

MEMORANDUM

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From: Corey Mack, EIT and Joe Segale, PE

Subject: Final Report: Exit 17 – Chimney Corners Traffic Analysis

Date: 30 December 2009

The purpose of this memorandum is to reanalyze the Exit 17 Growth Center traffic characteristics under two new scenarios. The first new condition involves the study of the impacts of a 6,000 square foot office development in the easternmost zone of the Exit 17 Growth Center in Colchester, VT. This proposed office development is assumed to be occupied by 2010 within the current transportation network.

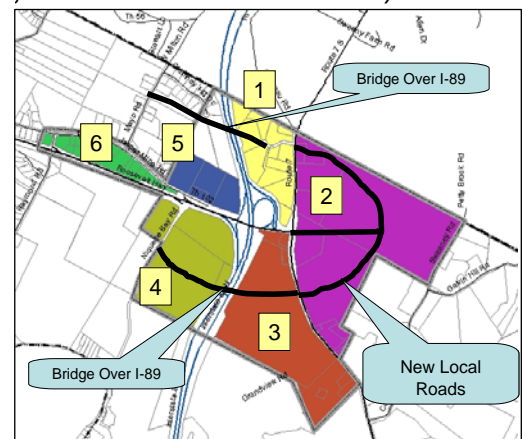
The second scenario presented in this memo is the result of the traffic redistribution and analysis due to the elimination of an access point to the Chimney Corners intersection. A previous study of the area, *Exit 17 Growth Center Study*¹, identifies potential future roadway improvements to the US 2 / US 7 (Chimney Corners) and US 7 / Brentwood Drive intersections. However, further consultation with the Vermont Agency of Transportation has indicated that restrictions of the Category 2 Access Management Classification of the Chimney Corners intersection complicate the proposed westbound approach regardless of any operational benefits. This study removes the westbound approach of the intersection and redistributes and analyzes the traffic associated with the easternmost development of the Growth Center. Finally, the intersection improvements proposed in the 2006 *Growth Center Study* are revisited to ensure that the recommended geometric layouts are consistent with the revised traffic circulation patterns.

1.0 Background Information

The area surrounding Exit 17 in Colchester was designated as a growth center by the Town of Colchester in its 1996 Municipal Plan. The resulting impacts to the transportation network from the development of this area were studied in the 2006 *Exit 17 Growth Center Study*. For the purpose of this study, all characteristics of this growth center have remained unchanged.

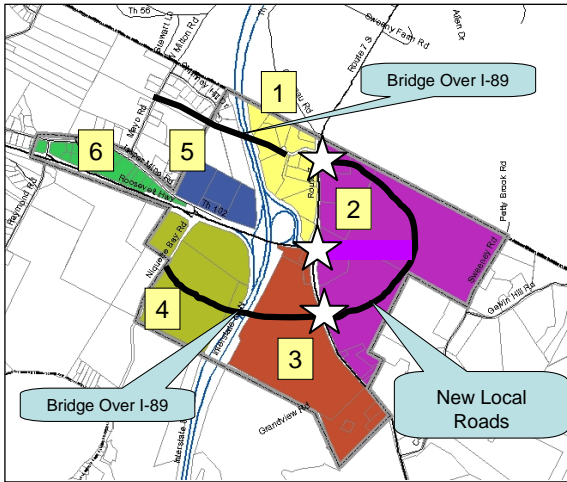
To project the amount of traffic generated in the project area, the growth center around Exit 17 was divided into 6 transportation analysis zones (TAZs). In the 2006 *Growth Center Study*, it was assumed that TAZ 2 would have three access points to US 7: a northern access shared with Brentwood Drive, an undeveloped southern access road, and a westbound leg into the Chimney Corners intersection. Figure 1 illustrates the new local roads as proposed by the Growth Center Study.

Figure 1: TAZs and proposed local road network from 2006 *Exit 17 Growth Center Study*.



¹ *Exit 17 Growth Center Study*, dated October 2006, by Resource Systems Group, Inc.

Figure 2: TAZs and new local roads without the westbound approach to Chimney Corners. Studied intersections in this memo are indicated by stars.



As discussed in the previous section, the westbound approach of the Chimney Corners intersection was removed and the traffic directly utilizing the Chimney Corners intersection to access TAZ 2 was redistributed to the Northern and Southern Access Drives. The resulting local road network and the intersections studied in this memorandum are shown in Figure 2.

Since the southernmost intersection was not analyzed in the 2006 *Growth Center Study*, the volumes and operations for this intersection have been developed. Due to the construction of the local road network and the bridge over I-89, it was assumed that traffic from both TAZ 3 and TAZ 4 would utilize this intersection. Consistent with the 2006 *Growth Center Study*, some trips originating from or destined to TAZ 3 access the development from the US 2 / Niquette Bay Road intersection outside the study area.

2.0 2010 Proposed Office Development Analysis

As the first growth center development of TAZ 2, a 6,000 square foot office space has been proposed at the Southern Access Drive, shown in Figure 2. This location would require the construction of a new intersection on US 2 / US 7.

2.1 2010 Volumes Development

For the purpose of this study, the 2005 volumes reported in the *Growth Center Study* were used as the 2010 volumes. By reviewing the automatic traffic recorder data located approximately 1 mile to the south of Chimney Corners, it is evident that traffic growth over the past 10 years has been negligible along this segment of US 2 / 7. This data is presented in Table 1.

Table 1: AADT data collected from an ATR south of project site.

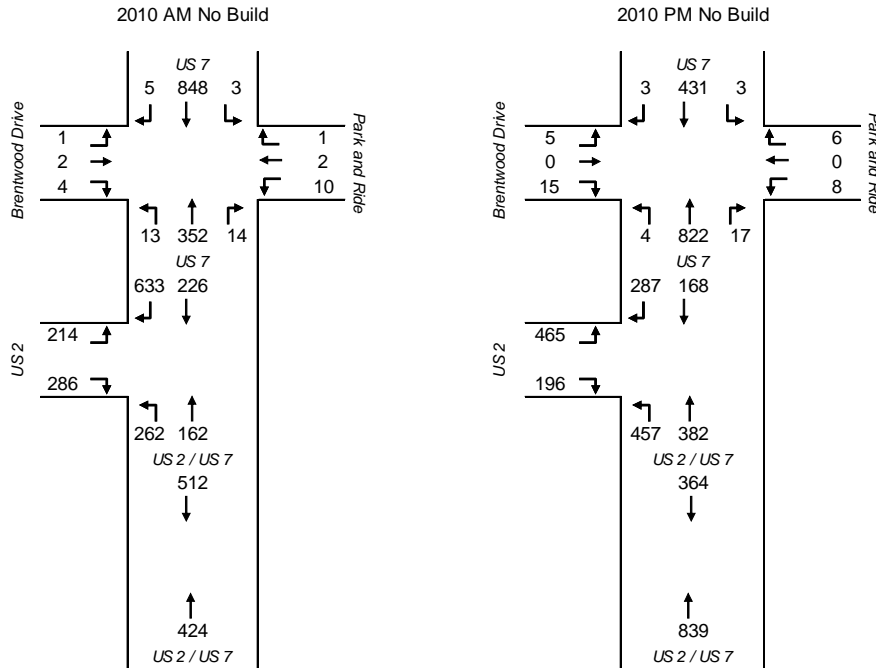
ATR S6D103 - 0.1 Mile South of Coon Hill Rd				
Year	2008	2004	2002	2000
AADT	10,800	10,600	10,800	11,100

Additionally, guidance in the 2008 VTrans *CTC Grouping Study and Regression Analysis (Redbook)* states that a short term growth factor of 1.0 is acceptable on this corridor based on data collected at CTC P6D040. This further indicates that the 2005 volumes reported in the *Growth Center Study* are still valid.

Since there is currently no intersection between US 2/7 and the southern access road, it was assumed that the 2010 volumes at the proposed location of the intersection are equal to the southbound entering and exiting volumes from the Chimney Corners intersection. The 2010 AM and PM peak hour volumes are shown in Figure 3.



Figure 3: 2010 No-Build AM and PM peak hour volumes.



2.2 ITE Trip Generation

To determine the number of trips generated by the proposed office, the methods outlined in the 8th Edition ITE Trip Generation manual were used. Due to the relatively small size of the office building, the average rate for the AM and PM peak hours were utilized to generate the entering and exiting trips shown in Table 2.

Table 2: ITE Trip Generation for 6000 square foot general office building.

	ITE Trip Generation			
	AM Peak Hour		PM Peak Hour	
Average Rate / 1000 Sq. Ft.	1.55		1.49	
	Entering	Exiting	Entering	Exiting
Vehicle Trips / Hr	9	2	2	8

2.3 Trip Distribution and Assignment

The trips shown in Table 2 were distributed through the study intersections based on the existing traffic pattern of vehicles traveling through Chimney Corners as shown in Figure 4. Figure 5 shows the resulting assignment of development trips.



Figure 4: AM and PM trip distribution from Chimney Corners.

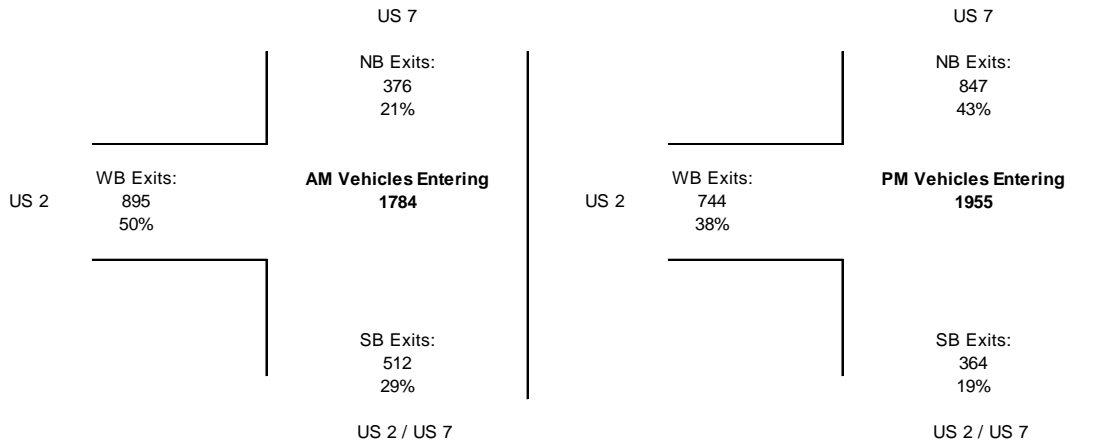
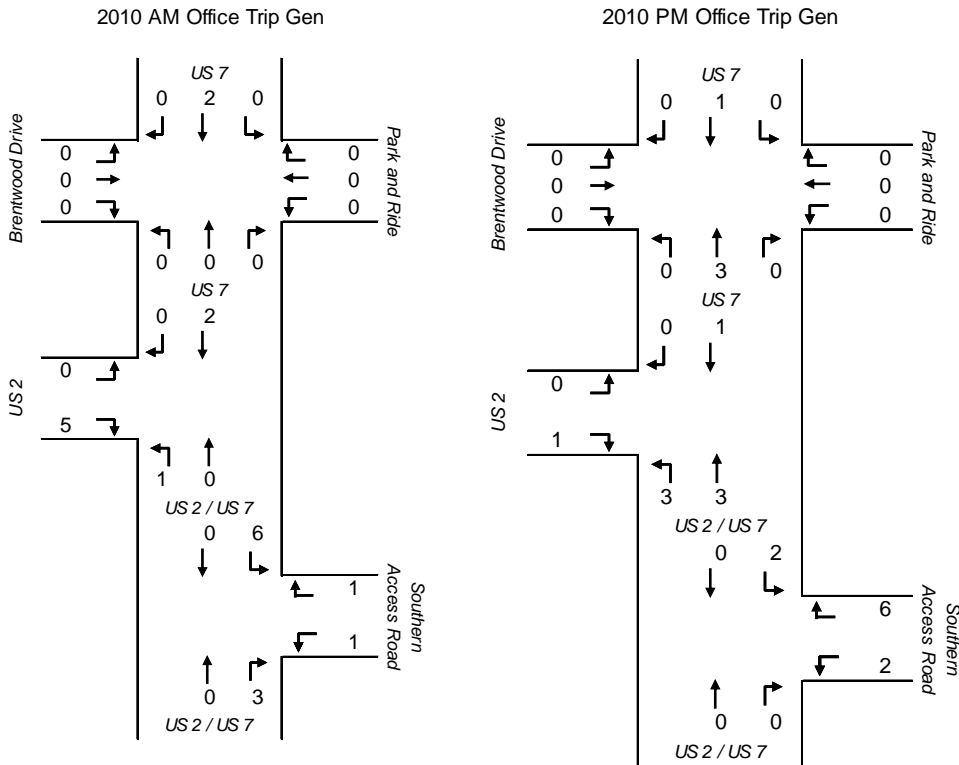


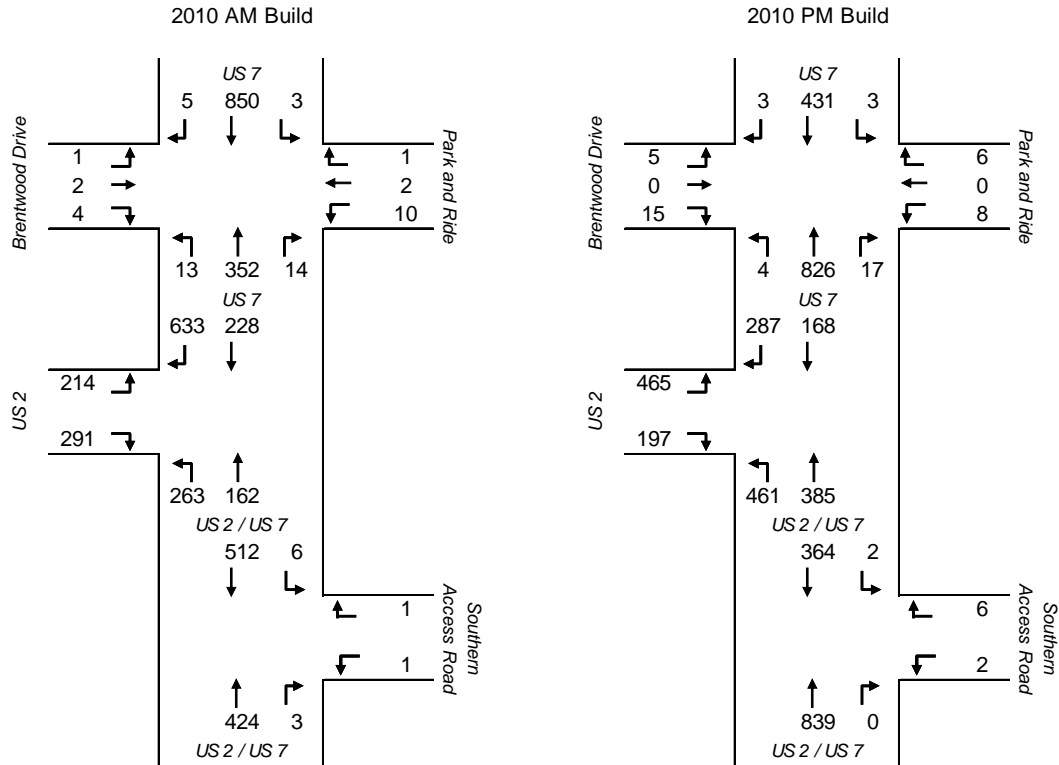
Figure 5: 2010 AM and PM trip assignment resulting from a proposed 6000 sq. ft. office building at Southern Access Drive.



When the trips generated from the office development are added into the overall network, the resulting AM and PM volumes are shown in Figure 6.



Figure 6: 2010 Build AM and PM peak hour volumes with a proposed 6000 sq. ft. office building.



2.4 LOS Analysis

A level of service (LOS) was conducted for the 2010 No-Build and Build scenarios at the Southern Access and Chimney Corners intersection. Synchro (v7), a traffic analysis software package from Trafficware, was used to estimate LOS, volume to capacity ratios (v/c) and vehicle queues in accordance with the 2000 Highway Capacity Manual.

2.4.1 US 2/ 7 and Southern Access Road Intersection

Due to the relatively small sideline demand on the southern access road, an unsignalized intersection with a stop controlled minor leg was assumed. The results follow in Table 3.

Table 3: Analysis results for an unsignalized intersection at US 2 / US 7 and Southern Access Drive.

Scenario		Approach			Overall Intersection
		WB	NB	SB	
2010 AM Build	LOS	B	A	A	A
	v/c	0.01	0.25	0.01	0.25
	95th Queue (ft)	<20	n/a	n/a	-
2010 PM Build	LOS	C	A	A	A
	v/c	0.03	0.49	0	0.49
	95th Queue (ft)	<20	n/a	n/a	-

In both AM and PM peak hours, the southern access road operates at an acceptable LOS. All approaches operate well under a v/c ratio of 1.0, indicating that the intersection is well below capacity. Queues departing the southern access road were minimal. Due to the nature of the unsignalized intersection, the



mainline US 2/ US 7 approaches do not experience any delay or queuing with the addition of the stop controlled sideline.

2.4.2 US 7 and US 2 – Chimney Corners Intersection

The results of the analysis for the 2010 Office Development Build and No Build scenarios at the US 7 and US 2 intersection follows in Table 4.

Table 4: Intersection analysis results for 2010 Build and No-Build scenarios at Chimney Corners.

Scenario		Movement						Overall Intersection
		EBL	EBR	NBL	NBT	SBT	SBR	
2010 AM No-Build	LOS	C	A	A	A	B	A	B
	v/c	0.38	0.41	0.43	0.16	0.36	0.67	0.67
	95th Queue	131	89	93	57	127	130	-
2010 PM No-Build	LOS	C	A	B	B	B	A	B
	v/c	0.77	0.29	0.71	0.39	0.31	0.43	0.77
	95th Queue	341	47	244	149	103	64	-
2010 AM Build	LOS	C	A	A	A	B	A	B
	v/c	0.38	0.42	0.43	0.16	0.36	0.67	0.67
	95th Queue	131	90	94	57	128	130	-
2010 PM Build	LOS	C	A	B	B	B	A	B
	v/c	0.77	0.29	0.72	0.39	0.31	0.43	0.77
	95th Queue	341	47	252	150	103	64	-

For both the AM and PM peak hours, the Chimney Corner intersection operates acceptably under both No-Build and Build scenarios. These results show that the nominal addition of traffic from the proposed office development has no significant impact on the operations of the existing intersection.

3.0 2025 Growth Center Future Conditions

With the removal of the westbound leg of the Chimney Corners intersection, traffic directly entering or exiting TAZ 2 must be re-routed to the remaining access points. This diversion of traffic will change the overall number of vehicles through the Chimney Corners intersection and shift the number of eastbound and westbound through vehicles to turning movements through the intersection. Additionally, it will increase the number of vehicles traveling through the Northern and Southern Access Drives as traffic is routed through these intersections.

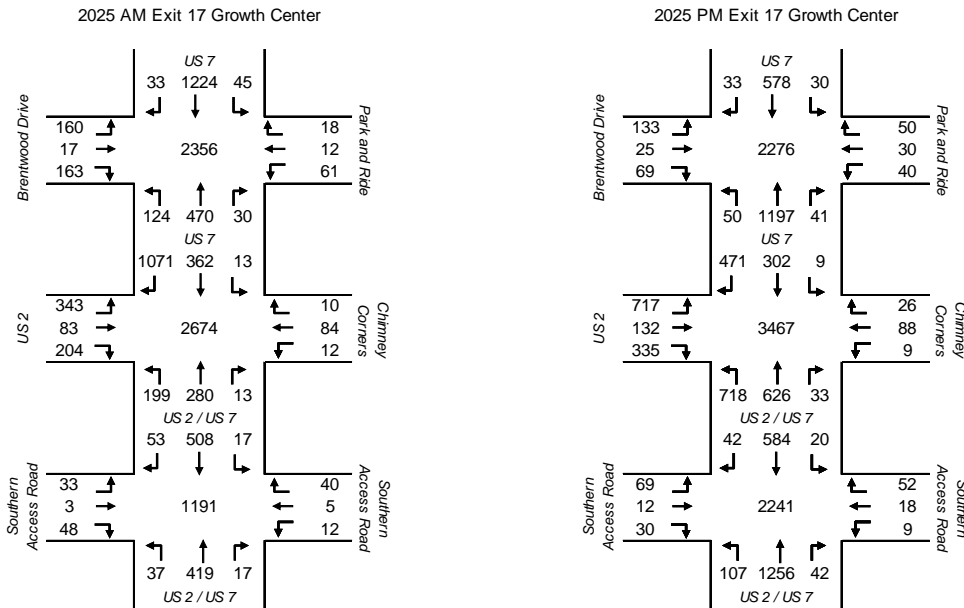
3.1 Revised Volumes and Trip Distribution

The 2025 traffic volumes are based on the projections included in the 2006 *Exit 17 Growth Center Study* and assume full build-out of the growth center¹ and completion of the Circumferential Highway from I-89 in Williston to VT 127 in Colchester. The 2006 *Exit 17 Growth Center Study* also evaluated the effect of a proposed interchange between I-89 and West Milton Road in Milton. The traffic volumes used in this study do not include the West Milton Road interchange. Figure 7 shows the 2025 AM and PM peak hour volumes as presented in the 2006 Study at the study intersections with these assumptions. As shown in Figure 7, the southern access points for TAZ 2 and TAZ 3 are assumed to be aligned to form a four legged intersection with US 2/7. Although not evaluated in the 2006 *Growth Center Study*, volumes for the intersection of TAZ 2/TAZ 3 and US 2/7 have been developed and are presented in the following figures.

¹ The full build-out of the growth center is based on the capacity of an off-site waste water system that was studied by the Town. See the 2006 *Exit 17 Growth Center Study* for additional information.



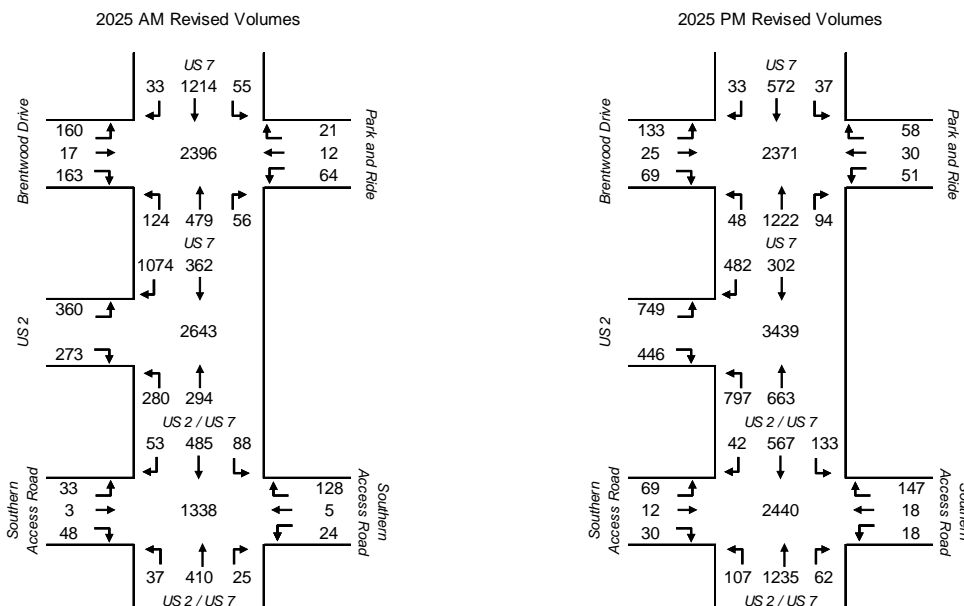
Figure 7: 2025 AM and PM volumes from the Exit 17 Growth Center Study modified to include volumes for the US 2/7 - Southern Access Road Intersection.



The trips associated with TAZ 2 in the 2006 Growth Center Study were subtracted out of the overall volumes presented above, and redistributed based on the updated geometry of the Chimney Corners intersection. These trip distributions can be found in Attachment 1.

The redistribution of trips increases the volume on the southern and northern access roads as traffic that had previously been modeled through the westbound approach of Chimney Corners is redistributed to these access points. Additionally, motorists from points north and south that were previously entering the development at Chimney Corners would now enter TAZ 2 at their first access point, reducing the volume entering Chimney Corners. The final 2025 volumes through the study intersections without the westbound approach of the Chimney Corners intersection are presented in Figure 8.

Figure 8: Revised 2025 AM and PM volumes due to the removal of the westbound approach to Chimney Corners.



3.2 Revised Traffic Analysis

In the 2006 *Exit 17 Growth Center Study*, both roundabout and signalized intersections were recommended for further study for the Chimney Corners and US 7 and Brentwood Drive intersections. For this study, only the signalized intersections will be analyzed at these two intersections as well as the Southern Access Drive intersection to determine if the recommendations are still valid with the revised volumes. For all 2025 analyses, the geometric layout included: 3-way intersection at Chimney Corners; 4-way intersection at Park and Ride/Brentwood Drive; 4-way intersection at the Southern Access Road; and coordinated signalization along the US 7 corridor.

3.2.1 US 2 /7 and Southern Access Road Intersection

The intersection of US 2/7 with the TAZ 2 southern access road was not included in the 2006 *Growth Center Study*. As part of the 2010 office development, an unsignalized intersection was recommended. In this 2025 analysis, an unsignalized intersection with stop controlled approaches from both TAZ 2 and TAZ 3 was analyzed as well as an alternative that includes a traffic signal and additional lanes, as shown in Attachment 2. The resulting traffic analysis is shown in Table 5.

Table 5: 2025 AM and PM traffic analysis results for the US 2 /7 and Southern Access Drive intersection.

Scenario		Movement								Overall Intersection
		EBL/T	EBR	WBL/T	WBR	NBL	NBT/R	SBL	SBT/R	
AM Stop Controlled	LOS	D	-	C	-	A	A	A	A	-
	v/c	0.35	-	0.22	-	0.04	0.04	0.08	0.08	0.35
	95th Queue (ft)	39	-	22	-	-	-	-	-	-
PM Stop Controlled	LOS	F	-	F	-	A	A	A	A	-
	v/c	647.03	-	4.98	-	0.11	0.11	0.25	0.25	647.03
	95th Queue (ft)	>500	-	>500	-	-	-	-	-	-
AM With Signal and Additional Lanes	LOS	C	A	C	A	A	A	A	A	A
	v/c	0.21	0.20	0.16	0.41	0.06	0.21	0.13	0.45	0.45
	95th Queue (ft)	35	27	30	46	13	90	<20	310	-
PM With Signal and Additional Lanes	LOS	C	A	C	A	A	B	A	B	B
	v/c	0.38	0.11	0.15	0.40	0.23	0.71	0.37	0.63	0.71
	95th Queue (ft)	61	20	32	46	34	447	<20	460	-

Due to the higher volumes anticipated from the build out of the Growth Center, an unsignalized intersection would not be appropriate here as recommended for the 2010 scenarios. However, a signalized intersection with additional lanes would operate acceptably on all approaches. Due to the large volume of mainline traffic, vehicle queues are likely at the signal. These queues are not projected to interfere with adjacent intersections and are expected to clear with every phase. The proposed 2025 geometric layout of this intersection can be found as Attachment 2.

3.2.2 US 7 and US 2 – Chimney Corners Intersection

With the removal of the westbound approach at the Chimney Corners intersection, the traffic movements through the intersection have simplified considerably. The overall number of phases has reduced to three from six, and the signalized operation, as well as overall intersection capacity has improved. The AM and PM peak hour LOS results are presented in Table 6, and the lane configuration is illustrated in Attachment 3.



Table 6: 2025 AM and PM traffic analysis results for the US 2 / US 7 Chimney Corners intersection.

Scenario		Movement						Overall Intersection
		EBL	EBR	NBL	NBT	SBT	SBR	
AM Existing Geometry	LOS	C	A	B	A	B	B	B
	v/c	0.76	0.44	0.46	0.26	0.43	0.87	0.87
	95th Queue (ft)	290	65	95	98	182	497	-
PM Existing Geometry	LOS	F	C	F	C	F	B	F
	v/c	1.06	0.60	1.14	0.65	1.06	0.74	1.14
	95th Queue (ft)	>500	393	>500	>500	>500	235	-
AM With Additional Lanes	LOS	B	A	A	A	B	B	B
	v/c	0.29	0.37	0.30	0.32	0.60	0.85	0.85
	95th Queue (ft)	77	52	37	87	181	345	-
PM With Additional Lanes	LOS	C	A	B	A	B	A	B
	v/c	0.69	0.55	0.78	0.66	0.51	0.43	0.78
	95th Queue (ft)	190	80	90	68	86	28	-

When compared with the 2006 *Growth Center Study*, the removal of the westbound approach slightly decreases the volume through the intersection. Additionally, simplified signal phasing due to the reduction in conflicting traffic movements provides more green time to the vehicles in the intersection. These two factors lead to an overall performance improvement from LOS C to LOS B.

3.2.3 US 7 and Brentwood Drive

The removal of the westbound approach at the Chimney Corners intersection led to an overall increase in traffic through the US 7 and Brentwood Drive intersection. The traffic was analyzed under two alternatives: existing stop controlled geometric conditions and with the traffic signal and lane modifications identified in the 2006 *Growth Center Study*. The *Growth Center Study* layout is illustrated in Attachment 4. The traffic analysis is presented in Table 7.



Table 7: 2025 AM and PM traffic analysis results through the US 7 and Brentwood Drive intersection.

Scenario		Movement								Overall Intersection
		EBL/T	EBR	WBL/T	WBR	NBL	NBT/R	SBL	SBT/R	
AM Stop Controlled	LOS	F	-	F	-	B	A	A	A	-
	v/c	7.50	-	17.01	-	0.22	0.31	0.05	0.73	17.01
	95th Queue (ft)	>500	-	>500	-	-	-	-	-	-
PM Stop Controlled	LOS	F	-	F	-	A	A	B	A	-
	v/c	9.58	-	3.70	-	0.05	0.77	0.07	0.36	9.58
	95th Queue (ft)	>500	-	>500	-	-	-	-	-	-
AM With Signal and Additional Lanes	LOS	C	A	B	A	C	B	A	C	B
	v/c	0.62	0.34	0.29	0.06	0.39	0.33	0.11	0.85	0.85
	95th Queue (ft)	112	44	52	<20	83	126	25	425	-
PM With Signal and Additional Lanes	LOS	C	A	B	A	A	A	B	A	A
	v/c	0.57	0.18	0.29	0.16	0.09	0.57	0.19	0.26	0.57
	95th Queue (ft)	112	44	52	<20	86	125	25	425	-

The results from the US 7 – Brentwood Drive analysis indicate that the improvements identified in the 2006 *Growth Center Study* remain effective even when additional traffic is added due to the removal of the westbound approach at the Chimney Corner intersection.

4.0 Conclusions and Recommendations

A proposed 6,000 square foot office building will add an insignificant amount of traffic to the existing US 2 / US 7 corridor. The development will generate about 10 peak hour trips, and the existing capacity of the roadway is sufficient to absorb these new trips. It is recommended that the access to US 2/7 for the proposed office be stop controlled on the minor leg. Delays to the minor leg will be minimal and acceptable.

In consideration of the long term build out of the growth center, it is recommended that this stop controlled intersection be located to ultimately serve as access to both TAZ 2 and TAZ 3. With this in mind, the location of the 2010 three way intersection serving the proposed office should allow for construction of an eastbound approach serving TAZ 3. The ideal location would have no obstructions in corner sight distance at the intersection or stopping sight distance on any approach. Furthermore, the proposed office driveway should intersect with the southern access road at least 200' east of US 2/7. This minimum intersection spacing will allow the necessary lane tapers and storage lengths necessary to accommodate the long-term design of the southern access road approach to US 2/7.

For the 2025 scenarios, the removal of the westbound approach to Chimney Corners significantly alters the trip distribution for development in TAZ 2. This change redistributes the overall volume of traffic from the Chimney Corners intersection to the northern and southern access drives. Additionally, the removal of the westbound approach to Chimney Corners allows for a simplified phasing plan that will improve the level of service as reported in the 2006 *Growth Center Study*. The intersection of the TAZ 2 southern access road with US 2/7 should be aligned with the access road to TAZ 3 and be controlled by a traffic signal. Northbound and southbound left turn lanes should be provided on the US 2/7 approaches to the TAZ 2 and TAZ 3 southern access roads. The intersection of US 7 with Brentwood Drive will also have to accommodate more traffic if a westbound approach to Chimney Corners is not allowed. The design recommended in the 2006 *Exit 17 Growth Center Study*, which includes a traffic signal and turn lanes, can accommodate the additional traffic with an acceptable level of service.

