the proposed median break, an inter-parcel connection to Wolverine Way, and the buildout of Pads 1 through 4 the signalized intersection of Garrisonville Road/Wolverine Way/Joyce Street and Garrisonville Road/Parkway Boulevard would continue to operate at acceptable levels of service, LOS “D” or better during both the AM and PM peak hours with the exception of the AM peak hour at the Wolverine Way/Joyce Street intersection which would degrade to LOS “E”.

The estimated delay per vehicle for certain turning movements from Garrisonville Road at Wolverine Way/Joyce Street and the minor street approaches would operate at LOS “F” during the AM peak hour. This is due to the increase in traffic at the intersection with the inter-parcel connection. The eastbound left U-turn on Garrisonville Road at Parkway Boulevard would operate at LOS “C” or better during peak periods.

The proposed westbound left turn on Garrisonville Road at the future site driveway would operate at LOS “C” during the critical AM peak hour and LOS “B” during the PM peak hour. Egress from the site (right-out only) would operate at LOS “B” during the AM and PM peak hours.

While the inter-parcel connection shows an increase in delay at the Garrisonville Road/Wolverine Way/Joyce Street intersection the connection would provide better connectivity on the south side of Garrisonville Road. Additionally the connection would reduce the number of eastbound U-turns at Parkway Boulevard for vehicles exiting the site destined to the west.

Scenario 2A (Proposed Access & Connection to Wolverine Way). As shown in Table 1 without the proposed median break, an inter-parcel connection to Wolverine Way, and the buildout of Pads 1 through 4 the signalized intersection of Garrisonville Road/Wolverine Way/Joyce Street and Garrisonville Road/Parkway Boulevard would continue to operate at acceptable levels of service, LOS “D” or better during both the AM and PM peak hours with the exception of the AM peak hour at the Wolverine Way/Joyce Street intersection which would degrade to LOS “F”.

When compared to other Scenarios this scenario results in the poorest levels of service during the AM peak hour at the intersection of Garrisonville Road/Wolverine Way/Joyce Street (LOS “F”). Similar to Scenario 1A, but to a greater extent, the increase in traffic at the intersection would result in failing levels of service for turning movements from Garrisonville Road and on the minor street approaches.

Egress from the site (right-out only) would operate at LOS “B” during the AM and PM peak hours.

2020 Conditions. As shown in Table 1 and summarized on Figure 16, at full built out of the site and the existing four (4) lane section under the preferred access (Scenario 1) on Garrisonville Road in the vicinity of the site overall delay per vehicle would increase. The intersection of the intersection of Garrisonville Road/Wolverine Way/Joyce Street would operate an overall LOS “E” during the AM peak hour and LOS “C” during the PM peak hour. The intersection of the intersection of Garrisonville Road/Parkway Boulevard would operate an overall LOS “D” during the AM peak hour and LOS “E” during the PM peak hour.

Similar to the detailed comparisons provided above for 2018 conditions with development, Scenario 1 (proposed access) resulted in the best overall operations at the adjacent signalized intersections. However, without the inter-parcel connection the westbound left turn in the site via the proposed median break would operate at LOS “F” during the AM peak hour. If the median break was in place and inter-parcel connection was provided (Scenario 1A) the westbound left turn at the site driveway would operate at LOS “E” and the average delay could be reduced in half when compared to Scenario 1 (without the inter-parcel connection).

As mentioned above, the proffered inter-parcel connection to Wolverine Way would provide better connectivity on the south side of Garrisonville Road, but would add additional traffic to the intersection of Wolverine Way/Joyce Street. The connection would better distribute site traffic and would reduce the potential number of eastbound U-turns at Parkway Boulevard for vehicles exiting the site destined to the west.

As shown on Table 1, assuming the Comprehensive Plan widening of Garrisonville Road from four (4) to six (6) lanes overall levels of service would improve at the signalized study intersections with the increased through capacity of Garrisonville Road. With the widening under Scenarios 1 and 1A both adjacent signalized intersections would operate LOS “D” or better during peak periods. With the widening of Garrisonville Road under Scenarios 2 and 2A the Garrisonville Road/Wolverine Way/Joyce Street intersection would operate at LOS “E” and “F”, respectively during the AM peak hour.

With the widening of Garrisonville Road the proposed westbound left turn at the future site driveway would operate at LOS “D” and “C” during the AM peak hour and LOS “B” during the PM peak hour under Scenarios 1 and 1A, respectively.

Queuing (2018 & 2020)

Table 2 provides a detailed summary of the 50th and 95th percentile and maximum queues are reported by SimTraffic, version 9.1.

Under 2018 conditions with the proposed median break in place the planned 200 foot turn lane would be adequate to accommodate the maximum queue for the westbound left turn into the site on Garrisonville Road. In 2020 without or with the Comprehensive Plan widening of Garrisonville Road to six (6) lanes the estimated maximum queue would require 300 feet of storage (or 250 feet full-width turn lane and a 100 foot taper).

Under all Scenarios in both 2018 and 2020 the existing and proposed turn lane storage is adequate to accommodate the average queue at all study intersections. Similar to existing and future conditions without development the maximum queue may extend beyond available full width storage into the taper during certain peak periods by approximately one (1) vehicle.



Figure 7
2018 Future Peak Hour Traffic Forecasts, & Levels of Service

Scenario 1

Patriot's Crossing
Stafford County, VA

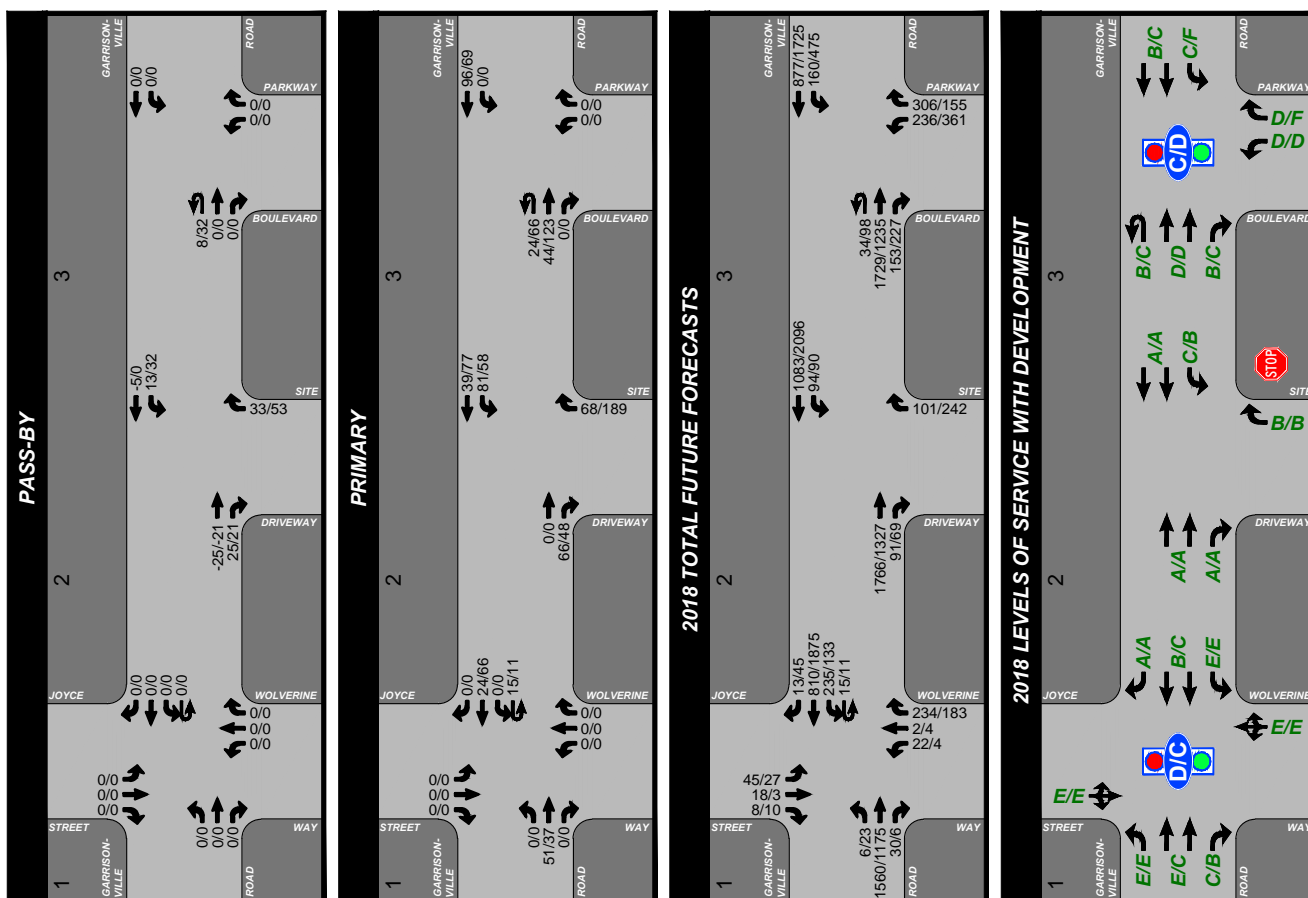




Figure 8

2018 Future Peak Hour Traffic Forecasts, & Levels of Service

Scenario 2

Patriot's Crossing

Stafford County, VA

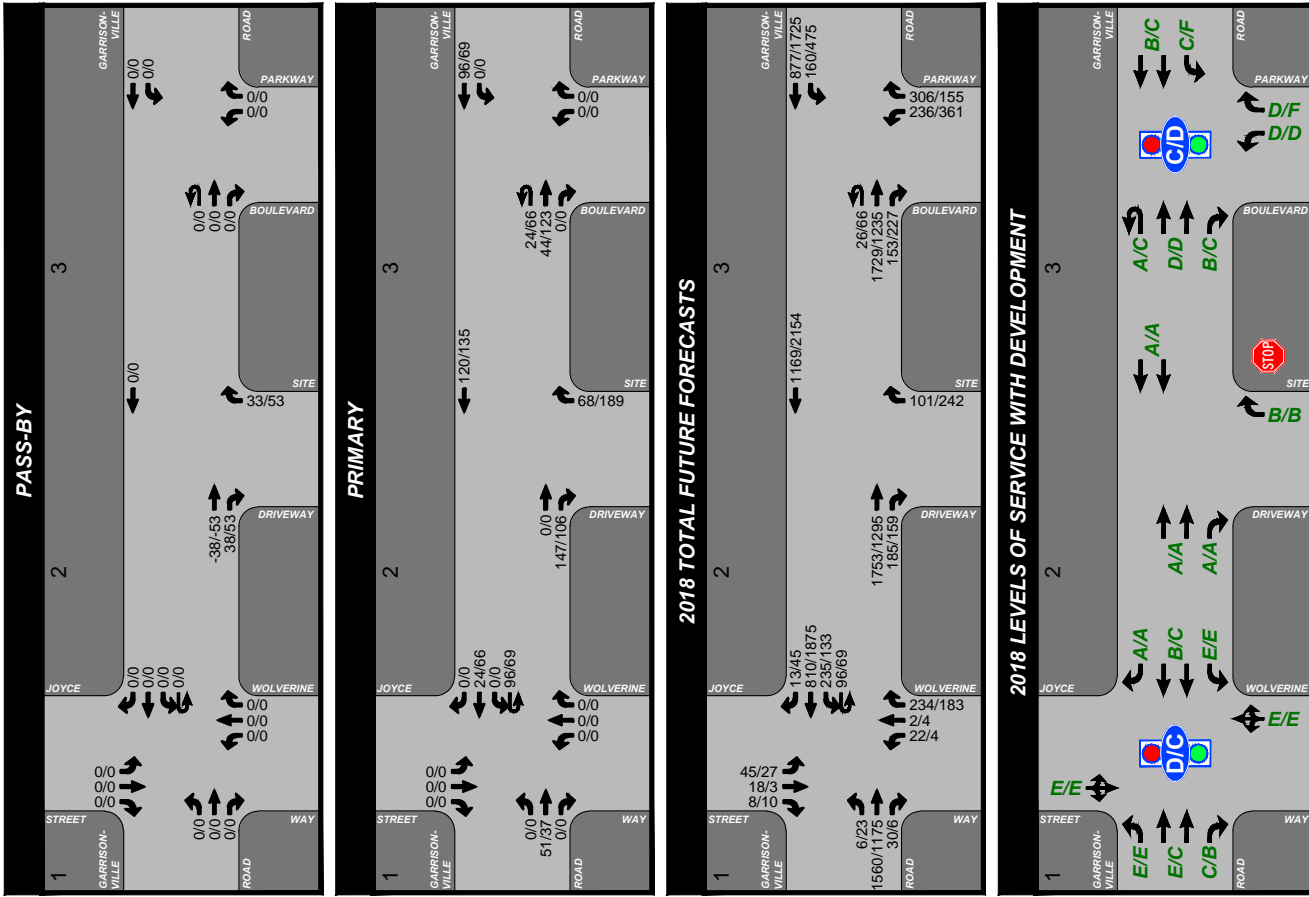




Figure 9

2018 Future Peak Hour Traffic Forecasts, & Levels of Service

Scenario 1A

Patriot's Crossing
Stafford County, VA

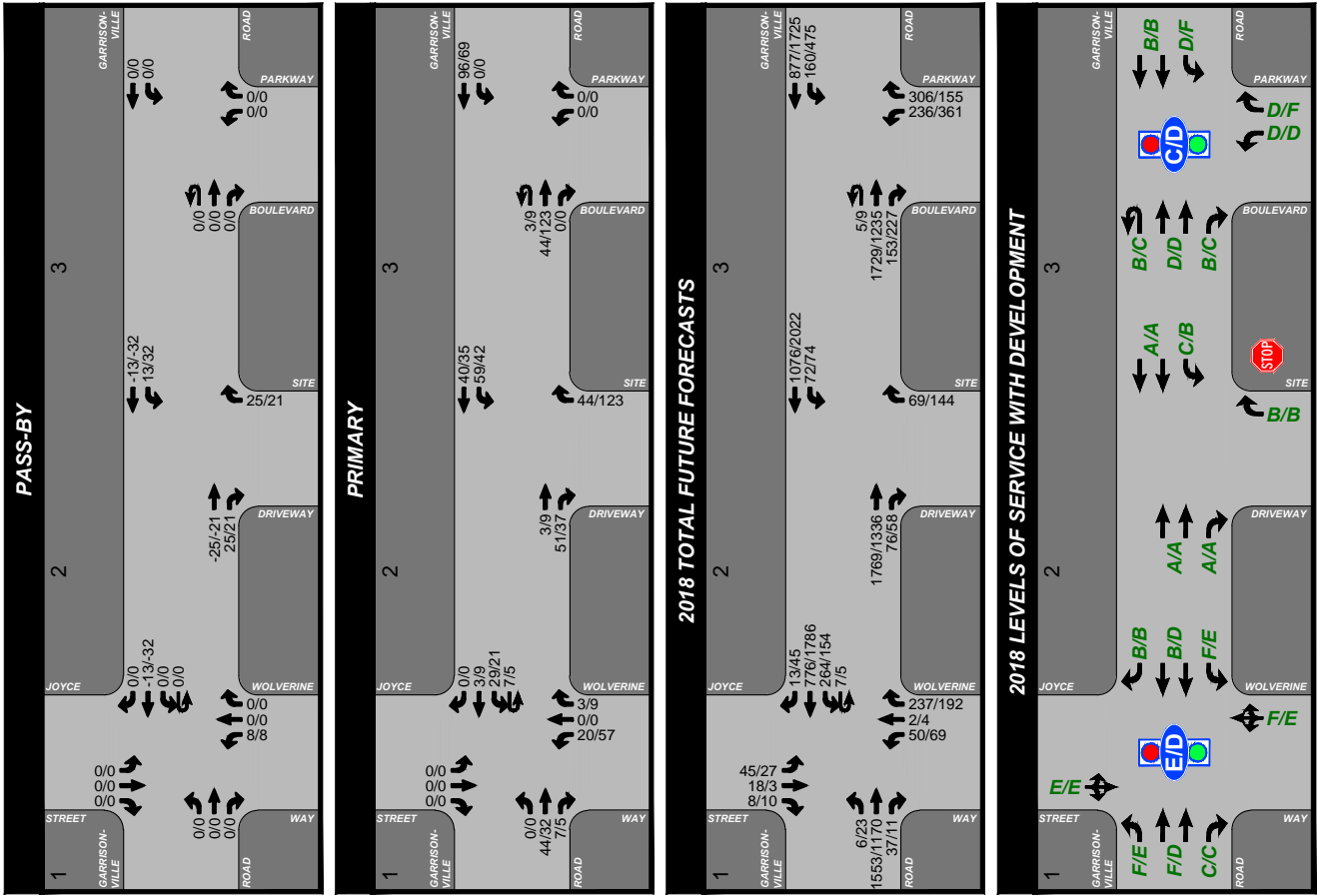




Figure 10

2018 Future Peak Hour Traffic Forecasts, & Levels of Service

Scenario 2A

Patriot's Crossing
Stafford County, VA

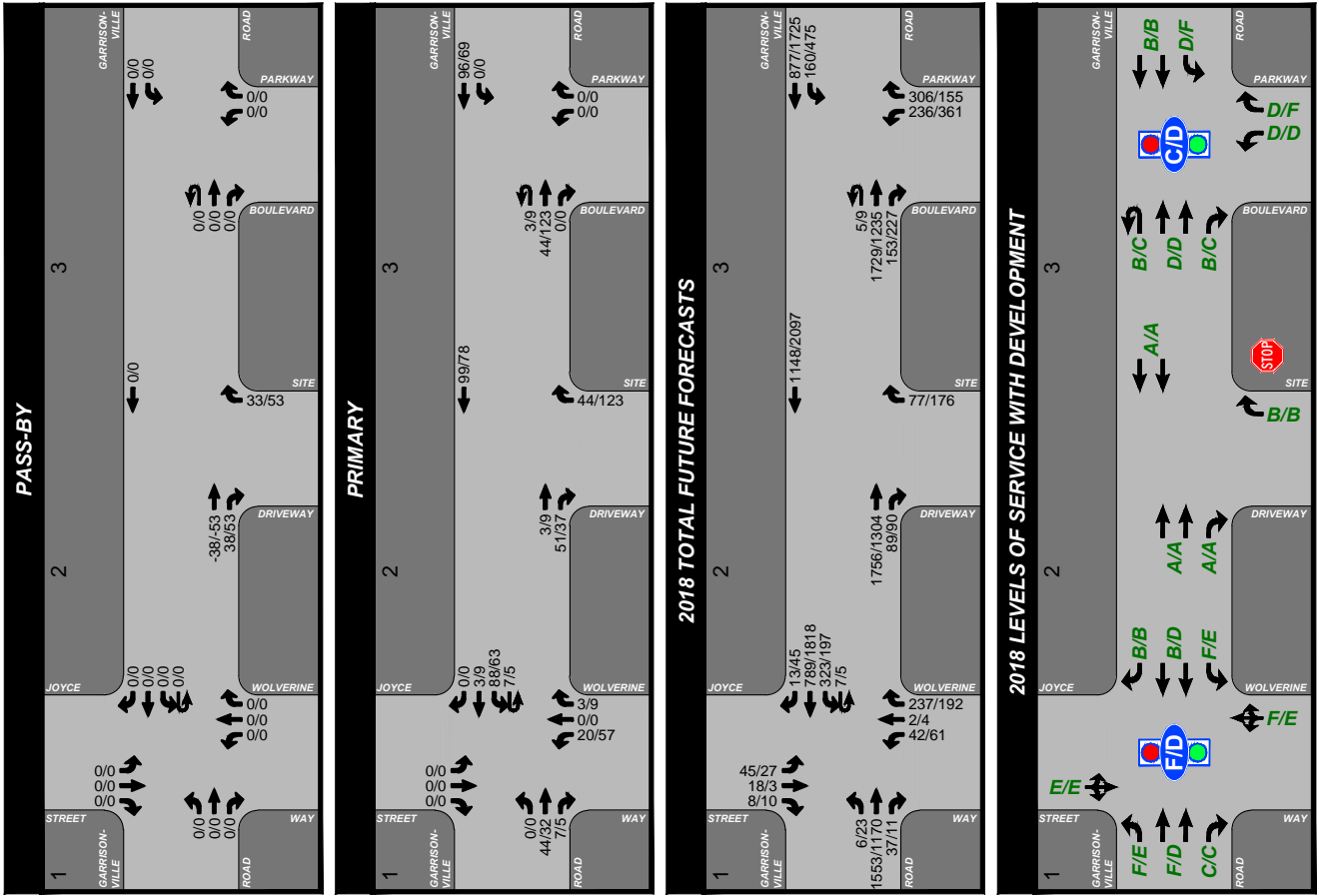
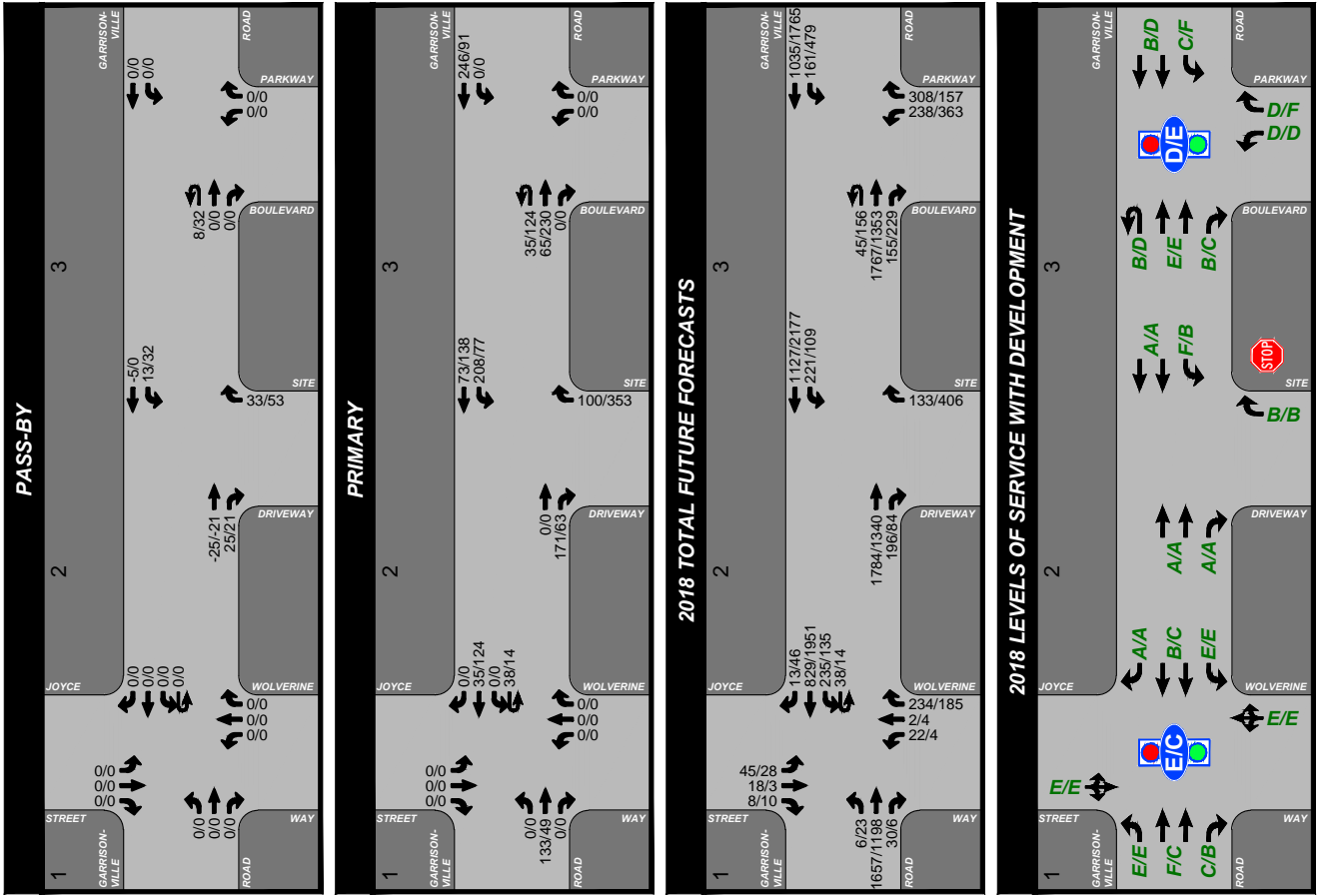




Figure 11
2020 Future Peak Hour Traffic Forecasts, & Levels of Service

Scenario 1

Patriot's Crossing
Stafford County, VA



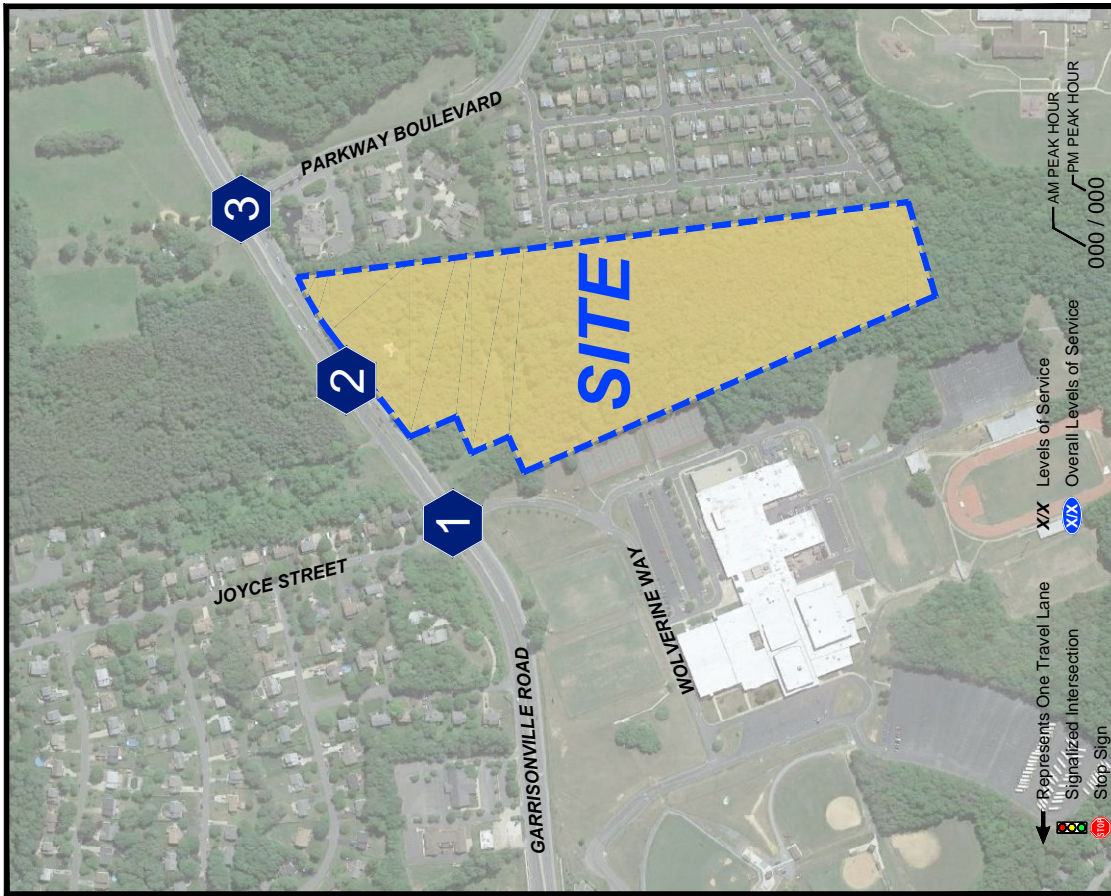


Figure 12
2020 Future Peak Hour Traffic Forecasts, & Levels of Service
Scenario 2

Patriot's Crossing
Stafford County, VA

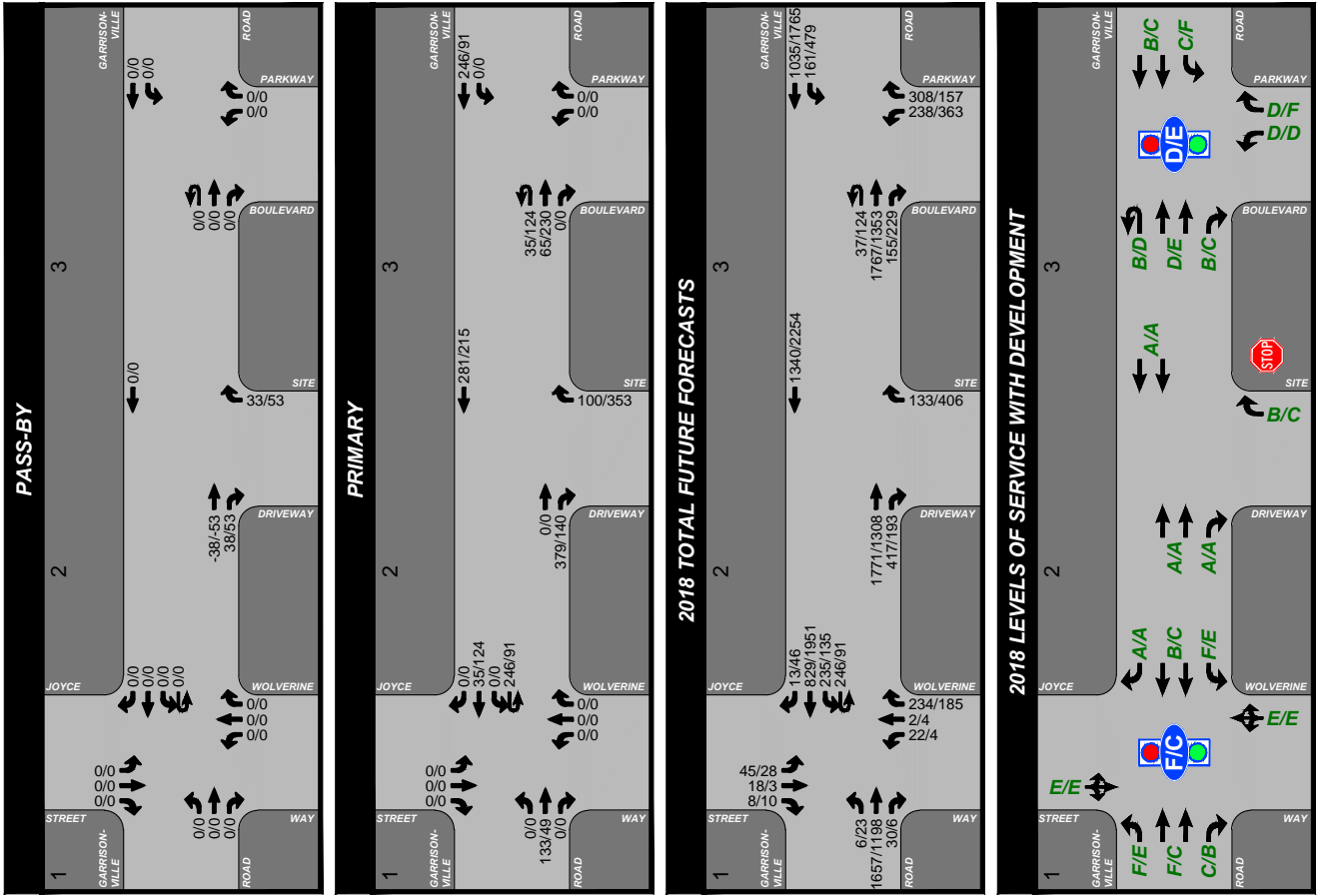




Figure 13
2020 Future Peak Hour Traffic Forecasts, & Levels of Service
Scenario 1A

Patriot's Crossing
Stafford County, VA

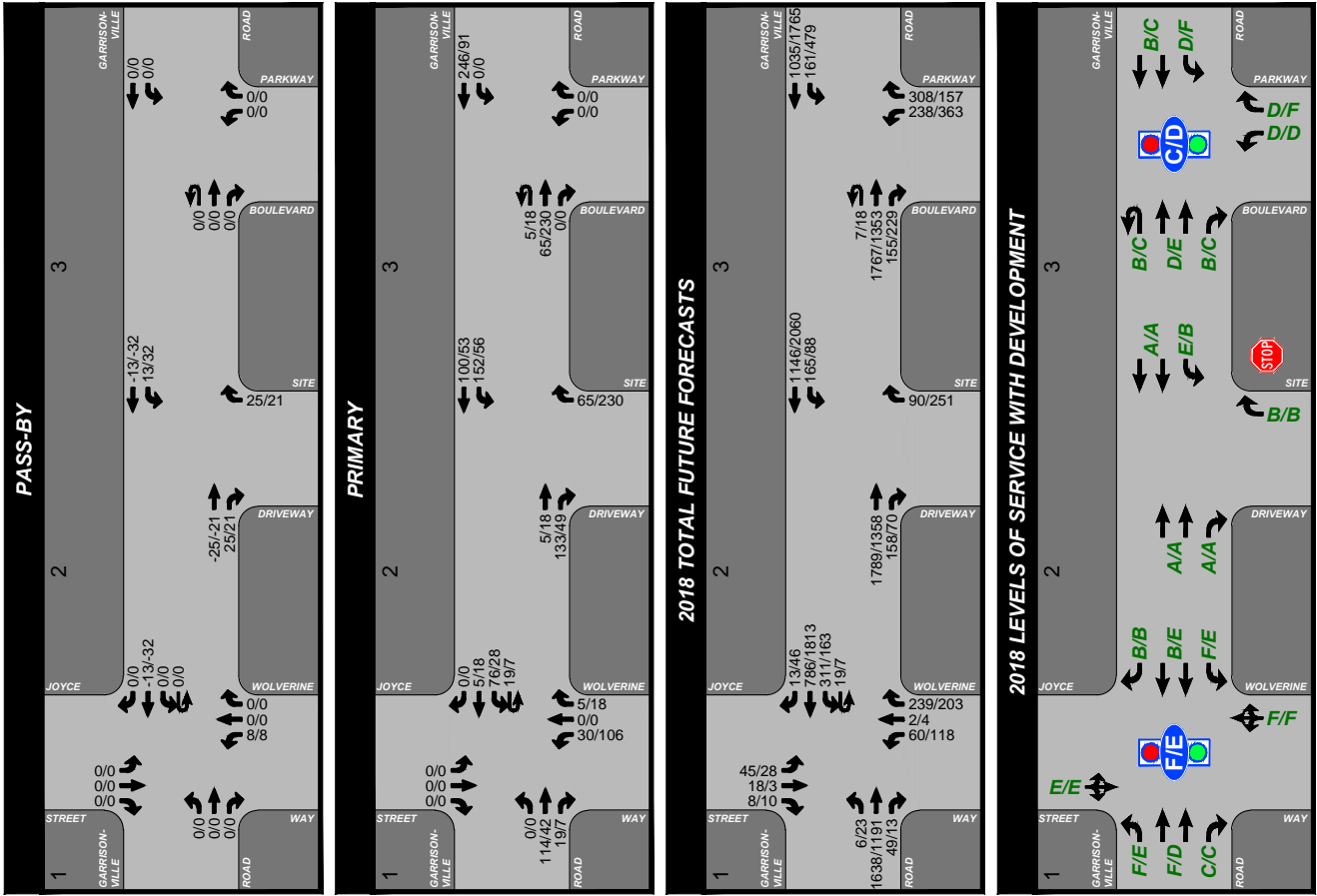




Figure 14

2020 Future Peak Hour Traffic Forecasts, & Levels of Service

Scenario 2A

Patriot's Crossing
Stafford County, VA

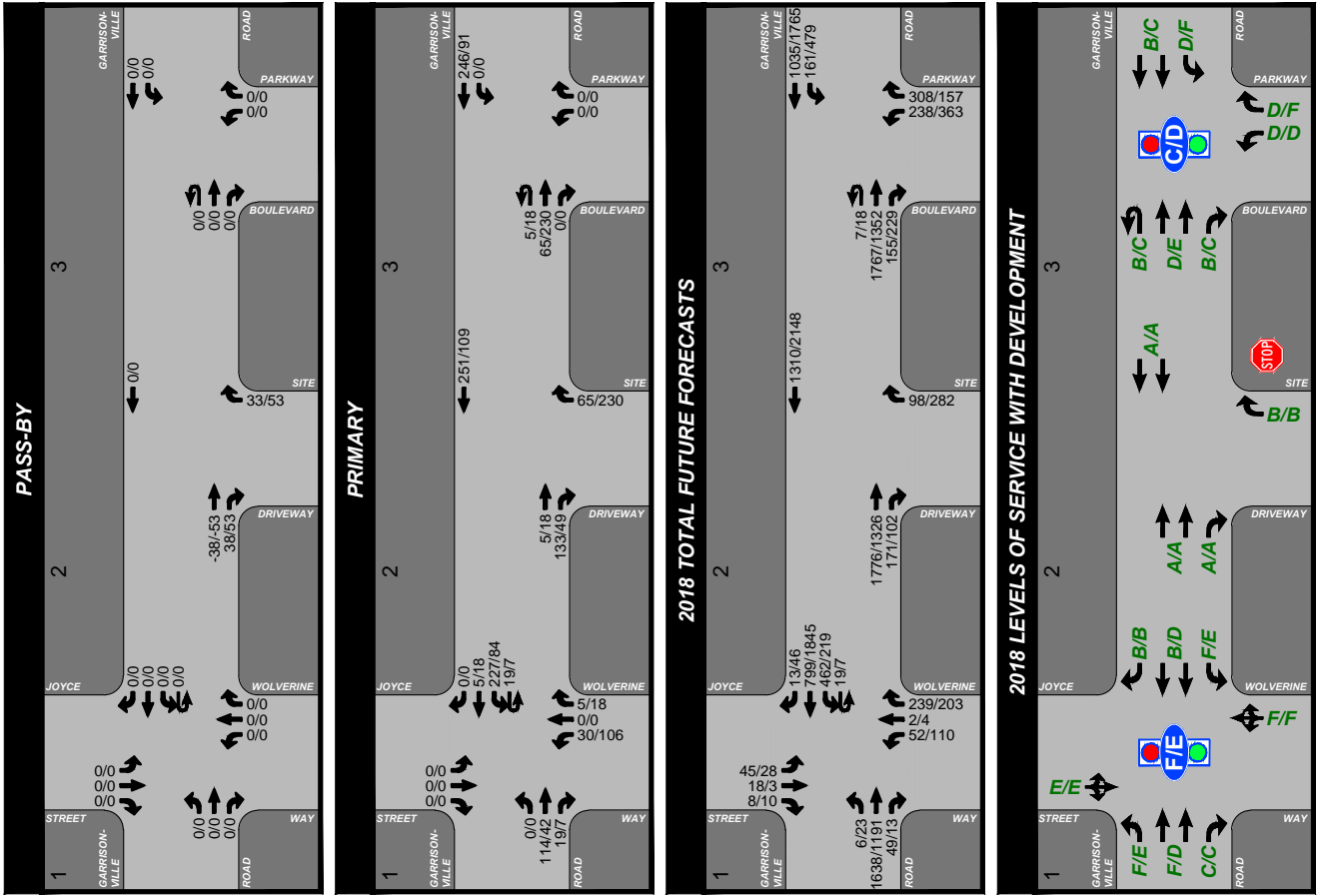
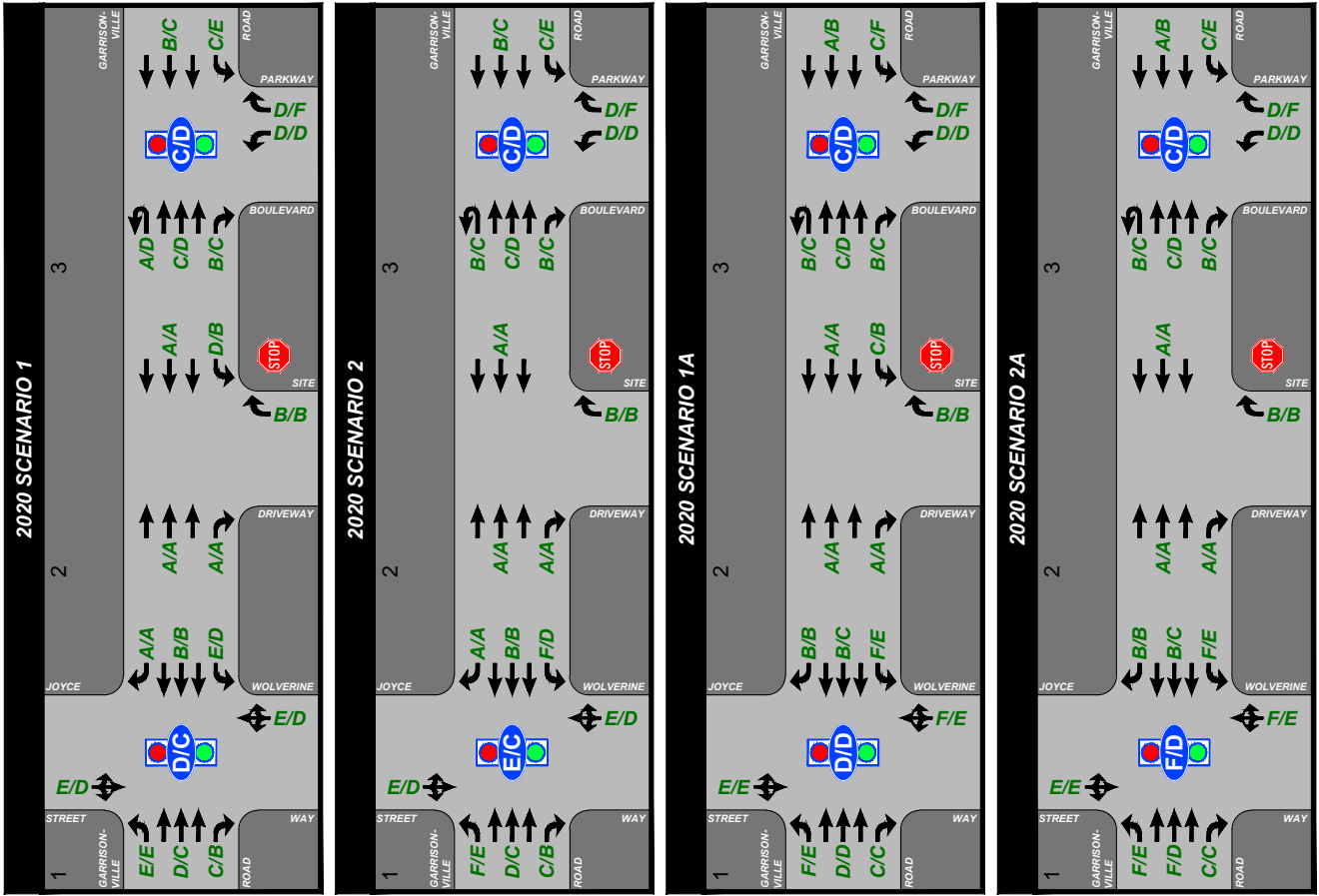




Figure 15
2020 Levels of Service with Development
And Garrisonville Road Widened to 6 Lanes
Patriot's Crossing
Stafford County, VA



SUMMARY/CONCLUSION

The results of this updated traffic analysis for Patriot's Crossing indicates that the adjacent signalized intersections operate with better overall levels of service with the proposed median break on Garrisonville Road (Scenarios 1 and 1A) to allow for westbound left turns into the site.

Table 4
Patriot's Crossing
Total Future Overall LOS Summary

Intersection		2018 Scenario				2020 Scenario				2020 - 6 lanes Scenario			
		1 AM/PM LOS	2 AM/PM LOS	1A AM/PM LOS	2A AM/PM LOS	1 AM/PM LOS	2 AM/PM LOS	1A AM/PM LOS	2A AM/PM LOS	1 AM/PM LOS	2 AM/PM LOS	1A AM/PM LOS	2A AM/PM LOS
Garrisonville Rd./Wolverine Way	Overall	D/C	E/C	E/D	F/D	E/C	F/C	F/E	F/E	D/C	E/C	D/D	F/D
Garrisonville Road/Site Driveway	WBL	C/B	-	C	-	F/B	-	E/B	-	D/B	-	C/B	-
Garrisonville Rd./Parkway Blvd.	Overall	C/D	C/D	C/D	C/D	D/E	D/E	C/D	C/D	C/D	C/D	C/D	C/D

The inter-parcel connection to Wolverine Way would provide for better circulation on the south side of Garrisonville Road, but would result in additional traffic on Wolverine Way during peak periods and would add additional delay to the intersection during peak periods as shown herein. The inter-parcel connection is not anticipated to result in cut-through traffic from the school since Wolverine Way provides direct signalized access to Garrisonville Road.

The 2020 analyses without the widening of Garrisonville Road indicate that the westbound left turn lane should provide a minimum of 250 feet of full width storage and a 100 foot taper in order to accommodate the estimated maximum queue during peak periods. The estimated maximum westbound left turn is not expected to occur throughout the day and is estimated to occur only during the AM peak hour when eastbound traffic on Garrisonville Road is heaviest. With the Garrisonville Road widening in place the adjacent signalized intersections would operate at an overall LOS "D" or better under access Scenarios 1 and 1A with the median break.