OBEY CREEK MIXED-USE DEVELOPMENT

TRAFFIC IMPACT STUDY

TECHNICAL MEMORANDUM #2

Prepared for:

The Town of Chapel Hill
Engineering Department

Prepared by:

HNTB North Carolina, PC

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NCBELS License #: C-1554

April 2014

HNTB

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2022 SITE CONCEPT ANALYSIS

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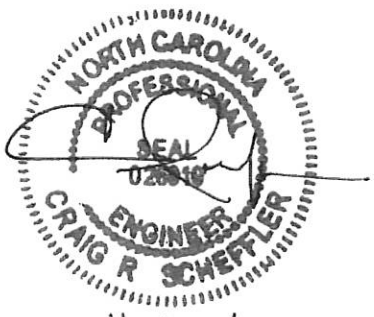

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I. INTRODUCTION

A. Project Overview

A new mixed-use development, tentatively named Obey Creek, is being proposed in southern Chapel Hill and will be located along US 15-501 just east of Southern Village. **Figure 1**, found in ***Appendix A***, shows the general location of the site and the project study area defined for this report and agreed-upon by Town of Chapel Hill staff and the Applicant. This technical memorandum analyzes the 2022 build-out year+1 traffic conditions in the project study area and will be used as a precursor to a final preferred alternative scenario and will be included in a full traffic impact study document that will be prepared following the final preferred alternative scenario analysis. 2013 existing year study area conditions were analyzed in *Obey Creek Mixed Use Development Traffic Impact Study - Technical Memorandum #1 Existing Conditions Analysis*, submitted by HNTB in May 2013.

B. Site Location and Study Area

This technical memorandum defines and analyzes the future transportation system in the Obey Creek project study area. The following 27 existing intersections are part of the project study area:

- NC 86 (Columbia Street) & Franklin Street
- NC 86 (S. Columbia Street) & Cameron Avenue
- NC 86 S (Pittsboro Street) & W. Cameron Avenue
- NC 86 S (Pittsboro Street) & McCauley Street
- NC 86 N (S. Columbia Street) & South Drive
- NC 86 (S. Columbia St) & Manning Drive
- NC 86 (S. Columbia St) & Mason Farm Road
- NC 86 (S. Columbia St) & NC 54 Bypass (Fordham Blvd) WB Ramps
- US 15-501 & NC 54 Bypass (Fordham Blvd) EB Ramps
- US 15-501 & Culbreth Road/Mt. Carmel Church Road
- US 15-501 & Arlen Park Drive/Bennett Road
- US 15-501 & Market Street
- US 15-501 & Southern Village Park & Ride Driveway
- US 15-501 & Dogwood Acres Drive
- US 15-501 & Smith Level Road
- Mt. Carmel Church Road & Bennett Road
- Greensboro Street & NC 54 Bypass (Fordham Blvd) WB On-Ramp/Merritt Mill Road
- Smith Level Road & NC 54 Bypass (Fordham Blvd) EB Ramps
- NC 54 Bypass (Fordham Blvd) WB Off-Ramp & Merritt Mill Road
- US 15-501/NC 54 Bypass (Fordham Blvd) & Manning Drive
- US 15-501/NC 54 Bypass (Fordham Blvd) & Old Mason Farm Road
- US 15-501 Bypass (Fordham Blvd) & NC 54 (Raleigh Rd) Interchange Ramps (4 quadrants)
- NC 54 & Burning Tree Drive/Finley Golf Course Road
- NC 54 & Hamilton Road
- Smith Level Road & Culbreth Road
- Smith Level Road & Dogwood Acres Drive
- Mt. Carmel Church Road & Old Lystra Road

The impacts of the proposed site at the study area intersections will be evaluated during the AM, noon, and PM peak hours of an average weekday, so all 2022 build-out+1 year analyses include these three peak time periods. A planning-level evaluation of daily traffic flows and capacities on study area roadway segments for future conditions will be completed in the analysis of the final design concept.

C. Site Description

The Obey Creek site is currently a heavily wooded parcel with several small residential buildings and driveway access points along US 15-501. Site frontage along US 15-501 would extend from a point north of the existing Market Street intersection down to approximately 200 feet north of the existing Dogwood Acres Drive intersection. No other access to any other transportation facilities in the vicinity of the site parcel currently exists, as land in the central and eastern portions of the site features Obey Creek and significant terrain changes.

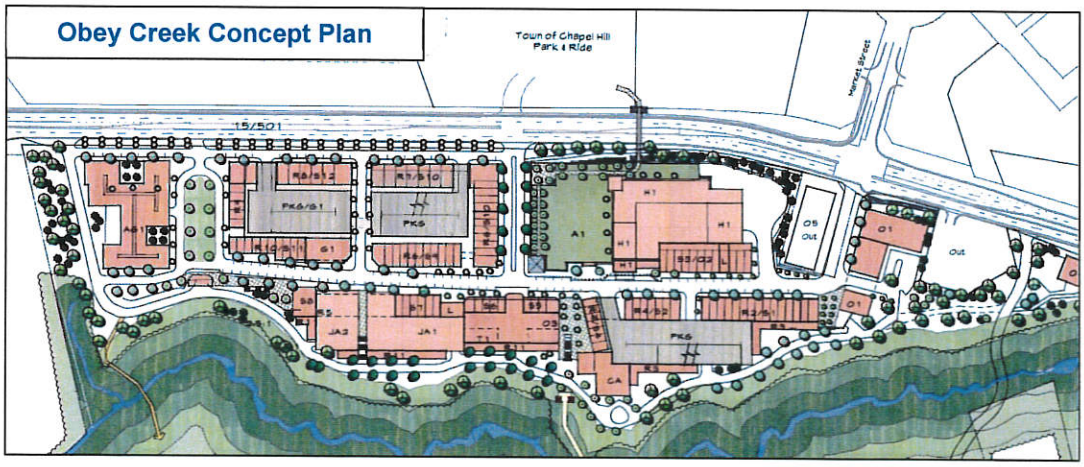
Obey Creek Site Parcel Looking East Near Southern Village P&R Driveway

Obey Creek Site Parcel Looking South Near Southern Village P&R Driveway

D. Proposed Site Concept

The Obey Creek preliminary site concept, developed in January 2014 and analyzed in this study is shown in **Figure 2**. The proposed site concept plan delineates five access points along US 15-501 site frontage. One proposed access point would form the fourth leg of the US 15-501/Market Street intersection. A second proposed full access point would be located directly across from the existing limited access Southern Village Park-and-Ride intersection with US 15-501. Per information from that Applicant, this intersection would feature full access and signalization. The remaining driveways would be right-turn in/right-turn out (RIRO) limited access intersections. A potential pedestrian bridge across US 15-501 is also shown on the plan. The site concept plan also shows potential building footprints and designations, as well as an internal street system and surface and structured parking locations. Land uses for each building footprint are also included and described in more detail in **Section II.C.i** of this report.

Obey Creek Concept Plan



II. FUTURE BUILD-OUT YEAR SCENARIO CONDITIONS

A. Future Ambient Traffic Growth Without Proposed Development

Area-wide ambient traffic growth for the study area was estimated by reviewing data from the latest version of the Triangle Region Travel Demand Model (TRM Version 5.0) and comparing it to historic NCDOT AADT traffic estimates for study area roadways. The TRM can be used to estimate regional traffic growth for the Chapel Hill area by comparing model daily traffic assignments for base year (2010) and future year (2040) conditions. Annual growth percentages, based on model daily traffic assignment data, were approximately 1.20 percent per year from the 2010 base model to 2040, using gross total daily traffic flows around the project study area roadway cordon. Individual link assignments show considerable variability, depending on the relative daily traffic levels, with lower volume facilities sometimes exhibiting high individual increases. Historic NCDOT AADT counts in the project study area also show considerable variability over the last decade, with many locations in the project study area actually showing a decrease in traffic volumes.

Table 1 displays the historic NCDOT AADT count data that is available for study area roadways. Over the last eight years, where data is available, the general trend in the study area is that daily traffic growth is stagnant or actually decreasing in multiple locations. Though historic NCDOT AADT information indicates that, overall, there is little growth (or even negative growth) in traffic volume in the project study area, TRM results in **Table 2** show that future regional traffic growth is expected to occur between the 2010 base year data and 2040 future year model estimates. To conservatively estimate that some growth is likely to occur in the project study area, the gross composite estimate of a 1.20 percent per year factor (corresponding to a 10.8 percent, nine-year growth factor for the estimated 2022 analysis year) applied to 2013 traffic count volumes for the baseline 2022 analysis year for the Obey Creek development.

B. Approved Background Traffic

There are numerous Town-approved developments and development plans under review in or near the project study area. Several projects are either currently under construction or could be fully built-out by the Obey Creek 2022 analysis year. Other projects are in early planning stages and are projected to be longer-term phased developments. There are also several development projects in nearby Carrboro that may have a potential background traffic growth impact on the project study area for Obey Creek.

In addition to specific private development, the Town has conducted a planning study for the NC 54 (Raleigh Road) corridor and the NCDOT is currently studying the US 15-501 Corridor, both studies and any recommendations that are implemented over the next 9 years from them may potentially affect study area background traffic patterns. The results of these studies were also considered in the anticipated traffic patterns and roadway networks in future Obey Creek analyses. These background developments and studies are listed in **Table 3**.

Table 1. Historic Study Area NCDOT AADT Information

NCDOT AADT STATION	ROUTE	LOCATION	Count Year					6/8 Year Growth	Per Year Growth
			2011	2009	2007	2005	2003		
753	SR 1962 (DOGWOOD ACRES)	W OF US 15-501	940	960	630	540	550	71%	8.9%
797	SR 2048 (RALEIGH RD)	W OF US 15-501	21000	20000	21000	20000	16000	31%	3.9%
754	US 15-501	N OF SR 1919 (SMITH LVL RD)	17000	16000	17000	13000	14000	21%	2.7%
793	NC 54	E OF FINLEY GOLF COURSE RD	44000	44000	46000	43000	37000	19%	2.4%
777	US 15-501	S OF SR 1994 (CULBRETH RD)	0	22000	21000	18000	20000	10%	1.7%
781	US 15-501	N OF SR 1008 (MT CARMEL CH)	32000	32000	33000	30000	30000	7%	0.8%
795	NC 54 BYPASS	E OF US 15-501	46000	46000	48000	44000	0	5%	0.8%
827	US 15-501 BYPASS	S OF SR 1750 (ESTES DR)	0	38000	40000	39000	37000	3%	0.5%
780	US 15-501 BYPASS	S OF WINTER RD	0	41000	43000	40000	40000	3%	0.4%
796	US 15-501 BYPASS	S OF NC 54 (RALEIGH RD)	0	51000	53000	51000	50000	2%	0.3%
951	SR 1008 (MT CARMEL CH RD)	S OF SR 1915 (OLD LYSTRA RD)	8700	8800	9400	9000	8700	0%	0.0%
823	NC 86 (N COLUMBIA ST)	N OF SR 1010 (FRANKLIN ST)	18000	18000	16000	16000	18000	0%	0.0%
755	SR 1919 (SMITH LEVEL RD)	S OF SR 1920 (WOODWARD RD)	7100	7000	6900	6700	7400	-4%	-0.5%
952	SR 1915 (OLD LYSTRA RD)	S OF SR 1008 (MT CARMEL CH)	1600	1700	1700	1800	1700	-6%	-0.7%
950	MERRITT MILL RD	E OF ROBERTS ST	11000	10000	11000	11000	12000	-8%	-1.0%
774	NC 54 BYPASS	W OF SR 1919 (SMITH LVL RD)	30000	30000	32000	31000	33000	-9%	-1.1%
779	NC 54 BYPASS	E OF SR 1919 (SMITH LVL RD)	30000	31000	32000	32000	34000	-12%	-1.5%
782	SR 1008 (MT CARMEL CH RD)	E OF US 15-501	9600	9900	11000	11000	11000	-13%	-1.6%
778	SR 1994 (CULBRETH DR)	W OF US 15-501	5000	5100	5300	5600	5800	-14%	-1.7%
811	SR 1919 (S.GREENSBORO ST)	S OF RAND RD	12000	12000	13000	12000	14000	-14%	-1.8%
775	SR 1919 (SMITH LEVEL RD)	S OF NC 54	16000	17000	17000	17000	19000	-16%	-2.0%
790	SR 1902 (MANNING DR)	N OF US 15-501	15000	17000	17000	17000	18000	-17%	-2.1%
824	SR 1010 (FRANKLIN ST)	E OF NC 86 (S COLUMBIA ST)	14000	15000	16000	15000	17000	-18%	-2.2%
807	NC 86	S OF SR 1010 (FRANKLIN ST)	15000	0	17000	16000	19000	-21%	-2.6%
783	NC 86	S OF MASON FARM RD	13000	16000	16000	15000	17000	-24%	-2.9%
786	MASON FARM RD	E OF DANIELS RD	6700	0	8500	7000	8800	-24%	-3.0%
806	CAMERON AVE	W OF NC 86 PITTSBORO ST	7500	9100	7700	7700	10000	-25%	-3.1%
802	SR 2048 (SOUTH RD)	W OF STADIUM DR	7400	7000	8100	8500	10000	-26%	-3.3%
785	SR 1902 (MANNING DR)	W OF WEST DR	11000	11000	12000	13000	15000	-27%	-3.3%

RED = High Volume Regional Arterial Facilities BLUE = 6 Year Data Trends

Table 2. TRM Daily Assignment and Study Area Cordon Growth Patterns 2010-2040

Cordon Segment Location	2010 Assignment	2040 Assignment	Overall Growth	Per Year Growth	2013-2022 Year Growth Factor
Greensboro Street	10,751	14,270	32.7%	1.1%	9.8%
Merritt Mill Road	11,974	14,788	23.5%	0.8%	7.1%
NC 54 Bypass W of Smith Level	31,757	46,790	47.3%	1.6%	14.2%
Smith Level S of Culbreth	13,263	20,065	51.3%	1.7%	15.4%
Smith Level at Wal-Mart	10,673	15,987	49.8%	1.7%	14.9%
US 15-501 South	23,596	34,601	46.6%	1.6%	14.0%
Market St	9,382	10,119	7.9%	0.3%	2.4%
Culbreth (Local)	7,664	8,869	15.7%	0.5%	4.7%
Mt. Carmel Church East	10,487	15,516	48.0%	1.6%	14.4%
Old Lystra	3,148	4,621	46.8%	1.6%	14.0%
Manning Drive East	21,459	27,432	27.8%	0.9%	8.4%
Raleigh Road	34,630	43,484	25.6%	0.9%	7.7%
US 15-501 North	39,412	58,719	49.0%	1.6%	14.7%
NC 54 East	63,371	97,475	53.8%	1.8%	16.1%
W. Cameron Avenue	12,662	13,982	10.4%	0.3%	3.1%
W. Franklin Street	16,490	25,588	55.2%	1.8%	16.6%
NC 86 (N. Columbia Street)	23,687	31,273	32.0%	1.1%	9.6%
E. Franklin Street	13,246	20,072	51.5%	1.7%	15.5%
E. Cameron Avenue	7,523	9,502	26.3%	0.9%	7.9%
South Road	8,545	9,332	9.2%	0.3%	2.8%
Manning Drive West	19,871	26,958	35.7%	1.2%	10.7%
Mason Farm Road	4,533	6,253	37.9%	1.3%	11.4%
Study Area Gross Composite	**398,124**	**555,696**	**39.6%**	**1.3%**	**11.9%**
		individual link mean	**35.6%**	**1.2%**	**10.7%**
		individual link median	**36.8%**	**1.2%**	**11.0%**

Due to the variability in the actual development of the study area background traffic-generating projects, the potential for changes in development intensity and for new developments not yet in the planning process over the next nine years, all specific background traffic growth estimates in the project study area were assumed to be incorporated in the ambient growth rate estimates discussed previously. Since the TRM accounts for projected planning-level development patterns regionally, its results provide a reasonable guide for developing background traffic growth estimates.

The only exception to this methodology is for two developments along US 15-501 near the site that were directly incorporated into the background traffic growth estimations. The new Chatham Wal-Mart was not open for business when original turning movement counts for the Obey Creek study were compiled in April 2013. The Wal-Mart has been open for over six months, and to account for traffic at its driveway intersection and trip assignments beyond the driveway, HNTB completed a new turning movement count in January 2014. The driveway data from this count was added directly to ambient area-wide traffic growth estimates.

The second development, the Southern Village Hotel & Apartments, was analyzed by HNTB in the *Southern Village and Apartments Traffic Impact Study*, November 2013. Per information from Town of Chapel Hill Planning Department staff, this development, located just to the north of the US 15-501 and Market Street intersection, is expected to be constructed prior to the 2022 analysis year – but at this time, plans only include the hotel portion. Site traffic assignments from the previous traffic impact study were directly applied (for the hotel only) to the ambient traffic growth estimates and Wal-Mart data for the Obey Creek 2022 analysis scenarios.

Table 3. Study Area Background Development and Studies

Development / Study Name	Study Area Location	Impacts to Obey Creek Study Traffic Volumes/Network
South Grove Residential	US 15-501 North of Smith Level Road	Specific traffic volume growth from these development projects accounted for in overall study area ambient growth rate
Boys & Girls Club	Merritt Mill Road	
SECU Family House	Old Mason Farm Road	
140 W. Franklin	W. Franklin Street West of NC 86 (Columbia Street)	
123 W. Franklin (University Square)	W. Franklin Street West of NC 86 (Columbia Street)	
Lloyd Farm	Carrboro	
Shelton Station	Carrboro	
Roberson Square	Carrboro	
300 E. Main Street	Carrboro	
UNC Main Campus Development Plan	UNC Campus East of NC 86	
Carolina North	Outside Study Area	
Glen Lennox Redevelopment	NE Quadrant of NC 54 / US 15-501	
Southern Village Hotel & Apartments	US 15-501 North of Market Street	Specific background traffic volumes added to network from 2013 TIS
Chatham County Wal-Mart	US 15-501 and Smith Level Road	Specific background traffic volumes added to network from peak hour traffic count data collected in January 2014
US 15-501 Superstreet Study (Stantec, 2014)	US 15-501 Corridor – Pittsboro to NC 54 Bypass	Compared initial future traffic volume growth estimates with methodology from this analysis
NC 54 / I-40 Corridor Study: Transportation – Land Use Master Plan	NC 54 from US 15-501 to E. Barbee Chapel Road	Proposed improvements considered if study area intersections warrant

Figure 3 shows the relative location of all existing background development projects, according to the latest information from the Town of Chapel Hill and Town of Carrboro Planning Departments, in relation to the Obey Creek site. The figure also shows the location of the recent planning study areas.

Figures 4A, 4B, 5A and 5B show the resulting 2022 No-Build Scenario weekday peak hour traffic volumes that account for ambient and background traffic growth, as previously described.

C. Proposed Project Traffic

i. Trip Generation

The projected trips generated by the proposed Obey Creek development were based on the *ITE Trip Generation Manual* (Institute of Transportation Engineers, 9th Edition, 2012). Seven separate land use types were analyzed for the development. The Applicant's basic development program is as follows:

Table 4. Obey Creek Development Program (January 2014)

Building	Shopping Center Retail	Office	munity Activi	Hotel	Condos	Notes
Anchor	135,000					1 STY + ROOFTOP PARK
JA1	29,000					1-STY
JA2	18,000					1-STY
G1	55,000					1-STY
T1	40,000					
S1	18,190					STREET LVL SHOPS (LESS LOBBY FOR USE ABV.)
S2	7,590					STREET LVL SHOPS (LESS LOBBY FOR USE ABV.)
S3	12,060					STREET LVL SHOPS (LESS LOBBY FOR USE ABV.)
S4	5,800					STREET LVL SHOPS (LESS LOBBY FOR USE ABV.)
S5	3,880					STREET LVL SHOPS (LESS LOBBY FOR USE ABV.)
S6	3,260					STREET LVL SHOPS (LESS LOBBY FOR USE ABV.)
S7	7,150					STREET LVL SHOPS (LESS LOBBY FOR USE ABV.)
S8	5,060					STREET LVL SHOPS/RESTAURANT
S9	13,335					STREET LVL SHOPS (LESS LOBBY FOR USE ABV.)
S10	28,400					STREET LVL SHOPS (LESS LOBBY FOR USE ABV.)
S11	9,200					STREET LVL SHOPS (LESS LOBBY FOR USE ABV.)
S12	13,600					STREET LVL SHOPS (LESS LOBBY FOR USE ABV.)
O1		92,750				3-STY @ 15/501 & 4-STY OVER DRIVE-THRU
O2		57,000				3 STY ABOVE SHOPS
O3		69,000				3 STY ABOVE THEATER
O4		7,500				1.5 STY OVER PARKING
O5						RESERVED
CA			48,000			2 STY BELOW + 2 AT PKG. DECK & ABOVE
H1				117,000		140 KEYS + FUNCTION 3 STY @ 15/501 & 4 STY ABOVE A1 AT MAIN
R2					78,760	4-STY ABV S1
R3					30,000	3 STY
R4					77,780	4 STY OVER SHOPS
R5					79,120	4-STY OVER SHOPS
R6					138,610	5 STY OVER SHOPS AT MAIN & 2-STY OVER SHOPS AT 15/501
R7					27,400	2 STY OVER SHOPS
R8					32,070	2 STY OVER SHOPS
R9					14,400	3 STY
R10					80,800	5 STY OVER SHOPS + 4-STY OVER GROCERY
R11					40,170	3 STY
AG1					181,400	3-STY ON 15/501 & 5 -STY ON MAIN
TOTAL (SF)	404,525	226,250	48,000	117,000	780,510	
TOTAL ALL U	809,050				1,576,285	700 RESIDENTIAL TOTAL

The selection of independent variables and the use of rate-based or equation-based generation methods for each particular land use type follow NCDOT Congestion Management Unit practices. Several assumptions were made, and agreed upon by the Town, Applicant and NCDOT, that allow consolidation of all commercial development into a single ITE Land Use Code (Shopping Center – LUC 820). The Applicant also provided information to separate planned residential components into three separate land use types – apartments, condominiums, and senior adult housing.

Additional information from the Applicant regarding location and intensity of proposed buildings within the Obey Creek site was used to initially determine all respective trip generation and then was used in the trip distribution process. Information in **Table 4** corresponds directly to building footprint locations in **Figure 2**. It should be noted that this plan is conceptual in nature and subject to change.

Table 5 shows the estimated number of trips generated by the Obey Creek site concept during the weekday AM, noon, and PM peak hours of adjacent streets. A truck percentage of two percent was estimated for all site-generated traffic.

The methodology used in **Table 5** follows a progression of:

1) deriving raw unadjusted trips from ITE data,

2) subtracting potential internally-captured trips, using the most recent ITE internal-capture methodologies,

3) reducing the "net" external trips by a transit/multi-modal factor for appropriate land uses, and

4) segregating new external vehicular site trips, diverted linked trips and pass-by type trips.

Both transit trip reduction and internal capture assumptions were discussed, and approved, by Town staff for recent similar mixed-use transit-oriented development projects as part of this process. Additional details and methodologies regarding all trip adjustment factors are contained in the sections following **Table 5**.

Table 5. Weekday Vehicle Trip Generation Summary - Obey Creek Development

1. ITE RAW TRIP GENERATION CALCULATIONS - TOTAL NEW DEVELOPMENT

Land Use	ITE Code	Size	Unit	24 Hour Volumes			AM Peak Hour Trips			Noon Peak Hour Trips			PM Peak Hour Trips		
				Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
Apartments	220	300	Dwelling Unit	971	971	1,942	30	121	151	38	47	84	119	64	183
Condominiums/Townhomes	230	100	Dwelling Unit	322	322	644	9	43	52	13	16	29	40	20	60
Senior Adult Housing - Attached	252	300	Dwelling Unit	516	516	1,032	21	39	60	32	36	68	42	33	75
Hotel	310	140	Rooms	572	572	1,144	43	31	74	43	36	79	43	41	84
Community Rec Center	495	48	1000 SF	812	812	1,624	65	33	98	65	50	115	64	67	131
General Office Building	710	226.25	1000 SF	1,221	1,221	2,442	324	44	368	143	120	263	56	276	332
Shopping Center	820	404.525	1000 SF	8,422	8,422	16,844	227	139	366	481	467	948	734	794	1,528
			TOTAL RAW TRIPS	**12,836**	**12,836**	**25,672**	**719**	**450**	**1,169**	**814**	**772**	**1,585**	**1,098**	**1,295**	**2,393**
2. INTERNAL CAPTURE (FROM ITE CALCULATIONS)				**1,284**	**1,284**	**2,568**	**46**	**46**	**92**	**144**	**144**	**288**	**241**	**241**	**482**
EXTERNAL TRIP GENERATION BEFORE MODAL REDUCTION				**11,552**	**11,552**	**23,104**	**673**	**404**	**1,077**	**670**	**628**	**1,297**	**857**	**1,054**	**1,911**

3. TRANSIT TRIP REDUCTIONS	Daily Factors#			AM Peak Hour %			Noon Peak Hour %			PM Peak Hour %		
	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
Apartments	--	--	1.67	--	--	15%	--	--	7.5%	--	--	15%
Condominiums/Townhomes	--	--	1.67	--	--	15%	--	--	7.5%	--	--	15%
Senior Adult Housing - Attached	--	--	2.00	--	--	20%	--	--	10.0%	--	--	20%
Hotel	--	--	1.11	--	--	10%	--	--	5.0%	--	--	10%
Community Rec Center	--	--	1.67	--	--	15%	--	--	7.5%	--	--	15%
General Office Building	--	--	0.85	--	--	15%	--	--	7.5%	--	--	15%
Shopping Center	--	--	2.21	--	--	15%	--	--	10.0%	--	--	15%

TRANSIT TRIP GENERATION BY LAND USE	ITE Code	Size	Unit	Daily Ridership			AM Peak Hour Trips			Noon Peak Hour Trips			PM Peak Hour Trips		
				Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
Apartments	220	300	Dwelling Unit	251	251	501	4	17	21	2	3	5	14	8	22
Condominiums/Townhomes	230	100	Dwelling Unit	84	84	167	1	6	7	1	1	2	5	2	7
Senior Adult Housing - Attached	252	300	Dwelling Unit	301	301	601	4	7	11	3	3	6	7	5	12
Hotel	310	117	1000 SF	65	65	129	4	3	7	2	1	3	3	3	7
Community Rec Center	495	48	1000 SF	40	40	80	9	5	14	4	3	7	8	8	16
General Office Building	710	226.25	1000 SF	96	96	192	45	6	51	9	7	16	7	33	40
Shopping Center	820	404.525	1000 SF	447	447	894	31	19	51	39	38	78	88	95	183
			TOTAL TRANSIT TRIPS	**1,282**	**1,282**	**2,565**	**98**	**63**	**161**	**60**	**57**	**116**	**131**	**155**	**286**

- Daily Trips Per 1000 SF

Table 5 (Continued). Weekday Vehicle Trip Generation Summary - Obey Creek Development

4. PED/BIKE TRIP REDUCTIONS	Daily Factors			AM Peak Hour %			Noon Peak Hour %			PM Peak Hour %		
	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
Apartments	--	--	0.167	--	--	1.5%	--	--	0.8%	--	--	1.5%
Condominiums/Townhomes	--	--	0.167	--	--	1.5%	--	--	0.8%	--	--	1.5%
Senior Adult Housing - Attached	--	--	0.200	--	--	2.0%	--	--	1.0%	--	--	2.0%
Hotel	--	--	0.111	--	--	1.0%	--	--	0.5%	--	--	1.0%
Community Rec Center	--	--	0.167	--	--	1.5%	--	--	0.8%	--	--	1.5%
General Office Building	--	--	0.085	--	--	1.5%	--	--	0.8%	--	--	1.5%
Shopping Center	--	--	0.221	--	--	1.5%	--	--	1.0%	--	--	1.5%

PED/BIKE TRIP GENERATION BY LAND USE	ITE Code	Size	Unit	Daily Ped/Bike Trips			AM Peak Hour Trips			Noon Peak Hour Trips			PM Peak Hour Trips		
				Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
Apartments	220	300	Dwelling Unit	25	25	50	0	2	2	0	0	1	1	1	2
Condominiums/Townhomes	230	100	Dwelling Unit	8	8	17	0	1	1	0	0	0	0	0	1
Senior Adult Housing - Attached	252	300	Dwelling Unit	30	30	60	0	1	1	0	0	1	1	1	1
Hotel	310	140	Rooms	8	8	15	0	0	1	0	0	0	0	0	1
Community Rec Center	495	48	1000 SF	4	4	8	1	0	1	0	0	1	1	1	2
General Office Building	710	226.25	1000 SF	10	10	19	4	1	5	1	1	2	1	3	4
Shopping Center	820	404.525	1000 SF	45	45	89	3	2	5	4	4	8	9	10	18
			TOTAL PED/BIKE TRIPS	**130**	**130**	**259**	**10**	**6**	**16**	**6**	**6**	**12**	**13**	**15**	**29**

TOTAL EXTERNAL VEHICLE TRIPS (DRIVEWAY VOLUMES)	24 Hour Volumes			AM Peak Hour Trips			Noon Peak Hour Trips			PM Peak Hour Trips		
	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
	10,140	**10,140**	**20,280**	**565**	**335**	**900**	**604**	**565**	**1,169**	**712**	**884**	**1,596**

5. PASS-BY TRIPS	ITE Code	Size	Unit	24 Hour Volumes			AM Peak Hour Trips			Noon Peak Hour Trips			PM Peak Hour Trips		
				Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
Pass-By Trip Rates - Shopping Center	820	404.525	1000 SF	17%	17%	17%	0%	0%	0%	34%	34%	34%	34%	34%	34%
Pass-By Trips				1,213	1,213	2,425	0	0	0	121	116	237	165	187	352
Adjusted Pass-By Trips				1,213	1,213	2,425	0	0	0	119	119	237	176	176	352
			TOTAL PASS-BY TRIPS	**1,213**	**1,213**	**2,425**	**0**	**0**	**0**	**119**	**119**	**237**	**176**	**176**	**352**

6. DIVERTED LINKED TRIPS	ITE Code	Size	Unit	24 Hour Volumes			AM Peak Hour Trips			Noon Peak Hour Trips			PM Peak Hour Trips		
				Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
DL Trip Rates - Shopping Center	820	404.525	1000 SF	14%	14%	14%	0%	0%	0%	28%	28%	28%	28%	28%	28%
Diverted Linked Trips				999	999	1,997	0	0	0	100	96	195	136	154	290
Adjusted DL Trips				999	999	1,997	0	0	0	98	98	195	145	145	290
			TOTAL DIVERTED LINKED TRIPS	**999**	**999**	**1,997**	**0**	**0**	**0**	**98**	**98**	**195**	**145**	**145**	**290**

TOTAL EXTERNAL VEHICLE TRIPS ADDED TO ADJACENT STREETS (NEW TRIPS)	24 Hour Volumes			AM Peak Hour Trips			Noon Peak Hour Trips			PM Peak Hour Trips		
	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
	7,928	**7,928**	**15,858**	**565**	**335**	**900**	**387**	**348**	**736**	**391**	**563**	**954**

ii.) Adjustments to Trip Generation Rates

Raw ITE trip generation estimates for daily and peak hour trips were adjusted for the following factors, in the recommended sequential order for reducing raw trip generation estimates to actual estimated vehicular trips produced by Obey Creek development.

a.) Internal Capture

The land use mix and density proposed for Obey Creek development would exhibit the potential for internally captured trips. The latest ITE methodologies for internal capture calculations automatically compute internally captured trips from raw vehicular trip generation data whenever two or more land use categories (that would be included in a mixed-use development) are aggregated. Information from the ITE results (See ***Appendix B*** for ITE trip generation output sheets) was used in reducing raw trip generation estimates. It was assumed that daily internal capture rates would be 10 percent of total daily generated trips, based on the range of AM and PM capture rates which varied between 8 and 20 percent. Noon peak internal capture data was estimated to be an average of AM and PM peak hour totals, and was compared to overall noon peak trip generation data for computation of internal capture percentages. **Table 6** displays the aggregate internal capture percentages for each peak hour. Summary results for internal capture reductions were applied directly to the raw trip generation rates and volumes and are shown previously in **Table 5**.

Table 6. Summary Internal Capture Rates

Statistic	24 Hour Daily Volumes			AM Peak Hour Trips			Noon Peak Hour Trips			PM Peak Hour Trips		
	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
Raw ITE Data	12,836	12,836	25,672	719	450	1,169	814	772	1,585	1,098	1,295	2,393
Internal Capture	1,284*	1,284*	2,568*	46	46	92	144	144	288	241	241	482
Internal %	**10%***	**10%***	**10%***	**6%**	**10%**	**8%**	**18%**	**19%**	**18%**	**22%**	**19%**	**20%**

* - No Specific ITE Calculation Available for Daily Trips

This information is incorporated in **Table 5** in Step 2, where internally captured trips are removed from raw overall trip estimates. No specific identification or estimate of modal distribution of internally captured trips was made for this study. A comparison of this information with the *Traditional Neighborhood Development Trip Generation Study* (Khattak, Stone, April 2004) made for the adjacent Southern Village neighborhood indicates potentially good correlation with that study's results which indicated internal capture rates for some trip types of approximately 20 percent (page v.).

b.) Modal Split

Transit
Since the study area is well served by several CHT and Triangle Transit fixed bus routes, with frequent existing service, and also has facilities for pedestrians and bicyclists with

potentially improved connectivity after the project is constructed, an analysis was conducted to estimate trip reductions for these modes. The basis for modal split estimation relies on three data sources:

a) existing field data that compares vehicle and transit trips to/from the existing adjacent Southern Village development and results from the *Traditional Neighborhood Development Trip Generation Study*;

b) information provided by the Town of Chapel Hill, including the document "Chapel Hill Payment-in-Lieu – Transit Trip Generation"; and

c) research and case studies compiled for the Transportation Research Board (TRB) Transit Cooperative Research Program (TCRP) *Report 128 – Effects of Transit-Oriented Development on Housing, Parking, and Travel* (Arrington and Cervero, 2008). Case study developments presented in the research that had similar characteristics as the proposed Obey Creek development and existing/future transit service along US 15-501 were analyzed for trip generation rates, mode splits, number of automobiles owned, and parking generation rates.

Existing Field Data – Southern Village Comparison

Chapel Hill Transit staff provided the following information in **Table 7** related to 2013 ridership for specific routes directly serving the existing Southern Village development and adjacent Southern Village Park-and-Ride Lot. Boarding and alighting data (corresponding to "trips" exiting and entering Southern Village, respectively) was summarized for the total amount of peak hour and daily transit activity "produced" by Southern Village – minus estimates for the Park-and-Ride Lot usage. Route V, which winds through the existing development, was assumed to have all its transit trips related specifically to Southern Village. Bus stops that are located immediately along the Southern Village frontage with US 15-501 were included in both route data sets, though ridership at these locations may be related to other development located along US 15-501. The purpose of the compilation is to compare existing vehicular traffic levels in Southern Village with projected transit trip generation methodologies described below.

Table 7. CHT Transit Ridership Within/Adjacent to Southern Village

Route	Daily			AM Peak			Noon Peak			PM Peak		
	OFF (Enter)	ON (Exit)	Totals	OFF (Enter)	ON (Exit)	Totals	OFF (Enter)	ON (Exit)	Totals	OFF (Enter)	ON (Exit)	Totals
NS*	118	103	221	2	32	34	19	13	32	25	3	28
V	125	124	249	6	39	45	9	8	17	23	2	25
Total	**243**	**227**	**470**	**8**	**71**	**79**	**28**	**21**	**49**	**48**	**5**	**53**

* - Data Assumes 25% Southern Village/75% Park-and-Ride Usage Estimate for AM and PM peak hours

Table 8 provides a comparison of the CHT transit ridership data and available vehicular count data tabulated for all entrances/exits to/from the existing Southern Village parcel. Daily and peak hour volumes were not collected for all access points to/from Southern Village in the spring 2013 traffic counts for the Obey Creek project, so estimates from both raw ITE trip generation information and previous studies were used. Results indicate that general mode splits are in the four to seven percent range for both peak hour and daily trips.

Table 8. Transit/Vehicle Mode Splits for Southern Village From Field Data

Time Period	Transit Trips	Vehicle Trips	Mode Split	
			Transit	Vehicle
AM Peak	79	1,152	6.4%	93.6%
Noon Peak	49	650	7.0%	93.0%
PM Peak	53	1,168	4.3%	95.7%
Daily	470	12,609	3.6%	96.4%

Transit Trip Generation Estimates

Using the information from **Table 8** and general results from the TCRP Report 128, the mode splits for each proposed Obey Creek land use type were calculated, and are shown in **Table 9**. Information from the "Chapel Hill Payment-in-Lieu – Transit Trip Generation" study was analyzed, but was not used to develop peak hour transit mode splits because estimated transit trip generation factors in this document do not correlate well with overall ITE vehicular trip generation factors for several land use types. For example, the summary transit trip generation rates and resulting mode splits for the proposed Obey Creek land uses and densities would result in estimates of 40 percent or greater transit mode share compared to ITE vehicle trip data. However, the overall daily transit trip generation rates from the "Payment in Lieu – Transit Trip Generation Study" show reasonable correlation with existing field data and could be used to compute transit trip reduction factors from raw ITE trip generation results.

Table 9. Obey Creek Development Selected Transit Trip Reductions

Proposed Land Use	Daily Factors*	AM Peak Hour %	Noon Peak Hour %	PM Peak Hour %
Apartments	1.67	15%	7.5%	15%
Condominiums/Townhomes	1.67	15%	7.5%	15%
Senior Adult Housing - Attached	2.00	20%	10.0%	20%
Hotel	1.11	10%	5.0%	10%
Community Rec Center	1.67	15%	7.5%	15%
General Office Building	0.85	15%	7.5%	15%
Shopping Center	2.21	15%	10.0%	15%

* - From *Chapel Hill Payment-in-Lieu – Transit Trip Generation*, Renaissance Planning Group, 2012. Data Reflects Transit Trip Generation Rate Per 1,000 Square Feet of Development

Though no standard, simplified estimates for peak hour mode splits and trip generation rates are directly presented in the TCRP Report 128 information, the aggregate data suggests that a 10-20 percent vehicle trip reductions for a higher density/transit-oriented development with proximal, high frequency transit service is achievable. This 10-20 percent represents transit trips that are made after internal trips are removed from original raw trip generation estimates. This estimate correlates well with recent, generalized data on trip making characteristics for Chapel Hill and Orange County from the 2008 American Community Survey (source: *2010 Town of Chapel Hill Data Book*, pg 7.6-7.8). This data suggests that about 70 percent of Chapel Hill and 80 percent of Orange County work-related trips were made by single occupant vehicles or car pools.

As shown in **Table 9**, a 15-20 percent transit trip reduction factor is estimated for Obey Creek residential and commercial trips. A slightly lower 10 percent factor was estimated for hotel trips, as this land uses may likely not generate trips to the degree of other land uses. Similarly, the senior adult housing estimates may be slightly higher than a baseline 15 percent in the AM and PM peak hours, due to a higher potential capture rate/lower vehicle ownership rate. Since noon hour transit service is not provided with the same frequency as AM and PM peak service, transit trip reduction estimates were assumed to be 50 percent of the peak hour estimates. As a comparison of these results to the *Traditional Neighborhood Development Trip Generation Study* for Southern Village, that study indicated 11-13 percent transit mode shares for residential trips (Table 4-9, page 4-11).

Table 5 shows the effects of transit trip reductions on trip generation data in Step 3, after internally-captured trips are removed in Step 2.

By applying the transit trip reduction percentages to overall external trip generation estimates, rough estimates of actual daily and peak hour transit trips can be obtained. These results are shown in **Table 10**. Compared to daily and peak hour existing transit ridership data for Southern Village in **Table 7**, the Obey Creek development would represent significant increases in transit ridership, in the order of four to five times greater than existing ridership levels within to the adjacent Southern Village site.

Table 10. Total Transit Trip Generation Estimates

Daily Ridership			AM Peak Hour Trips			Noon Peak Hour Trips			PM Peak Hour Trips		
Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
1,282	1,282	2,565	98	63	161	60	57	116	131	155	286

Pedestrian/Bicycle Trips

To make some initial estimates of potential pedestrian and bicycle activity related to the Obey Creek development external to the site, a rough estimate of 10 percent of total transit trip generation data was used and is shown in **Table 11**. It should be noted that a significant percentage of potential pedestrian trips to/from the Obey Creek site would be locally-based, accessing the Southern Village development or Town of Chapel Hill Southern Community Park adjacent to the Obey Creek site. Any pedestrian trips made for the purposes of transit access at the existing Park-and Ride across US 15-501 would be considered under the transit trip generation reductions. Any pedestrian trips internal to the site would be considered under the internal trip reduction methodology.

Data found in the *Traditional Neighborhood Development Trip Generation Study* for Southern Village indicates that there is/was a high percentage of mode share for walk trips from residential development within the site (17-20 percent) and small percentages of bike trips (less than one percent). The walk trips would almost exclusively be considered internal trips, in this case.

Table 11. Total Pedestrian/Bicycle External Trip Generation Estimates By Phase

Daily Ridership			AM Peak Hour Trips			Noon Peak Hour Trips			PM Peak Hour Trips		
Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
130	130	259	10	6	16	6	6	12	13	15	29

Though this methodology for estimating external pedestrian and bicycle trips produces only small levels of trip-making via these modes, consideration for these modes will be made in any analyses and recommendations for the study since the likelihood will exist for an increase in biking and walking trips in the immediate project vicinity due to the development of Obey Creek.

c.) Pass-by and Diverted Linked Trips

Pass-by trips are accounted for in this study for retail components of the proposed Obey Creek development plan. ITE and NCDOT approved standards were incorporated for pass-by trip estimates and were applied to trip generation estimates after internally-captured trip reductions and transit/non-motorized trip reductions are applied.

ITE data only provides pass-by and diverted linked trip percentages for the PM peak hour. However, it will be assumed that PM peak rates would also apply to the noon peak hour (when retail would be open for business) and would be 0 percent for the AM peak hour, when retail typically would not be open. Daily overall estimates that are 50 percent of the PM peak hour estimates were also applied. Raw pass-by and diverted linked trip data will be balanced for inbound and outbound flows to achieve a 50-50 split of entering and exiting trips at site driveways serving Obey Creek retail components along US 15-501. **Table 12** shows pass-by trip generation percentages used in this study.

Table 12. Applied Pass-by Trip Generation Percentages

Land Use	Daily Estimate	ITE Pass-By Rates		
		AM	Noon	PM
Shopping Center (Retail)	17.0%	0.0%	34.0%	34.0%

Diverted linked trips are considered to be trips with an origin and destination not related to the Obey Creek site, but may be diverted to the Obey Creek site retail component and then to their final destination. The location of Obey Creek in relation to other significant study area transportation facilities would allow the potential for diverted linked trips from the following facilities:

- NC 54 Bypass (Fordham Boulevard) eastbound-westbound trips diverted to US 15-501/Obey Creek
- NC 86 (S. Columbia Street) northbound-southbound trips that normally access NC 54 Bypass at the interchange diverted to US 15-501/Obey Creek

The quantification of diverted linked trips was made through the review of previous data for similar shopping centers found in the *ITE Trip Generation Handbook, Second Edition*. Approximately 20 such similar data sets (see Table 5.6 in the Handbook) are available for

shopping centers ranging from 200,000 to 600,000 square feet (404,000 square feet of retail is proposed in the Obey Creek development plan documentation). An average of diverted linked trip percentages from those studies is used in the development of this trip type for Obey Creek. Diverted linked trips were assigned along the US 15-501 corridor to/from the facilities identified above and assigned to the appropriate proposed driveways serving the retail development component. **Table 13** summarizes the *ITE Trip Generation Handbook* data.

Table 13. ITE Diverted-Linked Trip and Pass-by Trip Percentages for LUC 820 – Shopping Center (PM Peak Data Only)

Site #	Size (1000 SF)	Diverted Linked Trip %	Pass-by Trip %
1	235	36%	35%
2	350	37%	18%
3	294	24%	25%
4	256	22%	27%
5	418	29%	20%
6	560	32%	19%
7	361	29%	17%
8	375	22%	30%
9	413	20%	28%
10	488	13%	12%
11	293	6%	24%
12	225	33%	35%
13	255	39%	24%
14	450	28%	23%
15	598	28%	17%
16	581	29%	18%
17	476	20%	26%
18	402	27%	48%
19	234	33%	46%
20	352	43%	38%
21	549	41%	33%
Averages	**389**	**28%**	**27%**

Thus, 28 percent of total external vehicular trips related to retail uses (and adjusted previously for internal capture estimates and transit/non-motorized trip reduction factors) would be considered to be diverted linked trips. The data shows 27 percent of total external vehicular trips related to retail uses to be pass-by trips, which is in the range of ITE/NCDOT recommended values. **Table 14** shows the diverted linked trip percentages, based on the data and methodology as described above.

Table 14. Applied Diverted-Linked Trip Percentages

Land Use	Daily Estimate	ITE Diverted Linked Trip Rates		
		AM	Noon	PM
Shopping Center (Retail)	14.0%	0.0%	28.0%	28.0%

After the application of all previous trip adjustments were made to each sub-phase and aggregated by phase, the total anticipated trip generation for Obey Creek was calculated and is shown in **Table 15**. **Table 15** lists anticipated overall trip generation for all driveways that will serve Obey Creek, as well as net external trips to be added to the study area network. Driveway volumes are higher, due to the presence of pass-by and diverted linked trips that utilize the driveways. As previously discussed pass-by trips represent no additional increase to traffic volumes on the study area network, and diverted linked trips will represent additional increases and changes to traffic flows between the existing US 15-501/NC 54 Bypass interchange and the Obey Creek site.

d.) Trip Generation Budget

Current plans for Obey Creek and discussions with the Applicant indicate that a phased construction process will likely occur over a multi-year horizon. For the purposes of this Concept Analysis, it was agreed upon by all stakeholders that a single analysis of total project build-out would be the most appropriate means of quantifying initial impacts of the proposed site.

Any additional phased analysis necessary for the Obey Creek project will be done either in the next refined analysis/concept phase of this traffic impact study, or will be done as future updates to the traffic study, as needed.

iii.) Trip Distribution

Trip distribution for site-related traffic was based on existing daily traffic patterns to determine the directional peak hour characteristics of traffic to and from the site from the major study area thoroughfares and from some of the lower volume minor arterials and collector streets, based on anticipated trip productions to/from nearby residential or commercial development areas. Local trips to/from several lower volume collector and residential streets were estimated in the analysis, as the possibility exists that a small portion of trips may occur to/from these local streets. The process for distributing trips to/from Obey Creek development used the following methodology.

- External Trip Distribution

  Trips to/from the Obey Creek site were primarily assumed to enter/exit the network from external study area network locations. Small percentages of trips (1 to 2 percent) were assumed to originate/terminate from development areas and residential neighborhoods served by roadway facilities in the project study area, while larger distributions were assumed for higher volume arterial facilities that connect to the UNC Main Campus/downtown Chapel Hill and other areas of Chapel Hill and Carrboro beyond the immediate project study area, as well as regional trips to/from Durham, the Triangle and Chatham County. Trips were assumed to use the most direct paths from external points to access Obey Creek site via US 15-501, the NC 54 Bypass, or collector / local roadways near the Obey Creek site.

Table 15. Obey Creek Development - Summary Trip Generation Data

Trip Generation Step	24 Hour Volumes			AM Peak Hour Trips			Noon Peak Hour Trips			PM Peak Hour Trips		
	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
1. ITE Raw Trip Generation Calculations	12,836	12,836	25,672	719	450	1,169	814	772	1,585	1,098	1,295	2,393
2. Internal Capture	-1,284	-1,284	-2,568	-46	-46	-92	-144	-144	-288	-241	-241	-482
EXTERNAL TRIP GENERATION BEFORE MODAL REDUCTION	**11,552**	**11,552**	**23,104**	**673**	**404**	**1,077**	**670**	**628**	**1,297**	**857**	**1,054**	**1,911**
3. Transit Trip Reductions	-1,282	-1,282	-2,565	-98	-63	-161	-60	-57	-116	-131	-155	-286
4. Ped/Bike Trip Reductions	-130	-130	-259	-10	-6	-16	-6	-6	-12	-13	-15	-29
TOTAL EXTERNAL VEHICLE TRIPS (DRIVEWAY VOLUMES)	**10,140**	**10,140**	**20,280**	**565**	**335**	**900**	**604**	**565**	**1,169**	**712**	**884**	**1,596**
5. Pass-By Trips	-1,213	-1,213	2,425	-0	-0	-0	-119	-119	-237	-176	-176	-352
6. Diverted Linked Trips	-999	-999	1,997	-0	-0	-0	-98	-98	-195	-145	-145	-290
TOTAL EXTERNAL VEHICLE TRIPS (NEW TRIPS)	**7,928**	**7,928**	**15,858**	**565**	**335**	**900**	**387**	**348**	**736**	**391**	**563**	**954**

Initial raw and revised external trip distribution proportions are shown in **Table 16**. Several raw proportions were revised, as potential site-related trips would either be expected to use other more direct roadway connections to/from the Obey Creek site, or the local AADT proportions do not address the likely potential of regionally-based trips. The most pertinent example of this is the need to adjust overall totals in the downtown Chapel Hill/UNC Main Campus area that would utilize NC 86 (S. Columbia Street) to access the Obey Creek site to provide a more realistic comparison to other external distribution nodes.

Table 16. External Trip Distribution Assumptions

Study Area Cordon Roadway	Entry ID	2010 TRM	2011 AADT	Raw TRM Proportion	Revised Proportion
Greensboro Street	1	10,751	12,000	3.6%	3%
Merritt Mill Road	2	11,974	11,000	4.0%	1%
NC 54 Bypass Using Smith Level	3a	N/A	N/A	N/A	2%
NC 54 Bypass Using 15-501	3b	31,757	30,000	10.6%	10%
Smith Level South of Culbreth	4	1,222	--	0.4%	1%
Smith Level North of Dogwood Acres	5	1,135	940	0.4%	1%
Smith Level South of Dogwood Acres	6	1,135	940	0.4%	0%
Smith Level at Wal-Mart	7	1,510	--	0.5%	1%
US 15-501 South	8	23,596	23,000	7.9%	13%
Market Street	9	6,255	N/A	2.1%	2%
Arlen Park Drive	10	3,127	N/A	1.0%	1%
Culbreth Street (Local)	11	5,236	5,000	1.7%	1%
Bennett Road	12	4,353	N/A	1.5%	1%
Mt. Carmel Church Road East	13	10,487	8,700	3.5%	3%
Old Lystra Road	14	3,148	1,600	1.0%	1%
NC 86 S. Columbia Street (Cut Line)	15	25,462	13,000	8.5%	**22%**
Manning Drive	16	21,459	15,000	7.2%	2%
Raleigh Road	17	34,630	21,000	11.5%	2%
US 15-501 North	18	39,412	38,000	13.1%	17%
NC 54 East	19	63,371	44,000	21.1%	16%
Cordon Sum		**300,020**		**100%**	**100%**

Blue/Green/Red Cells = Centroid Connector Data; Grey Cells = Dogwood Acres Drive AADT;
Olive Cell = 2013 AADT Data from Traffic Count ; Orange Cell = Result from **Table 16a**

Table 16a. UNC/Downtown Chapel Hill Sub-Area

Study Area Cordon Roadway	Entry ID	2010 TRM	2011 AADT	Raw TRM Proportion	Revised Proportion	Obey Creek Cordon Proportion
W. Cameron Avenue	1	12,662	7500	11.9%	10%	2%
W. Franklin Street	2	16,490	13,000	15.5%	15%	3%
NC 86 (N. Columbia Street)	3	23,687	18,000	22.2%	28%	6%
E. Franklin Street	4	13,246	14,000	12.4%	12%	3%
E. Cameron Avenue	5	7,523	N/A	7.1%	5%	1%
South Road	6	8,545	7,400	8.0%	5%	1%
Manning Drive	7	19,871	11,000	18.6%	15%	3%
Mason Farm Road	8	4,533	6,700	4.3%	10%	2%
Cordon Sum		**106,557**		**100%**	**100%**	**22%**

Figures 6A and 6B present the projected external trip distribution traffic percentages for the proposed site in the 2022 Build-out+1 scenario.

- Driveway Trip Distribution
  From the external trip distribution estimates to/from the general site location, trips were distributed to site access points based on the spatial relationship of the trips generated by an individual development building footprints, as defined in **Figure 2**. Since the Obey Creek site has multiple proposed external access connections to US 15-501 adjacent to the site, in addition to a fully developed internal street network as shown on the site concept plan, several assumptions were made to route site-related traffic to origins/destinations within the site. Trip generation data was broken out for external site trips to assign specific trip generation to each driveway, based on the most proximal land uses/parking that each would serve. ***Appendix C*** contains the detailed driveway breakout data and methodology.

- Pass-By Trip Distribution
  The distribution of pass-by trips differs from the external (new) trip distribution in that pass-by trips would have directional distribution patterns specific to the adjacent US 15-501 where pass-by trip-making would be expected. The pass-by trip distribution and assignment was then estimated separately from new site trips. It was assumed that the following overall pass-by percentages would occur, based on the relative weight of existing 2013 peak period traffic counts northbound and southbound on US 15-501:

  - 5%/4% To/From US 15-501 Northbound at Site Driveway #2 (Noon/PM Peak, respectively)
  - 30%/30% To/From US 15-501 Northbound at Site Driveway #3
  - 15%/15% To/From US 15-501 Northbound at Site Driveway #4
  - 5%/6% To/From US 15-501 Southbound at Site Driveway #2
  - 30%/30% To/From US 15-501 Southbound at Site Driveway #3
  - 15%/15% To/From US 15-501 Southbound at Site Driveway #4

  Relative pass-by trip proportions for the each of the roadways described above were routed to the site access point (and removed, as appropriate, from through traffic streams related to each pass-by distribution). **Figure 7** presents the projected pass-by trip distribution traffic percentages for the proposed site in the 2022 build-out year+1 scenario.

- Diverted Linked Trip Distribution
  The distribution of diverted-linked trips uses the assumption that distribution patterns are specific to the noon and PM peak hour existing traffic volumes at the US 15-501 / NC 54 Bypass interchange where diverted-linked trip-making would be expected to occur. The diverted-linked trip distribution and assignment was then estimated separately from new site trips and pass-by trips. It was assumed that the following overall diverted-linked percentages in **Table 17** would occur, based on the relative weight of existing peak period traffic counts:

Table 17. Diverted Linked Trip Distribution

Noon Peak Hour	Diverted Flow Direction	PM Peak Hour
15%	NC 86 Southbound to NC 54 Bypass Westbound	17%
7%	NC 86 Southbound to NC 54 Bypass Eastbound	5%
31%	NC 54 Bypass Eastbound to NC 54 Bypass Eastbound	46%
12%	NC 54 Bypass Eastbound to NC 86 Northbound	9%
30%	NC 54 Bypass Westbound to NC 54 Bypass Westbound	21%
5%	NC 54 Bypass Westbound to NC 86 Northbound	2%
100%	**Totals**	100%

All diverted-linked trip distribution percentages were broken out at the individual site driveways using the same basic methodology employed for the pass-by trips, where 30 percent of trips enter/exit at Driveway #4, 60 percent enter/exit at Driveway #3 and 10 percent enter/exit at Driveway #2. **Figure 7** presents the projected diverted-linked trip distribution traffic percentages for the proposed site in the 2022 build-out year+1 scenario.

iv.) Trip Assignment

Appendix D contains a summary of the site traffic volumes distributed on the 2022 study area network. Total volumes into and out of the site correspond to total external vehicular trips generated, based on the trip generation methodology developed previously. **Table 10** lists the anticipated transit trip generation totals from Obey Creek site. Additional transit capacity may be necessary to serve demand generated by Obey Creek site. No specific determination of distribution and assignment of these trips was made for this study. Similarly, no specific forecasts or estimates of pedestrian or bicycle trip distribution and assignment were made for this study.

D. Future Traffic Forecasts with the Proposed Development

Figures 8A, 8B, 9A and 9B display the 2022 projected study area traffic volumes with site traffic added. These traffic volumes represent the aggregate traffic growth over existing traffic volumes for a) ambient traffic growth, b) specific background site-related traffic assignments, and c) estimated overall site traffic assignments for the Obey Creek development that include all external new trips, diverted linked trips and pass-by trips.

III. 2022 PEAK HOUR INTERSECTION LEVEL OF SERVICE ANALYSIS

A. Methodology

Evaluation of traffic operations on suburban arterials is most effective through the determination of level of service (LOS) criteria. The concept of level of service correlates qualitative aspects of traffic flow to quantitative terms. This enables transportation professionals to take the qualitative issues, such as congestion and substandard geometrics, and translate them into measurable quantities, such as operating speeds and vehicular delays. The 2010 *Highway Capacity Manual (HCM 2010)* characterizes level of service by letter designations A through F. Level of service A represents ideal low-volume traffic operations, and level of service F represents over-saturated high-volume traffic operations. Level of service is measured differently for various roadway facilities, but in general, level of service letter designations are described by the following in **Table 18**.

Table 18. Level of Service (LOS) Characteristics

Level of Service Description	Per Vehicle Delay at Signal	Per Vehicle Delay at Stop Sign
LOS A ➢ Free flow ➢ Freedom to select desired speed and to maneuver is extremely high ➢ General level of comfort and convenience for motorists is excellent	**< 10.0 sec**	**< 10.0 sec**
LOS B ➢ Stable flow ➢ Other vehicles in the traffic stream become noticeable ➢ Reduction in freedom to maneuver from LOS A	**10.0 – 20.0 sec**	**10.0 – 15.0 sec**
LOS C ➢ Stable flow ➢ Maneuverability and operating speed are significantly affected by other vehicles ➢ General level of comfort and convenience declines noticeably	**20.0 – 35.0 sec**	**15.0 – 25.0 sec**
LOS D ➢ High density but stable flow ➢ Speed/freedom to maneuver are very restricted ➢ General level of comfort / convenience is poor ➢ Small increases in traffic will generally cause operational problems	**35.0 – 55.0 sec**	**25.0 – 35.0 sec**
LOS E ➢ Unstable flow ➢ Speed reduced to lower but relatively uniform value ➢ Volumes at or near capacity level ➢ Comfort and convenience are extremely poor ➢ Small flow increases or minor traffic stream disturbances will cause breakdowns	**55.0 – 80.0 sec**	**35.0 – 50.0 sec**
LOS F ➢ Forced or breakdown flow ➢ Volumes exceed roadway capacity ➢ Formation of unstable queues ➢ Stoppages for long periods of time because of traffic congestion	**> 80.0 sec**	**> 50.0 sec**

The *Synchro Professional Version 7* operations analysis software was used to analyze peak hour conditions at signalized intersections. The *Highway Capacity Software (HCS+ Version 5.6)* was used to analyze peak hour conditions at unsignalized intersections.

The minimum acceptable peak hour intersection level of service established for this project is LOS D for signalized intersections or LOS E for critical movements at unsignalized intersections, or no increase in delay for signalized intersections operating below LOS D or unsignalized intersection critical movements operating below LOS E without the inclusion of site traffic. These conditions and thresholds will be further analyzed and mitigation recommendations made for future scenarios that account for No-Build and Build development scenarios for the Obey Creek site.

The results of this analysis are based on the procedures presented in the *HCM 2010* and performed with the corresponding capacity analysis software described previously. The methodology of evaluating each condition for signalized intersections is to use current Town of Chapel Hill data for the cycle length and splits of individual signalized intersections and report LOS and delay values from Synchro. There are several traffic signals in the project study area that operate as "free-run" signals at all times. These were analyzed as such in all scenarios. Input data includes traffic volumes, truck percentages, individual approach peak hour factors, and pedestrian data for all study area intersections.

Appendix E contains the Synchro output for the three peak hours analyzed for all signalized intersections in the project study area.

Unsignalized intersections were analyzed directly in HCS. Their results were evaluated on a per-movement basis, since HCS does not produce an overall intersection level of service for unsignalized intersections. ***Appendix F*** contains the HCS output for all unsignalized intersections under study.

Study area roadway geometrics, speed limits and traffic control assumptions remain constant from 2013 existing base year conditions and are shown in **Figures 10A and 10B**, along with any changes in the Build Scenario that are shown on the Obey Creek preliminary concept plan.

B. 2022 No-Build Scenario (Condition 2) Results

Table 19 presents the results for the existing year traffic conditions as compiled from field data. The table lists LOS and delay values for those movements that are in existence at this time. It also only lists data for individual movements encountering delay at the stop-controlled intersections (which do not have an overall intersection delay value produced by HCS). **Figures 11A and 11B** present a summary intersection LOS for each peak period.

Table 19. Capacity Analysis Results for Study Area Intersections – 2022 Analysis Year Scenarios

ID	Intersection Name	2022 No-Build Scenario						2022 Build Scenario						2022 Build Scenario with Mitigation					
		LOS			Average Delay (sec/vehicle)			LOS			Average Delay (sec/vehicle)			LOS			Average Delay (sec/vehicle)		
		AM	Noon	PM	AM	Noon	PM	AM	Noon	PM	AM	Noon	PM	AM	Noon	PM	AM	Noon	PM
1	NC 86 (Columbia Street) & Franklin Street	D	D	*E*	42.3	53.5	*70.8*	D	D	*E*	43.1	54.3	*76.6*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
2	NC 86 (S. Columbia Street) & Cameron Avenue	C	C	D	34.9	33.5	35.1	D	C	D	36.3	33.9	35.7	N/A	N/A	N/A	N/A	N/A	N/A
3	NC 86 S (Pittsboro Street) & W. Cameron Avenue	C	C	C	25.4	23.3	27.0	C	C	C	25.8	24.4	27.6	N/A	N/A	N/A	N/A	N/A	N/A
4	NC 86 S (Pittsboro Street) & McCauley Street	B	B	C	15.2	18.1	21.2	B	B	C	14.1	17.0	22.1	N/A	N/A	N/A	N/A	N/A	N/A
5	NC 86 N (S. Columbia Street) & South Drive	C	C	D	30.9	32.0	39.2	C	C	D	29.6	31.7	40.1	N/A	N/A	N/A	N/A	N/A	N/A
6	NC 86 (S. Columbia Street) & Manning Drive	C	D	D	27.9	38.4	43.2	C	D	D	26.4	37.0	43.4	N/A	N/A	N/A	N/A	N/A	N/A
7	NC 86 (S. Columbia Street) & Mason Farm Road	C	C	C	27.4	24.5	31.3	C	C	C	30.4	24.3	32.3	N/A	N/A	N/A	N/A	N/A	N/A
8	NC 86 (S. Columbia Street) & NC 54 Bypass (Fordham Blvd) WB Ramps	C	C	*E*	26.3	26.5	*57.9*	D	C	*F*	39.2	29.9	*103.3*	SEE TABLE 18					
9	US 15-501 & NC 54 Bypass (Fordham Blvd) EB Ramps	C	B	B	22.3	12.4	14.0	C	B	D	22.9	16.8	39.0	SEE TABLE 18					
10	US 15-501 & Culbreth Road / Mt. Carmel Church Road	*E*	B	C	*59.1*	17.8	24.2	*F*	B	D	*80.3*	17.9	51.3	SEE TABLE 18					
11	US 15-501 & Arlen Park Drive / Bennett Road	B	A	B	13.8	7.6	12.0	B	A	B	14.7	6.4	13.5	N/A	N/A	N/A	N/A	N/A	N/A
12	US 15-501 & Market Street / **Site Driveway #4**	C	B	C	27.4	16.2	24.4	D	C	D	44.1	24.4	46.7						
13	US 15-501 & Southern Village Park & Ride Driveway@ / **Site Dr #3**	A	B	C	9.9	10.6	17.5	C	C	D	26.2	30.4	44.9						
14	US 15-501 & Dogwood Acres Drive	A	A	A	5.2	2.6	5.5	B	A	A	11.1	7.6	9.5	N/A	N/A	N/A	N/A	N/A	N/A
15	US 15-501 & Smith Level Road	C	C	C	27.2	22.6	31.7	C	C	C	29.0	23.0	33.6	N/A	N/A	N/A	N/A	N/A	N/A
16	Mt. Carmel Church Road & Bennett Road@	D	B	D	28.6	12.0	34.6	E	B	E	40.9	13.1	48.2	N/A	N/A	N/A	N/A	N/A	N/A
17	Greensboro Street & NC 54 Bypass (Fordham Blvd) WB On-Ramp / Merritt Mill Road	B	B	C	15.2	19.8	29.0	B	B	C	15.4	19.9	29.3	N/A	N/A	N/A	N/A	N/A	N/A
18	Smith Level Road & NC 54 Bypass (Fordham Blvd) EB Ramps	C	B	B	30.4	13.0	19.1	C	B	C	32.1	13.4	20.1	N/A	N/A	N/A	N/A	N/A	N/A
19	NC 54 Bypass (Fordham Blvd) WB Off-Ramp & Merritt Mill Road@	E	C	*F*	37.9	15.6	*108.1*	E	C	*F*	40.0	15.9	*121.3*	B	A	A	10.5	6.2	9.6
20	US 15-501/NC 54 Bypass (Fordham Blvd) & Manning Drive	D	C	D	44.7	31.3	44.5	*E*	C	*E*	*58.6*	34.6	*60.1*	B	B	B	12.9	14.9	11.6
21	US 15-501/NC 54 Bypass (Fordham Blvd) & Old Mason Farm Road	*F*	D	*F*	*93.7*	35.5	*82.9*	*F*	D	*F*	*109.6*	43.4	*108.4*	D	B	D	51.7	17.4	36.5
22 N	US 15-501 Bypass (Fordham Blvd) & NC 54 (Raleigh Road) Interchange Ramps (North)$	C E#	C E#	D *F#*	28.0 42.2#	20.9 41.1#	37.3 *199.0#*	C E#	C E#	D *F#*	34.4 48.1#	22.6 47.2#	44.9 *238.4#*	B&	B&	C&	18.6&	17.4&	22.5&
22 S	US 15-501 Bypass (Fordham Blvd) & NC 54 (Raleigh Road) Interchange Ramps (South)@	C	C	E	22.1	18.6	38.6	D	C	E	26.5	20.8	48.5	N/A	N/A	N/A	N/A	N/A	N/A
22 W	US 15-501 Bypass (Fordham Blvd) & NC 54 (Raleigh Road) Interchange Ramps (West)@	C	C	*F*	21.5	17.1	*51.3*	C	C	*F*	21.7	17.1	*51.3*	A	A	B	9.9	6.3	10.2
22 E	US 15-501 Bypass (Fordham Blvd) & NC 54 (Raleigh Road) Interchange Ramps (East)@	C	B	C	20.0	13.3	17.3	C	B	C	21.6	13.7	18.8	N/A	N/A	N/A	N/A	N/A	N/A
23	NC 54 (Raleigh Road) & Burning Tree Drive/Finley Golf Course Road	B	B	C	20.0	12.3	21.2	C	B	C	20.8	12.3	21.7	N/A	N/A	N/A	N/A	N/A	N/A
24	NC 54 (Raleigh Road) & Hamilton Road	C	B	C	27.0	18.1	22.5	C	B	C	28.1	18.4	23.1	N/A	N/A	N/A	N/A	N/A	N/A
25	Smith Level Road & Culbreth Road	C	B	B	24.9	10.6	14.5	C	B	B	25.8	11.1	15.3	N/A	N/A	N/A	N/A	N/A	N/A
26	Smith Level Road & Dogwood Acres Drive@	B	B	C	13.1	10.5	15.2	B	B	B	13.1	10.4	14.8	N/A	N/A	N/A	N/A	N/A	N/A
27	Mt. Carmel Church Road & Old Lystra Road@	C	B	C	23.6	13.0	19.2	D	B	C	26.6	13.4	20.8	N/A	N/A	N/A	N/A	N/A	N/A
28	**US 15-501 & Site Driveway #1 (RIRO)@**	N/A	N/A	N/A	N/A	N/A	N/A	C	B	B	15.3	11.0	11.2	N/A	N/A	N/A	N/A	N/A	N/A
29	**US 15-501 & Site Driveway #2 (RIRO)@**	N/A	N/A	N/A	N/A	N/A	N/A	C	B	B	15.3	11.5	12.1	N/A	N/A	N/A	N/A	N/A	N/A
30	**US 15-501 & Site Driveway #5 (RIRO)@**	N/A	N/A	N/A	N/A	N/A	N/A	C	B	C	17.2	13.2	16.2	N/A	N/A	N/A	N/A	N/A	N/A
31	US 15-501 Bypass (Fordham Blvd) & Median U-Turn #1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	D	A	D	41.2	6.2	46.8
32	US 15-501 Bypass (Fordham Blvd) & Median U-Turn #2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A	A	A	8.6	6.2	6.4

N/A – Not Applicable, i.e. movement is non-existent or no improvements made
* - No Movement Capacity Estimated By HCM Methodology, Delay Theoretically Infinite
@ - Unsignalized Intersection, LOS/Delay Values Correspond to Worst-Case Critical Movement

BOLD/ITALICS – Movement or Overall Intersection is over capacity as defined by Town of Chapel Hill TIS Standards
- Estimated LOS/Delay For Yield-Controlled Movement Based on HCM Stop-Controlled Methodology
BLUE = New/Proposed Intersections/intersections with Changes Due to Site Access

$ - Intersection Signalized Southbound/Yield Controlled Northbound

Of the 30 intersection locations analyzed, seven are expected to experience deficient overall peak hour LOS in the AM, Noon, or PM peak periods, based on projected 2022 No-Build Scenario traffic volume data and reoptimized signal timings from 2013 base year conditions. The specific intersections and issues that contribute to the deficient LOS E or LOS F operations include the following:

- **Franklin Street & NC 86 (Columbia Street) – ID #1**
  The 2022 PM peak hour overall intersection LOS is expected to be LOS E at this intersection. This intersection will continue to face high volumes of pedestrian crossing conflicts, coupled with the presence of buses and bus stops in the vicinity, on-street parking, bicycles and other heavy vehicles all contribute to reducing vehicular throughput.

- **NC 86 (S. Columbia Street) and NC 54 Bypass Westbound Ramps – ID #8**
  The projected 2022 PM peak overall LOS E operational issues at this intersection are primarily due to high ramp volumes for the westbound off-ramp approach and conflicting volumes of northbound left-turns and southbound through traffic on NC 86.

- **US 15-501 and Mt. Carmel Church Road – ID #10**
  This intersection is expected to operate over capacity (LOS E) in the 2022 AM peak hour, due to heavy through traffic volumes on US 15-501 and several significant turning volumes, particularly westbound right-turns on Mt. Carmel Church Road.

- **NC 54 Bypass Westbound Off-Ramp and Merritt Mill Road – ID #19**
  This unconventional stop-controlled intersection (the off-ramp has dual left-turn stop-controlled movements) is expected to operate at a LOS F for the off-ramp approach in the 2022 PM peak hour, with queues extending back to the NC 54 Bypass mainline roadway.

- **US 15-501 Bypass (Fordham Blvd) and Old Mason Farm Road – ID #21**
  This intersection is expected to operate at a LOS F in both AM and PM peak hours in 2022, regardless of Obey Creek development traffic. Heavy through traffic volumes on US 15-501 are expected to cause extensive queuing issues upstream of this intersection in both directions and the unconventional 5-leg approaches hamper efficient signal phasing and decrease available green time for US 15-501.

- **US 15-501 Bypass Northbound and NC 54 Westbound On-Ramp – ID #22N**
  The intersection of the US 15-501 northbound travel lanes with the NC 54 Westbound on-ramp is currently yield-controlled for the on-ramp. From field observations of peak hour operations, a short acceleration lane downstream causes driver confusion and hesitancy in many cases, with the result being that many vehicles react to the intersection as being stop-controlled. The intersection has been conservatively analyzed as a stop-controlled intersection in this study and in the 2022 PM peak hour, expected traffic volumes degrade operations to a LOS F.

- **US 15-501 Bypass Southbound Off-Ramp and NC 54 Eastbound – ID #22W**
  The stop-controlled intersection at the US 15-501 southbound off-ramp and NC 54 eastbound is expected to operate at a LOS F for the off-ramp stop-controlled approach in 2022.

All other remaining signalized and unsignalized intersections in the project study area are anticipated to provide acceptable LOS, as determined by Town of Chapel Hill thresholds (LOS

D overall for signalized intersections or LOS E for critical movements for unsignalized intersections).

C. 2022 Build Scenario (Condition 3) Results

Table 19 presents the results for the 2022 Build Scenario, which includes impacts of site-related traffic (new trips, pass-by trips, diverted-linked trips) to the 2022 study area roadway network. 2022 No-Build Scenario signal timings were held constant for the Build Scenario – to provide a comparable impact of site traffic on intersection operations. Signal timings and network geometrics were updated in the vicinity of the Obey Creek site, based on assumptions taken from the site concept plans. **Figures 12A and 12B** present a summary intersection LOS for each peak period.

Of the 33 intersection locations analyzed, eight are expected to experience deficient overall peak hour LOS in the AM, Noon, or PM peak periods, based on projected 2022 Build Scenario traffic volume data. The specific intersections and issues that contribute to the deficient LOS E or LOS F operations include the following:

- **Franklin Street & NC 86 (Columbia Street) – ID #1**
  The 2022 PM peak hour overall intersection LOS is expected to be LOS E at this intersection, with a marginal increase in overall intersection delay.

- **NC 86 (S. Columbia Street) and NC 54 Bypass Westbound Ramps – ID #8**
  The projected 2022 PM peak overall LOS is expected to drop from LOS E to LOS F with the addition of site traffic. The degradation in operations is due to site-related increases in westbound off-ramp left-turn, southbound through and northbound left-turn/through volumes.

- **US 15-501 and Mt. Carmel Church Road – ID #10**
  This intersection is expected to degrade from a LOS E to a LOS F in the 2022 AM peak hour due to northbound and southbound site-related through traffic volume increases on US 15-501. The PM peak hour operations also degrade from a LOS C to a LOS D, with overall delay values doubling from No-Build conditions.

- **NC 54 Bypass Westbound Off-Ramp and Merritt Mill Road – ID #19**
  The 2022 PM peak hour NC 54 westbound off-ramp critical movement LOS is expected to remain at LOS F at this intersection, with a marginal increase in critical movement delay.

- **US 15-501/NC 54 Bypass (Fordham Blvd) & Manning Drive – ID #20**
  2022 AM and PM peak hour overall intersection LOS degrades from LOS D to LOS E in both peak hours with the addition of site-related traffic (primarily through traffic increases on US 15-501). US 15-501 operations in the vicinity of this intersection and the upstream Old Mason Farm Road intersection are near or above capacity in the 2022 No-Build scenario and will likely worsen with the addition of site-related traffic.

- **US 15-501 Bypass (Fordham Blvd) and Old Mason Farm Road – ID #21**
  This intersection is expected to continue to operate at a LOS F in both AM and PM peak hours in the 2022 Build Scenario, with increases in overall delay due to site-related through traffic on US 15-501.

- **US 15-501 Bypass Northbound and NC 54 Westbound On-Ramp – ID #22N**
  With the assumption that this intersection could be analyzed as a stop-controlled intersection in this study, the 2022 PM peak hour operations remain a LOS F for the on-ramp movement.

- **US 15-501 Bypass Southbound Off-Ramp and NC 54 Eastbound – ID #22W**
  The stop-controlled intersection at the US 15-501 southbound off-ramp and NC 54 eastbound is expected to operate at a LOS F for the off-ramp stop-controlled approach in 2022, with no projected increase in delay due to site-related traffic.

All other remaining signalized and unsignalized intersections in the project study area are anticipated to provide acceptable LOS, as determined by Town of Chapel Hill thresholds (LOS D overall for signalized intersections or LOS E for critical movements for unsignalized intersections).

D. 2022 Build Scenario – With Mitigation (Condition 4) Results

Table 19 presents the results for the 2022 Build Scenario traffic conditions that require mitigation to meet Town thresholds for acceptable traffic operations. Specific improvements tested to improve operations are described below and in **Section IV** of this report. **Figures 12A and 12B** present a summary intersection LOS for each peak period for any intersections requiring mitigation in the 2022 No-Build or Build Scenarios. **Figures 13A and 13B** highlight schematic improvements to geometrics and/or traffic control recommended.

- **Franklin Street & NC 86 (Columbia Street) – ID #1**
  The location of this intersection in proximity to existing development limits the ability to feasibly increase intersection capacity through widening roadways/adding auxiliary lanes. Signal retiming with the addition of site-related traffic does not improve projected operations to levels that are better than No-Build Scenario estimates, but should be considered as a feasible possibility to ensure the maintenance of traffic flow at this location.

- **NC 86 (S. Columbia Street) and NC 54 Bypass Westbound Ramps – ID #8**
  To mitigate projected operational deficiencies in the 2022 No-Build and Build Scenarios, two feasible options exist – a conversion of the existing diamond interchange to a Diverging Diamond Interchange or a reconfiguration of the existing north side of the interchange to provide a westbound NC 54 loop off-ramp for traffic heading southbound on US 15-501. Other options to retime this intersection signal or add auxiliary lanes either do not provide significant operational improvement or would require widening to the existing bridge structure over the NC 54 Bypass without the amount improvement provided by the two options suggested above. A comparison of operational improvements from these two options is shown in **Table 20**, and additional information is provided in **Section IV** of this report.

- **US 15-501 and Mt. Carmel Church Road – ID #10**
  Deficient traffic operations at this intersection in the AM peak hour were analyzed by attempting to restripe existing laneage for a more optimal efficiency with existing and future projected traffic patterns. An effective strategy that was tested involved converted the existing westbound approach to a shared left-turn through lane and dual exclusive right-turn lanes. This provides a more efficient use of optimized signal timing for the intersection. A comparison of results in **Table 20** to projected No-Build and Build Conditions in **Table 19**

indicate that this potential improvement to the westbound approach mitigates deficient operations in either Alternative Scenario.

Table 20. US 15-501/NC 86 & NC 54 Bypass (Fordham Boulevard) Interchange 2022 – With Mitigation Capacity Analysis Results

Alternative 1 – Diverging Diamond Interchange

ID	Intersection Name	2022 Build Scenario with Mitigation					
		LOS			Average Delay (sec/vehicle)		
		AM	Noon	PM	AM	Noon	PM
8	NC 86 Northbound & NC 86 Southbound Crossover	D	C	D	40.4	21.3	36.8
81	NC 86 Northbound & NC 54 Westbound Off-Ramp Right-Turn	A	A	A	6.6	4.5	3.0
82	NC 86 Southbound & NC 54 Westbound Off-Ramp Left-Turn	A	C	C	7.8	21.2	24.7
9	US 15-501 Northbound & US 15-501 Southbound Crossover	C	C	***E***	29.0	22.5	***55.3***
91	NC 54 Eastbound Off-Ramp Left-Turn & US 15-501 Northbound	B	A	A	12.1	4.9	3.7
92	NC 54 Eastbound Off-Ramp Right-Turn & US 15-501 Southbound	A	A	B	8.1	4.6	13.9
10	US 15-501 & Culbreth Road / Mt. Carmel Church Road	D	B	D	40.0	15.6	41.0

BOLD/ITALICS – Movement or Overall Intersection is over capacity as defined by Town of Chapel Hill TIS Standards

Alternative 2 – NC 54 WB Loop Off-Ramp

ID	Intersection Name	2022 Build Scenario with Mitigation					
		LOS			Average Delay (sec/vehicle)		
		AM	Noon	PM	AM	Noon	PM
8	NC 86 (S. Columbia Street) & NC 54 Bypass WB On-Ramp	A	A	C	2.2	2.0	21.5
	NC 86 (S. Columbia Street) & NC 54 Bypass WB Off-Ramp@	B	B	B	10.4	10.7	10.1
9	US 15-501 & NC 54 Bypass EB Off-Ramp	C	B	C	30.2	18.9	23.4
10	US 15-501 & Culbreth Road / Mt. Carmel Church Road	D	B	D	40.7	18.7	43.7

@ - Unsignalized Intersection, LOS/Delay Values Correspond to Worst-Case Critical Movement

- **NC 54 Bypass Westbound Off-Ramp and Merritt Mill Road – ID #19**
  A potential option to improve operations at this intersection would be to convert the unconventional stop-controlled intersection to a roundabout. Additionally, the westbound leg, which is currently a three-lane undivided cross-section, could be converted to develop an additional approach lane westbound to provide additional capacity. This laneage arrangement was tested in the SIDRA roundabout evaluation software and overall

operations improve greatly, with projected queues not affecting the NC 54 westbound mainline roadway. SIDRA results are presented in ***Appendix G***.

- **US 15-501/NC 54 Bypass (Fordham Blvd) & Manning Drive – ID #20**
- **US 15-501 Bypass (Fordham Blvd) and Old Mason Farm Road – ID #21**
  Standard improvements to the US 15-501 corridor in the vicinity of these intersections would require additional throughput capacity on US 15-501 to make significant improvements to overall corridor traffic operations. However, the existing four-lane divided cross-section could be maintained without widening (and with significant operational and safety benefit) with the construction of superstreet concept in this area. **Table 19** highlights the benefits of a superstreet, with the inclusion of two additional necessary median u-turn intersections.

- **US 15-501 Bypass Northbound and NC 54 Westbound On-Ramp – ID #22N**
  To mitigate this intersection's operational issues, and maintain free flowing conditions on US 15-501 northbound, the intersection was converted to a free flowing on-ramp, with a true ramp acceleration lane. This geometric change would require the removal of the US 15-501 northbound to NC 54 westbound loop off-ramp and the creation of a northbound signal-controlled left-turn lane to accommodate this movement. No operational issues are expected with that conversion and testing the upgraded westbound on-ramp merging movement in the HCS Freeway Merge software module indicates that LOS C or better operations are expected in the 2022 Build Scenario.

- **US 15-501 Bypass Southbound Off-Ramp and NC 54 Eastbound – ID #22W**
  This existing stop-controlled intersection was tested to check if it met MUTCD peak hour signal warrants in the 2022 Build Scenario. Analysis results indicate that projected volumes and the existing intersection geometrics meet multiple peak hour warrants. The proposed improvement would be to signalize the south side of the intersection and coordinate that signal with downstream signals east of the interchange. ***Appendix H*** contains the signal warrant analysis details.

IV. MITIGATION MEASURES/RECOMMENDATIONS

A. Planned Improvements

Based on information from the Town of Chapel Hill and NCDOT, there are two roadway projects, currently under construction in the project study area. Though the projects do feature improvements for traffic flow, transit operations and pedestrian/bicyclists, they are not expected to significantly affect geometrics or intersection traffic operations at study area intersections.

NCDOT STIP U-2803 – Smith Level Road Widening
Per information from NCDOT, this project will improve a section of Smith Level Road in Carrboro between Rock Haven Road and the bridge over Morgan Creek south of NC 54. The plan is to widen this section of Smith Level Road to include bike lanes, sidewalks and turn lanes with a center median. A roundabout is planned for the intersection of Rock Haven Road and Smith Level Road. Construction began in March 2013 and runs through June 2014.

NCDOT STIP U-0624 - South Columbia Street Enhancement Project
Per information from NCDOT, this project affects a 0.8-mile section of N.C. 86/South Columbia Street from Purefoy Road to Manning Drive to include improvements for a center turn lane and bus pullouts, with the purpose of improving safety and the flow of traffic in the area. Sidewalks

and bike lanes will be added to both sides of the road. The project began in November 2012 and is expected to be completed by July 2014

B. Background Committed Improvements

No significant background committed improvements from private developments or the University of North Carolina to the study area roadway network are expected between 2013 and 2022.

C. Applicant Committed Improvements

Per the current Obey Creek Site Concept Plan, shown in **Figure 2**, the Applicant proposes five site access points to facilitate traffic to/from the site along US 15-501. The plan proposes the following details:

- US 15-501 & Market Street Intersection – Construct 4th (westbound) leg to the intersection with adequate width for two exiting lanes and approximately 250 feet of vehicular storage in those lanes, along with a single entry lane. It was assumed that this would include all necessary signal upgrades to facilitate the most efficient traffic flow with this configuration.

- US 15-501 & Southern Village Park-and-Ride Driveway Intersection – Construct 4th (westbound) leg to the intersection and create a full access median break with signalization. Create a southbound left-turn lane with 200 feet of storage. The Site Driveway leg to this intersection is initially assumed to have single lane entry and exit, with approximately 300 feet of exit lane storage.

All other proposed site driveways are to be single lane entry/exit stop-controlled intersections with US 15-501 Northbound. A fully developed internal roadway network is also depicted, with a single lane one-way frontage road proposed between the southernmost access driveway and the existing Park-and-Ride Driveway median break. In addition, a potential pedestrian bridge spanning US 15-501 is shown just north of the proposed full median break at the existing Park-and-Ride Driveway.

No other external transportation-related improvements are shown on the site plan or were analyzed as being committed to by the Applicant at this time.

D. Necessary Improvements

To meet Town of Chapel Hill thresholds for adequate intersection traffic operations (overall signalized intersection LOS D or better, stop-controlled critical movement LOS E or better) in the 2022 analysis scenario, an investigation of those intersections/movements failing to meet these thresholds in the No-Build and Build Scenarios was undertaken and a description of these intersections and proposed improvements is listed in **Table 19**. Initial improvements were considered to attempt to bring vehicular delays and LOS back to No-Build Scenario levels, and if those failed to meet this qualification, additional improvement strategies were tested.

Information contained in **Table 19** is also schematically displayed in **Figures 13A and 13B.**

Improvements at the NC 54 Bypass / US 15-501 interchange may require considerable investments to widen the bridge structure or redesign and construct existing laneage to accommodate an innovative DDI design. Additional issues related to right-of-way impacts,

environmental issues, construction cost estimates and other details related to these two alternative improvement scenarios have not been discussed by project stakeholders. Due to existing limitations with the current interchange configuration and proximity of the nearby US 15-501 / Mt. Carmel Church Road/Culbreth Road intersection, conventional improvements to improve traffic operations in this area (auxiliary lane or through lane widening, signal phasing, lane restriping) would either be infeasible or would not likely provide substantial improvement to projected operations in the 2022 analysis year.

Due to the fact that the NC 54 Bypass westbound ramp terminal is expected to require improvements regardless of the development of the Obey Creek site, while still acknowledging that site traffic impacts in the interchange area do cause degradation of Level-of-Service, **Table 19** notes that the proposed improvement strategies are "partially" the responsibility of the developer. Additional discussions, evaluation, and analysis will be necessary to fully develop and compare the impacts of these alternatives.

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

PAT McCRORY
GOVERNOR

ANTHONY J.TATA
SECRETARY

September 26, 2014

ORANGE COUNTY

Kumar Nepalli
Traffic Engineering Program Manager
Town of Chapel Hill
405 Martin Luther King Jr. Blvd.
Chapel Hill, NC 27514

Subject: Proposed Obey Creek Mixed-Use Development
Located on US 15-501 South near Southern Village
Review of Traffic Impact Study, Technical Memorandum #2

Dear Mr. Nepalli,

Per your request, NCDOT Division and Congestion Management Unit staff have reviewed the Traffic Impact Study Technical Memorandum #2, (TIA) prepared by HNTB and the preliminary concept site plan enclosed therein. Based on the submitted information and upon conferring with Town staff, we offer the following comments relevant to the impacts to the State maintained highway system.

General:

The site is located on US 15-501 South directly across from the existing Southern Village development. As analyzed, the multi-use site consists of a 404,525 SF shopping center, 226,250 SF of general office space, a 48,000 SF recreation center, a 300 room hotel, 300 attached senior housing units, 100 condominium/townhome units, and 300 apartments. Upon planned build out in 2022, the site is expected to generate approximately 25,000 raw daily trips with applicable adjustments for internal capture, pass-by, diverted link, and transit and bicycle/pedestrian reductions. The site concept plan proposes five access points on US 15-501 consisting of addition of a fourth leg of the existing signalized intersection at US-15-501 and Market Street and a new full movement signalized median break on US 15-501 at the existing access to the transit park and ride lot. Three additional

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restricted right-in/right-out accesses to US-15-501 are proposed along the site frontage. A proposed pedestrian overpass spanning US-15-501 and connecting the site to the existing transit park and ride facility is located to the north of proposed access #3.

The development is within the study area of an NCDOT corridor study The scope of the study is to assess the ability of current infrastructure to accommodate anticipated future growth and evaluate potential for future installation of "super streets" along the US 15-501 corridor from NC 54(Fordham Boulevard) in Chapel Hill to US 64 in Pittsboro for study years 2013 and 2040. The study is currently underway with final recommendations expected later in 2014. The development also lies within the study area of the Chapel Hill Transit North-South Corridor Study. The scope of this study includes assessment of existing conditions and recommendations for enhancements to meet projected need on the transit corridor. This study is scheduled for completion in Fall 2015. Information for the Obey Creek development has been provided to the study consultants for their use and consideration.

US 15-501 is designated as a strategic highway corridor. Routes with this designation are considered critical to statewide and regional mobility and connectivity and are subject to specific access management guidelines based on the corridor designation. US 15-501 is designated as a Boulevard with partial control of access. Development access is typically limited to no more than that justified to meet the access needs of the property in order to minimize impacts to traffic operations and preserve public safety.

Site Access and Required Improvements:

Proposed US-15-501 and Site Access #1 Intersection:

NCDOT concurs with the study recommendations to eliminate this access due to proximity to the Dogwood Acres Drive signalized intersection and the existing U-turn bulb out.

Proposed US-15-501 and Site Access #2 Intersection:

NCDOT is agreeable to connection of the proposed restricted right-in/right-out access subject to:

- Construction of an exclusive northbound right turn lane with 150' of full storage and appropriate deceleration taper on US 15-501.

- Construction of a single ingress lane and a single right turn-only egress lane with a minimum of 100' of full storage on the site access.

- Provision of a minimum of 150' of protected internal driveway stem length prohibiting all turning and parking maneuvers on the site access.

- Closure or relocation of the proposed frontage road connection beyond the limits of the internal protected stem.

Proposed US-15-501 and Site Access #3/Transit Park and Ride Intersection:

Because of the specific guidelines relative to this Strategic Highway Corridor as well as analysis results in the study, NCDOT cannot support a new full-movement access on US 15-501 as proposed, due to insufficient spacing relative to existing median crossings and the anticipated negative impacts on traffic operation on the corridor. Subject to the conditions listed below, NCDOT is agreeable to a connection served by a directional median crossover at this location. This configuration provides for direct left turns from US-15-501 to both the proposed new access and the transit park and ride lot while restricting left turn and through movements from the side streets.

- Construction of an exclusive southbound left turn lane with 350' of full storage and appropriate deceleration taper on US 15-501
- Construction of an exclusive northbound left turn lane with 200' of full storage and appropriate deceleration taper on US 15-501.
- Construction of an exclusive northbound right turn lane with 150' of full storage and appropriate deceleration taper on US 15-501.
- Construction of a single ingress lane and a single right turn-only egress lane with a minimum of 300' of full storage on the site access.
- Provision of a minimum of 300' of protected internal driveway stem length prohibiting all turning and parking maneuvers on the site access.
- Closure or relocation of the proposed frontage road connection beyond the limits of the internal protected stem.
- Monitor intersection for signal warrants and install traffic signal when warranted.

  The project traffic consultant is currently performing additional analysis including traffic warrant evaluation for review by NCDOT and Town staff.

Proposed US 15-501 and Access #4/Market Street Intersection:

NCDOT is agreeable to connection of a fourth leg at this intersection subject to the following improvements necessary to retain acceptable intersection operation:

- Construction of dual exclusive southbound left turn lanes, each with 350' of full storage and appropriate tapers on US 15-501.

- Construction of a second exclusive westbound left turn lane with appropriate tapers on Market Street.

- Construction of an exclusive northbound right turn lane with 150' of full storage and appropriate deceleration taper on US 15-501.

- Construction of dual ingress lanes and four egress lanes consisting of dual exclusive left turn lanes, an exclusive through lane, and an exclusive right turn lane, each with 350' of full storage on the site access.

- Provision of a minimum 350' protected internal driveway stem length prohibiting all turning and parking maneuvers on the site access.

- Closure or relocation of the proposed frontage road connection beyond the limits of the internal protected stem.

- Modification of existing signal to accommodate the new intersection geometry.

Proposed US 15-501 and Site Access #5 Intersection:

NCDOT is agreeable to the proposed connection subject to:

- Construction of an exclusive northbound right turn lane with 150' of full storage and appropriate deceleration taper on US 15-501.

- Construction of a single ingress lane and a single right turn-only egress lane with minimum of 100'full storage on the site access.

- Provision of a minimum 100' protected internal driveway stem length prohibiting all turning and parking maneuvers on the site access.

US 15-501 and Culbreth Road/Mt. Carmel Church Road Intersection:

In consideration of existing geometric and right of way constraints at this location, NCDOT concurs with the TIA recommendation to reconfigure the westbound Mount Carmel Church Road approach to provide dual exclusive right turn lanes and a combination through/left turn lane and optimize signal timing as a feasible approach to enhance existing operation and mitigate anticipated impacts of site traffic at this intersection.

- As a condition of the pending driveway permit, the applicant shall reconfigure the intersection geometry as recommended and modify and optimize existing signal as needed to accommodate the new configuration.

NC 86 (Columbia Street)/NC 54 (Fordham Boulevard) Interchange:

NCDOT concurs with the TIA recommendations as follows:

- Create NC 54 By-pass westbound loop off ramp with free-flow southbound traffic at the bridge.

- Reconfigure existing intersection for longer northbound left turn lane.

- Create existing westbound off-ramp stop controlled right-turn movement.

- Provide single southbound through lane and right turn lane.

- Modify and optimize signal.

  - As a condition of the pending driveway permit, the applicant shall explore constructability of the above modifications and submit design concepts for NCDOT and Town review. If determined to be feasible the applicant shall construct the modifications to mitigate anticipated impacts.

  - If these modifications are determined to not be feasible at this time, the applicant shall extend storage lengths on the existing eastbound and westbound interchange off-ramps to accommodate anticipated queuing.

Internal Intersections and Circulation:

The study and conceptual site plan do not provide detailed information or analysis of internal traffic circulation and intersection operation. Additional site plan detail and evaluation is necessary to ensure appropriate internal circulation so as to avoid unacceptable operational and safety impacts on the adjacent road network.

Multi-modal Enhancements:

The study indicates that the site is expected to generate approximately 2565 daily transit trips and 259 daily bicycle/pedestrian trips. The concept plan indicates a proposed pedestrian overpass spanning US-15-501. No additional detail for the bridge or other multi-modal infrastructure is provided.

NCDOT is agreeable to installation of appropriate multi-modal infrastructure deemed to be necessary for this development. Though the TIA does not provide specific recommendations, any stipulated multi-modal enhancements including but not limited to sidewalk, bike lanes, bus pull offs, lighting, landscaping etc. on State maintained routes are subject to NCDOT design and encroachment requirements.
Installation of the proposed pedestrian overpass is subject to the requirements of North Carolina General Statute 136-18(37).

Cross-Access Connectivity:

Provision of cross access with the adjacent properties is encouraged to accommodate internal connectivity and improve distribution of existing and future traffic volumes on the adjacent public road network. There appear to be opportunities for future connections to the site backage road to properties to the north, south and east.

General Requirements:

It is necessary to obtain an approved driveway permit and/or encroachment agreement(s) prior to performing work on the NCDOT right of way. As a condition of the permit, the permitee shall be responsible for design and construction of the above stipulated improvements in accordance with NCDOT requirements. An approved permit will be issued upon receipt of approved roadway and signal construction plans, inspection fee, and any necessary performance and indemnity bonds.

The applicant shall dedicate any additional right of way necessary to accommodate the required road improvements or future improvements as stipulated.

Intersection radii and geometry shall be designed to accommodate turning movements of the largest anticipated vehicle.

All pavement markings shall be long life thermoplastic. Pavement markers shall be installed if they previously existed on the roadway.

The permitee shall be responsible for the installation and relocation of any additional highway signs that may be necessary due to these improvements and shall comply with the requirements of the MUTCD.

Feel free to contact me if you have any questions.

Sincerely,

C. N. Edwards Jr., PE
District Engineer

Cc: J. M. Mills, PE, Division Engineer
Dawn Mcpherson, Division Traffic Engineer
Ed Lewis, PE, Division 7 Planning Engineer
Darius Sturdivant, PE, Division 8 Planning Engineer
Doumit Ishak, PE, NCDOT Congestion Management Regional Engineer
Derrick Lewis, PE, NCDOT Feasibility Study Unit Head
Craig Scheffler, PE, HNTB
Ben Perry, East-West Partners Management Co.
Earl Llewellyn, PE, Kimley- Horn
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