

**APPENDIX A**

**Interstate 26 Widening  
Traffic Analysis Report**

# Interstate 26 Widening Traffic Analysis Report

I-26 Widening Project MM85 – MM101  
Newberry, Lexington and Richland Counties

Submitted to:

South Carolina Department of Transportation



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## EXECUTIVE SUMMARY

This report summarizes traffic analyses performed to evaluate multiple improvements along Interstate 26, including widening I-26 from two to three lanes in each direction generally between Exit 85 and Exit 101.

The analysis includes the existing interchanges at Exits 85, 91, 97, and 101. The analysis also includes the existing interchanges at Exits 82 and 102, which are the next full interchanges adjacent to the study area interchanges, for the purposes of evaluating potential interstate access modifications within the study area.

The interchange at Exit 102 was constructed in its current configuration around 1996, while the interchange at Exit 97 was constructed in the early 1970s and the interchange at Exit 101 was constructed around 2000. Exits 85 and 91 are generally configured in the manner in which they were constructed in the late 1950s/early 1960s.

The additional capacity provided by the construction of a third lane in each direction along I-26 will result in design year LOS comparable to those experienced under existing conditions. The 2040 Build analysis results indicate that most freeway segments are predicted to operate at LOS B or C during the morning peak hour, and LOS C and D during the afternoon peak hour when I-26 is widened to three lanes. However, the interstate segments between Exit 97 and Exit 101 will likely require four lanes in each direction by 2040. Additionally, the segment between Exit 101 and Exit 102 may need to be widened to provide more than four lanes by 2040; however, this segment is largely outside the scope of this project and will likely be addressed as part of SCDOT's on-going Carolina Crossroads project that includes I-26 interchanges between Exit 101 and Exit 110.

The additional widening to four lanes between Exits 97 and 101 should be considered and incorporated to the extent possible in this widening project. If these segments are not widened to four lanes as part of this project, then, at a minimum, the design and construction of permanent roadway features, such as drainage and retaining walls will help to minimize disruption to these features when future widening becomes necessary to construct.

The interchanges at Exits 85, 91, and 97 are expected to be modified to improve their operation and enhance safety. The analysis of the operation of potential improvement alternatives (Exit 85 – five build alternatives, and Exit 97 three build alternatives) on the ramp termini and adjacent intersections at these interchanges are included in this analysis. The improvements at Exit 91 were evaluated as part of a separate project, and summarized in the *Interchange Modification Report, I-26 at S-48 (Columbia Avenue) Interchange Improvements*, dated December 2016.

The five build alternatives at Exit 85 consist of:

- Alternative 1: Diamond Interchange – this concept would replace the existing interchange configuration with a diamond interchange. The eastbound and westbound off-ramp approaches to the ramp termini intersections would be controlled by stop signs.
- Alternative 1A: Diamond Loop Interchange – this concept is similar to Alternative 1 but replaces the diamond ramp in the northeast quadrant with a loop ramp in the northwest quadrant.
- Alternative 2: Partial Cloverleaf (ParClo) Interchange – this concept would add a westbound off-ramp for traffic traveling to the north on SC 202, and eastbound on-ramp for traffic traveling from the south on SC 202 to the existing interchange configuration, along with adjustments to acceleration and deceleration lane lengths for the existing ramps. The eastbound and westbound off-ramp approaches to the ramp termini intersections would be controlled by stop signs.
- Alternative 2A: ParClo Modified – this concept would be similar to Alternative 2 but would remove the ramp in the northeast quadrant and shift that movement to the loop ramp in the northwest quadrant.
- Alternative 3: Dual Roundabout (Bowtie) Interchange – this concept would eliminate the westbound loop off-ramp and eastbound loop on-ramp and provide for a diamond interchange with roundabouts instead of stop sign controlled intersections at the ramp termini.

Exit 91 has previously been proposed to be modified from its current diamond configuration to provide a Diverging Diamond Interchange as part of the S-48 (Columbia Avenue) Corridor Improvement Project initiated by Lexington County. The Interchange Modification Report for this project identified and evaluated three build alternatives: a Diverging Diamond Interchange (DDI), a ParClo, and a Bowtie Interchange. The DDI was identified as the preferred alternative. This interchange has been included as part of the 2040 Build scenario, along with the proposed modifications to Exits 85 and 97.

The three build alternatives at Exit 97 consist of:

- Alternative 1: DDI – the concept would replace the existing interchange with a DDI.
- Alternative 2: ParClo Interchange – this concept would add a westbound on-ramp and eastbound on-ramp to the existing interchange configuration.
- Alternative 3: Single Point Urban Interchange (SPUI) – this concept would replace the existing interchange configuration with a SPUI.

In each of the Exit 97 alternatives, traffic from the existing ramp intersections of Julius Richardson Road and Rauch-Metz Road would be redirected to West Shady Grove Road and Broad Stone Road respectively. The existing intersection ramp intersections with Broad River Road would be eliminated, and Broad River Road would be widened through the interchange

area between Broad Stone Road and the main Shopping Center Driveway. The eastbound off-ramp intersection would operate under traffic signal control. The existing traffic signal at the shopping center driveway would remain, and traffic signals would be installed at the Broad River Road intersections with Broad Stone Road and West Shady Grove Road.

The final build alternative network was identified based on the preferred alternative improvements selected for each interchange. Through traffic operations on I-26 were a consideration in the evaluation of alternatives. *The preferred alternatives for the interchange improvements are:*

- Exit 85: Alternative 1A (Diamond Loop) –all five alternative improvement concepts provided comparable LOS in the 2040 Build scenario; therefore, the selection of the preferred alternative was based on other considerations, such as construction cost and no property relocations.
- Exit 91: Diverging Diamond Interchange (DDI) – this is the preferred alternative identified in the *Interchange Modification Report, I-26 at S-48 (Columbia Avenue) Interchange Improvements*
- Exit 97: Alternative 1 (DDI) – all three alternative improvement concepts provided comparable LOS in the 2040 Build scenario, with Alternative 3 (SPUI) having some intersections operating at LOS D. Alternative 1 was chosen due to having the least environmental impacts and lowest overall construction cost in addition to the safety improvements and operational improvements.

The traffic operations analysis of the preferred alternatives identified areas where traffic control improvements were projected to be needed to provide acceptable operating LOS. These include:

Exit 85 – Alternative 1

- No traffic control improvements anticipated; acceptable operating LOS attained.

Exit 97 – Alternative 1

- Installation of a traffic signal may be required at the intersection of West Shady Grove Road (S-40-612) and Broad River Road due to the diversion of traffic resulting from the elimination existing of the Julius Richardson Road (S-40-959) intersection with the westbound ramps.
- Installation of a traffic signal may be required at the intersection of Broad Stone Road (S-40-2805) and Broad River Road due to the diversion of traffic resulting from the elimination of the existing Rauch-Metz Road (S-40-385) intersection with the eastbound ramps.

- Widening of Broad River Road through the interchange area between Broad Stone Road and the Shopping Center driveways would be required.

## I. INTRODUCTION

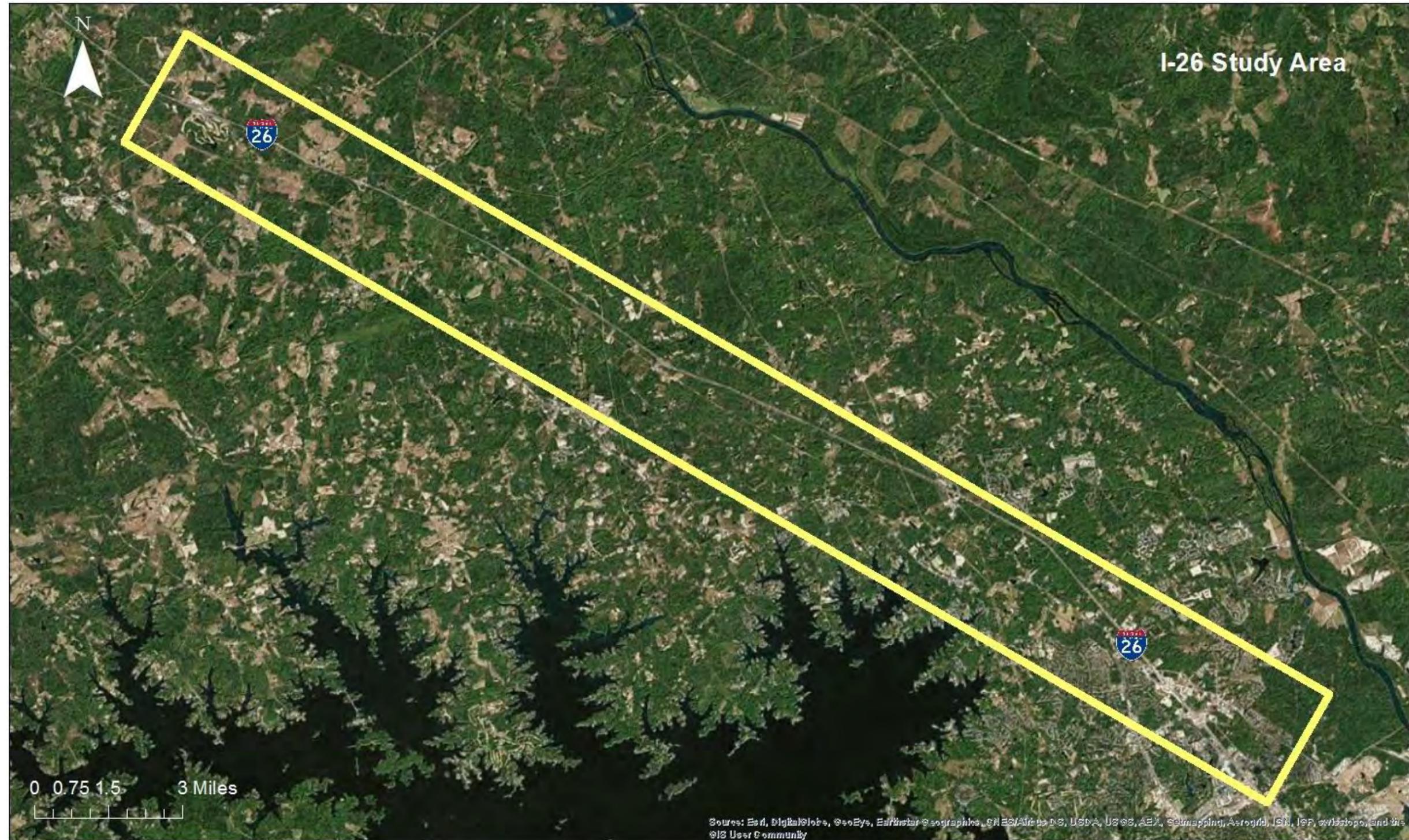
Interstate 26 (I-26) is an important link in the Southeastern United States' Interstate Highway System that nominally runs east-west (but physically more northwest-southeast). I-26 runs from the junction of U.S. Route 11W and U.S. Route 23 in Kingsport, Tennessee, generally southeastward through North Carolina to U.S. Route 17 in Charleston, South Carolina for a total of 306 miles. The major part of I-26 (221 miles) is located within South Carolina, with smaller portions in North Carolina (54 mi) and Tennessee (31 mi). The portion of I-26 within SC traverses ten counties. Cities on the route include Charleston, Columbia, and Spartanburg in South Carolina, as well as Asheville in North Carolina, and Johnson City in Tennessee. In South Carolina, I-26 connects directly to I-85, I-385, I-20, I-77, and I-95. In addition to being a corridor for transporting people and freight between urban areas, I-26 serves other specific needs, including:

- Daily commuting routes for intra- and interstate travelers;
- Access to primary distribution centers in Columbia for companies such as Michelin, Honeywell, and Bose Corporation;
- Access to one of the nation's leading container ports in Charleston and to heavy industry associated with the port;
- Access to Appalachian Mountains; and,
- Access to the Blue Ridge Mountains.

The South Carolina Department of Transportation (SCDOT) proposes multiple improvements to the I-26 corridor designed to increase capacity, upgrade interchanges to meet design requirements, and expand vertical clearance at overpass bridges and/or replace them. For this study, I-26 will be examined to determine the need to widen the interstate from two to three lanes from approximately 1.6 miles west of Exit 85 to about 2,200 feet west of Exit 101. The interstate within the study area is located within Newberry, Lexington and Richland Counties, and includes interchanges at Exit 85 (SC 202), Exit 91 (S-32-48/Columbia Avenue) and Exit 97 (US 176/Broad River Road), which will be modified to bring them into compliance with design requirements. To provide sufficient coverage to prepare interchange modification reports, the analysis includes the existing interchanges at Exits 82, 101 and 102. The study area location is shown in **Figure 1**.

The traffic analysis also includes ramp termini intersections with arterial roadways at the interchanges along with analysis of adjacent intersections influenced by existing interchange operations or that may be affected by modifications to the interchanges. Several frontage roads adjacent to the interstate, and roadways crossing the interstate that may also be affected are also included in the analysis.

Figure 1 - I-26 Study Area



## II. FREEWAY DESCRIPTION

I-26 is an east-west interstate highway that begins at the junction of U.S. Route 11W and U.S. Route 23 in Kingsport, Tennessee. From this origin, I-26 runs generally southeastward through Tennessee, North Carolina, and South Carolina, where it ends at U.S. Route 17 in Charleston, South Carolina.

Along its nearly 306 mile length, I-26 provides access to Johnson City, Tennessee; Asheville, North Carolina; and Spartanburg, Columbia and Charleston, South Carolina.

In South Carolina, I-26 covers about 221 miles, and provides connections to I-95 south of Providence, to I-77 south of Cayce, to I-20 west of Columbia, and to I-85 north-west of Spartanburg.

In Newberry County, interchanges considered in this analysis are located at Exits 82, and 85. In Lexington County, the interchange considered in this analysis is located at Exit 91. The remaining interchanges are located in Richland County at Exits 97, 101, and 102.

### Number of Lanes

Throughout nearly all of the study area, I-26 currently provides two lanes in each direction. From Exit 82 southeastward, the two lane section is maintained, until it is widened from two to three lanes approaching Exit 101. In the eastbound direction, I-26 widens from two lanes about 900 feet from the off-ramp gore of Exit 101 and becomes a full three lane road about 350 feet west of the off-ramp gore of Exit 101. In the westbound direction, I-26 has three lanes entering the study area, and narrows to two lanes about 235 feet from westbound on-ramp gore of Exit 101, becoming two lanes about 1,580 feet from on-ramp gore. I-26 continues northwestward with two lanes past the end of study area.

### Posted Speed Limit

The posted speed limit throughout most of the I-26 study area is 70 miles per hour from Exit 82 southeastward. The posted speed limit decreases to 60 miles per hour in the eastbound direction approximately 1,700 feet west of the Exit 101 off-ramp gore. In the westbound direction, the speed limit changes from 60 to 70 miles per hour approximately 2,700 feet northwest of the westbound on-ramp gore at Exit 101 and about 1,100 feet from the end of the taper for the transition from the three-lane to two-lane section.

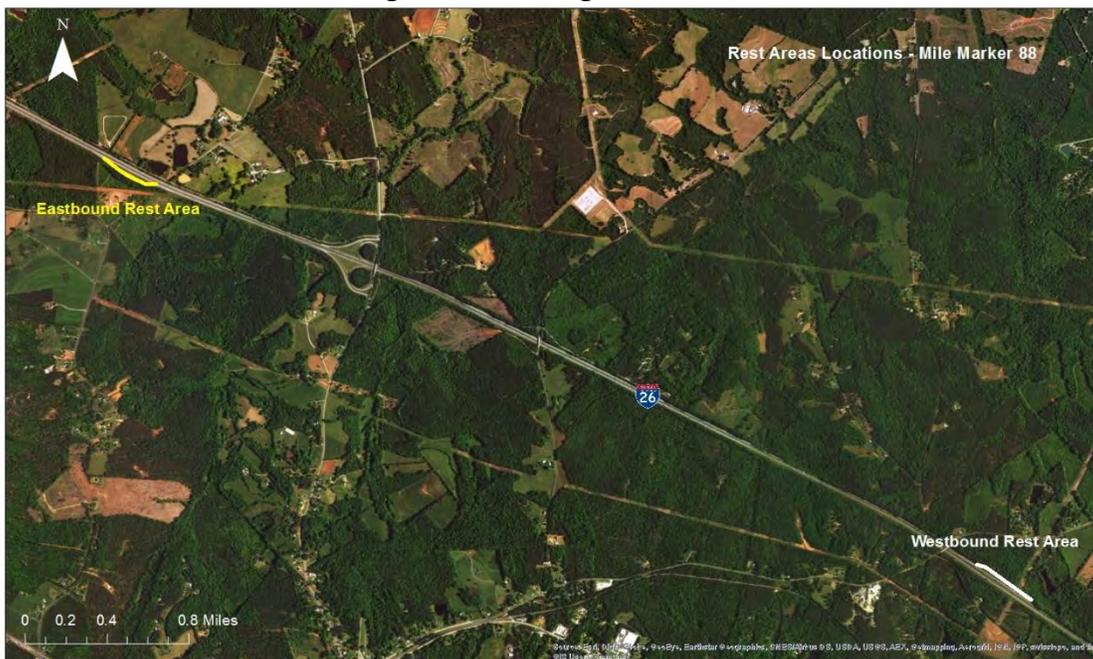
## Grades

In general, interstate routes can be characterized as having either level, rolling, or mountainous terrain. Along I-26, the interstate grades fluctuate between a maximum -4.00 percent down grade to a maximum 4.63 percent upgrade. Based on these grades, the portion of I-26 within the study area can be characterized as having a *rolling terrain*.

## Rest Areas

Two closed rest areas (without facilities) are located within the study area. On westbound I-26, the closed rest area is located at approximately mile marker 88 (just east of the Holy Trinity Church Road overpass). On eastbound I-26, the closed rest area is located opposite Central School Road approximately 4,300 feet west of the off-ramp. The general locations of the rest areas are shown in **Figure 2**. The westbound exit to the rest area has a diverging taper of 250 feet. The westbound entrance includes an acceleration lane approximately 435 feet long with a 210 feet long parallel acceleration lane. The eastbound exit to the rest area has a diverging taper of 220 feet. The eastbound entrance includes an acceleration lane approximately 425 feet long with a 210 feet long parallel acceleration lane.

**Figure 2 - Existing Rest Areas**

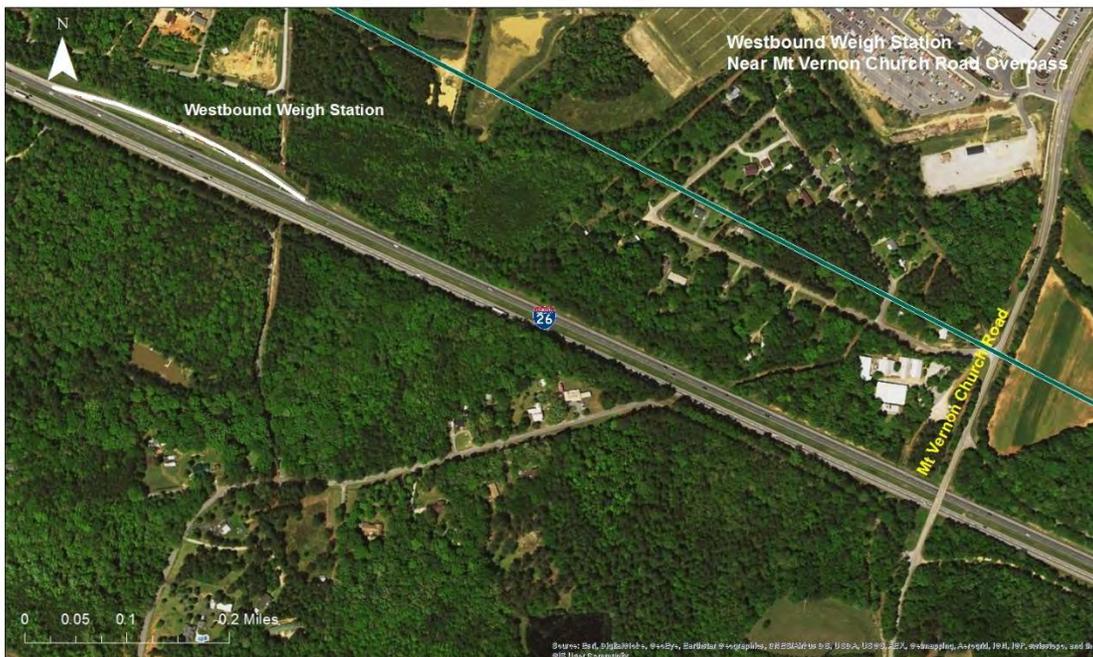


## Weigh Stations

A weigh station is located on westbound I-26 approximately 2,950 feet west of the Mt Vernon Church Road overpass. The exit to the weigh station has a diverging taper of 240 feet. The entrance from this weigh station includes an acceleration lane approximately 530 feet long with a 280 feet long parallel acceleration lane. The general location of the weigh station is shown in **Figure 3**.

The closest eastbound weigh station is located at approximately mile marker 81 and is outside of the study area.

**Figure 3 - Existing Weigh Station**



## Frontage Road System

A parallel frontage road system is present at portions of both sides of I-26 throughout the study area. Illustrations of the extent of the frontage road system are shown in **Figure 4** through **Figure 7**.

### Westbound Frontage Road System

The following roadways are considered part of the frontage road system on the north side of I-26.

- Western Lane (S-40-2894) begins at a signalized intersection located approximately 1,700 feet east of the intersection of Broad River Road and the Exit 101 westbound on-ramp

Western Lane runs generally parallel to the westbound on-ramp and the westbound lanes of I-26 for 1.84 miles before it ends at Koon Road (S-40-58) approximately 130 feet from the north end of the Koon Road overpass.

- Broad Bill Road (S-40-2897) runs parallel to westbound lanes of I-26 for 1,170 feet from its intersection with S-40-80 (Shady Grove Road). This intersection is located about 200 feet from the northern end of the Shady Grove Road overpass. Broad Bill Road provides access to a storage facility.
- Broad Berry Road (S-40-2898) is a short frontage road providing access to a single residence. Broad Berry Road runs parallel to the Exit 97 westbound off-ramp for about 820 feet from its intersection with Julius Richardson Road (S-40-959). The intersection of Broad Berry Road and Julius Richardson Road is located within 100 feet of the Julius Richardson Road stop bar at its intersection with the Exit 97 westbound off-ramp.
- Bookie Richardson Road starts from Broad River Road (US 176), runs southwestward towards I-26 for approximately 3,440 feet, then turns west to run parallel to I-26 for about 1,570 feet until it ends at its intersection with Mt Vernon Church Road (S-40-234). The intersection of Bookie Richardson Road with Mt Vernon Church Road is located approximately 200 feet from the north end of the Mount Vernon Church Road overpass.
- Mt Olivet Church Road starts from Broad River Road (US 176), runs southeastward towards I-26 for about 3,385 feet, and then runs parallel to I-26 westbound for approximately 2,965 feet until it ends at its intersection with Old Hilton Road (S-40-405). The intersection of Mt Olivet Church Road and Old Hilton Road is located about 295 feet from the north end of the Old Hilton Road overpass.
- While a frontage road, Chapin Road (S-40-39) runs generally parallel to westbound I-26 approximately 1,700 feet north of the interstate. Chapin Road begins at Broad River Road (US 176) near Exit 97, and runs westward parallel to I-26 for about 1.48 miles to its intersection with Flips Road (S-40-592) where it is named Columbia Avenue (S-32-48). Columbia Avenue continues west from Flips Road and runs parallel to I-26 westbound for approximately 2,600 feet where it curves to the south where it becomes part of Exit 91 where it intersects the westbound ramps approximately 1,600 feet to the south. From there, Columbia Avenue continues to the southwest for approximately two miles towards its terminus at its intersection with US 76.
- Four Oaks Road (S-36-370) functions as a frontage road along a portion of westbound I-26. From its eastern end, Four Oaks Road runs parallel to I-26 for approximately 3,000 feet until its intersection with Parr Road (S-36-167). Its intersection with Parr Road is located approximately 200 feet from the north end of the Parr Road overpass. Four Oaks Road continues on a curving course to the northwest before its terminus at its intersection with SC 202 approximately 520 feet north of Exit 85.
- Meadow Brook Road intersects SC 202 within 100 feet of the westbound on-ramp intersection. Meadow Brook Road runs parallel to the Exit 85 on-ramp for 1,150 feet and then runs parallel to I-26 for about 1.64 miles until the paved roadway terminates at a dirt road.

Figure 4 - Frontage Road Locations: Exits 82-85

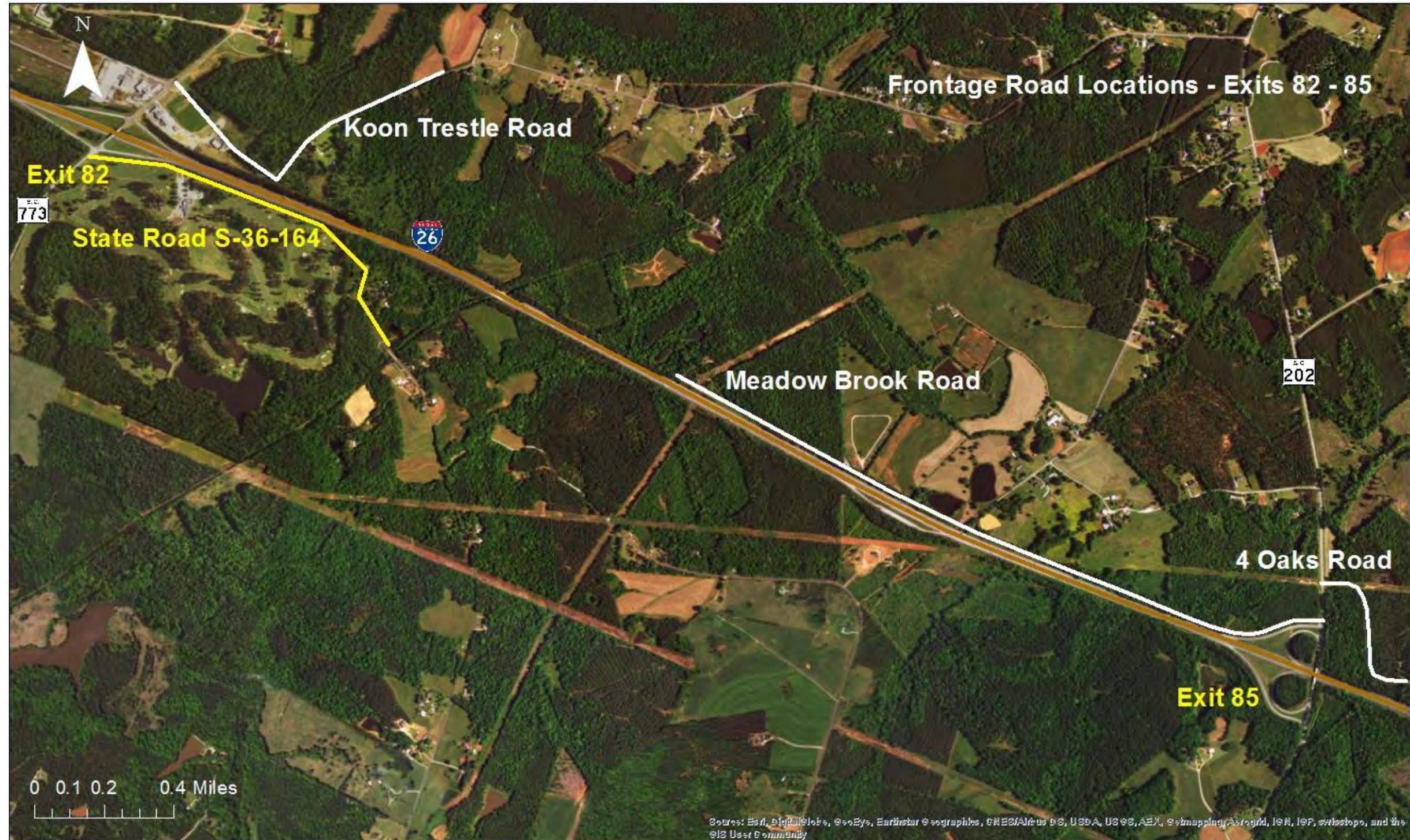


Figure 5 - Frontage Road Locations: Exits 85-91



Figure 6 - Frontage Road Locations: Exits 91-97

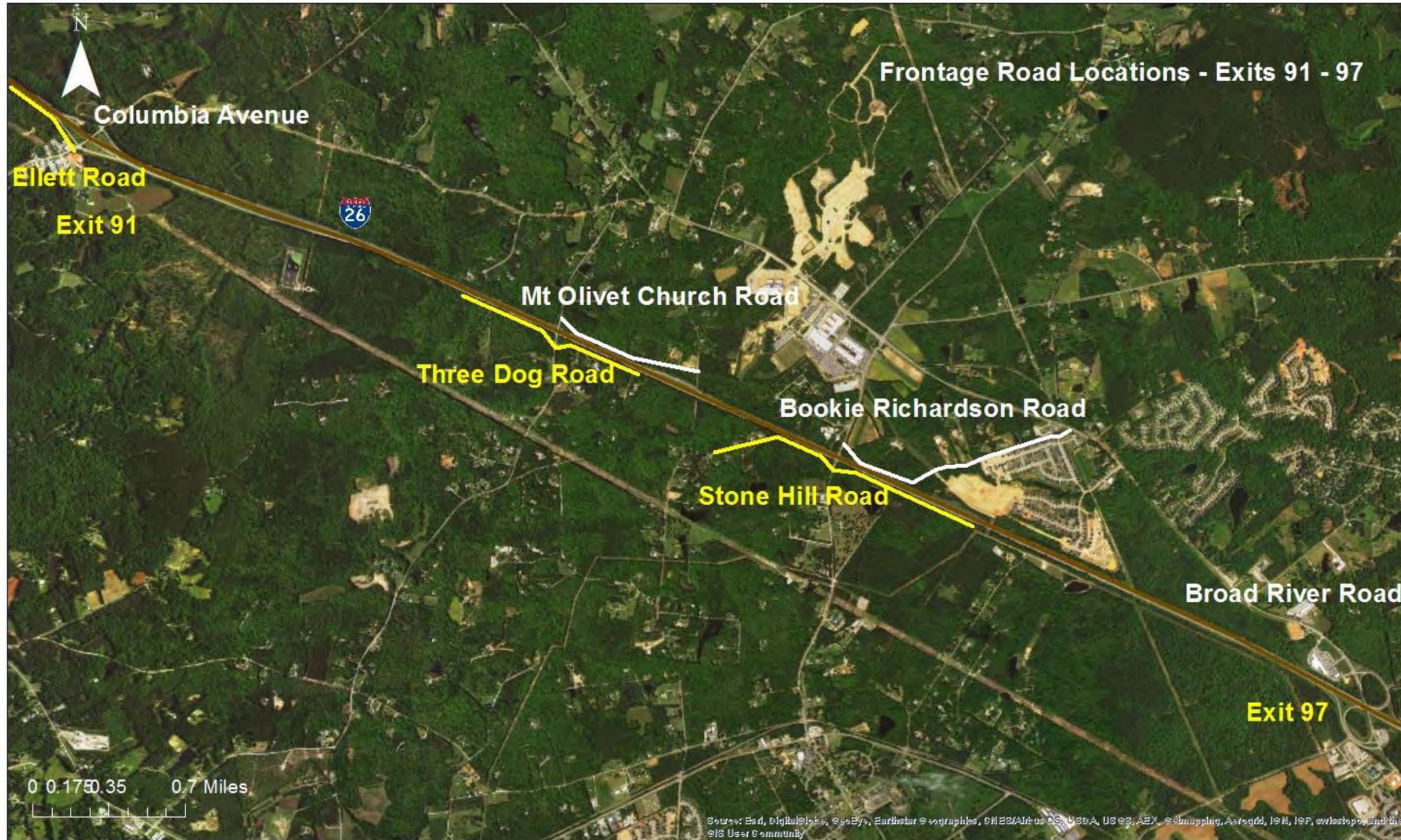


Figure 7 - Frontage Road Locations: Exits 97-102



### Eastbound Frontage Road System

The following roadways are considered part of the frontage road system on the south side of I-26.

- Short S-814 (Frontage Road) runs to the west of Parr Road. This frontage road, which is approximately 800 feet long, intersects Parr Road approximately 255 feet south of the Parr Road overpass. This frontage road appears to provide access to wooded property: there are no other road intersections or buildings along this road.
- Beagle Run Road (S-36-354) begins at its intersection with Trinity Church Road within 100 feet of the south end of the Trinity Church Road overpass. Beagle Run Road runs parallel to eastbound I-26 for approximately 450 feet before curving to the southeast away from I-26.
- One of the fragments of the eastbound frontage road system is Kiblers Brige Road (S-36-164). This road starts at SC 773 about 345 feet southwest of I-26, runs for 1,040 feet parallel to the Exit 82 eastbound on-ramp, runs parallel to the I-26 eastbound lanes for 1,985, and then runs generally in the southeast direction towards US 76. S-36-164 is a short fragment that has no connectivity and cannot be used as a freeway alternative in case of accident.
- Brentwood Court intersects Columbia Avenue adjacent to the eastbound off-ramp and runs to the northwest parallel to eastbound I-26 for approximately 2,820 feet where it ends at Ellett Road.
- Julius Eleazer Road (S-40-2904) begins approximately 1,750 feet west of Old Hilton Road (S-40-405). Julius Eleazer Road intersects Old Hilton Road opposite Three Dog Road approximately 170 feet south of the south end of the Old Hilton Road overpass.
- Three Dog Road (S-40-2902) begins at Old Hilton Road opposite Julius Eleazer Road and continues to the east running parallel to I-26 for approximately 3,000 feet before turning south to its terminus at Stone Hill Road (S-40-1403).
- Stone Hill Road (S-40-1403) runs in north-northeastern direction towards I-26 before turning east to run parallel to I-26 for about 1,310 feet to its intersection with Mt Vernon Church Road at a point about 175 feet south of the end of the Mt Vernon Church Road overpass. From this intersection, Stone Hill Road (S-40-2900) continues generally parallel to I-26 for about 3,270 feet until it dead-ends.
- Columbiana Drive (S-40-3048) runs from its intersection with Broad River Road, located approximately 350 feet west of the westbound off-ramp intersection at Exit 101, for approximately 2,665 feet to its intersection with Lake Murray Boulevard (SC 60) approximately 875 feet from the southbound off-ramp intersection. From here, Columbiana Drive continues to run parallel to I-26 further to the east.

## Alternatives to I-26

If an incident were to take place that disrupts traffic on I-26, or requires the closing a section of I-26, the fragmented frontage road system does not provide a continuous alternative route adjacent to I-26 between Exits 85 and 101.

If necessary, traffic can still bypass I-26 within the study area. Beginning at Exit 101, traffic can bypass I-26 for about 2.6 miles using the Western Lane frontage road that is located on the north side of I-26 between Broad River Road and Koon Road, or can use Broad River Road along the south side of I-26. Between where Koon Road intersects Broad River Road, to the US 76/US 176 split located approximately 3,500 feet west of Koon Road, Broad River Road is the only reasonable alternative to traveling on I-26. West of the split, Broad River Road (US 176) crosses I-26 at Exit 97 and continues to the west on the north side of I-26, while US 76 continues to the west on the south side of I-26. From the location where US 76 and US 176 split approximately two miles southeast of Exit 97, US 176 is generally a more rural roadway, especially to the north of Exit 97, with fewer intersections and higher speeds. US 76 is generally a more urban roadway connecting Ballentine and Chapin, with lower speeds and more frequent intersections.

US 176 north of I-26 can be accessed from Exits 82, 85, 91 and 97 to bypass I-26. It is approximately 3.4 miles from I-26 to US 176 along SC 773 from Exit 82, and approximately 2.75 miles along SC 202 from Exit 85. From Exit 91, traffic has to travel generally parallel to I-26 for about 2.25 miles along Columbia Avenue/Chapin Road before reaching US 176 approximately 3.3 miles north of Exit 97. Exit 97 intersects directly with US 176.

US 76 south of I-26 can similarly be accessed from Exits 82, 85, 91 and 97 to bypass I-26. It is approximately two miles from Exit 82 to US 76, and about 1.8 miles from Exit 85 to US 76. From Exit 91, traffic has to travel about two miles along Columbia Avenue to Reach US 76. From Exit 97, traffic has to travel about two miles to reach US 76 via Broad River Road. From this intersection, Broad River Road is a parallel alternative to I-26 to Exit 101.

## III. INTERCHANGES

The following interchanges are present within the study area along I-26 or are the next immediately full interchange adjacent to those that may be modified as part of this project.

- Exit 82 - SC 773 – adjacent interchange
- Exit 85 - SC 202
- Exit 91 - Columbia Avenue (S-32-48)
- Exit 97 - Broad River Road (US 176)
- Exit 101 - Broad River Road (US 76/US 176)
- Exit 102 – Lake Murray Boulevard (SC 60) – adjacent interchange

All exits have on- and off-ramps directly intersecting the crossing roadways.

The following are detailed descriptions of the individual interchanges, including information about ramp lengths, acceleration/deceleration lane lengths, distance between ramps, ramp termini and their traffic control, the intersecting arterial roadways, and existing adjacent intersections.

#### Exit 82 – SC 773

SC 773 interchange is a diamond interchange carrying traffic to and from SC 773. The exit is signed “SC 773” in both directions on I-26. While this interchange is not expected to be updated or modified, it is included in this analysis as it is the next full access interchange along I-26 adjacent to an interchange potentially being modified (Exit 85).

The westbound off-ramp is approximately 780 feet long with an 840 feet long parallel deceleration lane (with a parallel length of approximately 615 feet). The off-ramp has a 40 mph posted advisory speed limit. The off-ramp remains a single lane until it intersects with SC 773. At the intersection traffic can make a left or turn, and both movements are controlled by a stop sign.

The westbound on-ramp is a single lane ramp approximately 1,265 feet long that merges into I-26 with a 1,300 feet long parallel acceleration lane (with a parallel length of approximately 740 feet). The ramp accepts the southbound right turn and the northbound left turn traffic from SC 773. No control is provided to neither of these movements.

The westbound off-ramp and on-ramp are separated by approximately 2,050 feet.

The eastbound off-ramp is approximately 1,195 feet long with an 875 feet long parallel deceleration lane (with a parallel length of approximately 550 feet). The off-ramp has no posted advisory speed limit. The off-ramp remains a single lane until it intersects with SC 773. At the intersection traffic can make left or right turn, and both movements are controlled by a stop sign.

The eastbound on-ramp is a single lane ramp approximately 1,050 feet long that merges into I-26 with a 1,375 feet long parallel acceleration lane (with a parallel length of approximately 890 feet). The ramp accepts the southbound left turn and the northbound right turn traffic from SC 773. No control appears to be provided to these movements. The eastbound on-ramp is located adjacent to Kiblers Bridge Road. The on-ramp and Kiblers Bridge Road are separated by a landscaped area approximately 40 feet wide.

The eastbound off-ramp and on-ramp are separated by approximately 2,265 feet.

The existing SC 773 interchange is illustrated in **Figure 8**.

**Figure 8 - Exit 82: Existing Interchange Configuration**



### SC 773

SC 773 is a two lane roadway with a posted 35 mph speed limit in the vicinity of the interchange. The SC 773 bridge crossing I-26 is two lanes wide. No separate turn lanes are provided at the eastbound ramp intersection for a southbound left turn from SC 773 or at the westbound ramp intersection for a northbound left turn from SC 773. The eastbound ramp intersection is shown in **Figure 9**. The westbound ramp intersection is shown in **Figure 10**.

### Adjacent intersections

Two intersections are located in the vicinity of the interchange. The intersection of SC 773 with Kiblers Bridge Road (S-36-164) is located across from the eastbound off-ramp. Kiblers Bridge Road is separated from the eastbound on-ramp by a landscape area approximately 40 feet wide. The intersection of Koon Trestle Road (S-36-521)/travel plaza driveway is located approximately 715 feet northeast of the westbound ramps. The centerline of Koon Trestle Road is offset approximately 95 feet to the north of the travel plaza driveway.

### *SC 773 and Kiblers Bridge Road*

The intersection of SC 773 with Kiblers Bridge Road is an unsignalized intersection with the approach of Kiblers Bridge Road controlled by a stop sign. Kiblers Bridge Road is an undivided two-lane road with a 45 mph posted speed limit. The existing configuration of the SC 773 intersection with Kiblers Bridge Road is shown in **Figure 9**.

Figure 9 - Exit 82: SC 773 at Eastbound Ramps



Figure 10 - Exit 82: SC 773 at Westbound Ramps





posted advisory speed limit, and widens from a single lane to provide a separate left turn lane and a separate right turn lane that are separated from each other by a grass island. The left turn lane provides approximately 40 feet of storage upstream of the stop line and is controlled by a stop sign. The right turn lane provides approximately 110 feet of storage upstream of the stop line and is controlled by a yield sign.

The westbound on-ramp is a single lane ramp approximately 1,225 feet long that merges into I-26 with a 555 feet long parallel acceleration lane (with a parallel length of approximately 205 feet). The ramp accepts the southbound right turn and the northbound left turn traffic from SC 202. No control is provided to either of these movements. The westbound on-ramp is adjacent to Meadow Brook Road, which is located to the north of the on-ramp and separated by approximately 45 feet.

The westbound loop off-ramp and on-ramp are separated by approximately 980 feet.

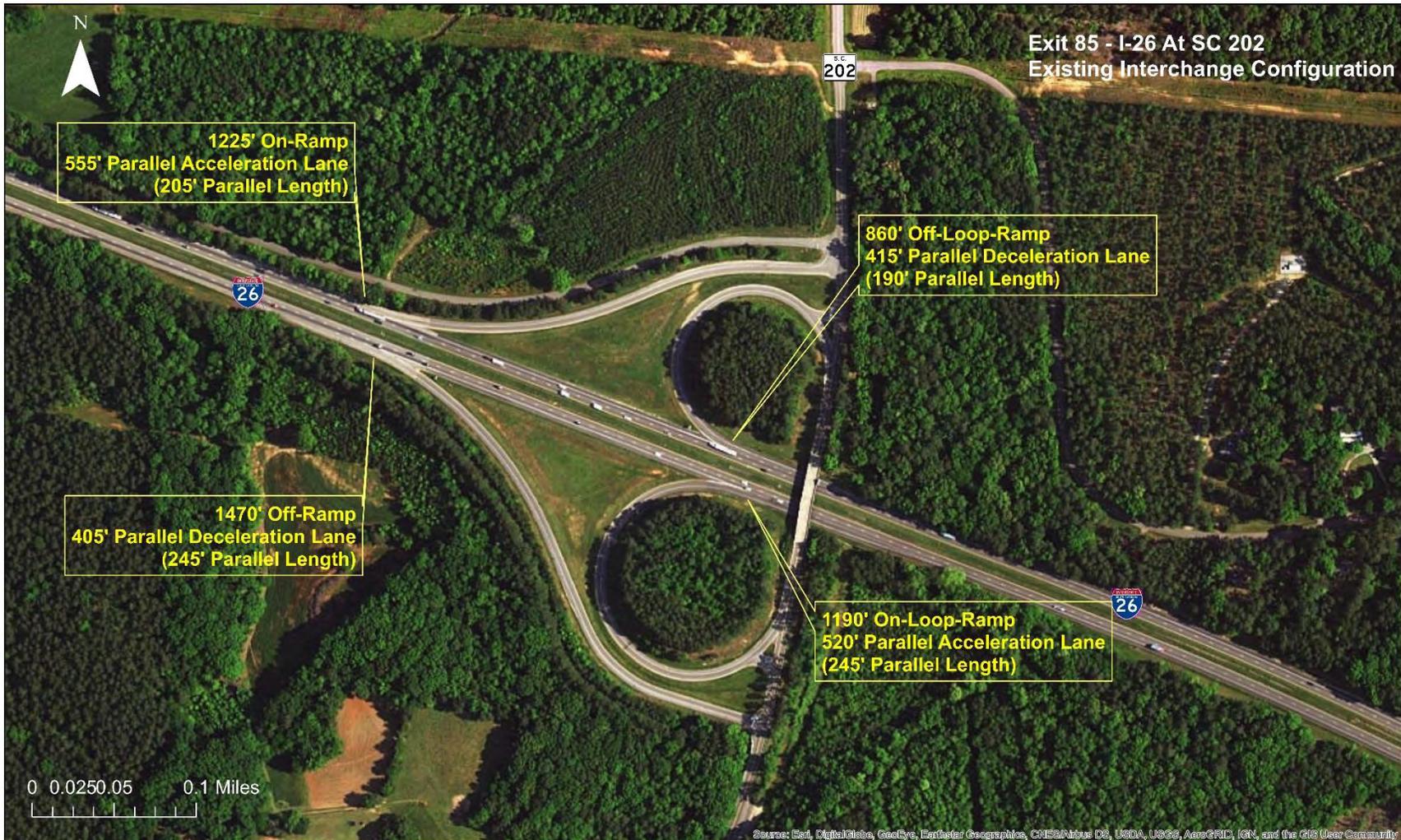
The eastbound off-ramp is approximately 1,470 feet long with a 405 feet long parallel deceleration lane (with a parallel length of approximately 245 feet). The off-ramp has a 40 mph posted advisory speed limit. The off-ramp remains a single lane until it intersects with SC 202. At the intersection traffic can make left or right turn. Both movements are controlled by stop signs.

The eastbound on-ramp is a single lane loop ramp approximately 1,190 feet long that merges into I-26 with a 520 feet long parallel acceleration lane (with a parallel length of approximately 245 feet). The ramp accepts the southbound right turn and the northbound left turn traffic from SC 202. Northbound left turning traffic and southbound right turning traffic are separated by a grass median; the northbound left turn traffic entering the on-ramp has to yield to the southbound right turn traffic.

The eastbound off-ramp and loop on-ramp are separated by approximately 1,050 feet.

The existing configuration of the Exit 85 interchange is shown in **Figure 12**.

**Figure 12 - Exit 85: Existing Interchange Configuration**



## SC 202

SC 202 is a two lane roadway with a posted 45 mph speed limit in the vicinity of the interchange. The SC 202 bridge crossing I-26 is two lanes wide. No dedicated turn lanes are provided for northbound left turn traffic from SC 202 merging into the eastbound loop on-ramp. However, there is a small island at the point of its merging with southbound right turn traffic from SC 202. Left turn traffic onto the eastbound loop on-ramp has to yield to southbound right turn traffic.

At the westbound on-ramp intersection, no vehicle storage turn lanes are provided for northbound left turn traffic or the southbound right turn traffic from SC 202. However, there is a wider section of pavement between the westbound on-ramp and Meadow Brook Road that could be used as a southbound right turn lane onto the ramp.

The eastbound ramp intersection is shown in **Figure 13**. The westbound ramp intersection is shown in **Figure 14**.

### Adjacent intersections

Two intersections are located in the vicinity of the interchange. The intersection of SC 202 with Meadow Brook Road (S-36-811) is located about 60 feet north of the westbound on-ramp. The intersection of 4 Oaks Road (S-36-370) is located approximately 520 feet north of the westbound on-ramp.

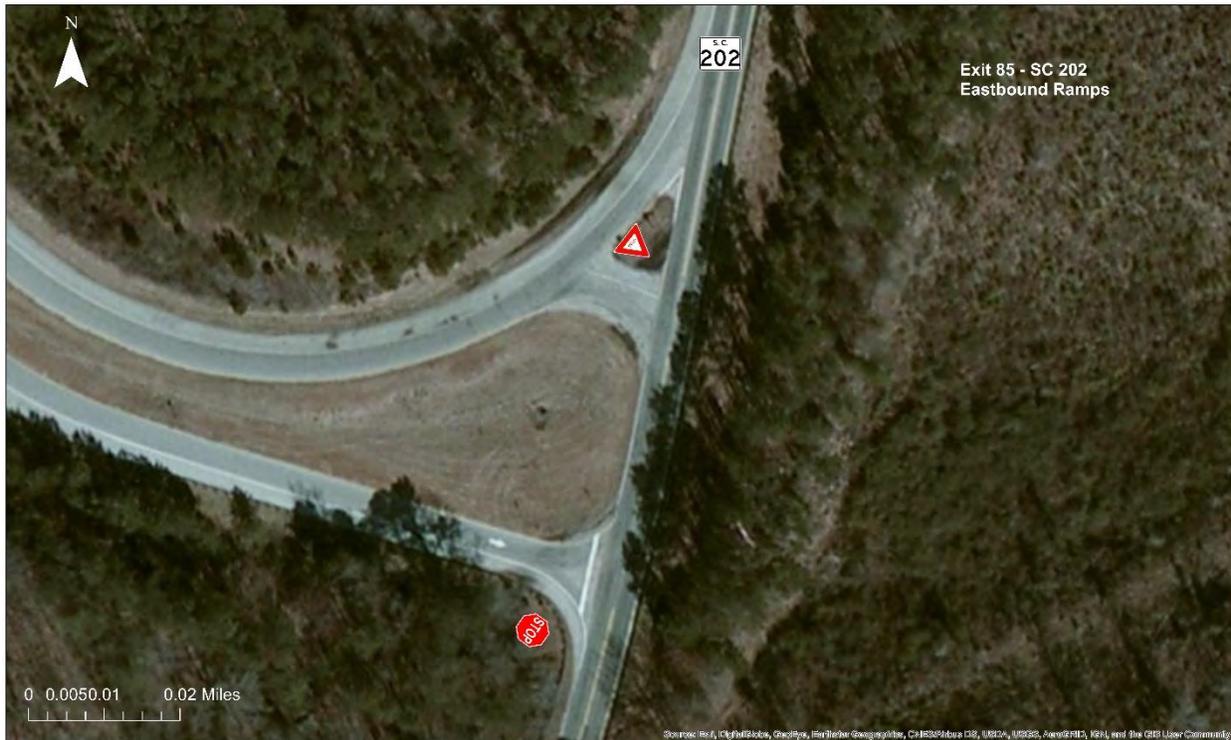
### Meadow Brook Road

Meadow Brook Road is a local undivided road without a posted speed limit. Meadow Brook Road is located approximately 60 feet north of the westbound on-ramp intersection, and runs westward and dead-ends in about 1.64 miles. At its intersection with SC 202, the eastbound approach of Meadow Brook Road is controlled by a stop sign. The existing configuration of the SC 202 intersection with Meadow Brook Road is shown in **Figure 14**.

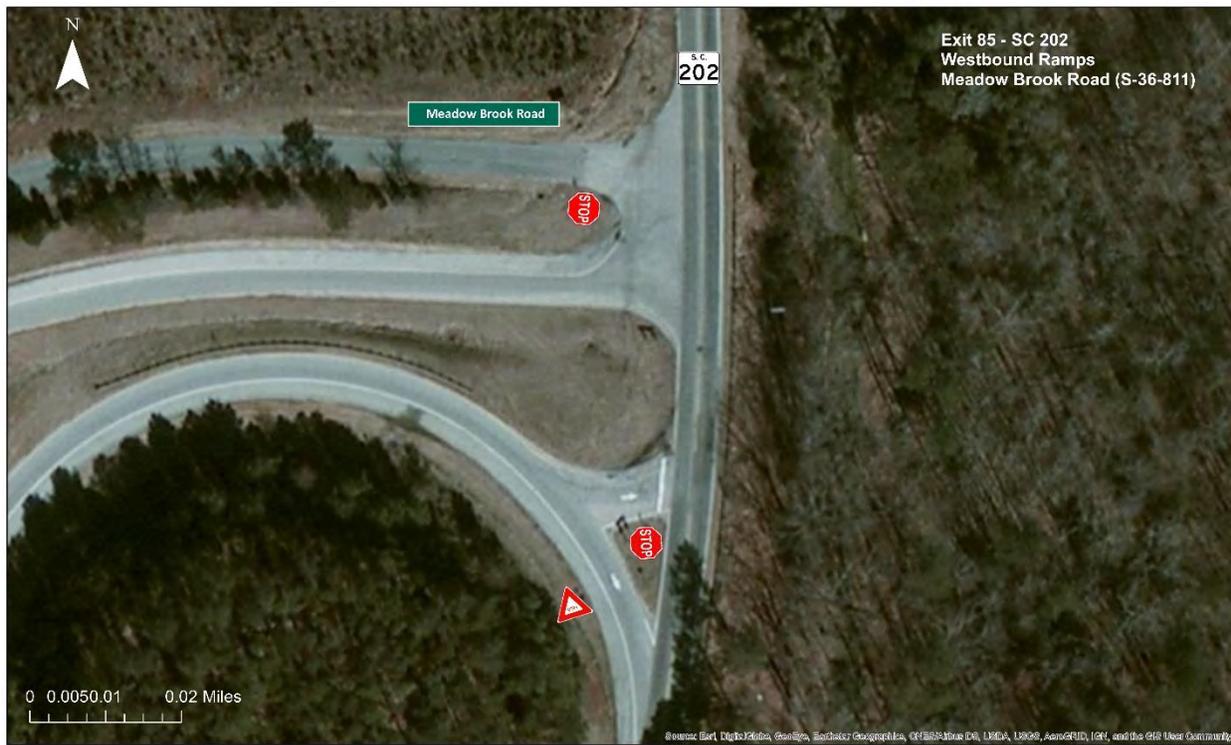
### 4 Oaks Road

4 Oaks Road is a local undivided road without a posted speed limit (although at the curves on the roadway, there are posted advisory speed limit signs of 25 and 30 mph). 4 Oaks Road is located approximately 520 feet north of the westbound on-ramp intersection, and runs eastward and dead-ends in 1.51 miles. At its intersection with SC 202, the westbound approach of 4 Oaks Road is controlled by a stop sign. The existing configuration of the SC 202 intersection with 4 Oaks Road is shown in **Figure 15**.

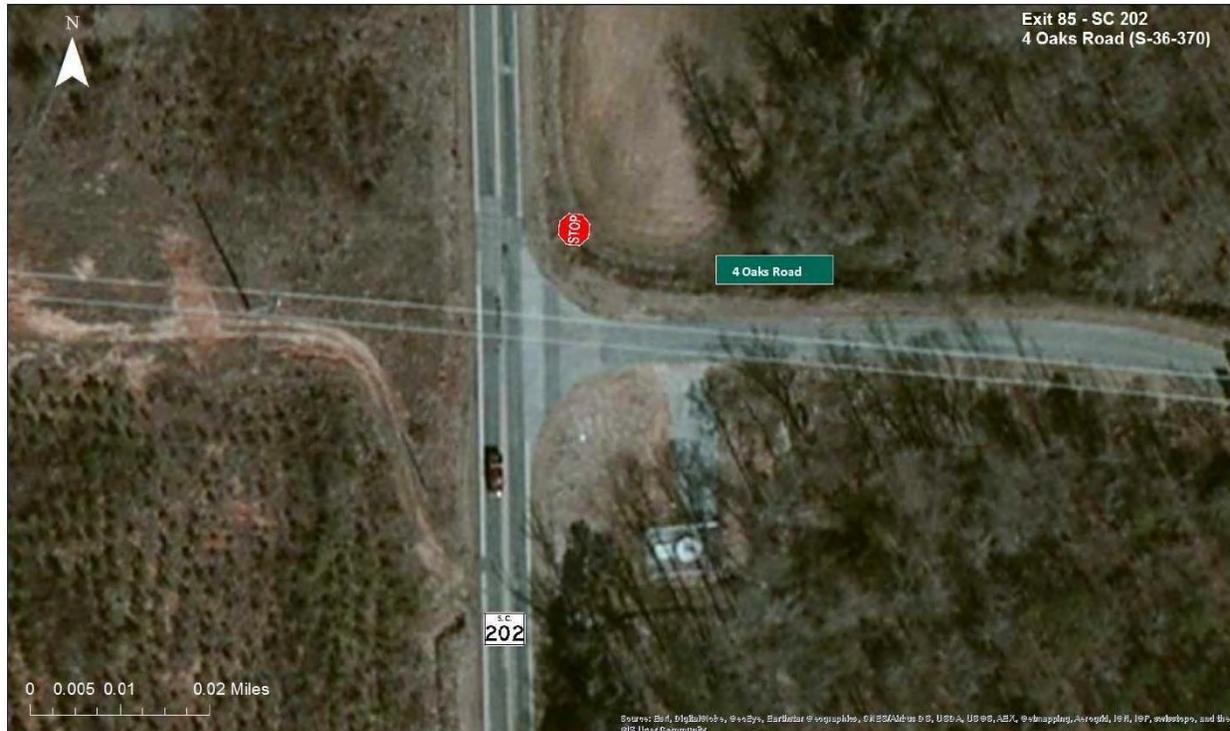
**Figure 13 - Exit 85: SC 202 at Eastbound Ramps**



**Figure 14 - Exit 85: SC 202 at Westbound Ramps**



**Figure 15 - Exit 85: SC 202 at 4 Oaks Road**



**Exit 91 – Columbia Avenue (S-32-48)**

The Columbia Avenue interchange is a diamond interchange carrying traffic to and from Columbia Avenue. The exit is signed “Columbia Ave” and “Chapin” in both directions on I-26.

The westbound off-ramp is approximately 665 feet long with a 1,150 feet long parallel deceleration lane (with a parallel length of approximately 920 feet). The off-ramp has a 40 mph posted advisory speed limit. The off-ramp remains a single lane until it intersects with Columbia Avenue. At the intersection, which is controlled by a traffic signal, traffic can go through (back to I-26) or make left or right turns. There are no dedicated turn lanes on the westbound off-ramp at its intersection with Columbia Avenue.

The westbound on-ramp is a single lane ramp approximately 800 feet long that merges into I-26 with a 1,195 feet long parallel acceleration lane (with a parallel length of approximately 885 feet). The ramp accepts the southbound right turn and the northbound left turn traffic from Columbia Avenue. No separate turn lanes are provided on Columbia Avenue for traffic turning onto the westbound on-ramp.

The westbound off-ramp and on-ramp are separated by approximately 1,465 feet.

The eastbound off-ramp is approximately 840 feet long with a 995 feet long parallel deceleration lane (with a parallel length of approximately 540 feet). The off-ramp has a 40 mph advisory speed limit. The off-ramp remains a single lane until it intersects with Columbia Avenue. At the intersection, traffic can go through (back to I-26) or turn left or right. There are no dedicated turn lanes on the eastbound off-ramp at its intersection with Columbia Avenue. The ramp off-approach is controlled by a stop sign.

The eastbound on-ramp is a single lane ramp approximately 910 feet long that merges into I-26 with a 1,050 feet long parallel acceleration lane (with a parallel length of approximately 955 feet). The ramp accepts the southbound left turn and the northbound right turn traffic from Columbia Avenue. No separate turn lanes are provided on Columbia Avenue for left or right turning traffic entering the on-ramp.

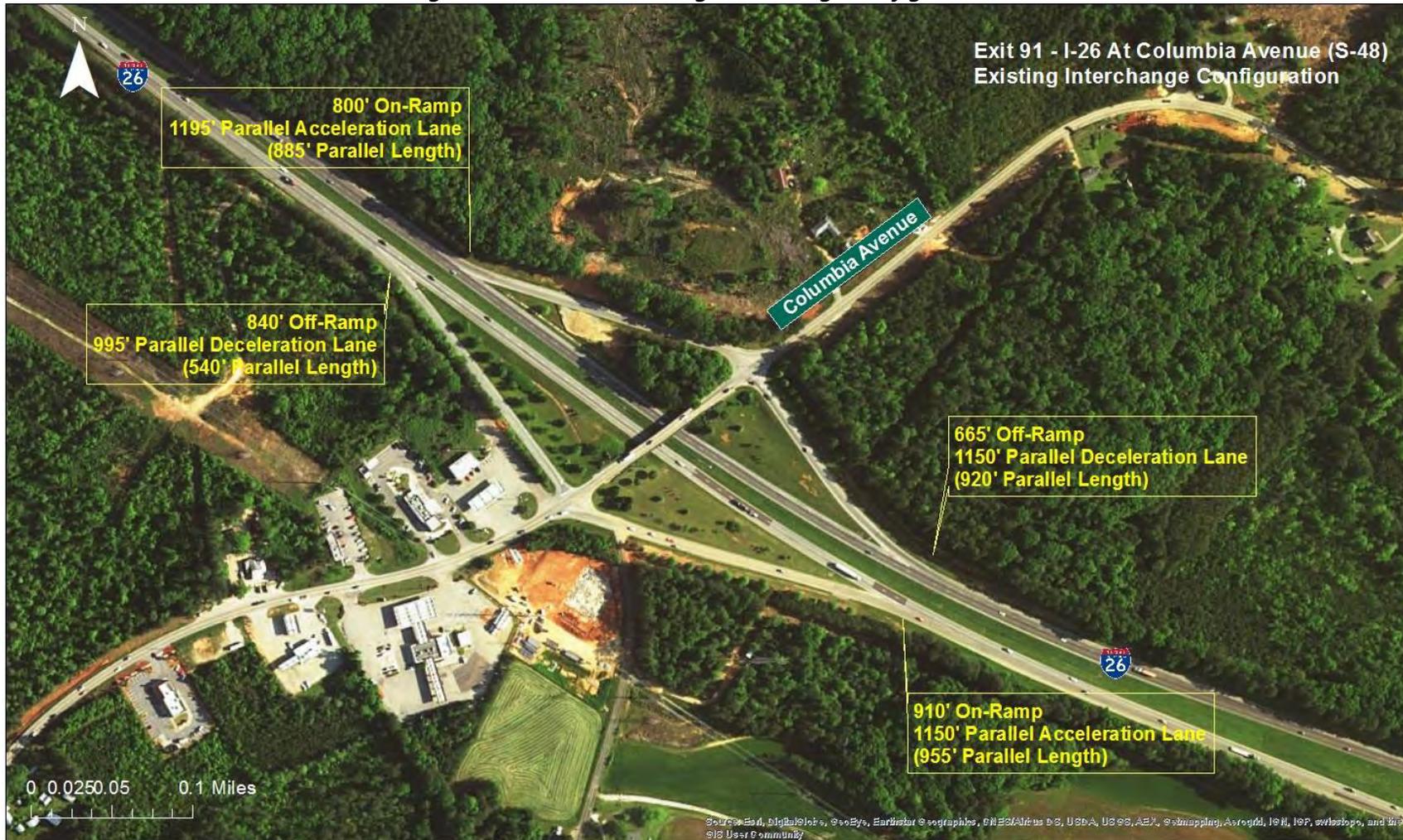
Two-way traffic is present for approximately 120 feet on the eastbound on-ramp between Columbia Avenue and Crooked Creek Road. East of Crooked Creek Road, the on-ramp is one-way eastbound to its merge area with I-26. At Columbia Avenue, the westbound portion of the two-way on-ramp section allows for a shared left turn-right turn movement under stop sign control.

The eastbound off-ramp and on-ramp are separated by approximately 905 feet.

A proposed interchange improvement project has been developed by Lexington County for Exit 91. This project would convert the existing diamond interchange to a diverging diamond interchange (DDI).

The existing Columbia Avenue interchange is illustrated in **Figure 16**.

**Figure 16 - Exit 91: Existing Interchange Configuration**



## Columbia Avenue

Columbia Avenue is a two lane roadway with a posted 35 mph speed limit in the vicinity of the interchange. The Columbia Avenue bridge crossing I-26 is two lanes wide. No vehicle storage turn lanes are provided for southbound left turns from Columbia Avenue at the eastbound ramp intersection or for northbound left turns at the westbound ramp intersection. The eastbound ramp intersection is shown in **Figure 17**. The westbound ramp intersection is shown in **Figure 18**.

## Adjacent intersections

Three adjacent intersections are located in the vicinity of the interchange. The intersection of Columbia Avenue with Brentwood Court is located next the eastbound off-ramp. The intersection of Crooked Creek Road and the eastbound on-ramp is located approximately 120 feet from Columbia Avenue. The intersection of Comalander Drive is located approximately 1,395 feet northeast of the westbound ramps.

### *Columbia Avenue and Brentwood Court*

The intersection of Columbia Avenue with Brentwood Court is an unsignalized intersection with the approach of Brentwood Court controlled by a stop sign. Brentwood Court is an undivided roadway without a posted speed limit. Near Columbia Avenue, Brentwood Court is separated from the eastbound off-ramp by approximately 30 feet. The existing configuration of the Columbia Avenue intersection with Brentwood Court is shown in **Figure 17**.

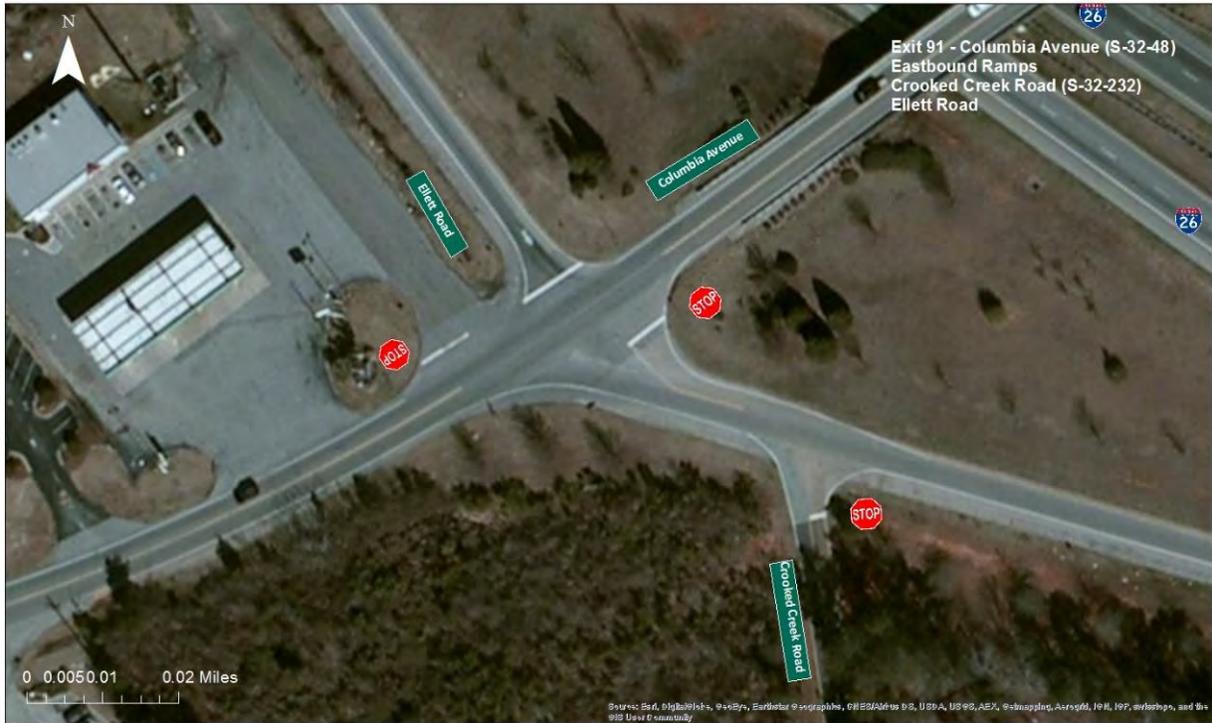
### *Eastbound On-Ramp and Crooked Creek Road*

Crooked Creek Road intersects the eastbound on-ramp approximately 120 feet from Columbia Avenue. This creates a two-way section on the on-ramp, which can be contrary to driver expectation when entering a freeway on-ramp. Crooked Creek Road is a two lane roadway with a 45 mph posted speed limit. At its intersection with the eastbound on-ramp, Crooked Creek Road has a single shared left turn-right turn lane controlled by a stop sign. The existing configuration of the eastbound on-ramp with Crooked Creek Road is shown in **Figure 17**.

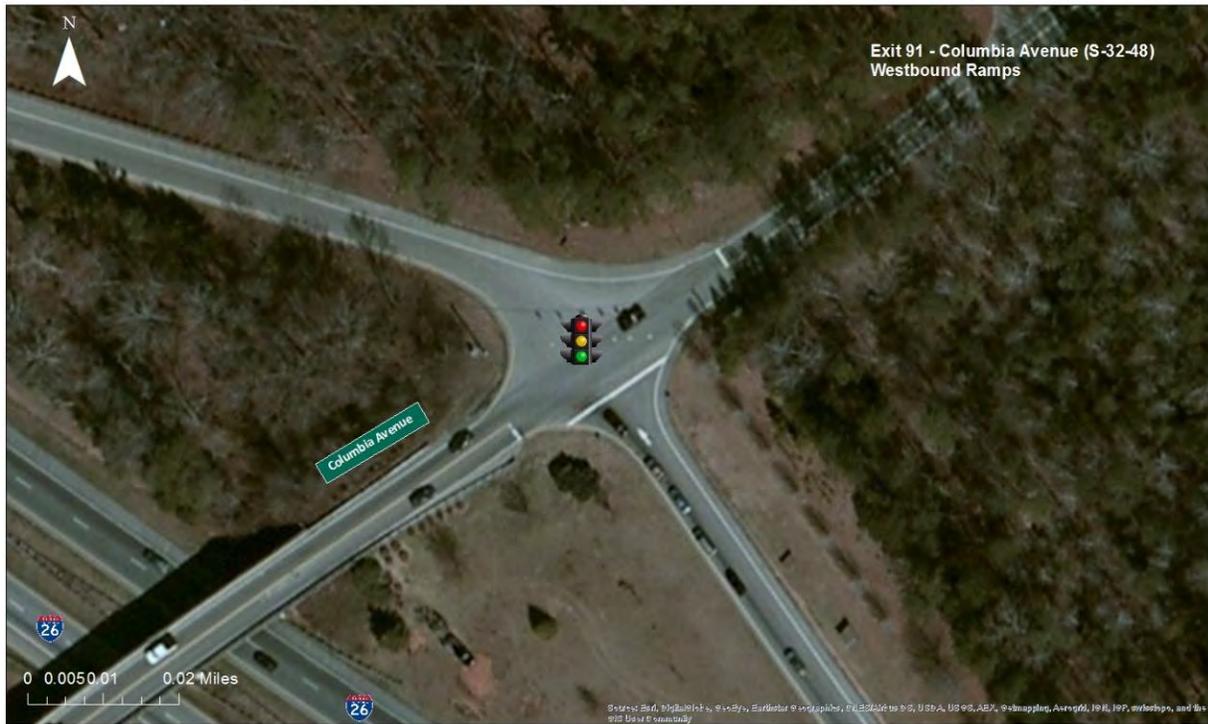
### *Columbia Avenue and Comalander Drive*

The intersection of Columbia Avenue with Comalander Drive is an unsignalized intersection with the approach of Comalander Drive controlled by a stop sign. Comalander Drive is an undivided two lane road with a 50 mph posted speed limit. No separate turn lanes are provided on the approaches of Columbia Avenue or Comalander Drive at this intersection. The existing configuration of the Columbia Avenue intersection with Comalander Drive is shown in **Figure 19**.

**Figure 17 - Exit 91: Columbia Avenue at Eastbound Ramps**



**Figure 18 - Exit 91: Columbia Avenue at Westbound Ramps**



**Figure 19 - Exit 91: Columbia Avenue at Comalander Road**



**Exit 97 – Broad River Road (US 176)**

This interchange is a partial cloverleaf interchange with loop on-ramps in the northeast and southwest quadrants. The exit is signed “176” using the route shield, along with the text “Peak” in the westbound direction. In the eastbound direction, the route shield “176” is shown along with the text “Ballentine” and “White Rock”.

The existing configuration of Exit 97 was constructed in the early 1970s. The westbound off-ramp is approximately 1,525 feet long with a 1,210 feet long parallel deceleration lane (with a parallel length of approximately 965 feet). The off-ramp has a 35 mph posted advisory speed limit.

Approximately 800 feet from the westbound off-ramp gore, the off-ramp and loop on-ramp are intersected by Julius Richardson Road. Traffic on the westbound off-ramp can turn right onto Julius Richardson Road or continue through to Broad River Road. Similarly, traffic on the westbound loop on-ramp can turn left onto Julius Richardson Road or continue down the loop ramp to enter westbound I-26. In either case, this roadway intersection on the westbound ramps can be contrary to driver expectation.

Passing the Julius Richardson Road intersection on the off-ramp, traffic continues to Broad River Road. Approximately 725 feet from Julius Richardson Road, the off-ramp splits to two separate diverging lanes. Traffic traveling to the north on Broad River Road separates to the right from

the remaining ramp traffic, which continues through to the signal controlled intersection of Broad River Road and the Broad River Village shopping center driveway. The right turn movement off-ramp traffic enters northbound Broad River Road controlled by a yield sign. The ramp approach to the signal consists of a separate left turn lane and separate through lane separated by a painted island. The shopping center driveway has a separate left turn lane and a shared through-right turn lane.

The westbound loop on-ramp is a single lane ramp that begins at the signalized off-ramp intersection. The loop on-ramp is approximately 1,250 feet long and merges into I-26 with a 1,440 feet long parallel acceleration lane (with a parallel length of approximately 895 feet). The ramp accepts the southbound left turn from a separate left turn lane on Broad River Road, and northbound right turn traffic from Broad River. The lanes for these two movements are separated by a grass island, with the southbound left turn traffic from Broad River Road controlled by a yield sign at the merge with the northbound right turn traffic from Broad River Road. The intersection with Julius Richardson Road is located approximately 775 feet from the signalized ramp intersection on Broad River Road.

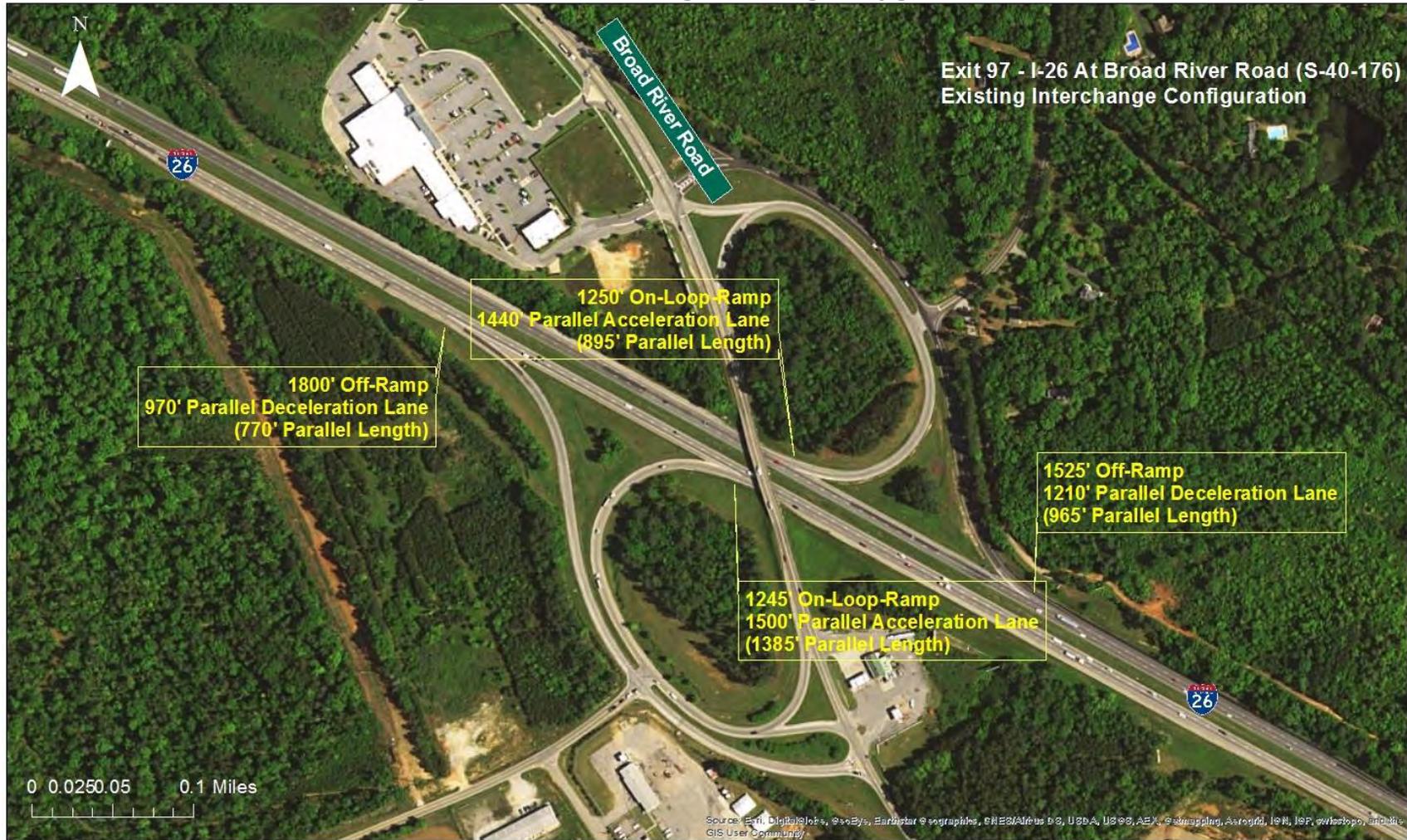
The westbound loop off-ramp and on-ramp are separated by approximately 710 feet on westbound I-26.

The eastbound off-ramp is approximately 1,800 feet long with a 970 feet long parallel deceleration lane (with a parallel length of approximately 770 feet). The off-ramp has a 35 mph posted advisory speed limit. In the middle of the ramp, traffic can make a right turn to Rauch-Metz Road (S-40-385) or it can proceed straight until the end of the ramp. At the end of the off-ramp, traffic can make a left turn to "Peak" and "Pomaria" or make a right turn to "Irmo" and "Ballentine". Near the end, the off-ramp widens from a single lane to provide a separate left turn lane and a separate right turn lane with approximately 200 feet of storage that are separated from each other by a concrete island. Both movements are controlled by the stop signs. The stop lines are set back 25-35 feet from the edge of Broad River Road.

The eastbound on-ramp is a single lane loop ramp approximately 1,245 feet long that merges into I-26 with a 1,500 feet long parallel acceleration lane (with a parallel length of approximately 1,385 feet). The ramp accepts the southbound right turn and the northbound left turn traffic from Broad River Road along with eastbound left turn traffic from Rauch-Metz Road. The northbound left turn traffic from Broad River Road has a yield sign at the merge with the southbound right turn traffic from Broad River Road. The Rauch-Metz Road approach is controlled by a stop sign.

The eastbound off-ramp and loop on-ramp are separated by approximately 905 feet. The existing configuration of the Exit 97 interchange is shown in **Figure 20**.

**Figure 20 - Exit 97: Existing Interchange Configuration**



Broad River Road

Broad River Road to the north of the interchange is a two lane roadway with a posted 45 mph speed limit. As Broad River Road approaches the interchange, separate right turn lanes are provided to the north and center driveway to the shopping center. At the signalized intersection with the westbound off-ramp, Broad River Road provides separate southbound left turn, through, and right turn lanes. The southbound left turn lane provides 270 feet of storage and the southbound right turn lane provides 175 feet of storage. In the northbound direction at this signal, Broad River Road provides a separate left turn lane with 140 feet of storage, and a separate through lane. The right turn movement to the westbound loop on-ramp diverges from northbound Broad River Road approximately 240 feet to the south of the stop line with a 130 feet long diverging taper. The Broad River Road bridge crossing I-26 is two lanes wide. At the eastbound ramp intersection, southbound Broad River Road provides a single through lane. The right turn lane to the eastbound loop on-ramp diverges approximately 250 north of where northbound traffic turns left onto the ramp. No separate turn lanes are provided to separate traffic turning left onto the eastbound loop on-ramp from the northbound through traffic on Broad River Road.

The eastbound ramp intersection is shown in **Figure 21**. The westbound ramp intersections are shown in **Figure 22** and in **Figure 23**.

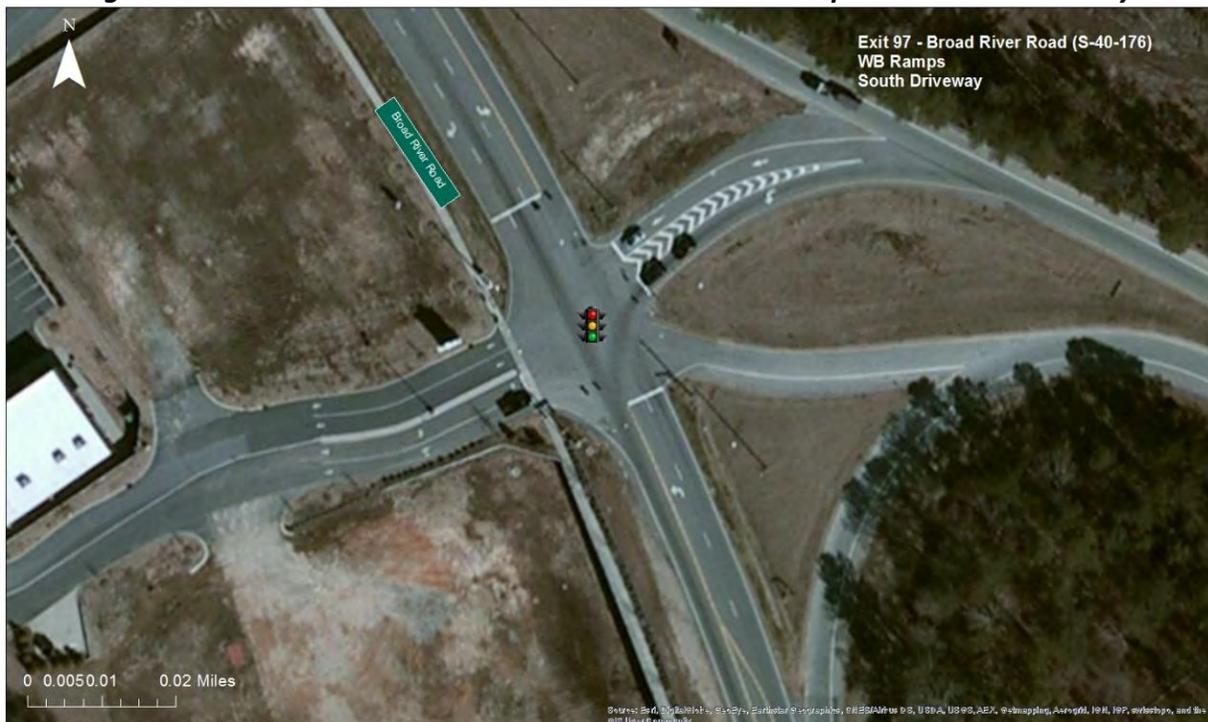
**Figure 21 - Exit 97: Broad River Road at Eastbound Ramps**



**Figure 22 - Exit 97: Broad River Road at Westbound Ramps and Central Driveway**



**Figure 23 - Exit 97: Broad River Road at Westbound Ramps and South Driveway**



Adjacent intersections

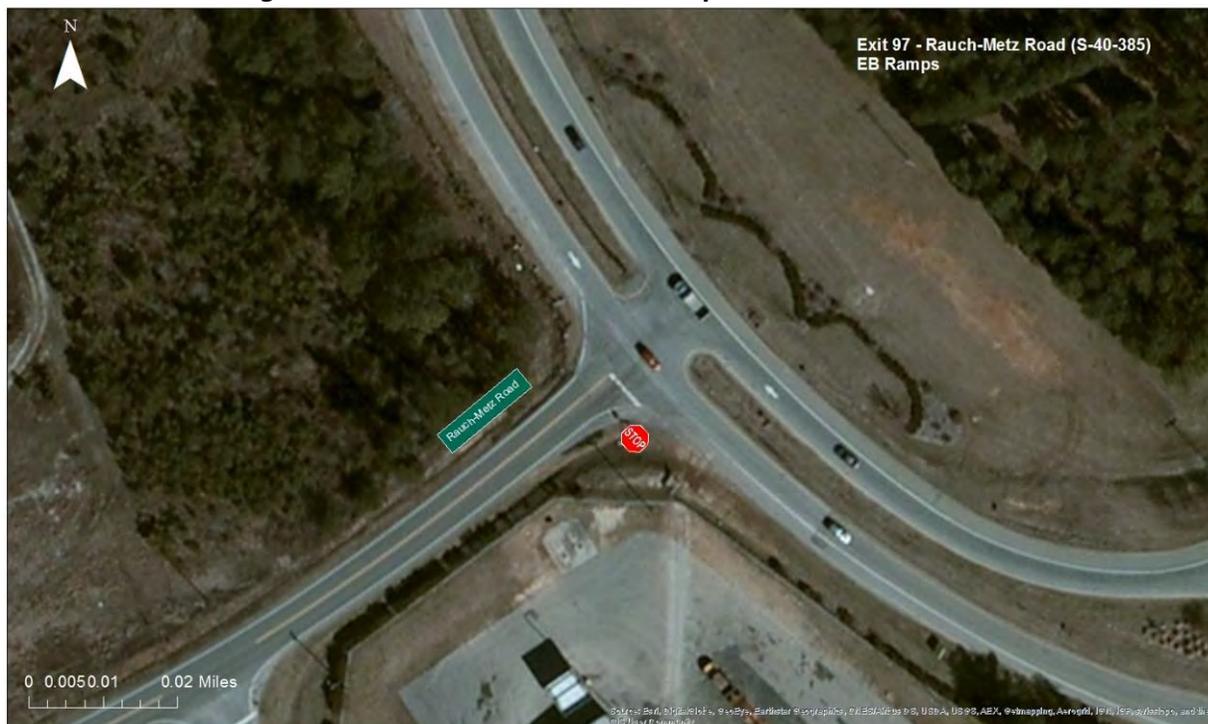
Seven intersections are located in the vicinity of the interchange. These are:

- Eastbound Ramps and Rauch-Metz Road (S-40-385)
- Broad Stone Road (S-40-2805) and Rauch-Metz Road
- Broad Stone Road with Broad River Road
- Westbound Ramps with Julius Richardson Road (S-40-959)
- Broad River Road and South Shopping Center Driveway/Westbound ramps
- Broad River Road and Center Shopping Center Driveway
- Broad River Road and North Shopping Center Driveway
- Broad River Road and West Shady Grove Road

*Eastbound Ramps and Rauch-Metz Road*

The intersection of the eastbound ramps with Rauch-Metz Road (S-40-385) is located in the southwestern quadrant of the interchange approximately 1,165 feet southeast from gore point of eastbound off-ramp. The intersection of the eastbound ramps with Rauch-Metz Road (S-40-385) is an unsignalized intersection with the approach of Rauch-Metz Road controlled by a stop sign. Rauch-Metz Road is an undivided two lane road with 45 mph posted speed limit. The existing configuration of the eastbound ramps with Rauch-Metz Road is shown in **Figure 24**.

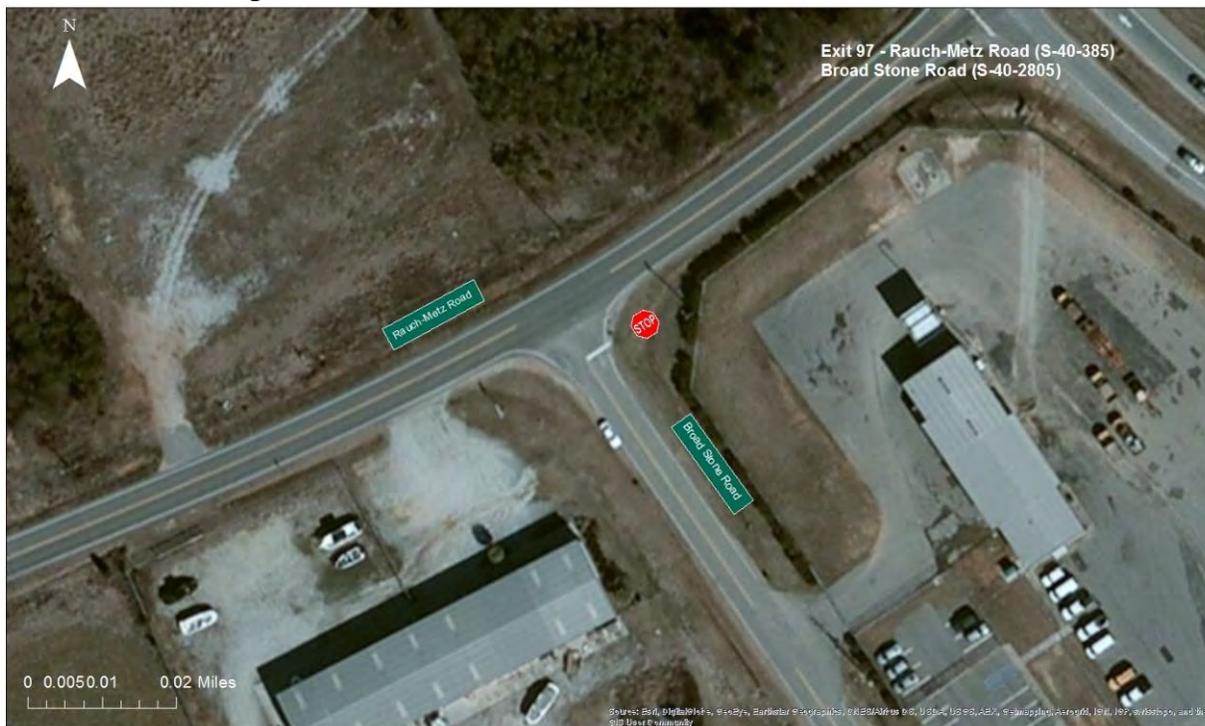
**Figure 24 - Exit 97: Eastbound Ramps at Rauch-Metz Road**



*Broad Stone Road and Rauch-Metz Road*

The intersection of Broad Stone Road (S-40-2805) with Rauch-Metz Road is located in the southwestern quadrant of the interchange approximately 310 feet from the intersection of the eastbound ramps with Rauch-Metz Road. The intersection of Broad Stone Road (S-40-2805) with Rauch-Metz Road is an unsignalized intersection with the approach of Broad Stone Road controlled by the stop sign. Broad Stone Road is an undivided two lane road without posted speed limit, however, it has a 15 mph advisory speed at the curves. The existing configuration of the Broad Stone Road with Rauch-Metz Road intersection is shown in **Figure 25**.

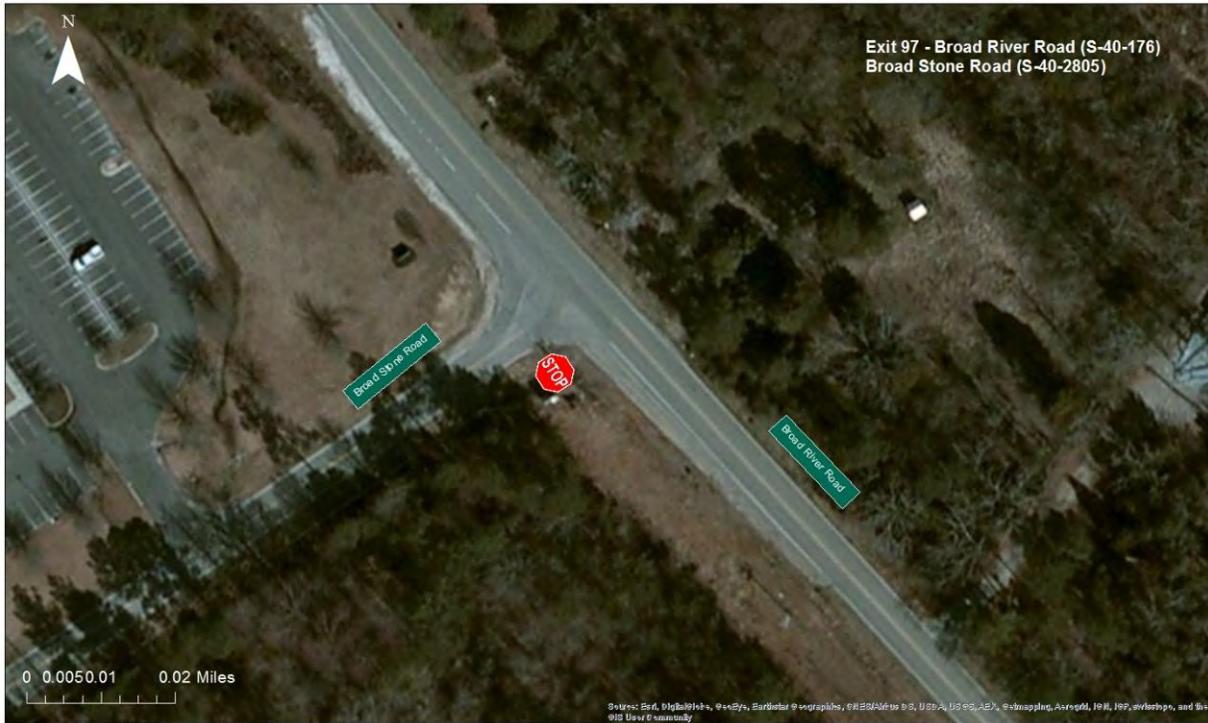
**Figure 25 - Exit 97: Broad Stone Road at Rauch-Metz Road**



*Broad Stone Road and Broad River Road*

The intersection of Broad Stone Road with Broad River Road is located in the southern end of the interchange area approximately 1,395 feet from the middle of the I-26 and Broad River Road intersection. The intersection of Broad Stone Road with Broad River Road is an unsignalized intersection with the approach of Broad Stone Road controlled by a stop sign. Broad Stone Road is an undivided two lane road without a posted speed limit, however, it has a 15 mph advisory speed at the curves. At the intersection with Broad River Road, Broad River Road has a southbound right turn lane with 170 feet of storage and a 115 feet long taper. Broad Stone Road has a separate right turn lane with 260 feet of storage and a 185 feet long taper. The existing configuration of Broad Stone Road with Broad River Road intersection is shown in **Figure 26**.

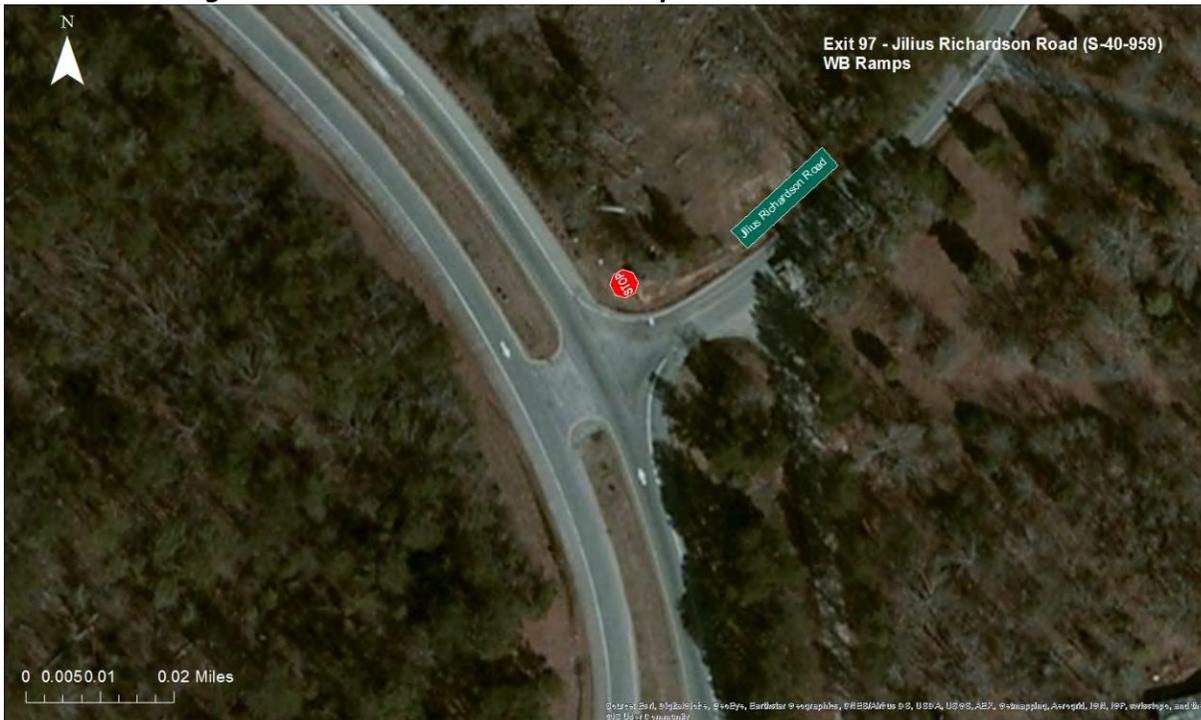
**Figure 26 - Exit 97: Broad Stone Road at Broad River Road**



*Westbound Ramps and Julius Richardson Road*

The intersection of the westbound ramps with Julius Richardson Road (S-40-959) is located in the northeastern quadrant of the interchange approximately 835 feet northwest from gore point of westbound off-ramp. The intersection of westbound ramps with Julius Richardson Road (S-40-959) is an unsignalized intersection with the approach of Julius Richardson Road controlled by the stop sign. Julius Richardson Road is an undivided two lane road with 45 mph posted speed limit. The existing configuration of westbound ramps with Julius Richardson Road intersection is shown in **Figure 27**.

**Figure 27 - Exit 97: Westbound Ramps at Julius Richardson Road**



*Broad River Road and the South Shopping Center Driveway/Westbound Ramps*

The intersection of Broad River Road with the westbound ramps and with the south driveway to the Broad River Village shopping center is located in the northern end of the interchange approximately 790 feet from the middle of the I-26 and Broad River Road interchange. The intersection of Broad River Road with the westbound ramps and the south driveway to the shopping center is a signalized intersection. The south shopping center driveway has two inbound lanes and two outbound lanes consisting of a separate left turn lane and a shared through-right turn lane. These lanes are separated by a concrete median. The westbound off-ramp approach has a left turn lane with 185 feet of storage and a through lane with 185 feet of storage with a painted median between them. The existing configuration of the intersection of Broad River Road at the westbound ramps and the south driveway to the shopping center is shown in **Figure 23**.

*Broad River Road and Center Shopping Center Driveway*

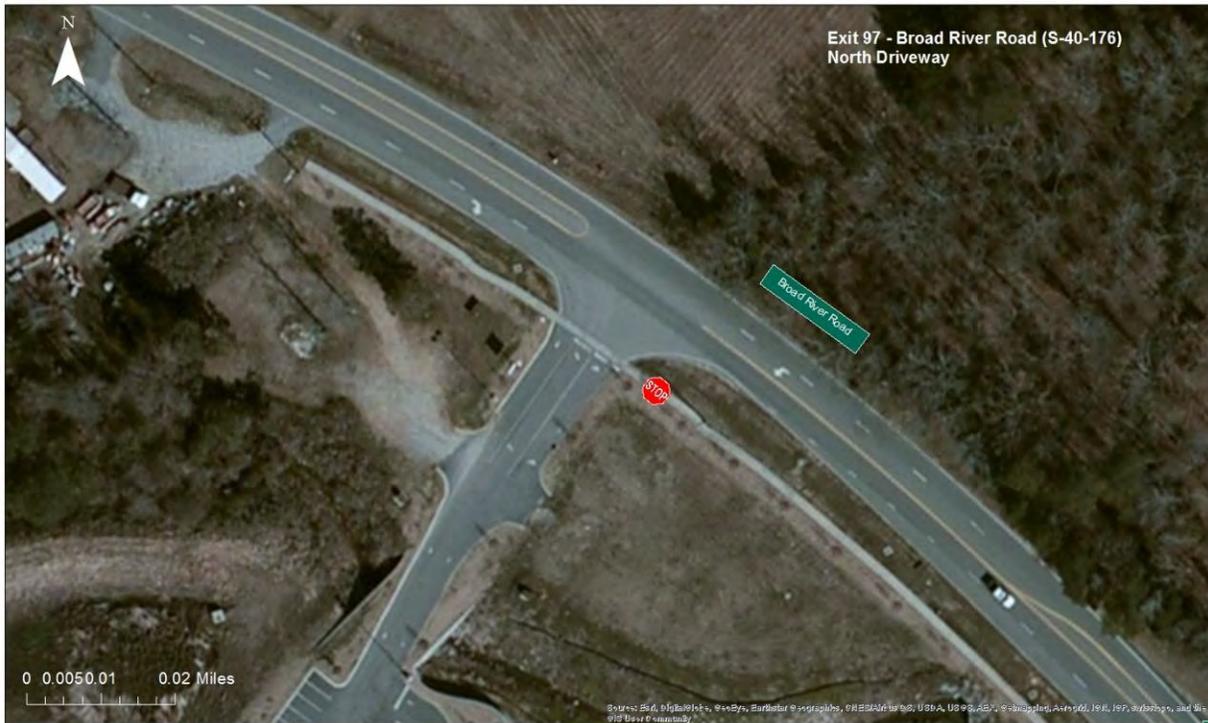
The intersection of Broad River Road with the center driveway to the Broad River Village shopping center is located in the northern end of the interchange approximately 1,150 feet from the middle of I-26 and Broad River Road interchange, and approximately 360 feet from the signalized intersection of Broad River Road with the westbound ramps and the southern shopping center driveway. The right turn movement from the westbound off-ramp merges into northbound Broad River Road approximately 60 feet north of the central driveway intersection. The central

shopping center driveway is an unsignalized right turn in/right turn out intersection with a concrete channelizing island. The southbound right turn movement into the driveway is made from a separate right turn lane with approximately 310 feet of storage, and a taper that ends just south of the northern shopping center driveway. The stop sign controlled right turn movement from the driveway is made into the southbound right turn lane at the signalized intersection with the westbound ramps and the southern shopping center driveway. Traffic wishing to travel through on southbound Broad River Road or turn left onto the westbound on-ramp has to weave into those lanes within the approximately 245 feet available between the outbound driveway stop line and the stop line at the signalized intersection. The existing configuration of Broad River Road with westbound ramps and with central driveway to the mall with Food Lion intersection is shown in **Figure 22**.

*Broad River Road and North Shopping Center Driveway*

The intersection of Broad River Road with the north driveway to the Broad River Village shopping center is located approximately 1,740 feet north of the middle of the I-26 and Broad River Road interchange and approximately 600 feet north of the center shopping center driveway. The intersection of Broad River Road with the north shopping center driveway is an unsignalized intersection with the approach of north driveway controlled by a stop sign. The approach of north driveway has a single entrance lane and separate left and right turn exit lanes. On southbound Broad River Road, there is a separate right turn lane for traffic entering the shopping center. This right turn lane has approximately 270 feet of vehicle storage. Northbound Broad River Road has a separate left turn lane for traffic turning left into this driveway. This left turn lane has approximately 215 feet of vehicle storage. The existing configuration of Broad River Road with westbound ramps and with north driveway to the mall with Food Lion intersection is shown in **Figure 28**.

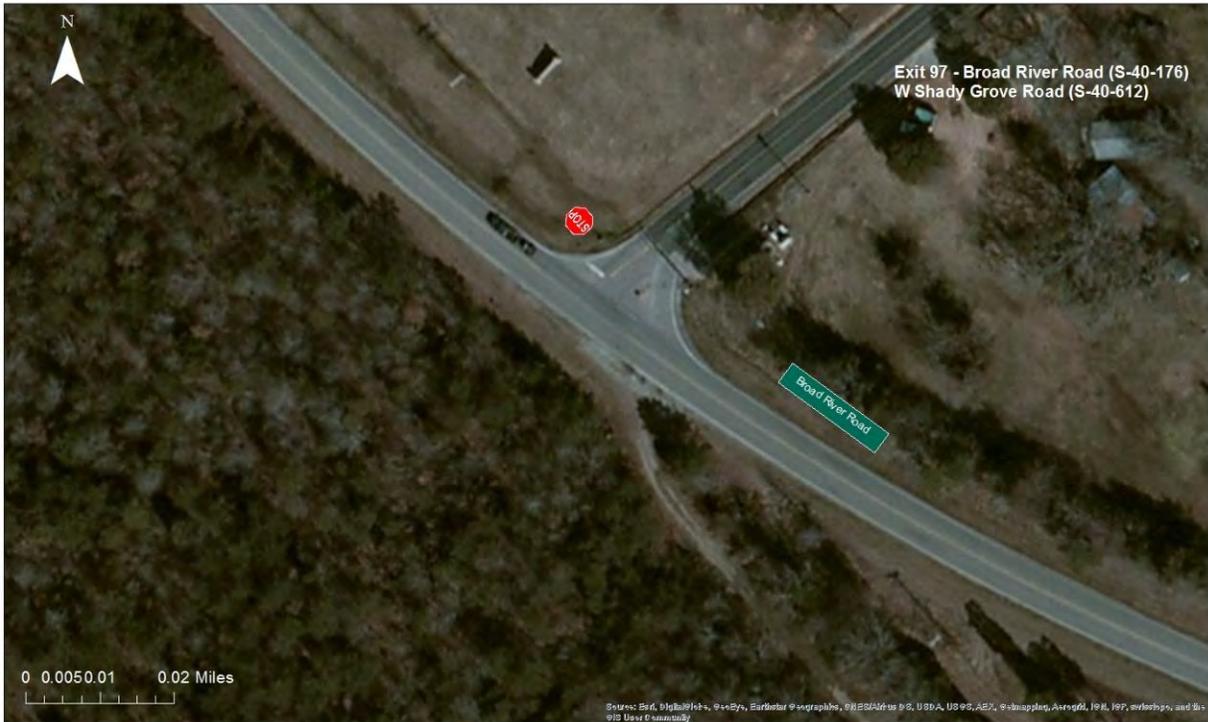
**Figure 28 - Exit 97: Broad River Road at Westbound Ramps and North Driveway**



*Broad River Road with West Shady Grove Road*

The intersection of Broad River Road with West Shady Grove Road is located approximately 3,400 feet north of the middle of the I-26 and Broad River Road interchange and approximately 1,680 feet north of the north shopping center driveway. West Shady Grove Road intersects Julius Richardson Road approximately 4,170 east of its intersection with Broad River Road. The intersection of Broad River Road with West Shady Grove Road is an unsignalized intersection with the westbound approach of West Shady Grove Road controlled by a stop sign. There are no separate turn lanes provided on any of the approaches to the intersection. The configuration of the intersection of Broad River Road and West Shady Grove Road is shown in **Figure 29**.

**Figure 29 - Exit 97: Broad River Road at West Shady Grove Road**



**Exit 101 – Broad River Road (US 76, US 176)**

Exit 101 is a partial cloverleaf interchange with loop off-ramps in the northwest and southeast quadrants. In the westbound direction, Exit 101A is signed “176”, “76” using the route shields, along with the text “Ballentine” and “White Rock”. Exit 101B is signed “176”, using the route shield, along with the text “Broad River Road-East”. In the eastbound direction, Exit 101A is signed “176” using the route shield, along with the text “Broad River Road-West” and Exit 101B is signed “176”, using the route shield, along with the text “Broad River Road-East”.

The existing configuration of Exit 101 was constructed around 2000. The westbound off-ramp is approximately 1,615 feet long with a 1,120 feet long weaving section from the upstream Exit 102 westbound on-ramp. The off-ramp has a 25 mph posted advisory speed limit. At its end, the ramp merges into Broad River Road (US 176) with a 530 feet long acceleration lane and 400 feet long taper.

The westbound loop off-ramp is approximately 1,495 feet long with a 1,035 feet long parallel deceleration lane (with a parallel length of approximately 800 feet). The off-ramp has a 25 mph posted advisory speed limit. At its end, the ramp merges into Broad River Road (US 176) with a 500 feet long acceleration lane and 285 feet long taper.

The westbound on-ramp is a single lane ramp approximately 1,835 feet long that merges into I-26 with a 1,135 feet long parallel acceleration lane (with a parallel length of approximately 625 feet). The ramp accepts westbound right turn and eastbound left turn traffic from Broad River Road. The westbound right turn traffic from Broad River Road has a yield sign at the ramp merge with the eastbound left turn traffic from Broad River Road.

The westbound off-ramp and the westbound loop off-ramp are separated by approximately 1,920 feet. The westbound loop off-ramp and the westbound on-ramp are separated by approximately 1,080 feet.

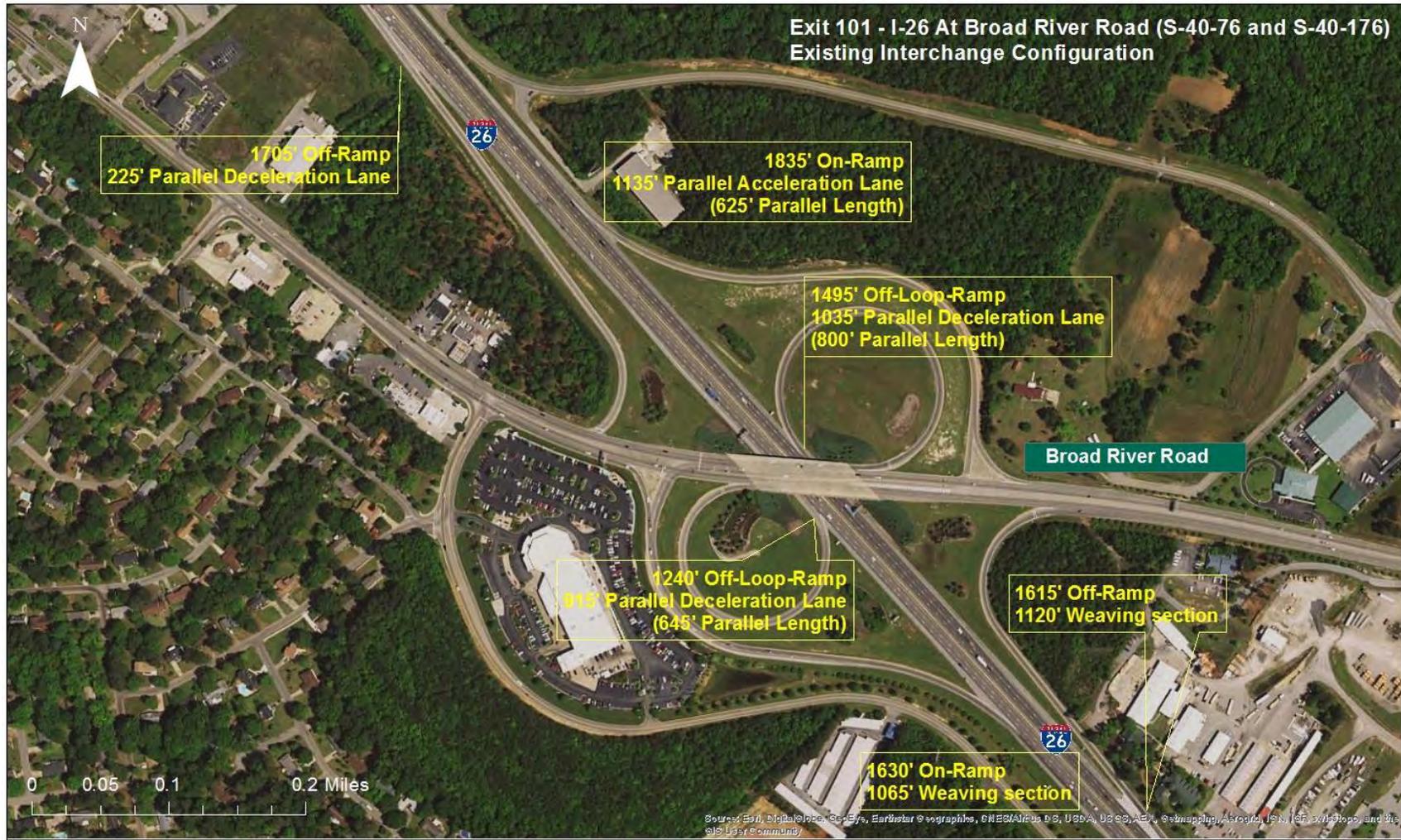
The eastbound off-ramp is approximately 1,705 feet long with a 225 feet long deceleration lane. The off-ramp has a 25 mph posted advisory speed limit. At its end, the ramp has a single stop sign controlled lane. While the lane has no specific designation, it is intended for traffic to turn right onto westbound Broad River Road. However, nothing precludes traffic from turning left onto eastbound Broad River Road.

The eastbound loop off-ramp is approximately 1,240 feet long with a 915 feet long parallel deceleration lane (with a parallel length of approximately 645 feet). The off-ramp has a 25 mph posted advisory speed limit. At its end, the ramp merges into Broad River Road (US 176) and with a 320 feet long acceleration lane and 405 feet long taper.

The eastbound on-ramp is a two lane ramp at its beginning with Broad River Road that merges into a single lane ramp prior to entering I-26. The on-ramp is approximately 1,630 feet long and creates a 1,065 feet long weaving section to the downstream Exit 102 eastbound off-ramp. The ramp accepts the eastbound right turn and the westbound left turn traffic from Broad River Road. The eastbound right turn traffic from Broad River Road has a yield sign at the merge with the westbound left turn traffic from Broad River Road.

The eastbound off-ramp and the eastbound loop off-ramp are separated by approximately 2,240 feet. The eastbound loop off-ramp and the eastbound on-ramp are separated by approximately 930 feet. The existing configuration of the Exit 101 interchange is shown in **Figure 30**.

Figure 30 - Exit 101: Existing Interchange Configuration



### Broad River Road

Broad River Road (US 176) in the vicinity of the interchange is a four lane roadway with a posted 45 mph speed limit with two way left turn lane that sometimes becomes a left turn lane at intersections. The four lane section of Broad River Road is located between Royal Tower Road (S-40-1862) and Western Lane (S-40-2894). Beyond this section, Broad River Road is generally a two lane roadway within the remainder of the study area.

At the eastbound approach to the eastbound on-ramp, eastbound Broad River Road has two through lanes and a separate right turn lane. The separate right turn lane, which is provided for eastbound traffic on Broad River Road to turn right onto the eastbound on-ramp, extends back 450 feet to the intersection of Broad River Road with Lordship Lane. For the next 395 feet, eastbound Broad River Road is two lanes until the merge point with eastbound loop off-ramp. At the merge point with eastbound loop off-ramp, the acceleration lane from the loop off-ramp extends along Broad River Road for 320 feet, before it tapers out within 405 feet approximately opposite the westbound on-ramp intersection.

At the westbound on-ramp intersection, a separate left turn lane consisting of approximately 270 feet of storage is provided. This left turn lane is separated by a painted island from the eastbound through lanes.

For the next 225 feet, until the merge point with I-26 westbound off-ramp, eastbound Broad River Road again provides two lanes. At the merge point with the I-26 westbound off-ramp, the acceleration lane for the off-ramp extends along Broad River Road for 530 feet, then tapers out within 400 feet. Eastbound Broad River Road continues with two lanes to Western Lane. At its intersection with Western Lane, an eastbound left turn lane with 205 feet of storage is provided. Approximately 250 feet east of its intersection with Western Lane, eastbound Broad River Road narrows from two lanes to one lane.

Beginning at Western Lane, westbound Broad River Road has two through lanes for about 930 feet before the right turn lane to the westbound on-ramp starts. The westbound right turn lane to the westbound on-ramp is approximately 285 feet long. Westbound Broad River Road continues with two lanes for approximately 545 feet where the westbound loop off-ramp begins to merge. The westbound loop off-ramp merges into Broad River Road with a 500 feet long acceleration lane and a 285 feet long taper, which ends just before the eastbound off-ramp intersection. At the intersection with the eastbound on-ramp, two westbound left turn lanes with 385 feet storage lengths are provided. Westbound Broad River Road continues with two lanes, with a separate left turn lane with 215 feet of storage at its intersection with Lordship Lane. West of its intersection with Lordship Lane, westbound Broad River Road continues with two lanes to just west of Royal Tower Road, where it tapers to a single lane within approximately 650 feet. At this point, Broad River Road continues running to the west towards Exit 97 as a two lane road.

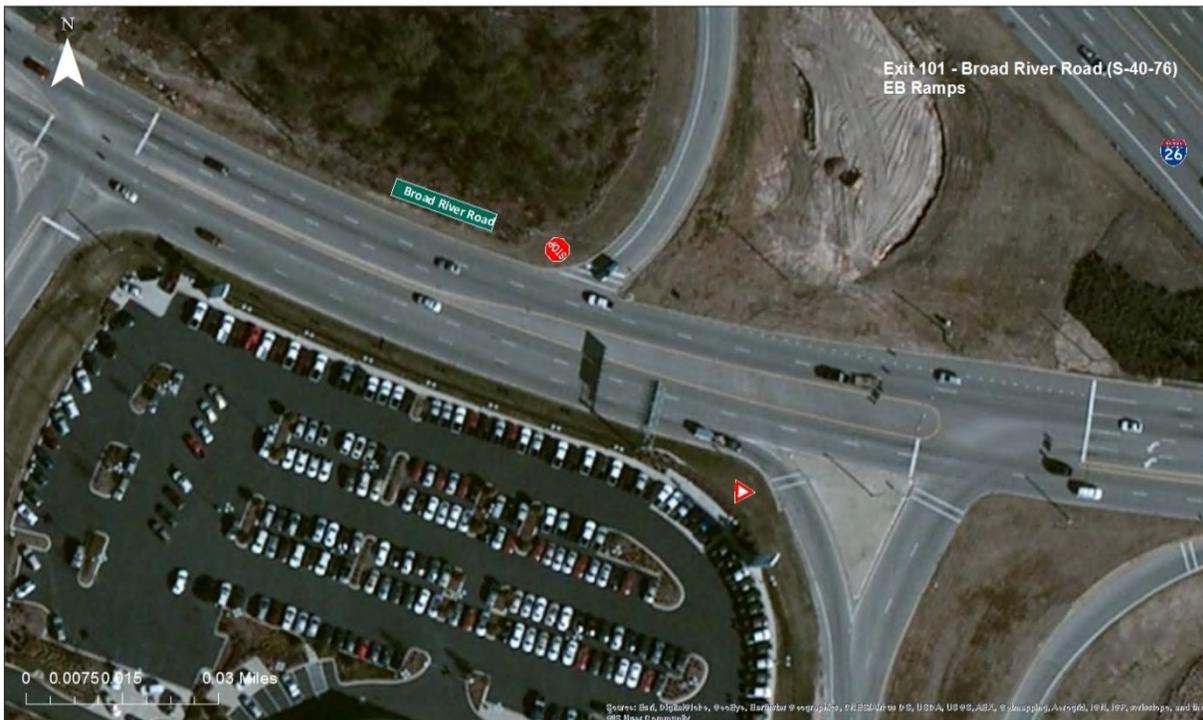
The intersection of Broad River Road and the eastbound on-ramp has a traffic signal that controls the eastbound and westbound through traffic on Broad River Road and the westbound left turn traffic turning onto the on-ramp.

As part of its Pennies Impacting People transportation sales tax program, Richland County is developing a project to widen Broad River Road between Royal Tower Road and the Broad Stone Road near the Exit 97 interchange.

According to the website <http://www.richlandpenny.com/december-15-2016-broad-river-road-widening-project/> the project is to consist of widening Broad River Road to a five lane section (two lanes each way with a center turn lane) between Royal Tower Drive and Dutch Fork Road. Between Dutch Fork Road and Broad Stone Road, Broad River Road will be widened to provide a three lane section (one lane each way with a center turn lane). Currently, right-of-way acquisition is scheduled to occur in Spring 2018, with construction beginning in Summer 2020.

The eastbound ramp intersection is shown in **Figure 31**. The westbound ramp intersection is shown in **Figure 32**.

**Figure 31 - Exit 101: Broad River Road at Eastbound Ramps**



**Figure 32 - Exit 101: Broad River Road at Westbound On-Ramp**



Adjacent intersections

Two intersections are located in the vicinity of the interchange. The intersection of Broad River Road with Lordship Lane/Columbiana Drive (S-40-3048) is located in the western part of the interchange area approximately 870 feet west of gore point of the eastbound loop off-ramp. The intersection of Broad River Road with Western Lane (S-40-2894) is located in the eastern part of the interchange area approximately 2,320 feet east of gore point of eastbound loop off-ramp.

*Broad River Road and Lordship Lane/Columbiana Drive*

The intersection of Broad River Road with Lordship Lane/Columbiana Drive (S-40-3048) is a signalized intersection. Lordship Lane/Columbiana Drive is an undivided two lane road with a 40 mph posted speed limit. At its intersection with Broad River Road, Lordship Lane/Columbiana Drive currently provides separate left and right turn lanes. The left turn lane provides 200 feet of storage. Eastbound Broad River Road has two through lanes and a separate right turn lane with 270 feet of storage. The eastbound right turn movement is channelized with a painted island and is under yield control. The westbound approach of Broad River Road has a separate left turn lane with 215 feet of storage and two through lanes. The existing configuration of Broad River Road with Lordship Lane/Columbiana Drive is shown in **Figure 33**. It should be noted that on the southbound approach a Circle K gas station entrance/exit has been added since the analysis was completed.

**Figure 33 - Exit 101: Broad Stone Road at Lordship Lane**



*Broad River Road and Western Lane*

The intersection of Broad River Road with Western Lane (S-40-2894) is a signalized intersection. Western Lane is an undivided two lane road with 45 mph posted speed limit. On its approach to Broad River Road, northbound Western Lane provides a separate left turn lane with 165 feet of storage and a shared through-right turn lane. On the southbound Western Lane approach, a separate left turn lane with 195 feet of storage and a shared through-right turn lane is provided. The eastbound approach of Broad River Road consists of a separate left turn lane with 210 feet of storage, a through lane and a shared through-right turn lane. The westbound approach of Broad River Road has a single through lane that begins to widen to two lanes approximately 735 feet from the stop line. At the intersection with Western Lane, westbound Broad River Road provides a separate left turn lane with 230 feet of storage, a through lane and a shared through-right turn lane. The existing configuration of Broad River Road with Western Lane intersection is shown in **Figure 34**.

**Figure 34 - Exit 101: Broad Stone Road at Western Lane**



**Exit 102 – Lake Murray Boulevard (SC 60)**

Exit 102 is a partial cloverleaf interchange with loop off-ramps in the northwest and southeast quadrants. In the westbound direction, Exit 102A is signed “60” with a state route shield, along with the text “Lake Murray Blvd-WEST” and “Irmo”. Exit 102B is signed “60” with a state route shield along with the text “Lake Murray Blvd-EAST”. In the eastbound direction, Exit 102A is signed “60” with a state route shield along with the text “Lake Murray Blvd-WEST” and “Irmo”. Exit 102B is signed “60” with a state route shield along with the text “Lake Murray Blvd-EAST”.

The existing configuration of Exit 102 was constructed around 1996. The westbound off-ramp is approximately 1,510 feet long with a 280 feet long parallel deceleration lane. The off-ramp has a 25 mph posted advisory speed limit. The ramp merges into Lake Murray Boulevard and continues east for approximately 510 feet, before it becomes a right turn lane at the intersection with Palmetto Health Parkway/Kinley Road.

The westbound loop off-ramp is approximately 1,460 feet long with a 995 feet long parallel deceleration lane (with a parallel length of approximately 775 feet). The off-ramp has a 25 mph posted advisory speed limit. At its end, the loop ramp merges into Lake Murray Boulevard with a 395 feet long acceleration lane, followed by a 520 feet long taper. The taper ends just before the westbound off-ramp intersection.

The westbound on-ramp is a single lane ramp approximately 1,740 feet long that merges into I-26 with a 1,120 feet long weaving section to the downstream Exit 101 westbound off-ramp. The ramp accepts the westbound right turn and the eastbound left turn traffic from Lake Murray Boulevard. The westbound right turn traffic from Lake Murray Boulevard has a yield sign at the merge with the eastbound left turn traffic from Lake Murray Boulevard.

The westbound off-ramp and the westbound loop off-ramp are separated by approximately 1,865 feet. The westbound loop off-ramp and the westbound on-ramp are separated by approximately 995 feet.

The eastbound off-ramp is approximately 1,705 feet long with a 1,065 feet long weaving section from upstream Exit 101 eastbound on-ramp. The off-ramp has a 25 mph posted advisory speed limit. At the end of the ramp, traffic merges into westbound Lake Murray Boulevard. This movement is controlled by a yield sign. The ramp has a 270 feet long acceleration lane onto Lake Murray Boulevard followed by a 445 feet long taper, which ends at the intersection with Columbiana Drive.

The eastbound loop off-ramp is approximately 1,230 feet long with an 845 feet long parallel deceleration lane (with a parallel length of approximately 575 feet). The off-ramp has a 25 mph posted advisory speed limit. At its end, the ramp merges into Lake Murray Boulevard with a 640 feet long acceleration lane followed by a 290 feet long taper. The taper ends just before the beginning of the westbound off-ramp merge lane.

The eastbound on-ramp is a two lane ramp approximately 2,930 feet long that merges into I-26 with a 750 feet long parallel acceleration lane (with a parallel length of approximately 245 feet). The eastbound on-ramp becomes a single lane ramp in 875 feet. The ramp accepts the eastbound right turn and the westbound left turn traffic from Lake Murray Boulevard. No yield signs are posted for the traffic turning from Lake Murray Boulevard.

The eastbound off-ramp and the eastbound loop off-ramp are separated by approximately 2,135 feet. The eastbound loop off-ramp and the eastbound on-ramp are separated by approximately 2,205 feet.

The existing configuration of the Exit 102 interchange is shown in **Figure 35**.

Figure 35 - Exit 102: Existing Interchange Configuration



### Lake Murray Boulevard

Lake Murray Boulevard (SC 60) in the vicinity of the interchange is a four lane roadway with a posted 40 mph speed limit with a two way left turn lane that becomes a dedicated left turn lane at the on-ramp intersections.

On eastbound Lake Murray Boulevard approaching the eastbound on-ramp, Lake Murray Boulevard has two through lanes and a separate right turn lane that leads to the eastbound on-ramp. This right turn lane is 275 feet long with 210 feet of taper. Beyond the eastbound on-ramp, eastbound Lake Murray Boulevard continues with two lanes until the merge point with the eastbound loop off-ramp. At this merge point, the eastbound loop off-ramp enters onto Lake Murray Boulevard with a 655 feet long acceleration lane followed by a 300 feet long taper. For the next 135 feet, until the merge point with I-26 westbound off-ramp, eastbound Lake Murray Boulevard has two lanes.

The westbound off-ramp merges into Lake Murray Boulevard with an acceleration lane that becomes the right turn lane about 520 feet downstream at Palmetto Health Parkway. In addition to this separate eastbound right turn lane at the Palmetto Health Parkway/Kinley Road intersection, eastbound Lake Murray Boulevard also provides a separate left turn lane with 145 feet of storage and two through lanes. From the intersection with Palmetto Health Parkway/Kinley Road, eastbound Lake Murray Boulevard has two through lanes with a third outside through lane that continues for 90 feet and tapers down within another 180 feet. From this point, Lake Murray Boulevard continues with two eastbound lanes to the Parkridge Drive intersection, where one through lane continues eastbound and the second through lane becomes a right turn lane.

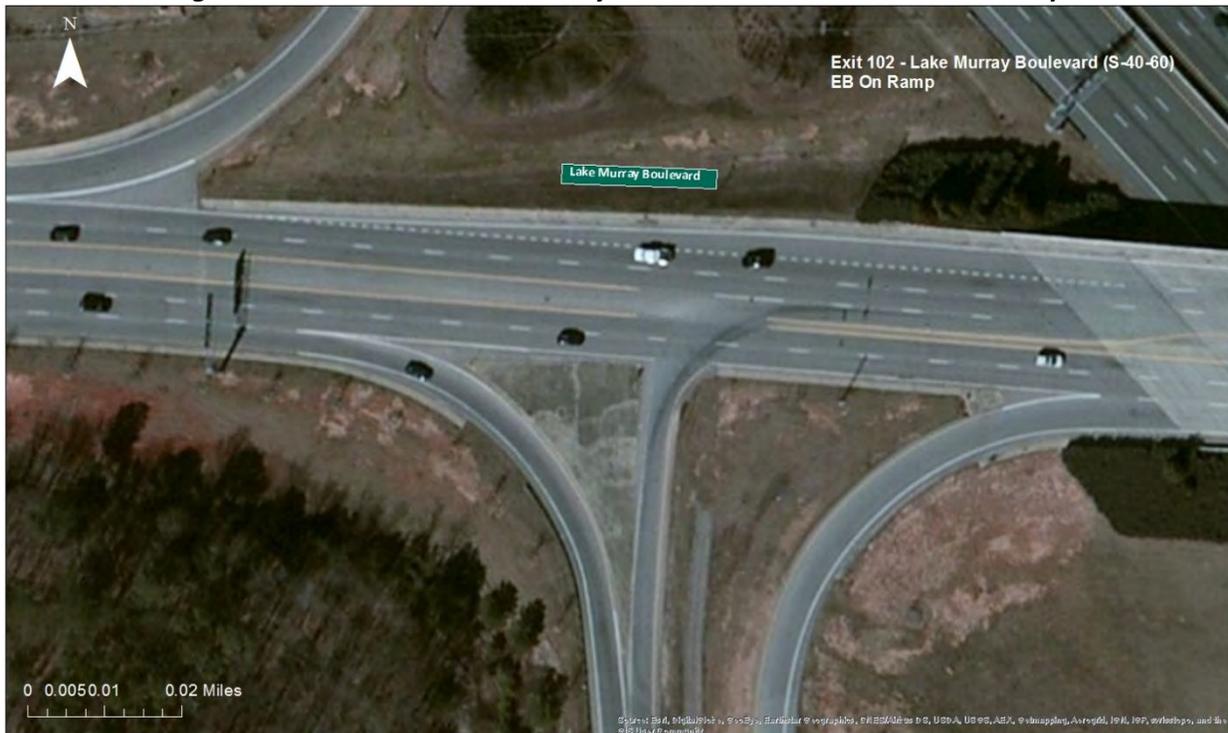
Westbound Lake Murray Boulevard widens from one to two lanes at the Parkridge Drive intersection, and continues westbound toward the signalized intersection with Palmetto Health Parkway/Kinley Road. Two through lanes continue through the intersection for about 325 feet where the right turn lane to the westbound on-ramp begins. This turn lane provides 315 feet of storage and a 230 feet long taper. Downstream of the westbound on-ramp intersection, two westbound lanes continue for about 470 feet where the westbound loop off-ramp merges into Lake Murray Boulevard. At this point, the westbound loop off-ramp merges into Lake Murray Boulevard with a 395 feet acceleration lane and a 505 feet long taper that ends just before the eastbound off-ramp.

Westbound Lake Murray Boulevard continues with two lanes to the merge point with the eastbound off-ramp, which has a 270 feet long acceleration lane followed by a 445 feet taper that ends at the intersection with Columbiana Drive. West of Columbiana Drive, Lake Murray Boulevard continues with two westbound lanes.

At the eastbound on-ramp intersection, westbound Lake Murray Boulevard includes a left turn lane with 155 feet of storage. At the westbound on-ramp intersection, eastbound Lake Murray Boulevard includes a left turn lane with 185 feet of storage. Both the eastbound and westbound on-ramp intersections are unsignalized.

The eastbound ramp intersection is shown in **Figure 36**. The westbound ramp intersection is shown in **Figure 37** and in **Figure 38**.

**Figure 36 - Exit 102: Lake Murray Boulevard at Eastbound On-Ramp**



**Figure 37 - Exit 102: Lake Murray Boulevard at Westbound On-Ramp**



**Figure 38 - Exit 102: Lake Murray Boulevard at Westbound Loop Off-Ramp**





*Lake Murray Boulevard and Palmetto Health Parkway/Kinley Road (S-40-670)*

The intersection of Lake Murray Boulevard with Palmetto Health Parkway is a signalized intersection. Palmetto Health Parkway is a local road without a posted speed limit providing access to a hospital and medical office building. The northbound approach of Palmetto Health Parkway provides a separate left turn lane with 230 feet of storage and a shared through-right turn lane. Kinley Road is an undivided two lane road with 35 mph posted speed limit. The southbound approach of Kinley Road widens to provide separate left turn, through, and right turn lanes. The left turn and right turn lanes each have 300 feet long storage. The eastbound approach of Lake Murray Boulevard has a separate left turn lane with approximately 150 feet of storage, two through lanes, and a separate right turn lane that extends back approximately 650 feet to the westbound off-ramp merge area. The westbound approach of Lake Murray Boulevard has a separate left turn lane with 160 feet of storage, two through lanes, and a separate right turn lane with 190 feet of storage.

The existing configuration of Lake Murray Boulevard with Palmetto Health Parkway/Kinley Road intersection is shown in **Figure 40**.

**Figure 40 - Exit 102: Lake Murray Boulevard at Kinley Road/Palmetto Health Parkway**



#### IV. DATA COLLECTION

The following data collection activities were performed for the I-26 corridor.

##### I-26 Mainline Traffic Volume Data

Three different types of I-26 Mainline Traffic Volume data were obtained from SCDOT and Quality Counts. The current and historic average annual daily traffic (AADT) on each of the I-26 segments within the study area along with Automatic Traffic Recording (ATR) data from three permanent stations located within or adjacent to the study area were obtained from SCDOT. Vehicle count and classification data from locations near Mile Marker 85 and Mile Marker 101 were obtained from Quality Counts.

Interstate Mainline Traffic data were collected for the eastbound and westbound approaches of I-26 approximately at Mile Marker 85 (MM 85) and at Mile Marker 101 (MM 101) on Tuesday, August 23rd and on Wednesday, August 24th 2016 in 15-minute time intervals within a 24 hour interval from midnight until midnight of the next day.

Each year, SCDOT produces a database of AADT on segments for state primary and secondary roadways. For each county, a list of the various AADT station numbers, their route designation and number, and the beginning and ending point of the segment are listed along with the AADT for those segments. For interstate routes, separate station numbers are generally assigned to individual freeway segments between interchanges. The SCDOT AADT data available for use in this study include the annual AADT between the 1996 and 2015 inclusive. These data are available for mainline freeway segments, for interchange arterial and for arterial roads. The SCDOT AADT data are provided in **Appendix A**.

Traffic volume data from three permanent ATR stations within the study area were provided by SCDOT. The three ATR stations are identified by SCDOT as Station P-95, P-15, and P-112. Station 0095 is located on I-26 between Exit 102 and Exit 103 outside of the east end of the study area. Station P-15 is located on I-26 between Exits 91 and 97 under the overpass of Mt Vernon Church Road. Station P-112 is located on I-26 between Exit 85 and 91 approximately 200 feet east of the Parr Road overpass.

The ATR data at all three stations contained all the traffic volumes recorded by the ATR between January 1, 2015 and October 30, 2016.

The AADT data will be used in the development of growth rates used to forecast future traffic. The ATR data will be used to establish the design hour traffic volumes and in the analysis of existing operating conditions for freeway segments and merge and diverge areas in the corridor.

### Vehicle Count Classification Data

Vehicle classification data that was collected near mile marker 85 and mile marker 101 are used to determine the heavy vehicle (trucks/buses) percentages to be used in the analysis.

The vehicle classification data summarize the number of vehicles in 15 separate vehicle classifications. The classifications are as follows:

- Class 1 – Motorcycles
- Class 2 – Cars
- Class 3 – Other 2-Axle, 4-Tire
- Class 4 – Buses
- Class 5 – Single Unit Trucks: 2-Axle, 6 Tire
- Class 6 – Single Unit Trucks: 3 Axle
- Class 7 – Single Unit Trucks: 4 or more Axles
- Class 8 – Single Trailer Trucks: 4 or fewer Axles
- Class 9 – Single Trailer Trucks: 5 Axle
- Class 10 – Single Trailer Trucks: 6 or more Axles
- Class 11 – Multi-Trailer Trucks: 5 or fewer Axles
- Class 12 – Multi-Trailer Trucks: 6 Axle
- Class 13 – Multi-Trailer Trucks: 7 or more Axles
- Class 14 – None
- Class 15 - Other

Class 4 (Buses) and Class 5 (2-Axle, 6 Tire Single Unit Trucks) are classified as Medium Trucks. Classes 6 through 13 are classified as Heavy Trucks.

The vehicle classification data will be used in developing estimates of the truck percentages to be used in the analysis in the corridor.

The vehicle classification data are provided in **Appendix B**.

### Arterial Traffic and Vehicle Classification Counts (Tube counts)

Speed, volumes and vehicle classification for a 48 hour period on Tuesday, August 23, 2016 and Wednesday, August 24, 2016 were obtained on the following arterials:

- SC 60 (Lake Murray Blvd) - Exit 102 between the ramps
- US 176 (Broad River Rd) - Exit 101 between the ramps
- US 176 (Broad River Rd) - Exit 97 between the ramps
- S-32-48 (Columbia Avenue) - Exit 91 between the ramps
- SC 202 - Exit 85 between the ramps
- SC 773 - Exit 82 between the ramps
- S-40-2894 (Western Lane)
- S-40-58 (Koon Road) over I-26
- S-40-80 (Shady Grove Road/Old Tamah Road) over I-26

- S-40-385 (Rauch-Metz Road) - Exit 97
- S-40-959 (Julius Richardson Road) - Exit 97
- S-40-234 (Mt Vernon Church Road) over I-26
- S-40-1403 (Stone Hill Road) west of Mt Vernon Church Road
- S-40-405 (Old Hilton Road) over I-26
- S-32-49 (Peak Street) over I-26
- S-36-39 (Holy Trinity Church Road) over I-26
- S-36-811 (Meadow Brook Road)
- S-36-164 (Frontage Road) - Exit 82

Interstate Ramp Traffic Counts (Tube counts)

Speed, volumes and vehicle classification over a 48 hour period on August 23rd-24th were obtained on the following ramps:

- Near I-26 & SC 773 interchange (Exit 82):
  - I-26 westbound exit ramp
  - I-26 westbound entrance ramp
  - I-26 eastbound exit ramp
  - I-26 eastbound entrance ramp
- Near I-26 & SC 202 interchange (Exit 87):
  - I-26 westbound exit loop ramp
  - I-26 westbound entrance ramp
  - I-26 eastbound exit ramp
  - I-26 eastbound entrance loop ramp
- Near I-26 & S-48 (Columbia Avenue) interchange (Exit 91):
  - I-26 westbound exit ramp
  - I-26 westbound entrance ramp
  - I-26 eastbound exit ramp
  - I-26 eastbound entrance ramp
- Near I-26 & US 176 (Broad River Road) interchange (Exit 97):
  - I-26 westbound exit ramp
  - I-26 westbound entrance loop ramp
  - I-26 eastbound exit ramp
  - I-26 eastbound entrance loop ramp
- Near I-26 & US 176 (Broad River Road) interchange (Exit 101):
  - I-26 westbound exit ramp
  - I-26 westbound exit loop ramp
  - I-26 westbound entrance ramp
  - I-26 eastbound exit ramp
  - I-26 eastbound exit loop ramp
  - I-26 eastbound entrance ramp

- Near I-26 & SC 60 (Lake Murray Boulevard) interchange (Exit 102):
  - I-26 westbound exit ramp
  - I-26 westbound exit loop ramp
  - I-26 westbound entrance ramp
  - I-26 eastbound exit ramp
  - I-26 eastbound exit loop ramp
  - I-26 eastbound entrance ramp

### Intersection Turning Movement Counts

Turning movement traffic count data was obtained for a number of ramp termini and other adjacent intersections within the study area from 7:00 to 9:00 AM and from 4:00 to 6:00 PM on Tuesday, August 23, 2016. The turning movement count data, which are provided in **Appendix C**, included:

- Near I-26 & SC 773 interchange (Exit 82):
  - SC 773 & S-36-164 (Frontage Road)
  - SC 773 & S-36-164 (Koon Trestle Road/Wilco Hess Drive)
- Near I-26 & SC 202 interchange (Exit 85):
  - SC 202 & S-36-811 (Meadow Brook Road)
  - SC 202 & S-36-370 (Four Oaks Road)
- Near I-26 & S-36-48 (Columbia Avenue) interchange (Exit 91):
  - S-32-48 & I-26 westbound ramps
  - S-32-48 & I-26 eastbound ramps
  - S-32-48 & (Brentwood Court/Ellett Road)
  - S-32-48 & S-32-689 (Comalander Drive)
  - I-26 eastbound entrance ramp & S-32-232 (Crooked Creek Road)
- Near I-26 & US 176 (Broad River Road) interchange (Exit 97):
  - US 176 & Center Food Lion Drive (right in/out)
  - US 176 & North Food Lion Drive (full access/stop controlled)
  - US 176 & S-40-612 (W Shady Grove Road)
  - S-40-385 Rauch-Metz Road & S-40-2805 (Broad Stone Road)
- Near I-26 & US 176 (Broad River Road) interchange (Exit 101):
  - US 176 & I-26 westbound entrance ramp
  - US 176 & I-26 eastbound entrance ramp
  - US 176 & S-40-2894 (Western Lane)
  - US 176 & S-40-3048 (Lordship Lane)
  - US 176 & S-40-1862 (Royal Tower Drive)
- Near I-26 & SC 60 (Lake Murray Boulevard) interchange (Exit 102):
  - SC 60 & I-26 westbound entrance ramp
  - SC 60 & I-26 eastbound entrance ramp
  - SC 60 & S-40-670 (Kinley Road)/Palmetto Health Parkway

- SC 60 & S-40-3048 (Columbiana Drive)
- At other locations within the study area
  - S-36-167 Parr Road & S-36-370 Four Oaks Road
  - S-36-39 Holy Trinity Church Road & Sam Koon Road
  - S-36-39 Holy Trinity Church Road & S-36-354 Beagle Run Road
  - S-36-39 Holy Trinity Church Road & S-36-29 Clark Road
  - S-40-405 Old Hilton Road & S-40-2697 Mt Olivet Church Road
  - S-40-405 Old Hilton Road & Julius Eleazer/S-40-2902 Three Dog Road
  - S-40-234 Mt Vernon Church Road & S-40-1403 Stone Hill Road
  - S-40-234 Mt Vernon Church Road & S-40-2899 Bookie Richardson Road
  - S-40-80 Old Tamah Road & Broad Bill Road
  - S-40-80 Old Tamah Road & Oscar Amick Road
  - S-40-58 Koon Road & S-40-497 James Ballentine Road

Turning movement counts conducted for 12 hours between 7:00 AM and 7:00 PM on Tuesday, August 23, 2016 were obtained at the following locations:

- Near I-26 & SC 773 interchange (Exit 82):
  - SC 773 & I-26 westbound ramps
  - SC 773 & I-26 eastbound ramps
- Near I-26 & SC 202 interchange (Exit 85):
  - SC 202 & I-26 westbound ramps
  - SC 202 & I-26 eastbound ramps
- Near I-26 & US 176 (Broad River Road) interchange (Exit 97):
  - US 176 & I-26 westbound ramps/Exxon Drive
  - US 176 & I-26 eastbound ramps/South Food Lion Drive
  - I-26 eastbound ramp & S-40-385 (Rauch-Metz Road)
  - I-26 westbound ramp & S-40-2894 (Julius Richardson Road)
  - US 176 & S-40-2805 (Broad Stone Road)
  - S-40-385 Rauch-Metz Road & S-40-2805 (Broad Stone Road)
- At other locations within the study area:
  - S-40-58 Koon Road & S-40-2894 Western Ln

The turning movement count data will be used in the analysis of intersection operations at ramp intersections and other intersections adjacent to the interchanges.

#### INRIX Speed Data

SCDOT provided an annual summary of 2015 INRIX speed data for the entire length of I-26. The data were provided for every Tuesday, Wednesday and Thursday, were divided by direction (eastbound and westbound) for each hour of the year, and are provided in **Appendix D**.

The speed data for AM and PM Peak periods for eastbound and westbound directions will be used in the analysis of the corridor and the calibration of the corridor microsimulation model.

### Crash Data

Historic crash data was provided from the SCDOT Safety Office. The crash data for the interstate corridor and ramps covered the period from January 1, 2013 through December 31, 2015. Crash data were provided for the following roadways:

- I-26 between mileposts 81.813 and 102.500
- S-36-48 (Columbia Avenue) at Exit 91 between mileposts 2.375 and 2.960
- SC 202 at Exit 85 between mileposts 1.550 and 2.150
- S-40-385 (Rauch-Metz Road) at Exit 97 between mileposts 0.900 and 1.170
- US 176 (Broad River Road) at Exit 101 from milepost 7.790 to 8.576
- US 76 (Broad River Road) at Exit 101 from milepost 8.620 to 9.110
- US 176 (Broad River Road) at Exit 97 from milepost 13.280 to 13.800

The crash data will be used to perform an accident analysis to identify ‘hotspots’ with frequent and/or severe history of accident occurrence.

### Signal Plans/Timings

There are seven existing traffic signals located at interchange ramp termini intersections or at adjacent intersections. Traffic signal plans were obtained from SCDOT for the existing signal installations at the following locations:

- Exit 91
  - S-36-48 (Columbia Avenue) at the I-26 westbound ramps
- Exit 97
  - US 176 (Broad River Road) at the I-26 westbound ramps/south Food Lion Drive
- Exit 101
  - US 176 (Broad River Road) at S-40-2894 (Western Lane)
  - US 176 (Broad River Road) at the I-26 eastbound ramps
  - US 176 (Broad River Road) at S-40-3048 (Lordship Lane)
- Exit 102
  - SC 60 (Lake Murray Boulevard) at S-40-670 (Kinley Road)/Palmetto Health Parkway
  - SC 60 (Lake Murray Boulevard) at S-40-3048 (Columbiana Drive)

The signals at Exits 91 and 97 are isolated intersections that are not part of a signal system. The signals located along US 176 (at Exit 101) and SC 60 (at Exit 102) currently operate as part of signal systems along those arterials. SCDOT provided the current coordinated signal timings

plans for these two systems. **Appendix E** includes all existing signal plans and signal timings. The signal plans and signal timings will be used in the analysis of intersections controlled by traffic signals.

## V. ANALYSIS

A series of traffic analyses were performed to assess existing and future operations of I-26, the interchange ramps, and intersections located adjacent to the interchange ramp termini. The analyses included:

- An accident analysis for the study area
- A traffic forecasting analysis to estimate future no-build and build condition traffic volumes
- Freeway segment operations analysis for existing, future no-build and future build conditions
- Freeway ramp merge/diverge area analysis for existing, future no-build and future build conditions
- Signalized and unsignalized intersection analysis for existing, future no-build and future build conditions,
- Roundabout analysis, performed as necessary for future build conditions that incorporate roundabouts as a design element

The individual interchanges were modeled using Synchro/SimTraffic to analyze and simulate the arterial and intersection operations and to aid in the development of traffic control and geometric recommendations. Traffic simulation models were created for the entire study area and at individual interchange locations for the existing, future no-build, and future build conditions. The entire study area was modeled using TransModeler, a micro-simulation software, to analyze and simulate the freeway operation.

### Accident Analysis

For the study, historic crash data covering the three year period from January 1, 2013 through December 31, 2015 for the interstate from mile marker 81.813 to 102.500 was used. Data included accidents occurring on the interstate as well as on the ramps and the surrounding roads in the vicinity of these interchanges.

The 1,167 crashes (1,037 interstate or interstate ramp crashes and 130 crashes on interchange arterial and adjacent roadways) were reviewed to identify hot spot locations and trends.

A majority of the crashes (about 82 percent) were classified as property damage only; however,

about 12 percent were classified as possible injuries, five percent as non-incapacitating injuries, less than one percent as incapacitating injuries and less than one percent as fatalities.

The seven fatal crashes were a mixture of fixed object (four crashes), sideswipe same direction and head-on crashes, as well as a crash involving a pedestrian illegally in the roadway (one each). Three crashes resulted from driving too fast for conditions, and two from driving under the influence. Two of the fixed object crashes involved collisions with guardrail face. All seven fatal crashes occurred on dry pavement, with only two occurring in daylight. Four of the seven crashes occurred at night between 11:30 PM and 3:00 AM. Three fatal crashes occurred on three separate eastbound freeway segments. Four fatal crashes occurred two separate westbound segments; three crashes took place on the segment between Exit 97 and Exit 91.

The most frequent crashes along I-26 were rear end crashes and no collision with motor vehicle crashes. These two crash types accounted for nearly equal numbers of crashes: 441 rear end crashes and 433 no collision with motor vehicle crashes totaling about 84 percent of all the crashes. Sideswipes same direction crashes (11 percent) were the third most common crash type.

The most frequent first harmful event for the rear end crashes involved motor vehicle in transport (244 or about 55 percent) and motor vehicle stopped (193 or about 44 percent). Together, these two causes account for approximately 99 percent of the rear end crashes. The most frequent contributing cause for rear end crashes is driving too fast for conditions (398 or about 90 percent), followed too closely (10 or about two percent), and DUI (six or about one percent). These three causes accounted for about 94 percent of the rear end crashes.

The most frequent first harmful event for the no collision with motor vehicle crashes involve median barrier (198 crashes or about 46 percent), guardrail face (48 crashes or about 11 percent), and other moveable object (33 crashes or about eight percent). Together, these three causes account for approximately 64 percent of the no collision with motor vehicle crashes. The most frequent contributing cause for no collision with motor vehicle crashes is driving too fast for conditions (246 crashes or about 57 percent), improper lane change (48 crashes or about 11 percent), and tires (26 crashes or about six percent). These three contributing causes account for about 74 percent of all the no collision with motor vehicle crashes.

Study area hot spots along I-26 include:

- Eleven freeway segments exceed the 2015 rural or urban statewide average ACR. Ten of the segments are rural segments that exceed the statewide average rural ACR of 0.626 crashes per one million vehicle miles (MVM). One urban segment exceeds the statewide average urban ACR of 1.431 MVM.
- Seven of the ten freeway segments with the highest total Actual Crash Rate are located between ramps at individual interchanges or on weaving sections between adjacent

interchanges. These include

- Both weaving sections in both directions between Exits 101 and 102
- Both segments between the off-ramp and loop on-ramps in both directions at Exit 97
- Both segments between the ramps/loop ramps in both directions at Exit 85
- The two freeway segments between interchanges with the highest Actual Crash Rate (exceeding the statewide average urban or rural ACR) include:
  - Eastbound between Exit 97 and Exit 101
  - Eastbound between Exit 85 and Exit 91
- Weaving segments and loop ramp merge/diverge areas are elements in nine of the ten segments with the highest rural or urban Actual Crash Rate

The geometric conditions resulting from merge/diverge areas of loop ramps and weaving sections of the interchanges seem to play a role in the frequency of the crashes. Merging distance at on-ramps and diverging distances at off-ramps should be improved to SCDOT standards where these standards are not already met.

Modifying interchanges to eliminate loop ramps at Exit 85 and Exit 97 may also reduce crashes on the segments adjacent to the loop ramps.

Study area hot spots along the interchange arterials include:

- Frequent crashes at Exit 91 along Columbia Avenue at business driveways to the west of the eastbound off-ramp intersection. It is anticipated that access controls implemented as part of the proposed diverging diamond interchange improvement will address these locations.
- There is a significant cluster of crashes at Exit 97 at the unsignalized eastbound off-ramp intersection with Broad River Road. Interchange improvement concepts at Exit 97 should consider addressing the possible causes of the frequent crashes at this location.
- At Exit 101, there are several clusters of crashes that occur at or near the signalized intersection of Broad River Road with Lordship Lane, at the unsignalized intersection with Royal Tower Drive (S-40-1862) and at the signalized intersection at the eastbound on-ramp. Since no improvements are anticipated at this interchange as part of this project, they may be evaluated and addressed as part of Richland County's proposed improvement project along Broad River Road.

A copy of the crash analysis report is provided in **Appendix F**.

## Traffic Volumes

### *I-26 Traffic Volume Data – Average Annual Daily Traffic*

Average annual daily traffic volumes (AADT) were obtained from SCDOT for the most recently available data set (2015) for the seven freeway segments within the study area. Each segment has an associated AADT count station number associated with it. The 2015 AADT for the seven freeway segments are summarized in **Table 1**.

**Table 1 - 2015 AADT for I-26 Freeway Segments**

I-26 Segment Number	I-26 Segment Description	2015 AADT
Segment A	I-26 FROM SC 219 (SC219) TO SC 773 (SC773) NEWBERRY COUNTY STA 2121	40,500
Segment 1	I-26 FROM SC 773 (SC773) TO SC 202 (SC202) NEWBERRY COUNTY STA 2123	41,800
Segment 2	I-26 FROM SC 202 (SC202) (NEWBERRY) TO S- 48 (COLUMBIA AVE) LEXINGTON COUNTY STA 2125	42,300
Segment 3	I-26 FROM S- 48 (COLUMBIA AVE) (LEXINGTON) TO US 176 (BROAD RIVER RD) RICHLAND COUNTY STA 2127	51,200
Segment 4	I-26 FROM US 176 (BROAD RIVER RD) TO US 76 RICHLAND COUNTY STA 2129	52,300
Segment 5	I-26 FROM US 76 TO SC 60 (LAKE MURRAY BLVD) RICHLAND COUNTY STA 2131	71,700
Segment B	I-26 FROM SC 60 (LAKE MURRAY BLVD) TO S- 757 (HARBISON BLVD) RICHLAND COUNTY STA 2133	95,600

Throughout the I-26 segments, the AADT increase to the east within the corridor, with the volume of the westernmost segment (40,500 vehicles per day) approximately 42 percent of the volume on the easternmost segment (95,600 vehicles per day).

AADT were also obtained for the arterial roadways with interchanges with I-26. The AADT for the 10 arterial roadway segments are summarized in **Table 2**.

*Table 2 - 2015 AADT for Arterial Segments*

Arterial Segment Number	Arterial Segment Description	2015 AADT
Segment 1	SC 60 (Lake Murray Boulevard (Exit 102)) FROM County Line - LEXINGTON TO I- 26 RICHLAND COUNTY STA 245	29,700
Segment 2	SC 60 (Lake Murray Boulevard (Exit 102)) FROM I- 26 TO US 176 (BROAD RIVER RD) RICHLAND COUNTY STA 248	10,000
Segment 3	US 76 (Broad River Road (Exit 101)) FROM S- 1862 (ROYAL TOWER DR) TO I- 26, US 176 RICHLAND COUNTY STA 149	24,200
Segment 4	US 176 (Broad River Road (Exit 101)) FROM US 76 TO SC 60 RICHLAND COUNTY STA 182	13,800
Segment 5	US 176 (Broad River Road (Exit 97)) FROM I- 26 TO US 76 (BROAD RIVER RD) RICHLAND COUNTY STA 180	11,500
Segment 6	US 176 (Broad River Road (Exit 97)) FROM S- 39 TO I- 26 RICHLAND COUNTY STA 178	10,200
Segment 7	S-32-48 (Columbia Avenue) FROM I- 26 TO County Line - RICHLAND LEXINGTON COUNTY STA 807	2,700
Segment 8	S-32-48 (Columbia Avenue) FROM S- 49 TO I- 26 LEXINGTON COUNTY STA 477	12,900
Segment 9	SC 202 FROM US 76 (Main St) TO I- 26 (I26) NEWBERRY COUNTY STA 183	2,400
Segment 10	SC 202 FROM I- 26 (I26) TO US 176 (US176) NEWBERRY COUNTY STA 185	1,400

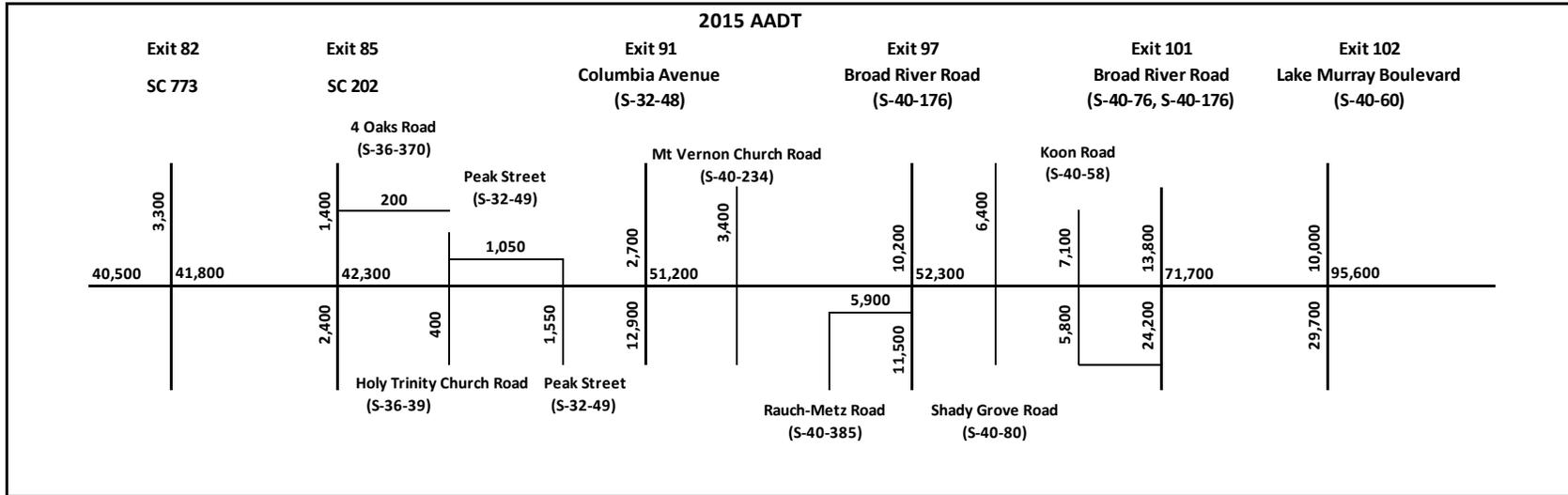
AADT were also obtained for the roadways crossing I-26 or located adjacent to I-26. The AADT for the 10 roadway segments are summarized in **Table 3**.

**Table 3 - 2015 AADT for Roadways Segments**

Arterial Segment Number	Arterial Road Segment Description	2015 AADT
Segment 1	S-40-58 (Koon Road) FROM S- 2894 TO US 76 (BROAD RIVER RD) RICHLAND COUNTY STA 486	5,800
Segment 2	S-40-58 (Koon Road) FROM S- 498 TO S- 2894 RICHLAND COUNTY STA 484	7,100
Segment 3	S-40-80 (Old Tamah/Shady Grove) FROM US 176 (BROAD RIVER RD) TO S- 244 RICHLAND COUNTY STA 453	6,400
Segment 4	S-40-385 (Rauch Metz Road) FROM US 76 (DUTCH FORK RD) TO I-26 EXIT RAMP RICHLAND COUNTY STA 396	5,900
Segment 5	S-40-234 (Mt Vernon Church Road) FROM US 76 (DUTCH FORK RD) TO US 176 (BROAD RIVER RD) RICHLAND COUNTY STA 455	3,400
Segment 6	S-32-49 (Peak Street) FROM S- 48 (COLUMBIA AVE) TO County Line - NEWBERRY LEXINGTON COUNTY STA 483	1,550
Segment 7	S-36-40 (Peak Street) FROM S- 39 (Holy Trinity Church Rd) TO County Line - LEXINGTON NEWBERRY COUNTY STA 293	1,050
Segment 8	S-36-39 (Holy Trinity Church Road) FROM US 176 (US176) TO S- 167 (Parr Rd) NEWBERRY COUNTY STA 291	400
Segment 9	S-36-370 (Four Oaks Road) FROM SC 202 (SC202) TO S- 167 (Parr Rd), S- 812 NEWBERRY COUNTY STA 399	200
Segment 10	SC 773 FROM US 76 TO US 176 (US176) NEWBERRY COUNTY STA 211	3,300

The 2015 AADT in the study area are depicted schematically in **Figure 41**.

Figure 41 - 2013 Study Area AADT



### *I-26 Traffic Volume Data – Existing Design Hour Volumes*

Traffic volume data from three permanent ATR stations within the study area were provided by SCDOT. The three ATR stations are identified by SCDOT as Station P-95, P-15, and P-112. Station 95 is located on I-26 between Exit 102 and Exit 103 outside of the east end of the study area. The ATR station corresponds to SCDOT's AADT station 2133. Station P-15 is located on I-26 between Exits 91 and 97 under the overpass of Mt Vernon Church Road. This ATR station corresponds to SCDOT's AADT station 2127. Station P-112 is located on I-26 between Exit 85 and 91 approximately 200 feet east of the Parr Road overpass. This ATR station corresponds to SCDOT's AADT station 2125.

The ATR data at all three stations contained all the traffic volumes recorded by the ATR between January 1, 2015 and October 30, 2016. This data was analyzed to identify a two-way design hour volume, the percentage of the design hour traffic to the AADT (k-factor) and the directional split between northbound and southbound traffic (D-factor). Typical values sometimes chosen for the design hour include the 10<sup>th</sup>, 30<sup>th</sup> and 100<sup>th</sup> highest hours of traffic.

The ATR station data was analyzed to identify the 10<sup>th</sup>, 30<sup>th</sup>, and 100<sup>th</sup> highest hours of traffic volumes at each station location for the following conditions:

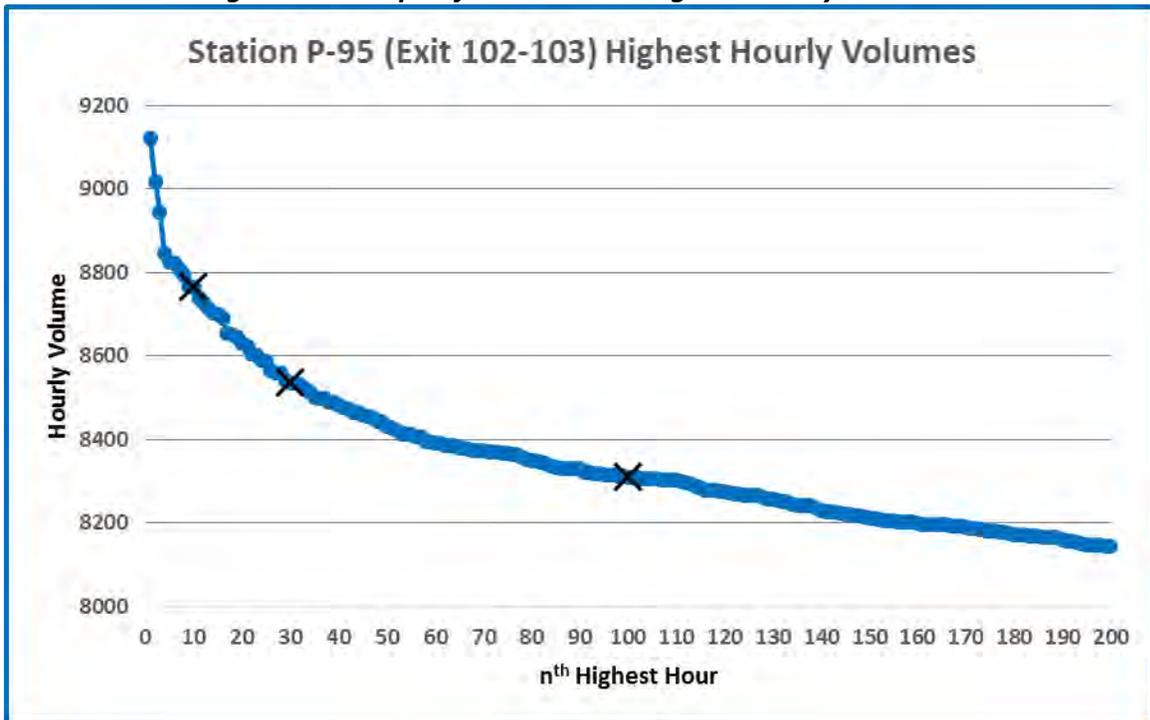
1. Two-way volume (each hour, each day);
2. Two-way AM volume (7:00 AM to 10:00 AM, each day)
3. Two-way PM volume(4:00 to 7:00 PM, each day)
4. Two-way weekday volume (each hour, Tuesday-Thursday);
5. Two-way weekday AM volume (7:00 AM to 10:00 AM, Tuesday-Thursday);
6. Two-way weekday PM Peak Period Volume (4:00 to 7:00 PM, Tuesday-Thursday).

The 200<sup>th</sup> highest hours of two-way traffic volumes for each hour and each day at ATR Stations P-95, P-15 and P-112 are included as part of an attachment in **Appendix G**.

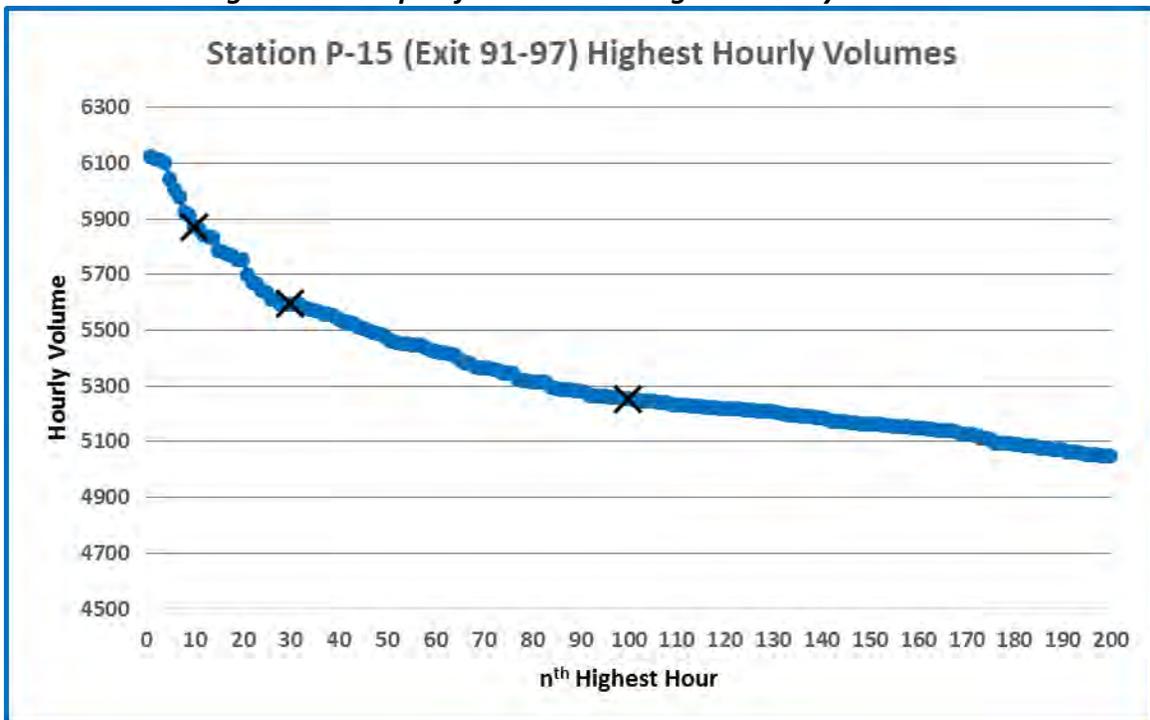
Typically, the 30<sup>th</sup> highest hour is selected for the design hourly volume (DHV). This hour generally falls at or near the inflection point of a graph of the highest volumes where the change in volumes becomes less pronounced and more consistent, with the steep curve depicting larger changes in volumes flattening to a more gradual curve indicating more consistent reductions in volume.

Graphs of the 200 highest volumes at stations P-95, P-15, and P-112, along with indications of the 10<sup>th</sup>, 30<sup>th</sup> and 100<sup>th</sup> highest hourly volumes are shown in **Figure 42**, **Figure 43**, and **Figure 44**.

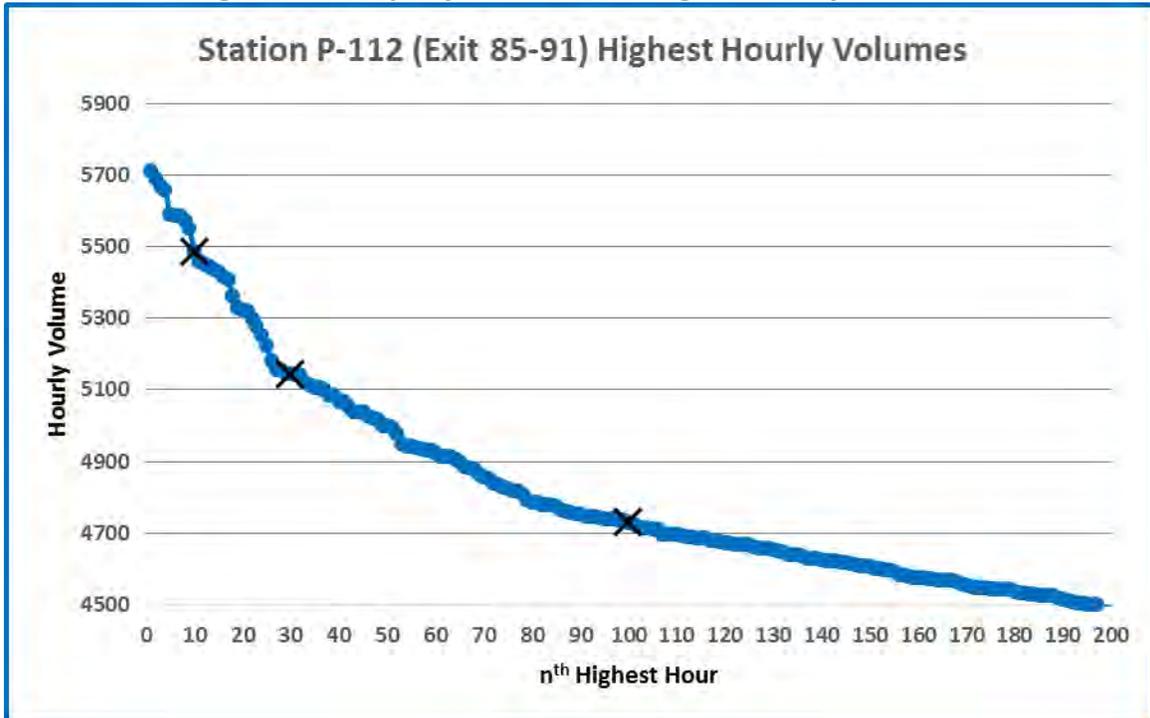
**Figure 42 - Graph of Station P-95 Highest Hourly Volumes**



**Figure 43 - Graph of Station P-15 Highest Hourly Volumes**



**Figure 44 - Graph of Station P-112 Highest Hourly Volumes**



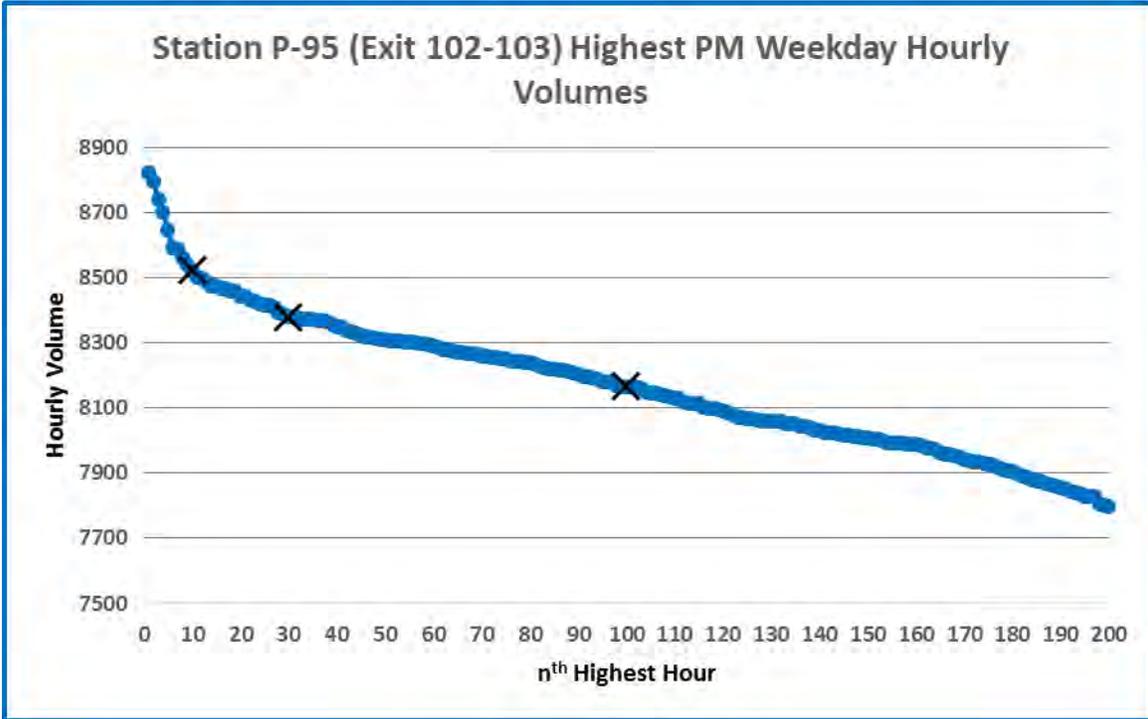
Graphs of the 200 highest weekday (Tuesday through Thursday) afternoon volumes (between 3:00 and 7:00 PM) at stations P-95, P-15, and P-112, along with indications of the 10<sup>th</sup>, 30<sup>th</sup> and 100<sup>th</sup> highest hourly volumes are shown in **Figure 45**, **Figure 46**, and **Figure 47**.

In the graphs of the weekday afternoon volumes at the ATR stations, the inflection points seem to fall at about the 10<sup>th</sup> highest hour. Therefore, to provide for a conservative analysis, the 10<sup>th</sup> highest hours are being used.

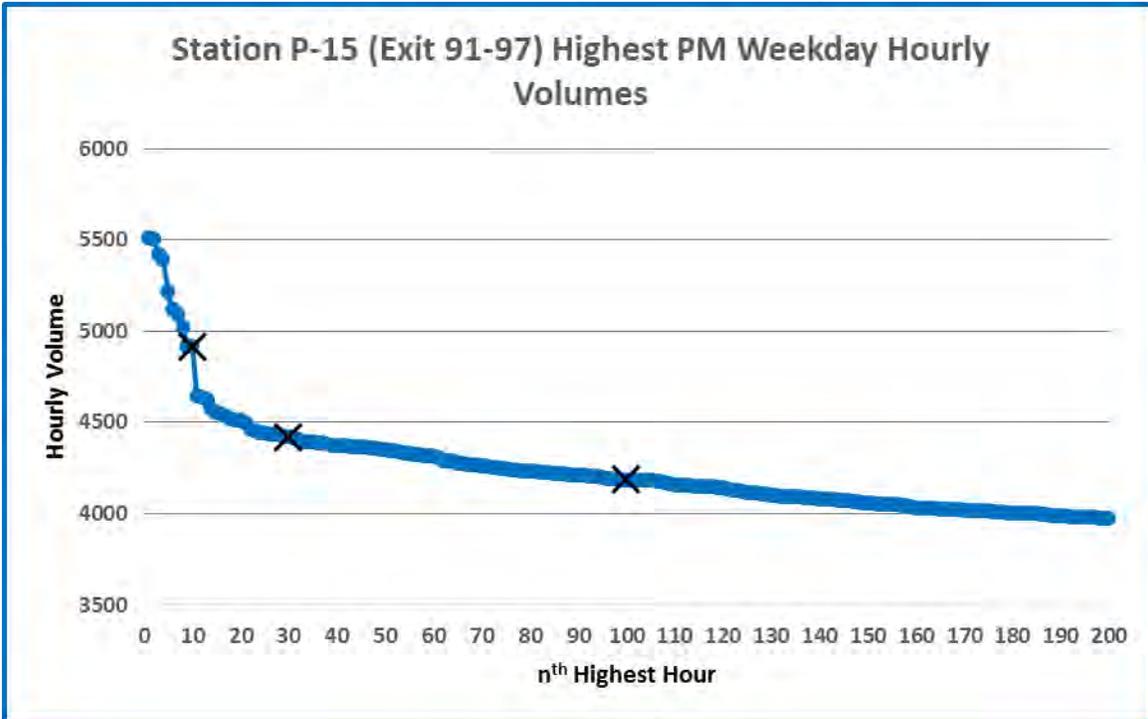
To provide for the analysis of a comparable AM Peak Hour design volumes, the 200 highest hours occurring during the morning peak hour period between 7:00 AM and 10:00 AM were identified, and the 10<sup>th</sup> highest hour was selected to represent the AM Peak Hour mainline I-26 volume on the segments where ATR are located. Graphs of the 200 highest volumes at stations P-95, P-15, and P-112, along with indications of the 10<sup>th</sup>, 30<sup>th</sup> and 100<sup>th</sup> highest hourly volumes are shown in **Figure 48**, **Figure 49**, and **Figure 50**.

The 200<sup>th</sup> highest hours of two-way traffic volumes during the morning peak period (7:00 to 10:00 AM) for each day at ATR Stations P-95, P-15, and P-112 are also included as part of an attachment in **Appendix G**.

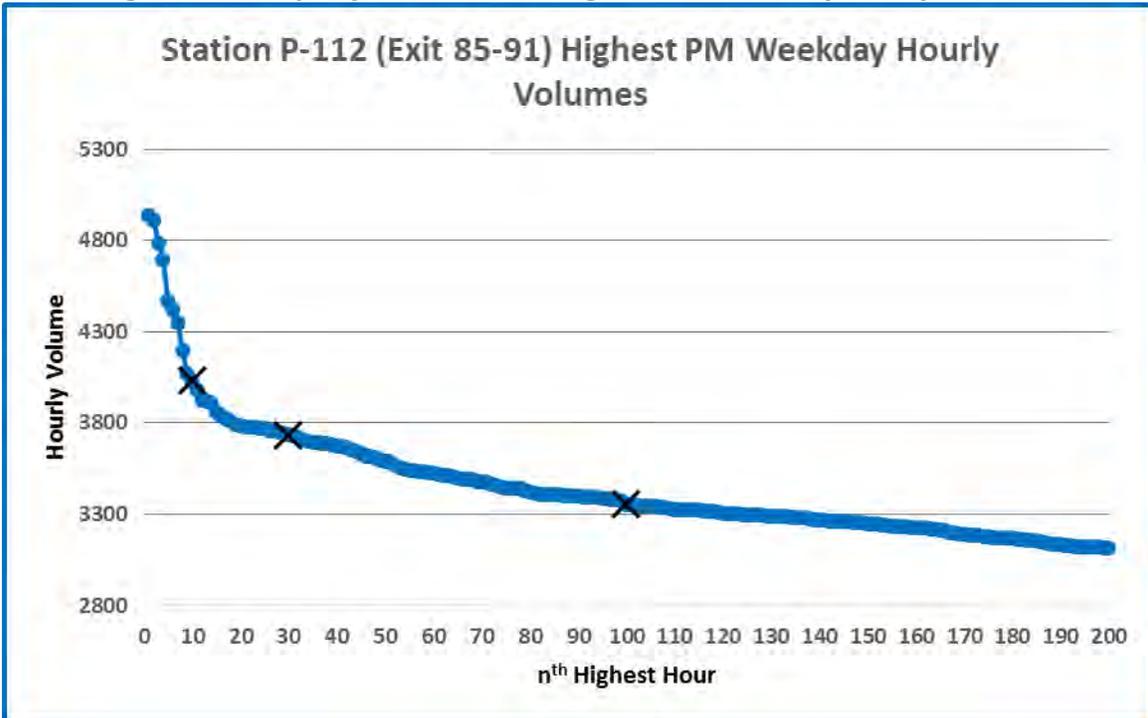
**Figure 45 - Graph of Station P-95 Highest PM Weekday Hourly Volumes**



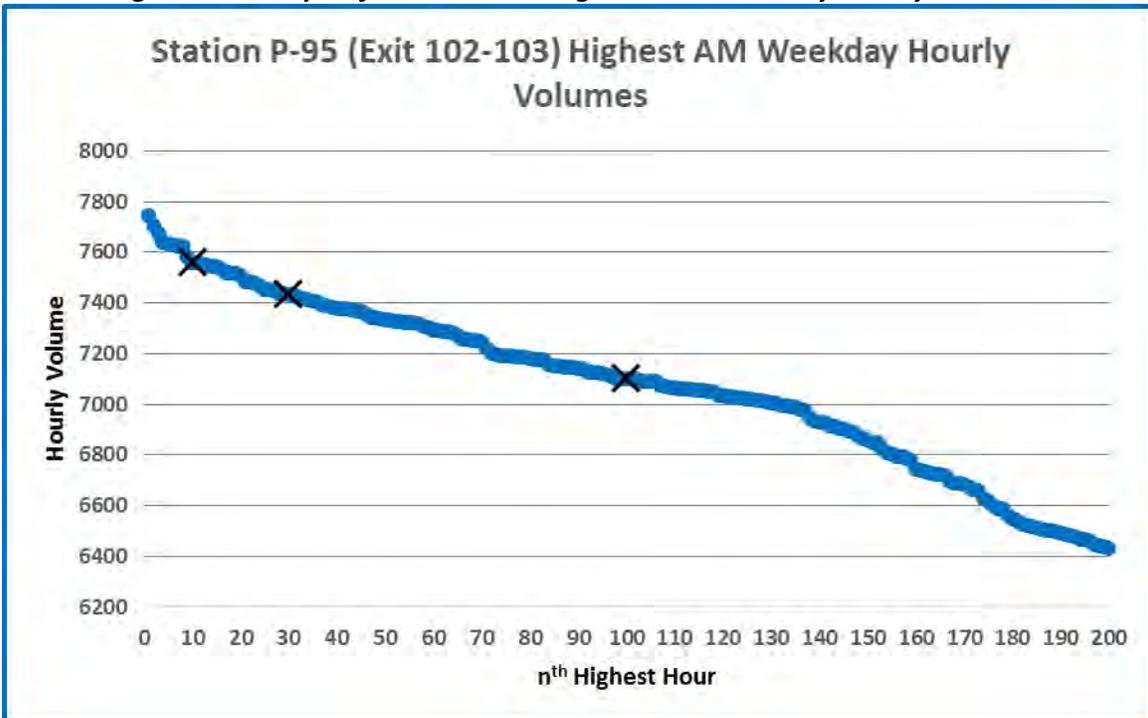
**Figure 46 - Graph of Station P-15 Highest PM Weekday Hourly Volumes**



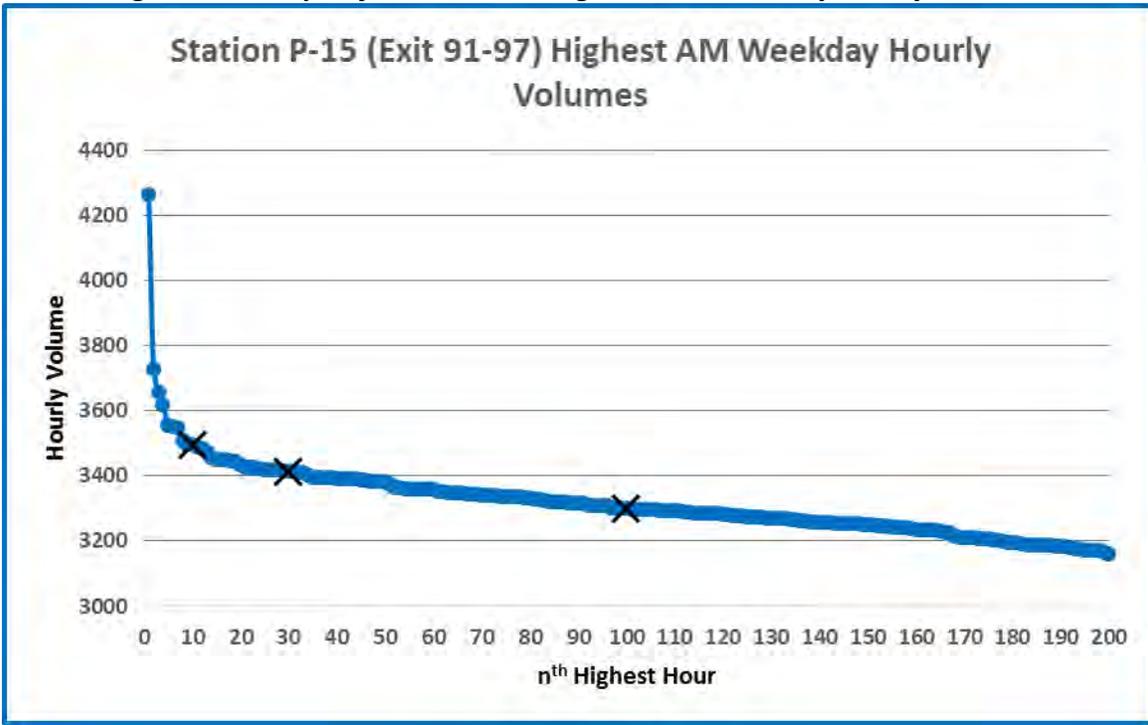
**Figure 47 - Graph of Station P-112 Highest PM Weekday Hourly Volumes**



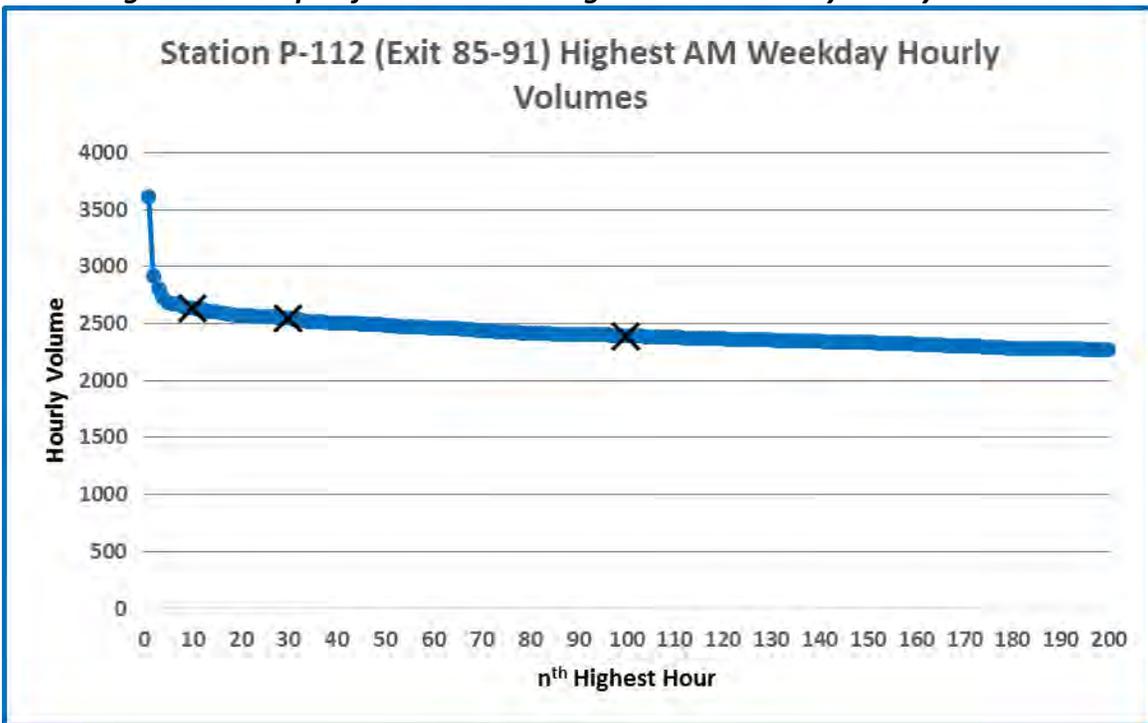
**Figure 48 - Graph of Station P-95 Highest AM Weekday Hourly Volumes**



**Figure 49 - Graph of Station P-15 Highest AM Weekday Hourly Volumes**



**Figure 50 - Graph of Station P-112 Highest AM Weekday Hourly Volumes**



The 10<sup>th</sup> highest weekday ATR Volumes and the 30<sup>th</sup> highest weekday ATR Volumes that will be used for the AM and PM design hour analysis are summarized in **Table 4** and in **Table 5**. These volumes include the design hour northbound and southbound volumes at each ATR station location, the segment AADT and the resulting K and D factors.

**Table 4 - 10th Highest AM and PM Volumes**

10th Highest Annual ATR Volumes						
ATR Station	AM Design Hour			PM Design Hour		
	EB	WB	TOTAL	EB	WB	TOTAL
ATR Station P-0112	1,446	1,192	2,638	1,912	2,119	4,031
AAADT 42,300	D = 54.8% EB		K = 6.2%	D = 52.6% WB		K = 9.5%
ATR Station P-0015	2,036	1,460	3,496	2,362	2,555	4,917
AAADT 51,200	D = 58.2% EB		K = 6.8%	D = 52.0% WB		K = 9.6%
ATR Station P-0095	5,045	2,516	7,561	3,595	4,927	8,522
AAADT 95,600	D = 66.7% EB		K = 7.9%	D = 57.8% WB		K = 8.9%

**Table 5 - 30th Highest AM and PM Volumes**

30th Highest Annual ATR Volumes						
ATR Station	AM Design Hour			PM Design Hour		
	EB	WB	TOTAL	EB	WB	TOTAL
ATR Station P-0112	1,419	1,128	2,547	1,753	1,981	3,734
AAADT 42,300	D = 55.7% EB		K = 6.0%	D = 53.1% WB		K = 8.8%
ATR Station P-0015	2,009	1,404	3,413	2,112	2,307	4,419
AAADT 51,200	D = 58.9% EB		K = 6.7%	D = 52.2% WB		K = 8.6%
ATR Station P-0095	4,739	2,694	7,433	3,594	4,785	8,379
AAADT 95,600	D = 63.8% EB		K = 7.8%	D = 57.1% WB		K = 8.8%

The I-26 ramp volumes at the study area interchanges were developed based on the peak hour turning movement count data for each ramp intersection with the adjacent street network. The morning and afternoon peak hour volumes on the off- and on-ramp approaches to the intersections were used to establish the existing design peak hour ramp volumes.

Using the I-26 ramp volumes, the design hour volumes for each mainline segment were estimated using the 10<sup>th</sup> highest weekday morning and afternoon ATR volumes on the segments. Three sets of estimated freeway segment volumes were generated. The first used the 10<sup>th</sup> highest ATR volume from station P-0112 as a “control” volume for the AM and PM design hours. Starting with this volume along the segment located between Exits 85 and 91, the on-and off-ramp volumes were added and subtracted from the mainline volumes as appropriate throughout the study area to derive the design hour volumes for the other freeway segments. The second set of freeway segment volumes were derived holding the P-0015 ATR station AM and PM design hours as the control volume for the segment located between Exits 91 and 97. The third set of

freeway segment volumes were derived holding the P-0095 ATR station AM and PM design hours as the control volume for the segment located between Exits 101 and 102. The segment volumes were evaluated, and the most conservative (high) volumes for the freeway segments were used to prepare the network volumes.

The three sets of freeway volumes were compared. The highest volumes throughout the system were obtained by using the P-0112 ATR design hour volumes as the control for the eastbound morning design hour, and the P-0015 ATR design hour volumes as the control for the eastbound PM, and westbound AM and PM design hours. The network volumes were then fixed in each direction at the segment between Exits 91 and 97. The existing design hour volumes used in the analysis of the existing corridor are shown in **Figure 51**, **Figure 52**, and **Figure 53**.

Figure 51 - Existing Design Hour Volumes (Exits 82-85)

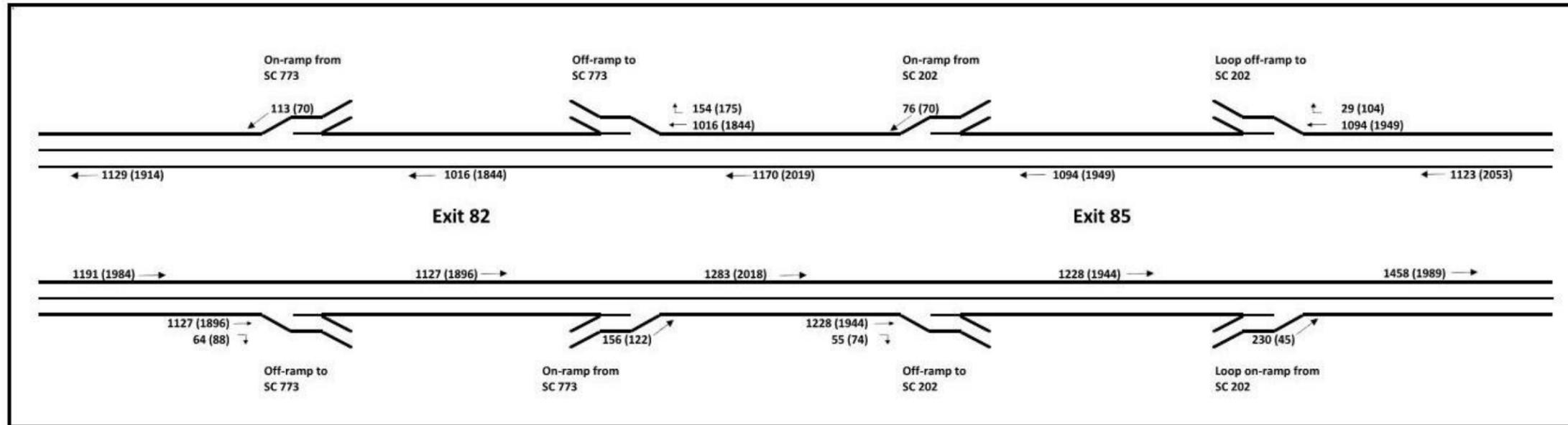


Figure 52 - Existing Design Hour Volumes (Exits 91-97)

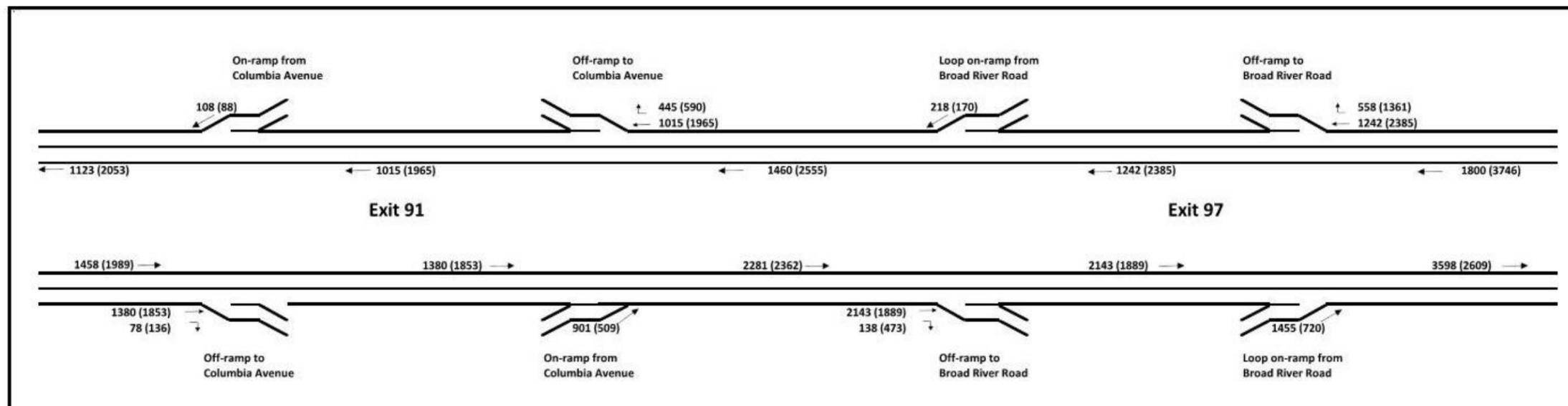
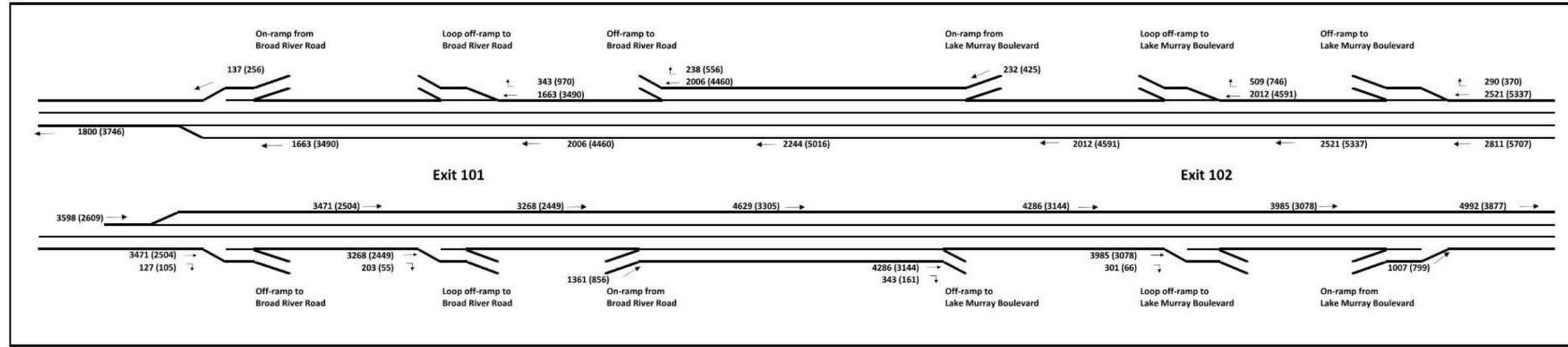


Figure 53 - Existing Design Hour Volumes (Exits 101-102)



Truck Percentages

Truck percentages were derived from the vehicle classification data obtained near Exits 85 and 101. The vehicle classification data is used to determine the heavy vehicle (trucks/buses) percentages to be used in the analysis. The data summarized traffic collected over a two day period starting Tuesday, August 23, 2016 and ending Wednesday, August 24, 2016. The weekday truck percentage data are summarized in **Table 6**.

**Table 6 - Observed Weekday Truck Percentages**

I-26 Vehicle Classification Data Location	Date	Weekday Truck Percent		
		Peak	Off-Peak	Total
Exit 85	8/23/2016	18.95%	24.83%	23.38%
	8/24/2016	17.97%	24.79%	23.12%
Exit 101	8/23/2016	11.66%	15.81%	14.76%
	8/24/2016	11.18%	15.87%	14.63%

Upon review of this data, and based upon concurrence with SCDOT, it was agreed that 23 percent would be used as the truck percentage throughout the analysis.

Traffic Projections

The growth rate of traffic within the corridor was estimated using two procedures. The first procedure evaluated the annual rate of change for the AADT between 1996 and 2015 for each freeway segment based on the SCDOT AADT station data. The second procedure evaluated the traffic assignments of the freeway segments in the South Carolina Statewide Travel Demand Model (SCSWM) 2010 and 2040 base networks.

*AADT Evaluation*

An evaluation of the historic AADT volumes for each of the segments within the study area was performed. The average annual rate of change in AADT on each of the segments was calculated for:

- The last five years of data available (2010 – 2015)
- The last ten years of data available (2005 – 2015).
- The last 19 years of available data (1996 – 2015)

The 2015, 2010, 2005 and 1996 AADT for each of the segments are shown in **Table 7**.

**Table 7 - Historic Freeway Segment AADT**

I-26 Segment Number	I-26 Segment Description	2015 AADT	2010 AADT	2005 AADT	1996 AADT
Segment 1	I-26 FROM SC 773 (SC773) TO SC 202 (SC202) NEWBERRY COUNTY STA 2123	41,800	37,300	37,500	26,600
Segment 2	I-26 FROM SC 202 (SC202) (NEWBERRY) TO S- 48 (COLUMBIA AVE) LEXINGTON COUNTY STA 2125	42,300	37,800	37,700	27,300
Segment 3	I-26 FROM S- 48 (COLUMBIA AVE) (LEXINGTON) TO US 176 (BROAD RIVER RD) RICHLAND COUNTY STA 2127	51,200	46,400	45,700	33,900
Segment 4	I-26 FROM US 176 (BROAD RIVER RD) TO US 76 RICHLAND COUNTY STA 2129	52,300	47,800	46,300	33,400
Segment 5	I-26 FROM US 76 TO SC 60 (LAKE MURRAY BLVD) RICHLAND COUNTY STA 2131	71,700	67,200	65,300	45,600

The annual average rate of change in the AADT is shown in **Table 8**.

**Table 8 - Average Annual Percentage Change in AADT**

I-26 Segment Number	I-26 Segment Description	2010-2015 Annual Rate (%)	2005-2015 Annual Rate (%)	1996-2015 Annual Rate (%)
Segment 1	I-26 FROM SC 773 (SC773) TO SC 202 (SC202) NEWBERRY COUNTY STA 2123	2.30	1.09	2.41
Segment 2	I-26 FROM SC 202 (SC202) (NEWBERRY) TO S- 48 (COLUMBIA AVE) LEXINGTON COUNTY STA 2125	2.28	1.16	2.33
Segment 3	I-26 FROM S- 48 (COLUMBIA AVE) (LEXINGTON) TO US 176 (BROAD RIVER RD) RICHLAND COUNTY STA 2127	1.99	1.14	2.19
Segment 4	I-26 FROM US 176 (BROAD RIVER RD) TO US 76 RICHLAND COUNTY STA 2129	1.82	1.23	2.39
Segment 5	I-26 FROM US 76 TO SC 60 (LAKE MURRAY BLVD) RICHLAND COUNTY STA 2131	1.30	0.94	2.41

The average annual five-year rate of change in the segment volumes based on the AADT ranged from 1.30 to 2.30 percent per year. The average annual ten-year rate of change in the segment volumes ranged from 0.94 to 1.23 percent per year. In these time periods, the annual growth inclined throughout the study area.

The average annual growth rate between 1996 and 2015 was assessed. The average rate of growth was positive throughout the corridor, ranging from 2.19 to 2.41 percent per year.

The annual percentage change in the AADT were reviewed for each segment. Note that in recent years (since 2010), the growth rate for the individual segments west of Exit 97 have been growing at the highest rate. The total Growth Rate from 1996 was all in a 2.5 percent range. The 2010-2015 Historic Annual Growth Rate is less than but close to 1996-2015 Historic Annual Growth Rate. The 2005-2015 Historic Annual Growth Rate is approximately half of 1996-2015 Historic

Annual Growth Rate and is likely due to the 2008 economic downturn. Whether or not that trend continues in the coming years remains to be seen.

*SCSWM Projection Evaluation*

The traffic growth rates for the I-26 freeway segments were derived from the SC Statewide Model. The statewide model traffic assignments are based on the calibrated 2010 model and the 2040 E+C model network. The average annual growth rate for each of the segments was calculated as shown in **Table 9**.

**Table 9 - Statewide Model Projection Growth Rates**

I-26 Segment Number	I-26 Segment Description	2010 SC SWM Projections	2040 SC SWM Projections	2010-2040 Annual Rate (%)
Segment 1	I-26 FROM SC 773 (SC773) TO SC 202 (SC202) NEWBERRY COUNTY STA 2123	32,500	41,500	0.82
Segment 2	I-26 FROM SC 202 (SC202) (NEWBERRY) TO S- 48 (COLUMBIA AVE) LEXINGTON COUNTY STA 2125	32,900	47,200	1.21
Segment 3	I-26 FROM S- 48 (COLUMBIA AVE) (LEXINGTON) TO US 176 (BROAD RIVER RD) RICHLAND COUNTY STA 2127	43,100	62,000	1.22
Segment 4	I-26 FROM US 176 (BROAD RIVER RD) TO US 76 RICHLAND COUNTY STA 2129	48,600	74,300	1.43
Segment 5	I-26 FROM US 76 TO SC 60 (LAKE MURRAY BLVD) RICHLAND COUNTY STA 2131	65,800	96,300	1.28

The projected SCSWM growth rates on the individual segments ranged from between 0.82 and 1.36 percent per year. Based on the model assignments, the average growth rate in the corridor between Exit 102 and Exit 82 is approximately 1.20 percent per year. The growth rate ranges from approximately 0.80 percent per year on the west end of the study area to about 1.5 percent per year between Exits 97 and 101.

A proposed average annual growth rate was estimated based on a comparison of the AADT average annual growth rates (for 1996 and 2015) and the SCSWM average annual growth rates for each of the segments. This proposed growth rate would be applied to all mainline, ramp and arterial turning movement volumes within the study area to generate the design year peak hour volumes for use in the alternatives analysis. In setting the growth rate, an annual percentage that is comparable to, but higher than the observed growth rates is often desirable so a conservative analysis of future traffic conditions may be attained.

A comparison of the growth rates derived from the historic AADT data and the SCSWM projections is shown in **Table 10**. Many of the segments in the study area had estimated growth rates exceeding 1.00 percent per year based on the statewide model. Historic data of all segments exceeded 2.00 percent per year. Given the long term historic growth in the corridor,

the growth rate falls in a range from 1.5 percent (based on the model assignments) and 2.5 percent per year (based on the long term growth rate from 1996 – 2015). Based on discussions with SCDOT it was determined that a growth rate of 1.5 percent would be used to the east of US 176 (Broad River Road), a growth rate of 2.0 percent would be used from US 176 (Broad River Road) to east of SC 202, and a growth rate of 2.5 percent would be used from SC 202 to the west. In order to balance the volumes for the varying growth rates ramp volumes were adjusted at Exits 97, 91, 85, and 82.

**Table 10 - Comparison of Growth Rate Projections**

I-26 Segment Number	I-26 Segment Description	1996-2015 Annual Rate (%)	2010-2040 SC SWM Annual Rate (%)
Segment 1	I-26 FROM SC 773 (SC773) TO SC 202 (SC202) NEWBERRY COUNTY STA 2123	2.41	0.82
Segment 2	I-26 FROM SC 202 (SC202) (NEWBERRY) TO S- 48 (COLUMBIA AVE) LEXINGTON COUNTY STA 2125	2.33	1.28
Segment 3	I-26 FROM S- 48 (COLUMBIA AVE) (LEXINGTON) TO US 176 (BROAD RIVER RD) RICHLAND COUNTY STA 2127	2.19	1.21
Segment 4	I-26 FROM US 176 (BROAD RIVER RD) TO US 76 RICHLAND COUNTY STA 2129	2.39	1.36
Segment 5	I-26 FROM US 76 TO SC 60 (LAKE MURRAY BLVD) RICHLAND COUNTY STA 2131	2.41	1.32

*I-26 Traffic Volume Data – 2040 Design Hour Volumes*

The 1.5/2.0/2.5 percent per year growth rate was applied to the ramp traffic to develop projections of the 2040 Design Hour Traffic Volumes and the freeway traffic was balanced with a base growth rate of 2.0 percent which was adjusted at certain interchanges to maintain a balanced network. The estimated freeway segment AADT for the 2040 Design Year using this growth rate is summarized in **Table 11**.

**Table 11 - Estimated 2040 Freeway Segment AADT**

I-26 Segment Number	I-26 Segment Description	2015 AADT	Projected Annual Growth Rate	Estimated 2040 AADT
Segment A	I-26 FROM SC 219 (SC219) TO SC 773 (SC773) NEWBERRY COUNTY STA 2121	40,500	2.0	81,000
Segment 1	I-26 FROM SC 773 (SC773) TO SC 202 (SC202) NEWBERRY COUNTY STA 2123	41,800	2.0	83,600
Segment 2	I-26 FROM SC 202 (SC202) (NEWBERRY) TO S- 48 (COLUMBIA AVE) LEXINGTON COUNTY STA 2125	42,300	2.0	84,600
Segment 3	I-26 FROM S- 48 (COLUMBIA AVE) (LEXINGTON) TO US 176 (BROAD RIVER RD) RICHLAND COUNTY STA 2127	51,200	2.0	102,400
Segment 4	I-26 FROM US 176 (BROAD RIVER RD) TO US 76 RICHLAND COUNTY STA 2129	52,300	2.0	104,600
Segment 5	I-26 FROM US 76 TO SC 60 (LAKE MURRAY BLVD) RICHLAND COUNTY STA 2131	71,700	1.9	136,230
Segment B	I-26 FROM SC 60 (LAKE MURRAY BLVD) TO S- 757 (HARBISON BLVD) RICHLAND COUNTY STA 2133	95,600	1.8	172,080

In order to account for the volumes developed as part of the *Interchange Modification Report: I-26 at S-48 (Columbia Avenue) Interchange Improvements* prepared for SCDOT and Lexington County, the ramp volumes from the IMR at Exit 91 were used and the mainline volumes were balanced to the west along I-26. The 2040 design hour volumes for the study area are shown in **Figure 54**, **Figure 55**, and **Figure 56**.

*Intersection Traffic Volume Data – Existing Peak Hour Volumes*

The turning movement traffic count data obtained from SCDOT and from the additional counts were evaluated and reviewed. The morning and afternoon peak hour volumes at each of the ramp termini and the adjacent intersections at each interchange were identified and the traffic balanced between intersections. The balanced morning and afternoon peak hour volumes for the interchanges are shown in **Figure 57** through **Figure 62**.

Turning movement volumes for the 2040 design year were derived by applying the 1.5/2.0/2.5 percent annual growth rate to the existing turning movement volumes at the various intersections. The 2040 estimated peak hour turning movement volumes shown on the existing (no-build) network at each interchange are shown in **Figure 63** to **Figure 68**. Exit 91 turning movement volumes were taken from the *Interchange Modification Report: I-26 at S-48 (Columbia Avenue) Interchange Improvements* prepared for SCDOT and Lexington County.

Figure 54 - 2040 Design Hour Volumes (Exits 82-85)

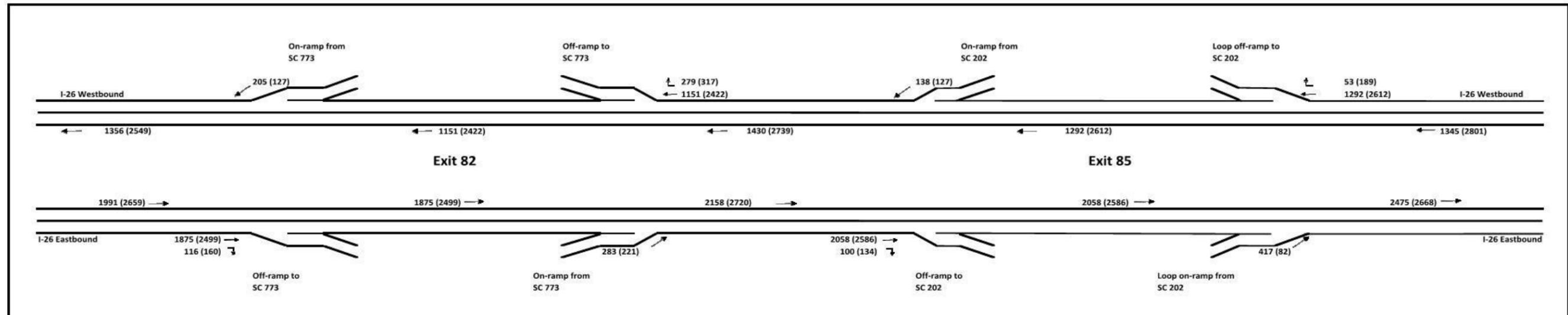


Figure 55 - 2040 Design Hour Volumes (Exits 91-97)

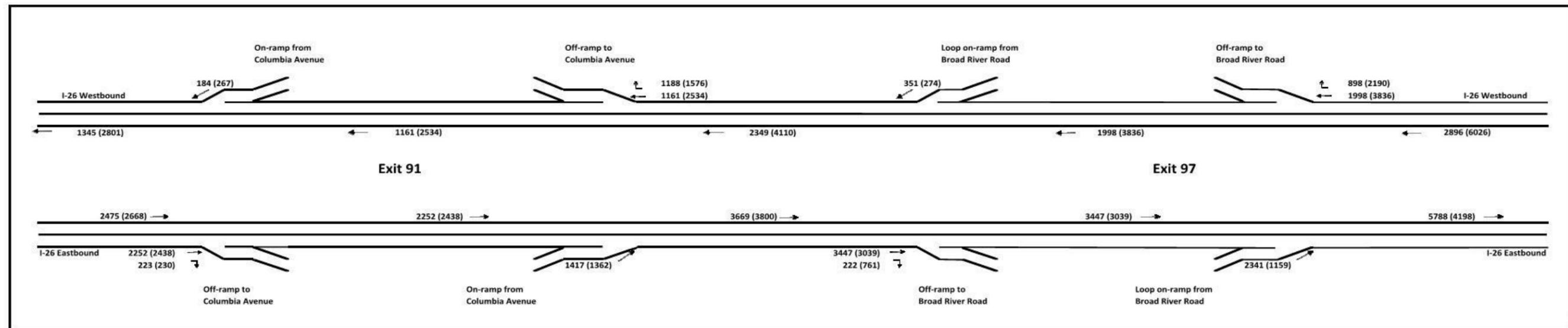


Figure 56 - 2040 Design Hour Volumes (Exits 101-102)

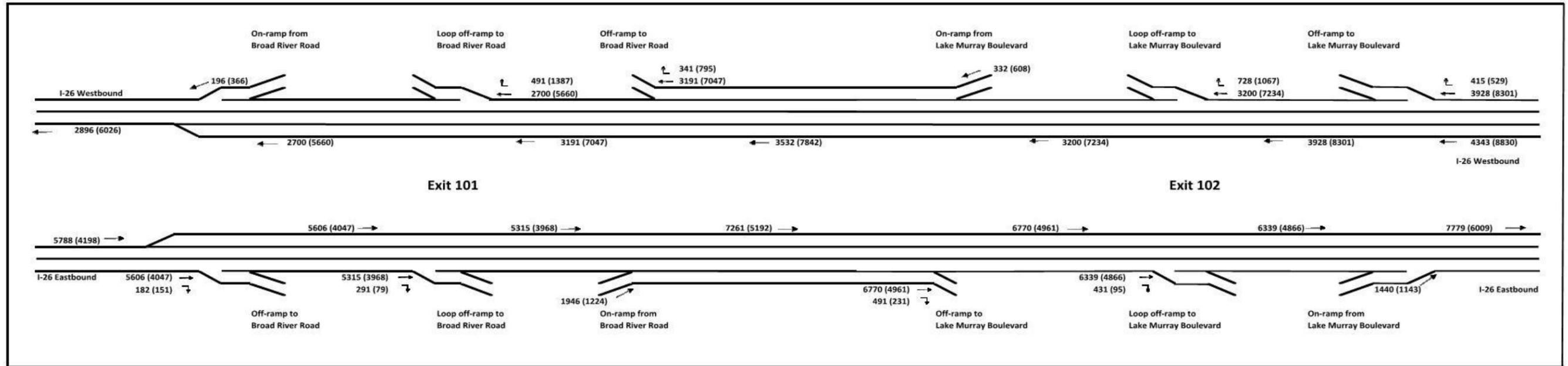


Figure 57 - Existing Peak Hour Turning Movement Volumes: Exit 82

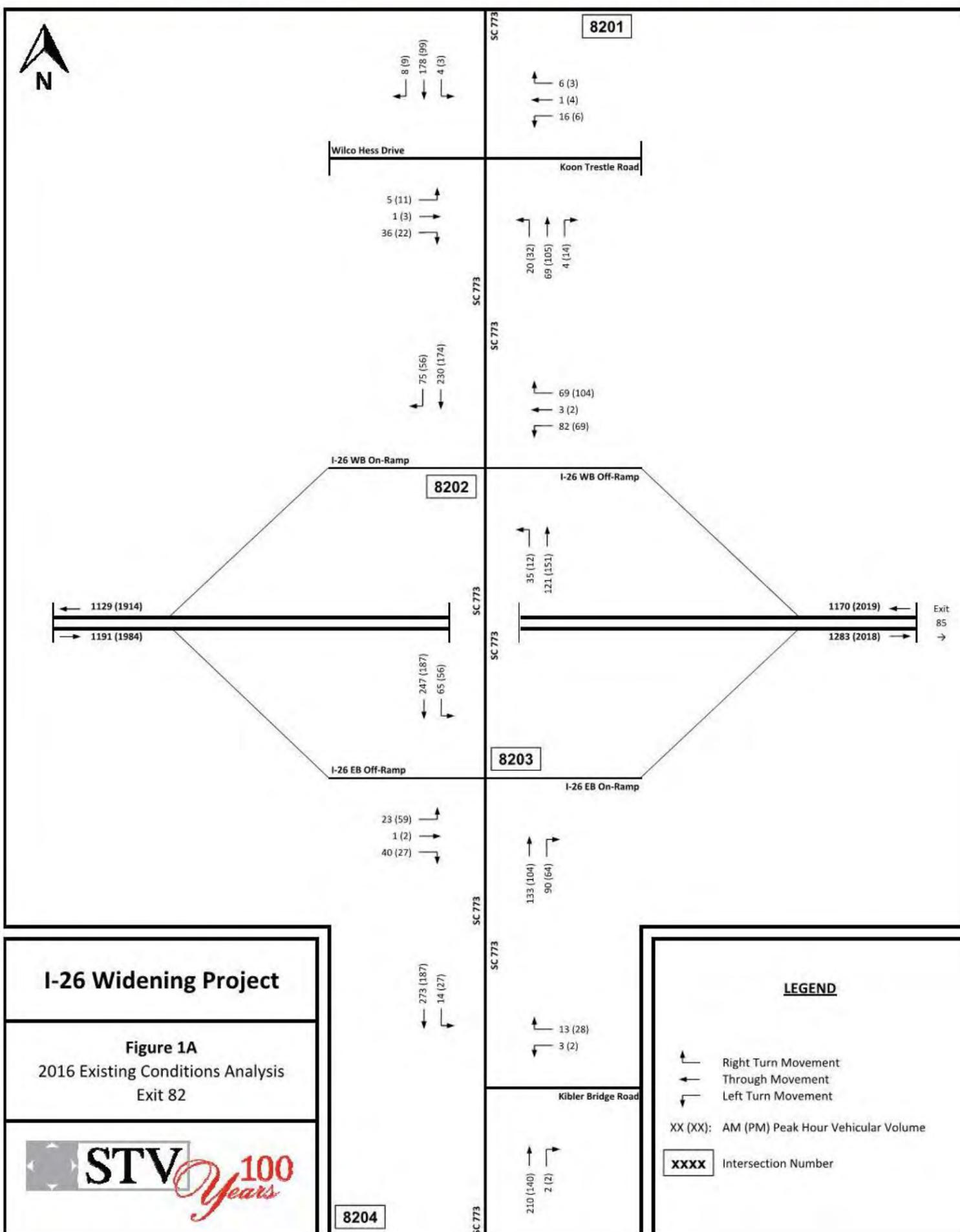


Figure 58 - Existing Peak Hour Turning Movement Volumes: Exit 85

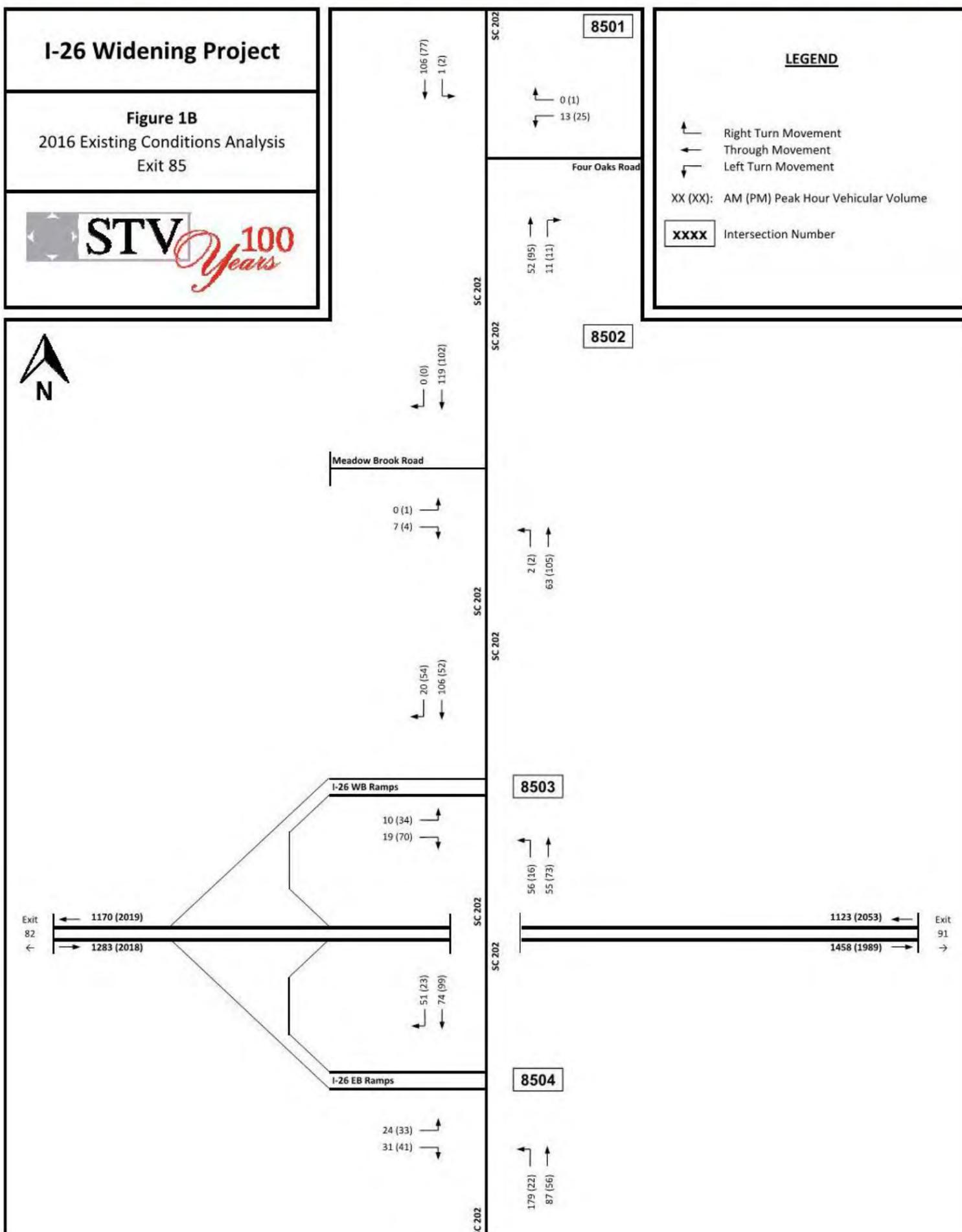


Figure 59 - Existing Peak Hour Turning Movement Volumes: Exit 91

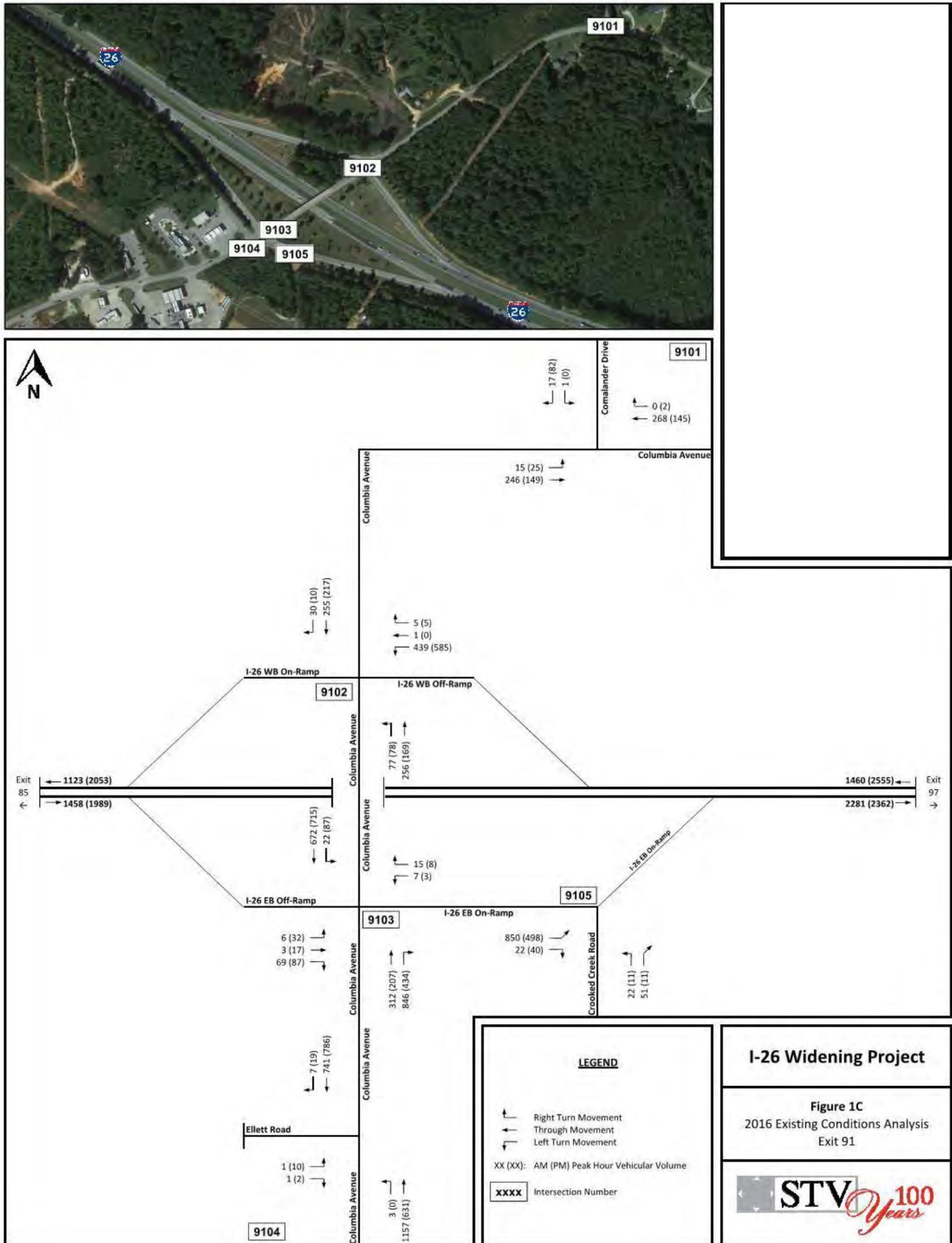


Figure 60 - Existing Peak Hour Turning Movement Volumes: Exit 97

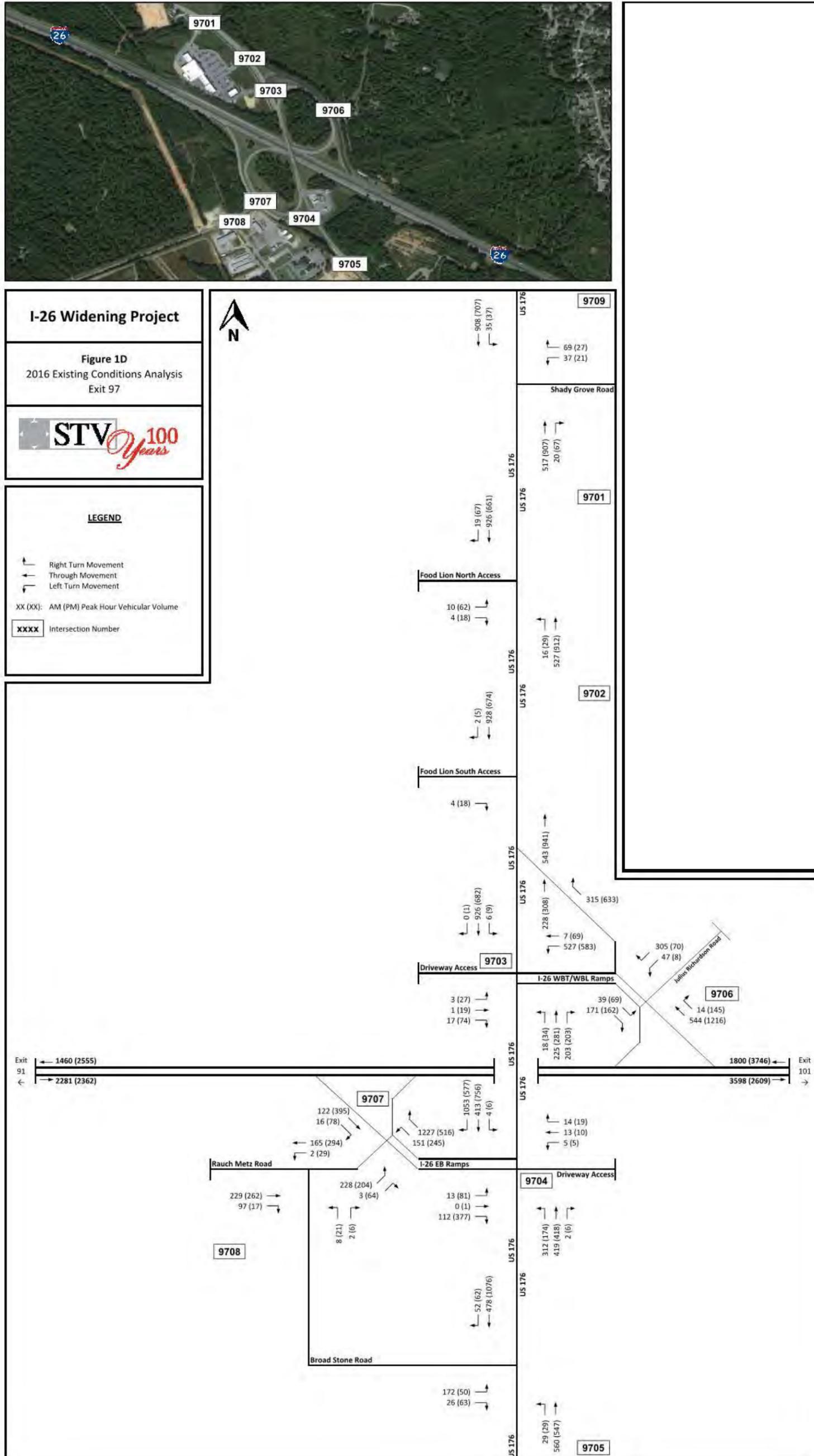


Figure 61 - Existing Peak Hour Turning Movement Volumes: Exit 101

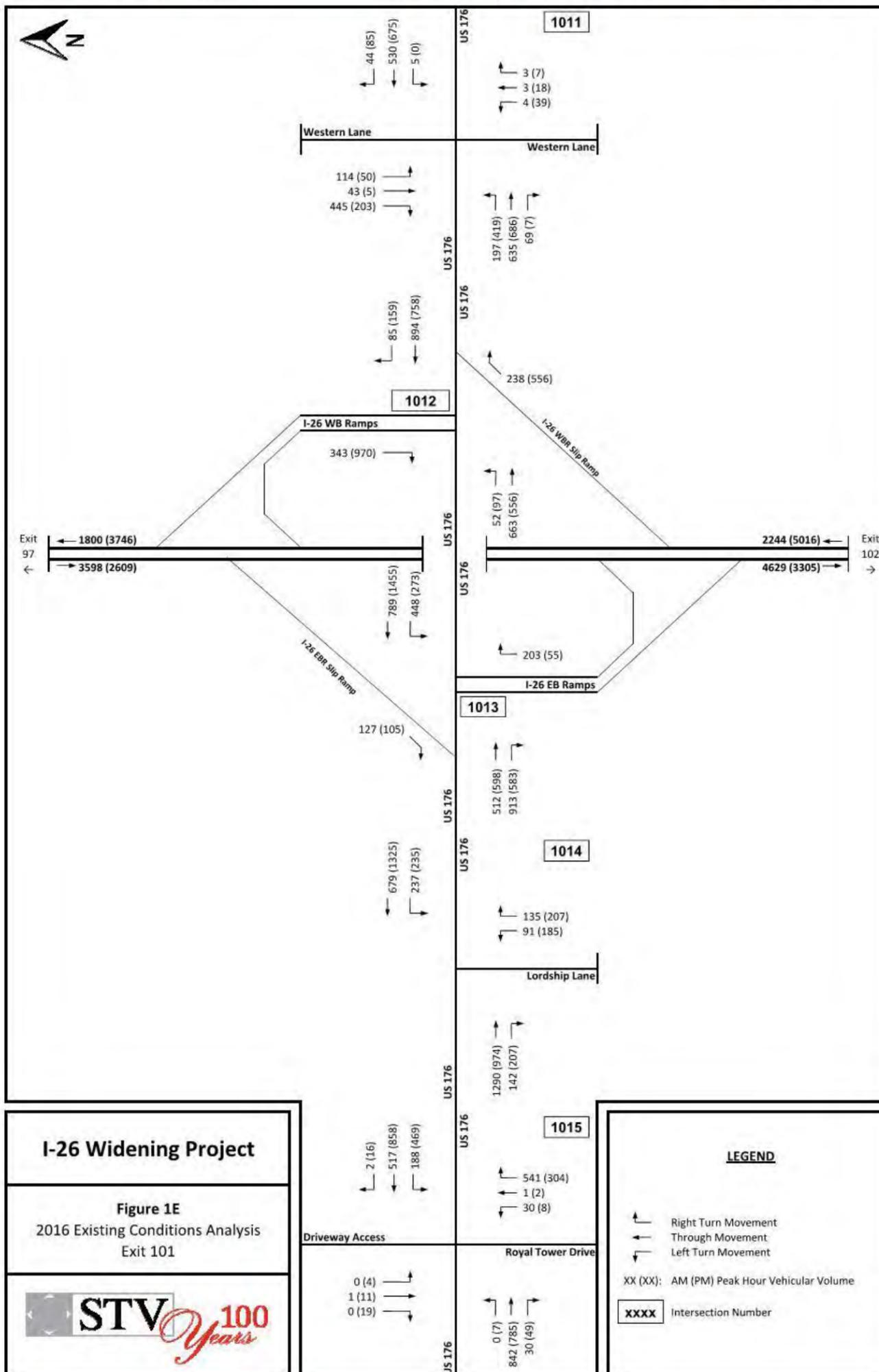


Figure 62 - Existing Peak Hour Turning Movement Volumes: Exit 102

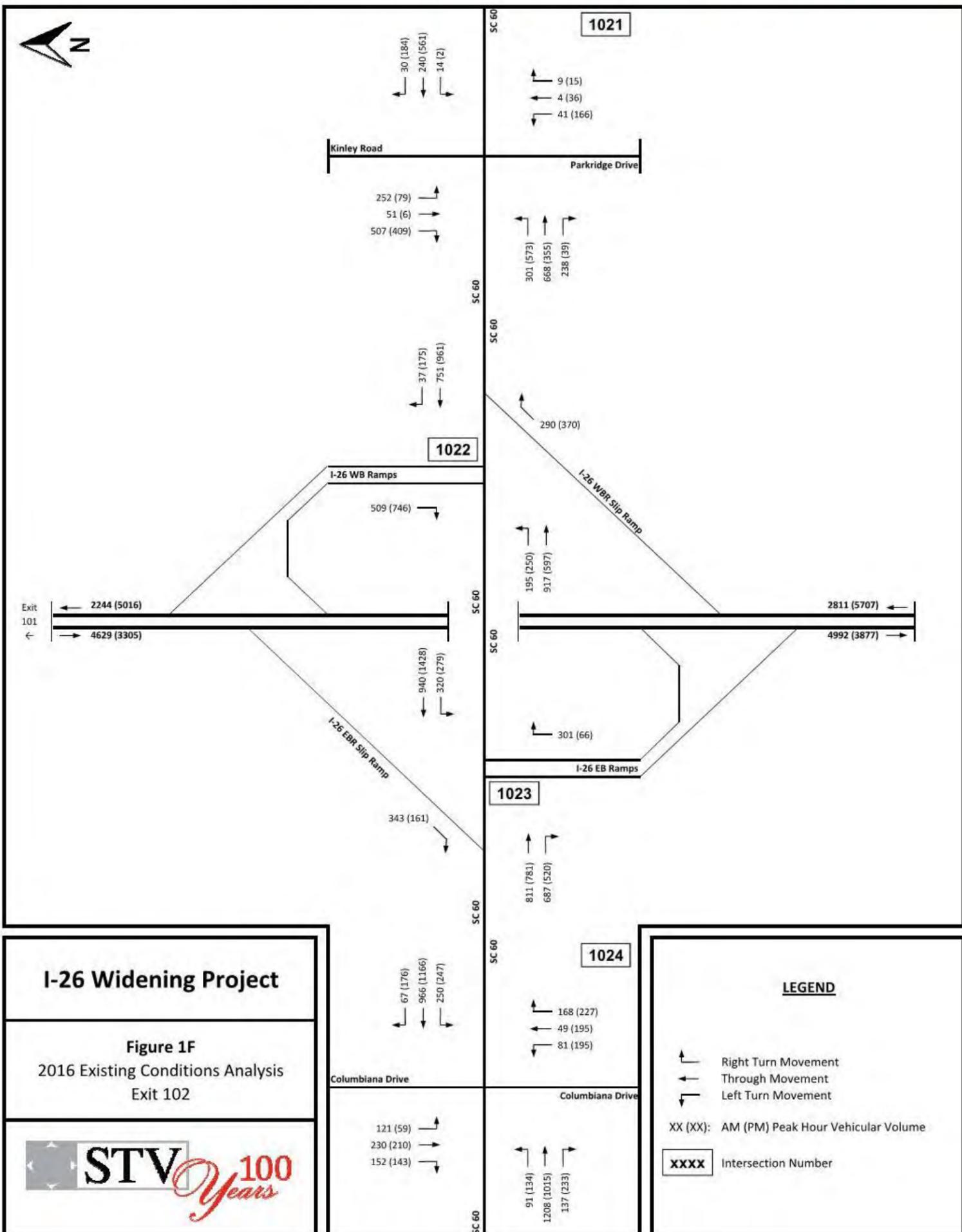
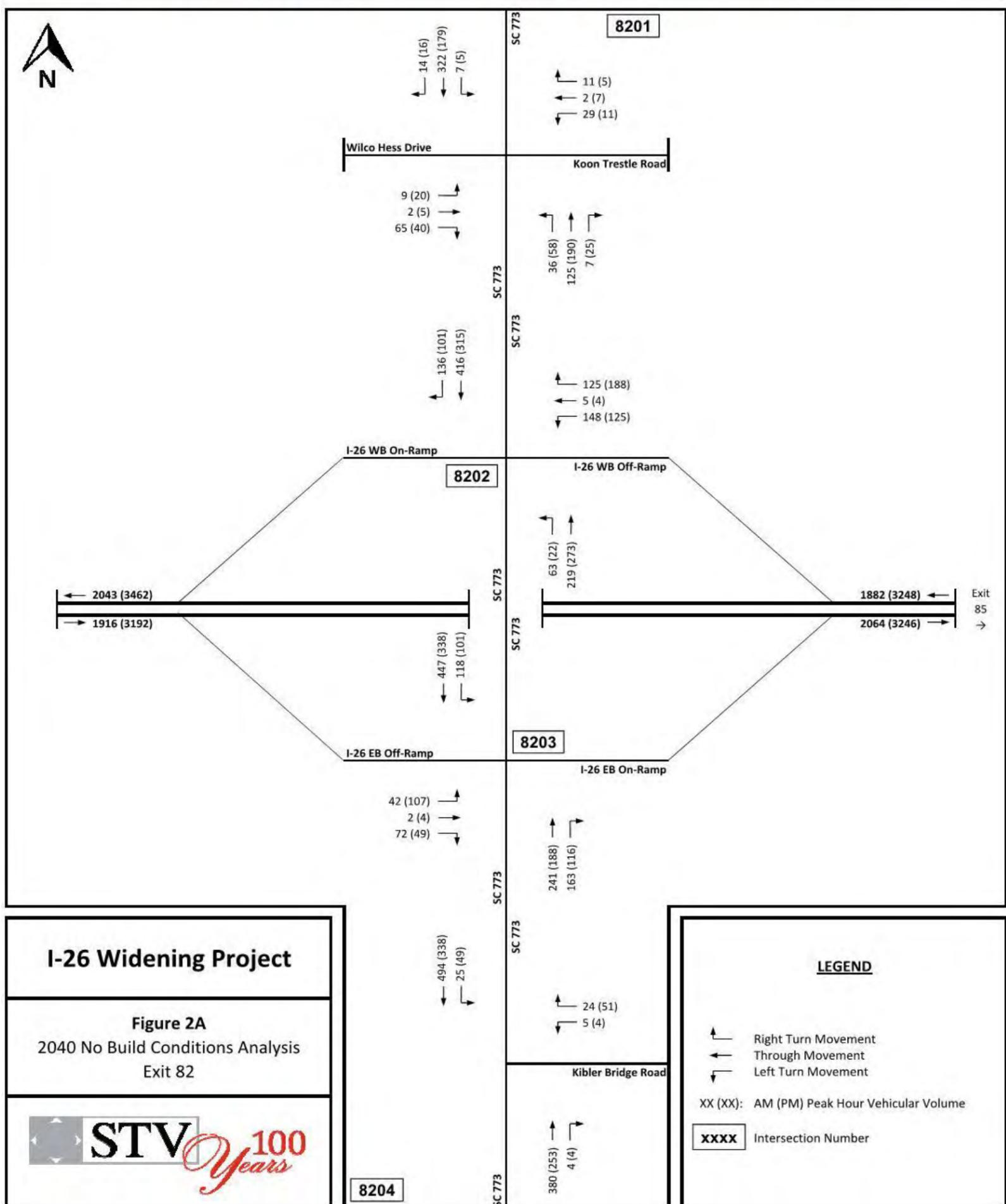


Figure 63 - 2040 Estimated Peak Hour Turning Movement Volumes: Exit 82



I-26 Widening Project

Figure 2A  
2040 No Build Conditions Analysis  
Exit 82



8204

Figure 64 - 2040 Estimated Peak Hour Turning Movement Volumes: Exit 85

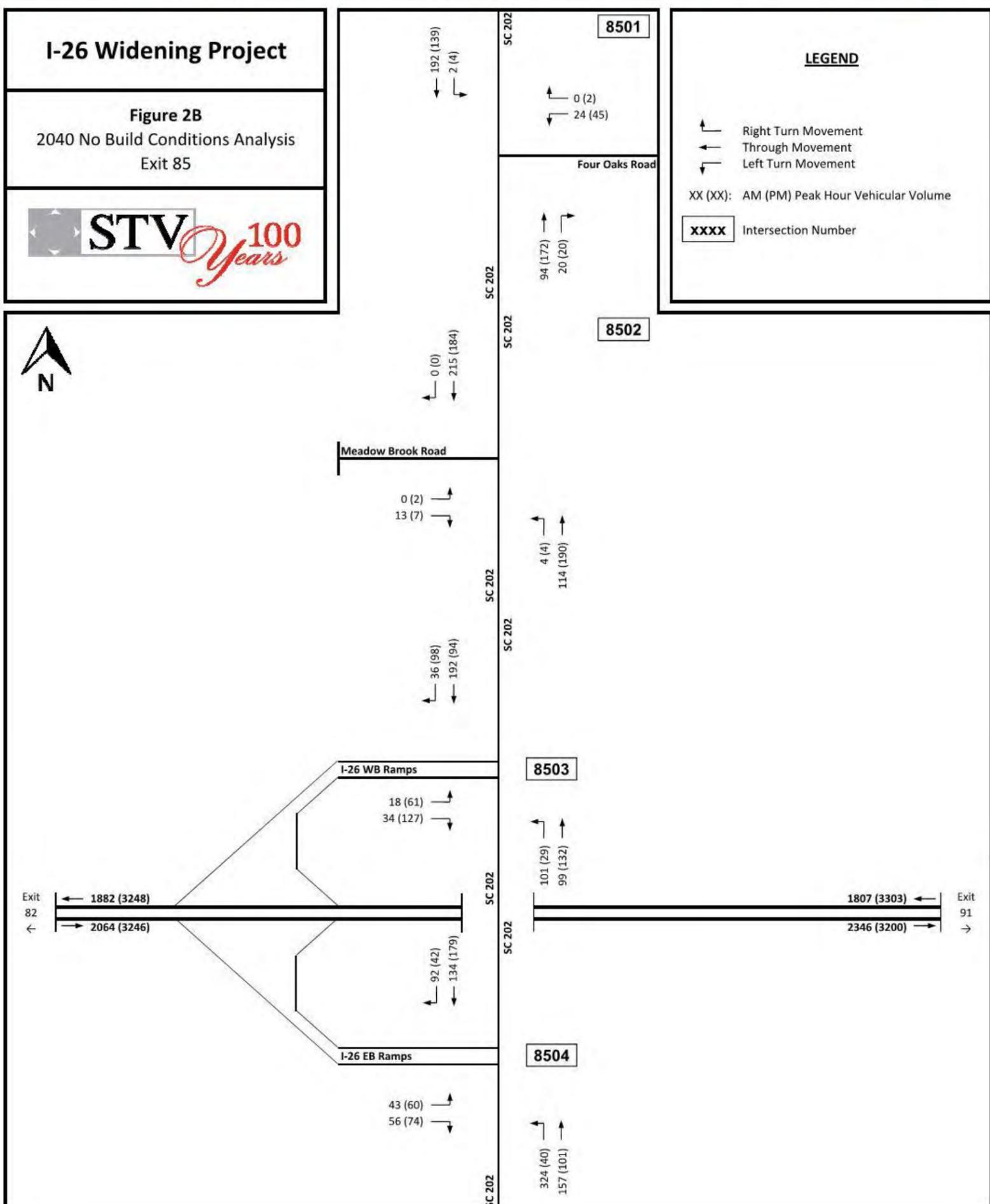


Figure 65 - 2040 Estimated Peak Hour Turning Movement Volumes: Exit 91

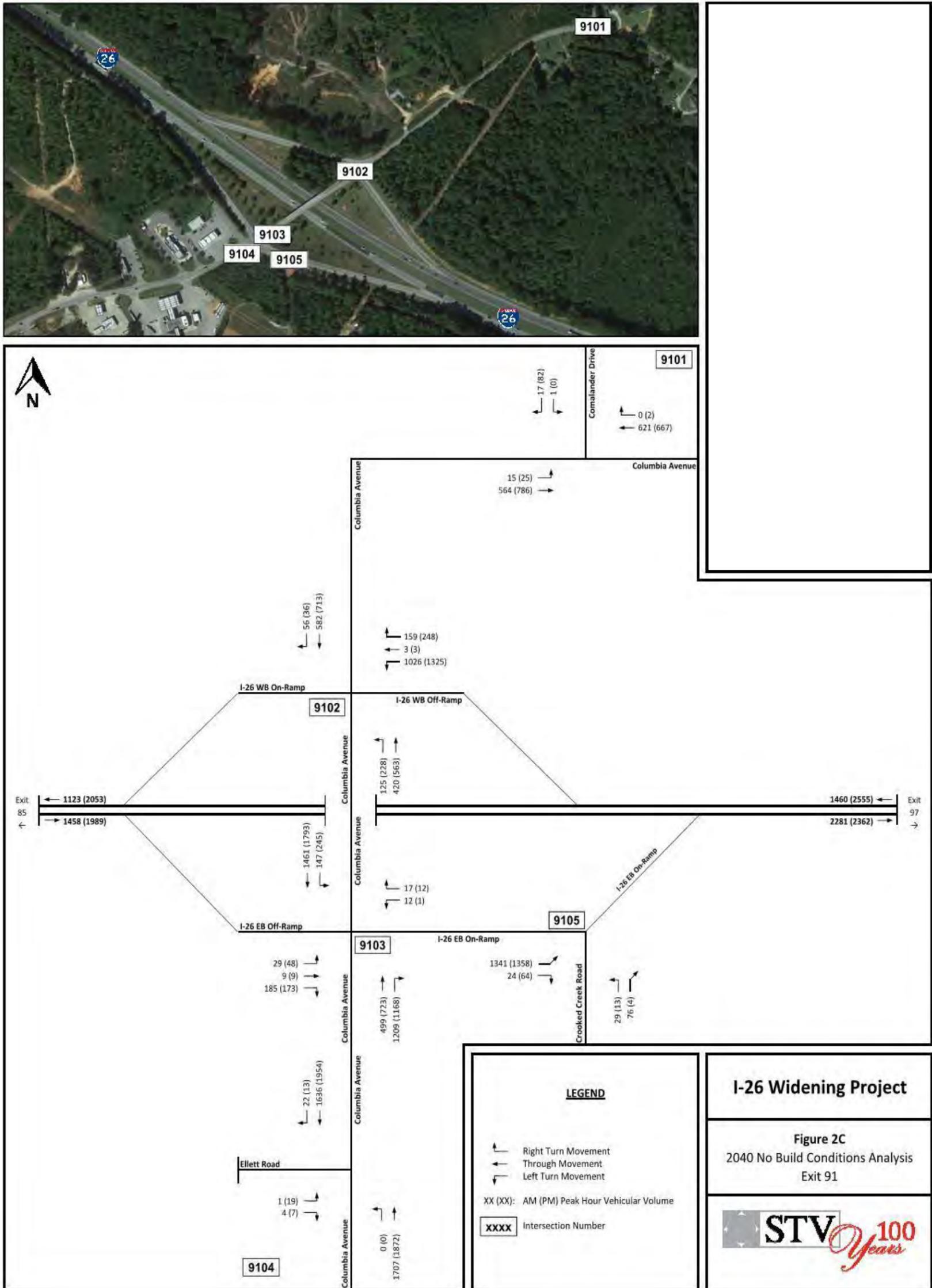


Figure 66 - 2040 Estimated Peak Hour Turning Movement Volumes: Exit 97

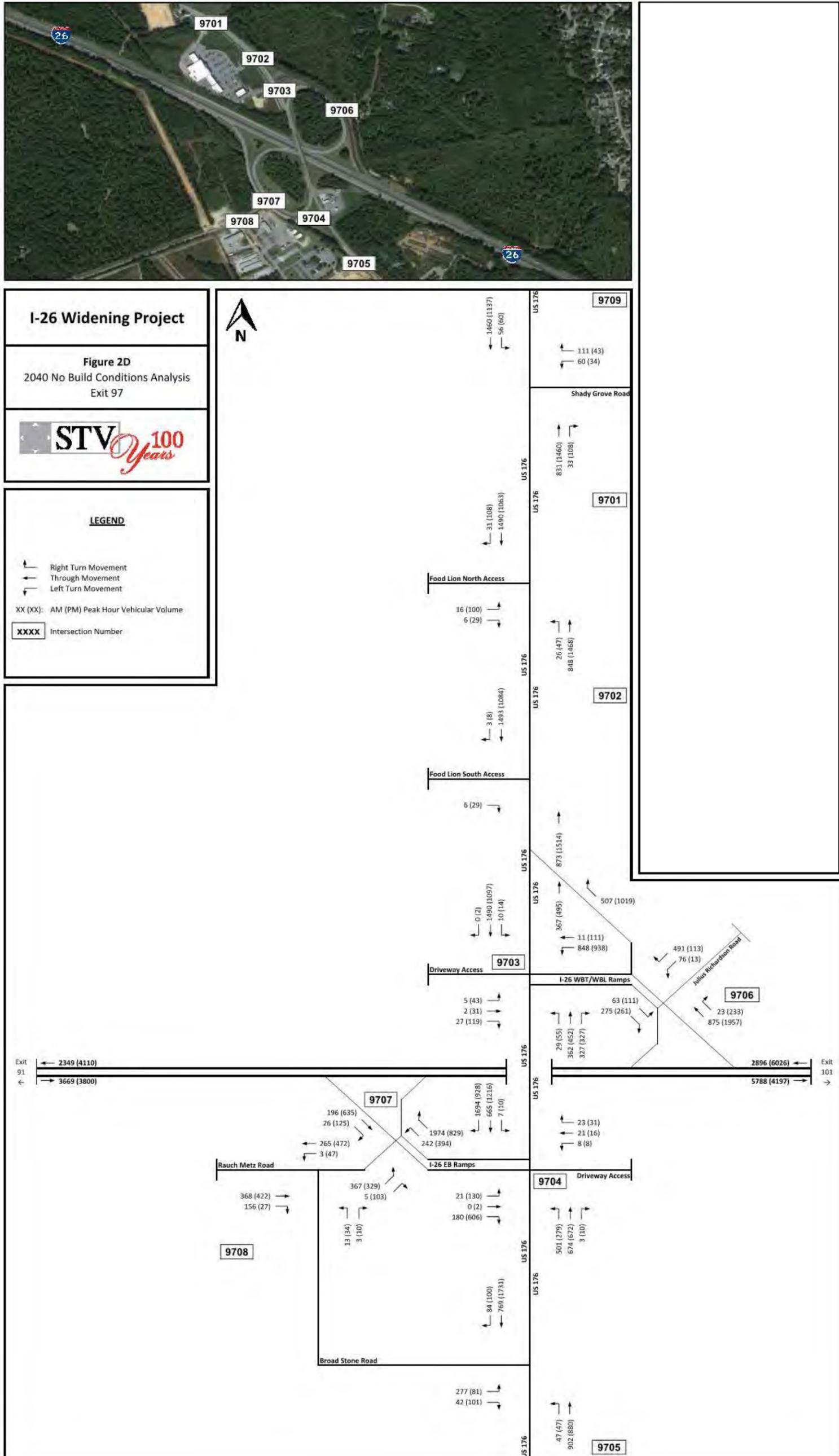


Figure 67 - 2040 Estimated Peak Hour Turning Movement Volumes: Exit 101

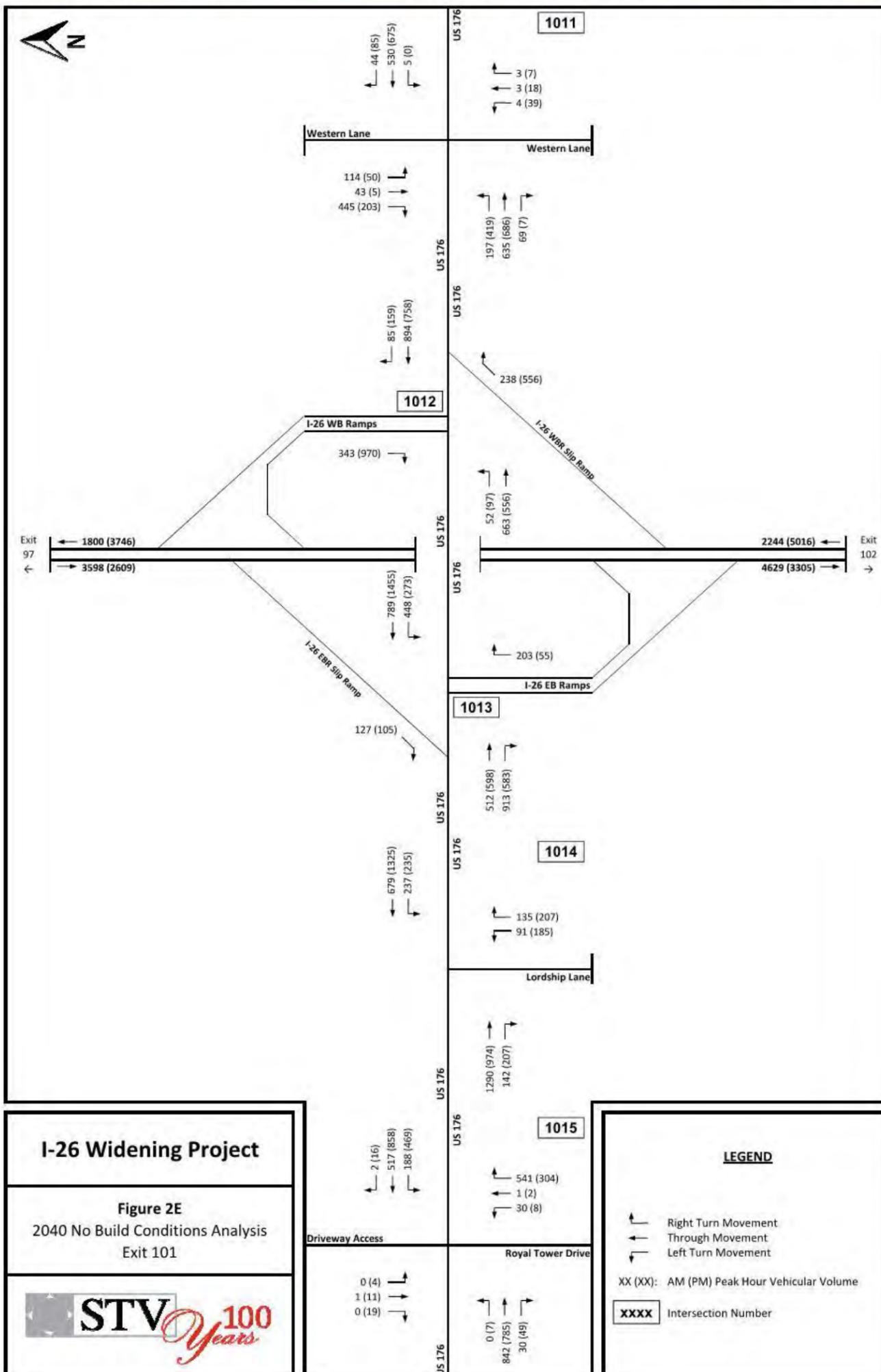
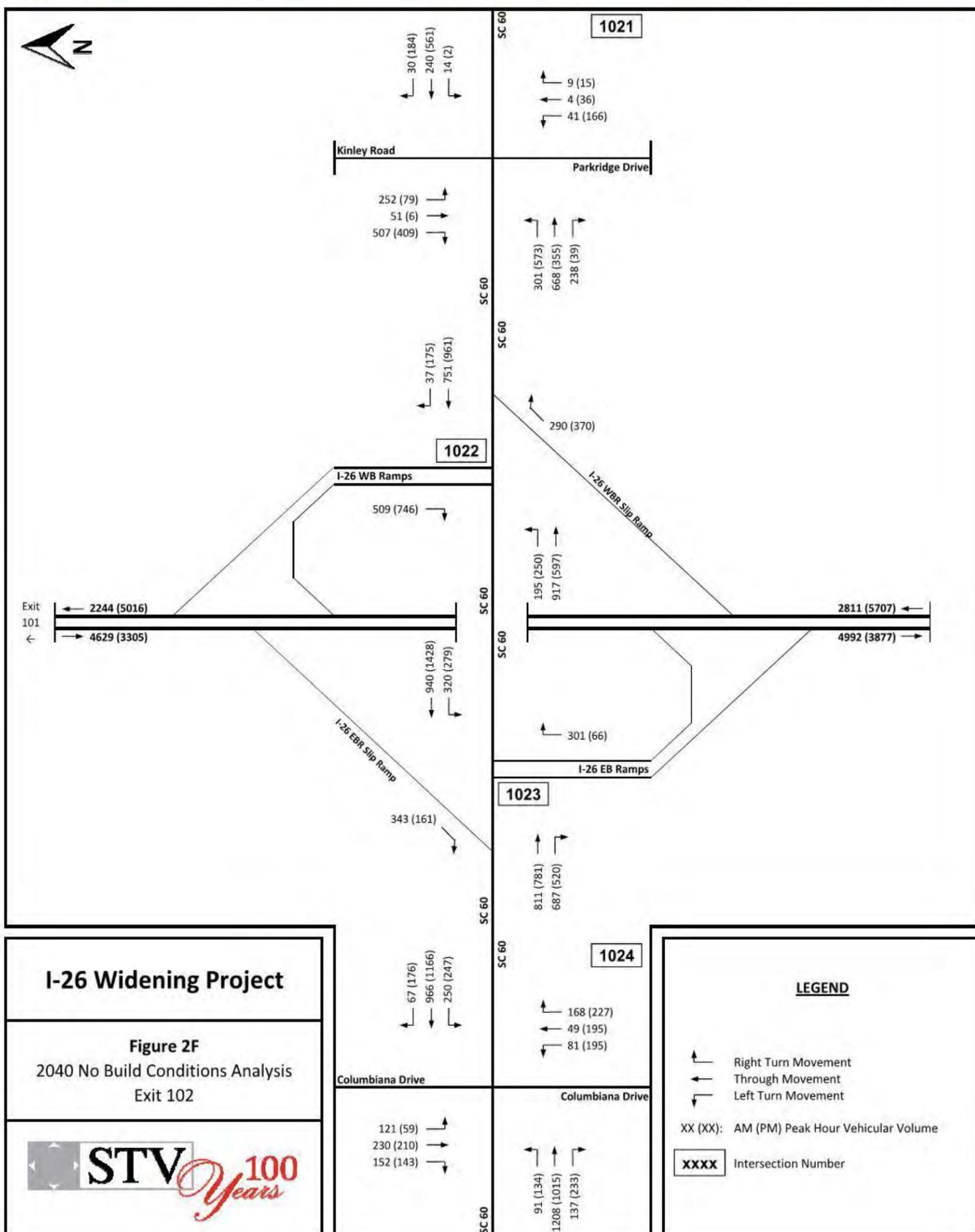


Figure 68 - 2040 Estimated Peak Hour Turning Movement Volumes: Exit 102

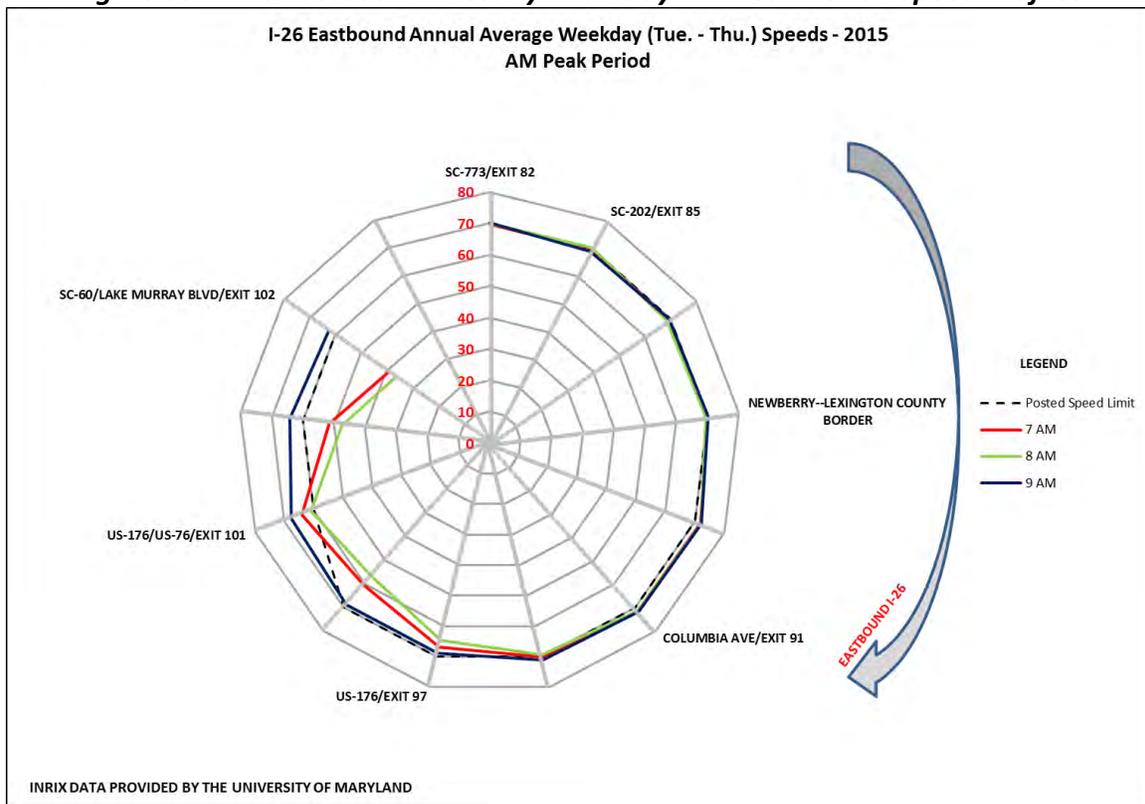


INRIX Speed Data

SCDOT provided travel speed data based on INRIX travel time data. The data provided by SCDOT are a summary of the average 2015 travel speeds for each hour of the day along the various segments of I-26 within the study area. The data are provided for Tuesday, Wednesday, and Thursday for the eastbound and westbound directions.

Graphs were created for each direction and AM and PM peak periods based on the format developed by SCDOT. The graphs depict a speed profile along the interstate in the chosen direction of travel and can clearly depict the time periods and locations where recurring congestion causes a drop of travel speed. The average annual travel speeds for the morning (7 to 9 AM) and afternoon (4 to 6 PM) peak periods in each direction for Tuesday-Thursday are shown in **Figure 69** through **Figure 72**.

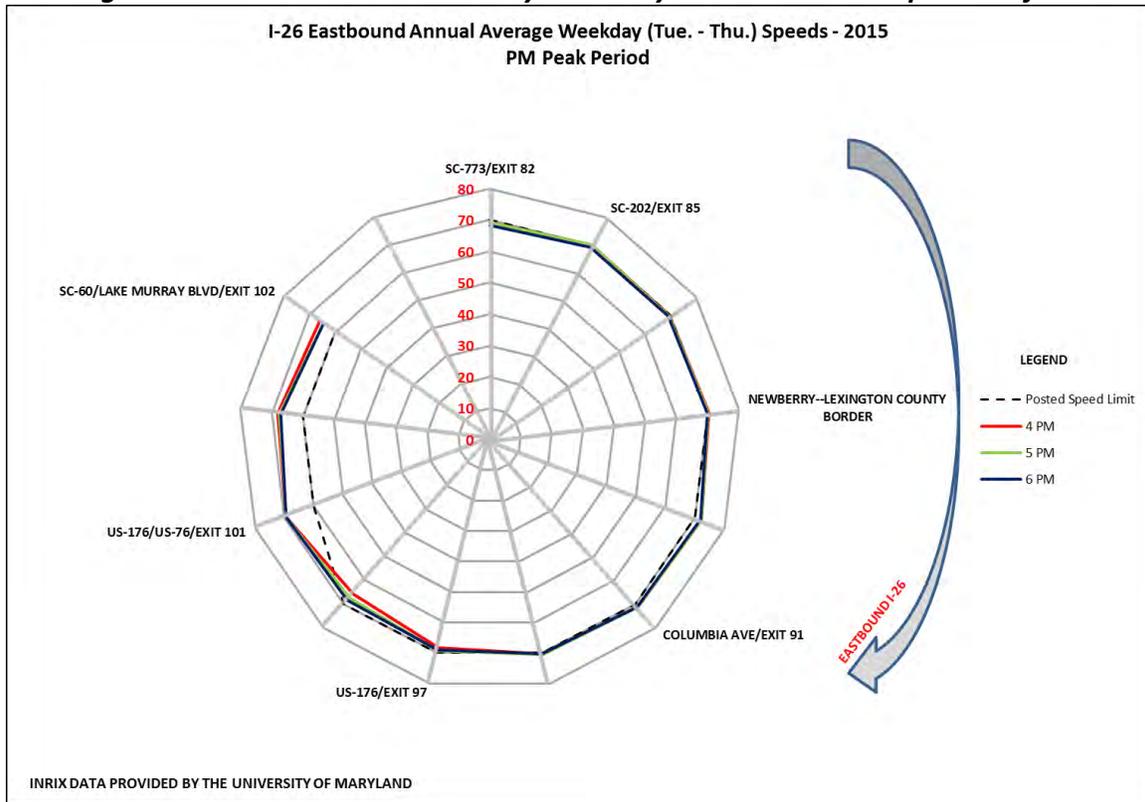
**Figure 69 - I-26 Eastbound Tuesday-Thursday AM Peak Period Speed Profiles**



The data plotted on the graphs indicate that eastbound travel speeds throughout the corridor during the morning peak period are generally near the posted speed limit. However, eastbound travel speeds begin to slow to between 60 and 70 miles per hour as traffic approaches Exit 97, likely from the friction caused by traffic entering from that interchange. Between Exit 101 and

Exit 102, eastbound AM speeds decrease significantly towards 40 miles per hour as morning commuting congestion is encountered.

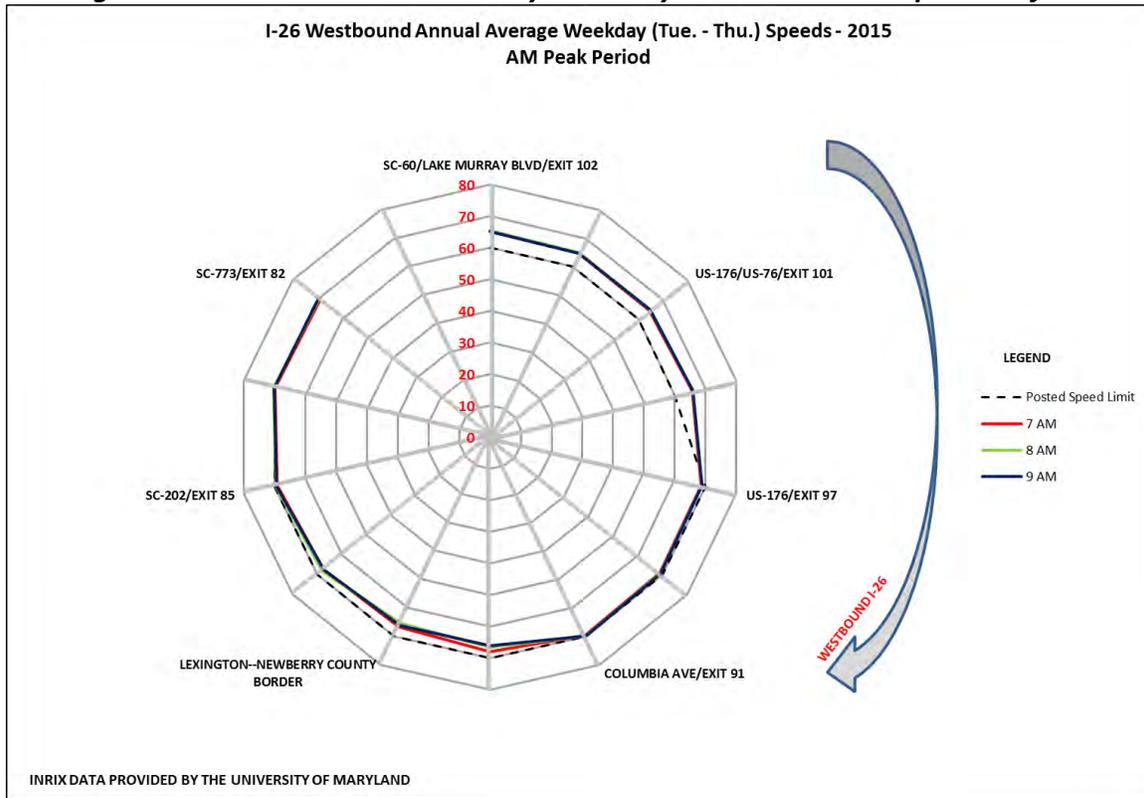
**Figure 70 - I-26 Eastbound Tuesday-Thursday PM Peak Period Speed Profiles**



The data plotted on the graph for the eastbound weekday PM Peak travel speeds indicate that travel speeds throughout the corridor are generally at or over the posted speed limit.

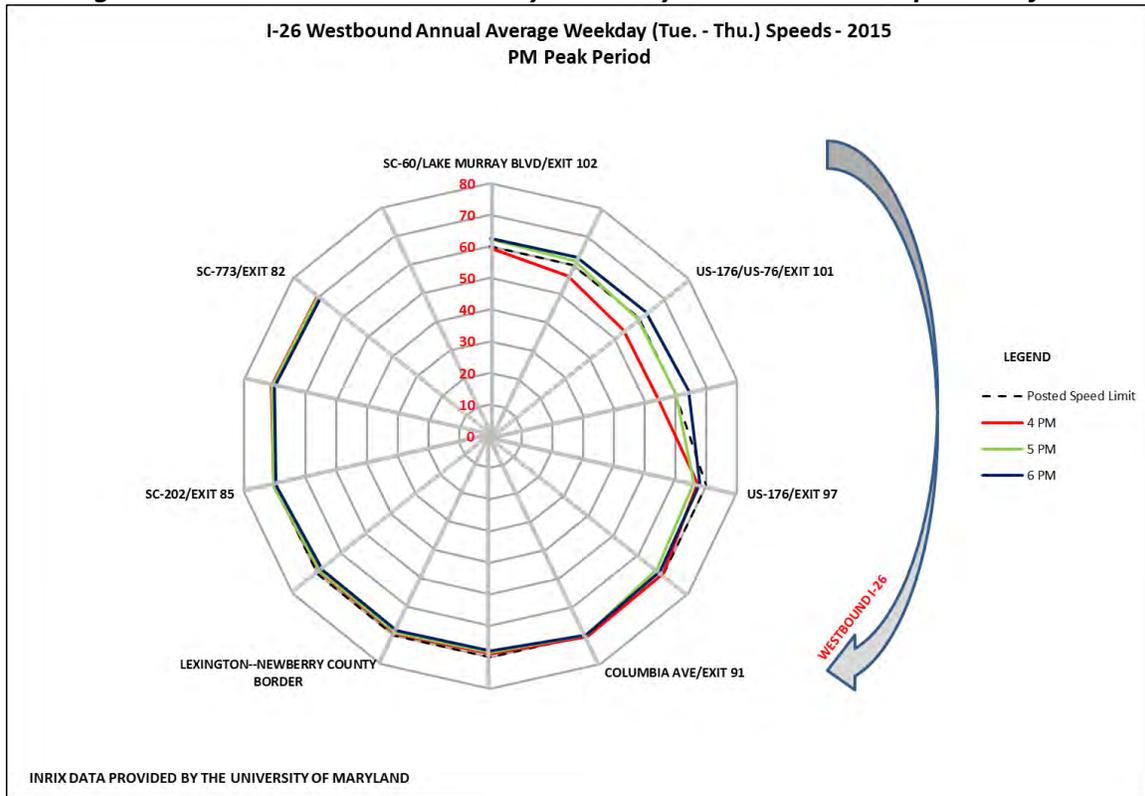
Similarly, the data plotted on the graph for the westbound weekday AM Peak travel speeds indicate that travel is generally at or above the posted speed limit between Exit 102 and Exit 91. Between Exit 91 and 85, travel is slightly below the posted speed limit. West of Exit 85, travel again at the posted speed limit.

**Figure 71 - I-26 Westbound Tuesday-Thursday AM Peak Period Speed Profiles**



The data plotted on the graphs indicate that westbound travel speeds throughout the corridor during the afternoon peak period are below the posted speed limit between 4:00 and 5:00 PM between Exit 102 and Exit 97. This is probably due to a combination of high commuting traffic, and the transition from the three lane to two lane westbound section west of Exit 101. Travel is at or near the posted speed limit during the rest of the afternoon period between Exit 102 and Exit 97. From Exit 97 to Exit 82, travel is generally at the speed limit during all three hours of the afternoon peak period.

**Figure 72 - I-26 Westbound Tuesday-Thursday PM Peak Period Speed Profiles**



### Capacity Analysis

A series of capacity analyses were performed based on the methodologies and guidelines contained in the Transportation Research Board's publication **HCM 2010 Highway Capacity Manual** (HCM). Various software analysis and simulation packages based on the HCM were used in performing the analyses. These included:

- a. McTrans' *HCS 2010* (Version 6.3)
  - o Freeway Segments
  - o Ramp Merge/Diverge Areas
  - o Weaving Segments
- b. Trafficware's *Synchro* (Version 9.1.910.24)
  - o Unsignalized Intersections
  - o Signalized Intersections
- c. Caliper's *TransModeler* (Version 4.0 Build 6020)
  - o Network Simulation
  - o Freeway Segments
  - o Ramp Merge/Diverge Areas

Level of Service Criteria

The analysis methodologies contained in the HCM for the various facility types and users describe the operational conditions in terms of a Level of Service (LOS). The HCM defines LOS as *“...a quality measure describing operations conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience. Six LOS are defined for each type of facility that has analysis procedures available. Letters designate each level, from A to F, with LOS A representing the best operating conditions and LOS F the worst. Each level of service represents a range of operating conditions and the driver’s perception of those conditions. Safety is not included in the measures that establish service levels.”*

The following discussions and tables describe the HCM LOS criteria for the freeway segments, ramp merge/diverge segments, weaving segments, unsignalized intersections and signalized intersections.

*Freeway Segments*

The HCM characterizes the capacity of a basic freeway segment *“...by three performance measures: density in passenger cars per mile per lane (pc/mi/ln), space mean speed in miles per hour (mi/h), and the ratio of demand flow rate to capacity (v/c). Each of these measures is an indication of how well traffic is being accommodated by the basic freeway segment.”* **Table 12** shows the HCM LOS criteria for basic freeway segments. LOS F occurs when either the segment density exceeds 45 pc/mi/ln or when the segment v/c ratio exceeds 1.0 (regardless of the segment density).

**Table 12 - Freeway Segment LOS Criteria**

Basic Freeway Segments	
LOS	Density (pc/mi/ln)
A	< 11
B	> 11-18
C	> 18-26
D	> 26-35
E	> 35-45
F	> 45 v/c > 1.0

*Weaving Segments*

Weaving segments occur where two or more streams of traffic traveling in the same direction are able to cross each other without traffic control devices. This typically occurs where a merge segment is followed by a diverge segment within a relative short distance (usually less than 2,800 feet). The LOS of a weaving segment is also related to the density of the segment. Regardless of the density, the weaving segment is considered to operate at LOS F when the v/c exceeds 1.0. **Table 13** shows the HCM LOS criteria for Freeway Weaving Segments.

**Table 13 - Weaving Segment LOS Criteria**

Freeway Weaving Segments	
LOS	Density (pc/mi/ln)
A	< 10
B	> 10-20
C	> 20-28
D	> 28-35
E	> 35
F	v/c > 1.0

*Ramp Merge and Diverge Areas*

Ramp-freeway junctions occur when merging maneuvers occur (on-ramps) or when diverging maneuvers occur (off-ramps). The operation of these merge and diverge areas are affected by a number of factors, including the operation of the adjacent freeway segment and the proximity and flow on adjacent ramps. Typically, the influence area of the ramps is 1,500 feet upstream of a diverge point and downstream from a merge point. As with freeway segments and weaving segments, the LOS of a merge or diverge area is related to the density of the segment. Regardless of the density, the merge or diverge areas are considered to operate at LOS F when the freeway demand exceeds the capacity of the upstream freeway segment (at diverge areas) or the downstream freeway segment (at merge areas), as well as when the ramp demand exceeds the ramp capacity. **Table 14** shows the HCM LOS criteria for Ramp Merge and Diverge areas.

**Table 14 - Merge/Diverge LOS Criteria**

Ramp Merge and Diverge Areas	
LOS	Density (pc/mi/ln)
A	< 10
B	> 10-20
C	> 20-28
D	> 28-35
E	> 35
F	v/c > 1.0

*Unsignalized Intersections*

The LOS for unsignalized intersections is based on the average control delay per vehicle. Since major street traffic is seldom controlled by stop signs (except at intersections with all-way stop control or in special circumstances), major street traffic generally will experience virtually no delay. Most of the delay will be encountered by traffic on approaches controlled by stop signs. Under certain conditions, delay will also be encountered by left turning traffic on the major street waiting for appropriate sized gaps in the opposing traffic flow to complete their turn. Therefore, the delay experienced by stop controlled movements and major street left turns, rather than the entire average intersection delay, are used to identify the critical LOS at these intersections. **Table 15** shows the HCM LOS criteria for unsignalized intersections.

**Table 15 - Unsignalized Intersection LOS Criteria**

Unsignalized Intersections	
LOS	Control Delay (sec/vehicle)
A	< 10
B	> 10-15
C	> 15-25
D	> 25-35
E	> 35-50
F	> 50

*Signalized Intersections*

The LOS for signalized intersections is based on the average control delay per vehicle. LOS can be identified for the entire intersection, individual intersection approaches, and each movement/lane-group. **Table 16** shows the HCM LOS criteria for signalized intersections.

**Table 16 - Signalized Intersection LOS Criteria**

Signalized Intersections	
LOS	Control Delay (sec/vehicle)
A	< 10
B	> 10-20
C	> 20-35
D	> 35-55
E	> 55-80
F	> 80

**a. HCS Analysis**

The analysis of basic freeway segments within the study area were performed for existing conditions, future (2040) no-build conditions and future (2040) build conditions. The following criteria were identified through discussions with SCDOT and used for various inputs within the freeway segment analysis:

- The 10<sup>th</sup> highest hour volumes based on the P-0112 ATR count station data for the eastbound AM design hour, and the P-0015 ATR count station data for the eastbound PM and westbound AM and PM design hours, balanced through the system, were used for the freeway segment mainline volumes.
- To develop future (2040) traffic volumes, a 1.5 percent annual growth rate was applied to existing volumes of the study area to the east of US 176 (Broad River Road), a growth rate of 2.0 percent was applied to existing volumes from US 176 (Broad River Road) to east of SC 202, and a growth rate of 2.5 percent was applied to existing volumes from SC 202 to the west.
- A peak hour factor of 0.90 was used for freeway segments and ramp areas.
- Mainline vehicle classification counts were completed in both directions east of Exit 101 and west of Exit 85. The highest observed peak hour truck percentages at the vehicle classification counts for all of the segments in each direction/peak hour were used. The highest observed truck percentages all ended up being the truck percentages observed west of Exit 85. The proportion of trucks and buses traveling on the freeway segments and ramp movements, based on SCDOT data, is:
  - Eastbound AM – 16%
  - Eastbound PM – 14%
  - Westbound AM – 23%
  - Westbound PM – 13%
- Based on the grades through the study area, the terrain was selected as “Rolling”, instead of “Level” or “Mountainous”.
- Free-flow speed was set at the posted speed limit along the segment.

**Basic Freeway Segment Analysis**

The existing condition and 2040 no-build condition analyses were performed using the existing number of freeway lanes present on the segments within the study area. The 2040 build condition analysis was performed assuming I-26 would provide three lanes in each direction from Exit 82 (or 85) to Exit 101 and four lanes in each direction from Exit 101 to Exit 102. In addition, analysis of four lanes between exits 97 and 101 and five lanes between exits 101 and 102 was performed due to inadequate LOS within these segments. The Basic Freeway Segment Analysis outputs are provided in **Appendix H** and a summary of results is shown in **Table 17**.

The three sets of freeway volumes were compared. The highest volumes throughout the system were obtained by using the P-0112 ATR design hour volumes as the control for the eastbound

morning design hour, and the P-0015 ATR design hour volumes as the control for the eastbound PM, and westbound AM and PM design hours. The network volumes were then fixed in each direction at the easternmost segment between Exits 101 and 102.

**Table 17 - Freeway Segment Capacity Analysis Results**

Basic Freeway Segment Analysis Results															
Direction	Segment	Existing # of lanes	Future # of lanes	AM Peak Hour						PM Peak Hour					
				2016 Existing		2040 No-Build		2040 Build		2016 Existing		2040 No-Build		2040 Build	
				LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density
WB	Exit 102-101 <sup>1</sup>	3	4	C	18.6	D	29.5	C <sup>2</sup>	22.0	E	40.2	F	2281.0	F <sup>2</sup>	58.3
WB	Exit 101-97	2	4	C	19.3	E	36.5	B <sup>2</sup>	15.5	F	46.5	F	n/a	D <sup>2</sup>	30.9
WB	Exit 97-91	2	3	B	15.6	D	26.4	B	16.7	C	24.6	F	59.4	D	26.9
WB	Exit 91-85	2	3	B	12.0	B	14.4	A	9.6	C	19.1	D	27.7	B	17.3
WB	Exit 85-82	2	3	B	12.5	B	15.3	A	10.2	C	18.8	D	26.9	B	16.9
WB	Exit 82-76	2	3	B	12.1	B	14.5	A	9.6	B	17.8	C	24.5	B	15.8
EB	Exit 76-82	2	3	B	12.0	C	20.2	B	13.4	C	18.9	D	26.7	B	16.8
EB	Exit 82-85	2	3	B	12.9	C	22.1	B	14.5	C	19.2	D	27.5	B	17.2
EB	Exit 85-91	2	3	B	14.7	D	26.2	B	16.6	C	18.9	D	26.8	B	16.9
EB	Exit 91-97	2	3	C	23.6	F	54.1	C	25.8	C	22.9	F	50.9	C	25.0
EB	Exit 97-101	2	4	F	51.4	F	n/a	D <sup>2</sup>	33.0	D	26.0	F	68.7	C <sup>2</sup>	20.1
EB	Exit 101-102	3	4	E	40.2	F	6738.0	F <sup>2</sup>	59.0	C	24.4	F	45.1	D <sup>2</sup>	28.9

<sup>1</sup> - Weaving section treated as freeway segment

<sup>2</sup> - Widened to four lanes

The analysis results for the freeway segments, summarized in **Table 17**, indicate the following:

### 2016 Existing Conditions

Using the design hour volumes for the morning and afternoon peak hours, the analysis results indicate that:

- During the morning peak hour, all freeway segments operate at LOS D or better except the segments from Exit 97 to Exit 101 and Exit 101 to Exit 102 in eastbound direction. The eastbound segment from Exit 97 to Exit 101 operates at LOS F and the segment from Exit 101 to Exit 102 operates at LOS E;
- During the afternoon peak hour, all freeway segments operate at LOS D or better except for the westbound segment from Exit 102 to Exit 101 and the segment from Exit 101 to Exit 97 that operate at LOS E and at LOS F respectively.

### 2040 No-Build Conditions

With traffic volumes projected to increase within the corridor at an annual rate of between 1.5 and 2.5 percent per year, and if I-26 is not widened, the increased traffic volumes traveling on the existing interstate capacity will result in increased density and reductions of freeway segment LOS.

- During the morning peak hour, all freeway segments operate at LOS D or better except the three eastbound segments from Exit 91 to Exit 102 that operate at LOS F and the westbound segment between Exit 101 and 97 that operates at LOS E;
- During the afternoon peak hour, the westbound segments from Exit 102 to Exit 91 operate at LOS F. The eastbound segments from Exit 91 to Exit 102 operate at LOS F. All other segments operate at LOS D or better.

### 2040 Build Conditions

The additional capacity provided by the construction of three lanes in each direction from west of Exit 85 to Exit 101 and four lanes in each direction from Exit 101 to Exit 102 will result in comparable LOS in the morning and afternoon peak hours compared to the Existing Conditions, and improved LOS over the 2040 No-Build condition.

Comparing LOS results of morning peak hour of existing and build condition, LOS decreased from LOS E to LOS F in eastbound direction from Exit 101 to Exit 102 and increased from LOS F to LOS D in the eastbound direction between Exit 97 and Exit 101. The LOS on the westbound segments between Exits 91 and 82 improved from LOS B to LOS A.

Comparing LOS results of afternoon peak hour of existing and build condition, LOS decreased from LOS E to LOS F in westbound direction from Exit 102 to Exit 101, and from LOS C to LOS D between Exit 97 and Exit 91. The eastbound segment LOS between Exit 101 and Exit 102

decreased from LOS C to LOS D. LOS on the westbound segment between Exits 101 to 97 improved from LOS F to LOS D, and from LOS C to LOS B on the segments between Exit 91 to Exit 82. On the eastbound segments, LOS improved from LOS D to LOS C between Exits 97 and 101, and from LOS C to LOS B on the segments between Exit 82 and Exit 91.

The 2040 Build analysis results indicate that:

- During the morning peak hour, all freeway segments operate at LOS D or better except the segment from Exit 101 to Exit 102 in the eastbound direction (LOS F) with four lanes in each direction between Exits 97 and 102;
- During the afternoon peak hour, all freeway segments operate at LOS D or better except the segment from Exit 102 to Exit 101 in the westbound direction (LOS F) with four lanes in each direction between Exits 97 and 102.

### Ramp Merge Analysis

The Ramp Merge Analyses outputs are provided in **Appendix I** and the summary results are shown in **Table 18**.

The analysis results for the ramp merge areas, summarized in **Table 18**, indicate the following:

#### 2016 Existing Conditions

Using the design hour volumes for the morning and afternoon peak hours, the analysis results indicate that:

- During the morning peak hour, all merge areas operate at LOS D or better;
- During the afternoon peak hour, all eastbound and westbound on-ramps operate at LOS C or better.

#### 2040 No-Build Conditions

With traffic volumes projected to increase within the corridor at an annual rate of between 1.5 and 2.5 percent per year, and if I-26 is not widened, the increased traffic volumes traveling on the existing interstate capacity will result in increased density and will reduce of merge area LOS.

- During the morning peak hour,
  - the merge areas for the eastbound on-ramp at Exit 91 and the eastbound loop on-ramp at Exit 97 operate at LOS F;
  - the remaining eastbound and westbound on-ramps operate at LOS D or better.
- During the afternoon peak hour,
  - the merge areas for the eastbound loop on-ramp at Exit 97 and on-ramp at Exit 91, and the westbound loop on-ramp at Exit 97 and the on-ramp at Exit 101 operate at LOS F;
  - the remaining eastbound and westbound on-ramps operate at LOS D or better.

**Table 18 - Ramp Merge Capacity Analysis Results**

Freeway Merge Analysis Results													
Direction	Merge Location	AM Peak Hour						PM Peak Hour					
		2016 Existing		2040 No-Build		2040 Build		2016 Existing		2040 No-Build		2040 Build	
		LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density
WB	Exit 101	B	11.3	B	19.2	B	12.6	C	22.1	F	37.8	C	24.4
WB	Exit 97 Loop	B	13.1	C	23.2	B	14.3	C	22.0	F	40.3	C	24.4
WB	Exit 91	B	10.8	B	13.2	A	7.9	B	18.9	C	26.8	B	16.8
WB	Exit 85	B	15.6	B	18.7	B	12.5	C	22.5	D	29.8	B	19.1
EB	Exit 82	B	10.6	B	18.5	B	11.1	B	17.9	D	30.7	B	18.6
EB	Exit 85 Loop	B	17.9	D	28.8	B	19.5	C	23.0	D	30.1	B	19.1
EB	Exit 91	B	19.8	F	34.3	C	24.9	C	20.5	F	35.3	C	25.7
EB	Exit 97 Loop	D	32.5	F	54.6	F <sup>1</sup>	40.2	C	21.7	F	37.3	C	25.3

<sup>1</sup> - Requires four lanes on mainline to achieve acceptable LOS (D, 31.9)

### 2040 Build Conditions

The additional capacity provided by the construction of a third lane in each direction along I-26 will lower densities in the ramp diverge areas, resulting in substantial improvement in LOS compared to the 2040 no-build condition, especially in during the afternoon peak hour. The 2040 Build analysis results indicate that:

- During the morning peak hour, on-ramp merge areas operate at LOS C or better with the exception of the merge area from the eastbound loop on-ramp from Exit 97. If mainline widening is limited to three lanes in the eastbound direction between Exits 97 and 101, the merge area will operate at LOS F. With the construction of a fourth mainline lane between Exits 97 and 101, the merge area is expected to operate at LOS D.
- During the afternoon peak hour, all ramp merge areas are expected to operate at LOS B or C.

### Ramp Diverge Analysis

The Ramp Diverge Analyses are also provided in **Appendix I** and the summary results are shown in **Table 19**.

The analysis results for the ramp diverge areas, summarized in **Table 19**, indicate the following:

### 2016 Existing Conditions

Using the design hour volumes for the morning and afternoon peak hours, the analysis results indicate that:

- During the morning peak hour, all ramp diverge areas operate at LOS D or better.
- During the afternoon peak hour,
  - the diverge area for the westbound off-ramp at Exit 97 operates at LOS F;
  - the remaining eastbound and westbound off-ramps operate at LOS C or better.

### 2040 No-Build Conditions

With traffic volumes projected to increase within the corridor at an annual rate of between 1.5 and 2.5 percent per year, and if I-26 is not widened, the increased traffic volumes traveling on the existing interstate capacity will result in increased density and will reduce the diverge area LOS at the off-ramps.

- The eastbound off-ramp at Exits 97, eastbound off-ramp at Exit 101, and eastbound loop off-ramp at Exit 101 will operate at LOS F;
- The remaining off-ramps are expected to operate at LOS D or better.
- During the afternoon peak hour:
  - The eastbound off-ramp at Exit 97, westbound loop off-ramp at Exit 101, westbound off-ramp at Exit 97, and westbound off-ramp at Exit 91 will operate at LOS F;

- The remaining off-ramps are expected to operate at LOS D or better.

### 2040 Build Conditions

The additional capacity provided by the construction of a third lane in each direction along I-26 will lower densities in the ramp diverge areas, resulting in substantial improvement in LOS compared to the 2040 No-Build condition, with LOS comparable to those experienced under existing conditions. The 2040 Build analysis results indicate that:

- During the morning peak hour, all of the off-ramp diverge areas operate at LOS B or C, with the exception of the off-ramp and loop off-ramp at Exit 101, which is projected to operate at LOS D.
- During the afternoon peak hour, all of the diverge areas are expected to operate at LOS B or C, with the exception of the westbound off-ramp to Exit 97 and the westbound loop off-ramp to Exit 101. With only the mainline widening, these diverge areas are projected to operate at LOS F and LOS E respectively. In addition to the mainline widening to provide four lanes at each diverge area, the volume of off-ramp traffic forecast at these two interchanges would likely require the construction of a two lane off-ramp in the diverge area. With a two-lane off-ramp, the diverge areas at Exit 97 and the Exit 101 loop off-ramps are projected to operate at LOS B.

**Table 19 - Ramp Diverge Capacity Analysis Results**

Freeway Diverge Analysis Results													
Direction	Diverge Location	AM Peak Hour						PM Peak Hour					
		2016 Existing		2040 No-Build		2040 Build		2016 Existing		2040 No-Build		2040 Build	
		LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density
WB	Exit 101 Loop	B	13.3	C	22.1	B	15.8	C	27.3	F	50.4	E <sup>2</sup>	37.2
WB	Exit 97	B	16.5	D	30.6	B	19.9	F	35.2	F	60.7	F <sup>3</sup>	35.8
WB	Exit 91	B	12.7	C	24.1	B	18.3	C	22.4	F	39.8	C	26.5
WB	Exit 85	B	14.9	B	17.8	B	13.0	C	23.5	D	31.8	C	21.8
WB	Exit 82 Loop	B	11.7	B	15.1	B	10.4	B	19.2	C	27.3	B	17.9
EB	Exit 85	B	16.2	C	26.8	B	18.7	B	23.7	D	31.7	C	21.7
EB	Exit 91	B	13.0	C	23.7	B	15.0	B	18.0	D	31.9	B	19.7
EB	Exit 97	C	23.2	F	40.0	C	24.4	C	22.5	F	39.0	C	26.6
EB	Exit 101	D	30.4	F	49.1	D	34.8	C	22.5	D	32.2	C	24.0
EB	Exit 101 Loop	C	23.3	F	40.7	D	28.2	B	15.5	C	25.1	B	16.7

<sup>2</sup> - Two lane off-ramp, four lane freeway segment required to achieve acceptable LOS (B, 13.4)

<sup>3</sup> - Two lane off-ramp, four lane freeway segment required to achieve acceptable LOS (B, 12.6)

Weave Analysis

The analyses of weaving sections are also provided in **Appendix J**. A summary of the results are shown in **Table 20**.

**Table 20 - Weave Capacity Analysis Results**

Freeway Weaving Analysis Results													
Direction	Segment	AM Peak Hour						PM Peak Hour					
		2016 Existing		2040 No-Build		2040 Build		2016 Existing		2040 No-Build		2040 Build	
		LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density
WB	Exit 102-101	B	15.8	C	27.0	C	21.1	E	36.9	F	n/a	F	n/a
EB	Exit 101-102	E	41.6	F	n/a	F	-	C	22.3	E	40.1	D	31.1

The analysis results for the weaving areas, summarized in **Table 20**, indicate the following:

2016 Existing Conditions

Using the design hour volumes for the morning and afternoon peak hours, the analysis results indicate that:

- During the morning peak hour,
  - the weave area for the westbound between Exit 102 and Exit 101 operates at LOS B;
  - the weave area for the eastbound between Exit 101 and Exit 102 operates at LOS E.
- During the afternoon peak hour,
  - the weave area for the westbound between Exit 102 and Exit 101 operates at LOS E;
  - the weave area for the eastbound between Exit 101 and Exit 102 operates at LOS C.

2040 No-Build Conditions

With traffic volumes projected to increase within the corridor at an annual rate of between 1.5 and 2.5 percent per year, and if I-26 is not widened, the increased traffic volumes traveling on the existing interstate capacity will result in increased density and will reduce the LOS at the weave areas.

- During the morning peak hour,
  - the weave area for the westbound between Exit 102 and Exit 101 operates at LOS C;
  - the weave area for the eastbound between Exit 101 and Exit 102 operates at LOS F.
- During the afternoon peak hour,
  - the weave area for the westbound between Exit 102 and Exit 101 operates at LOS F;
  - the weave area for the eastbound between Exit 101 and Exit 102 operates at LOS E.

## 2040 Build Conditions

With the projected volumes and possible widening of the mainline lanes in these weaving sections, the westbound weaving section and the eastbound weaving section are expected to operate at LOS C and LOS D in the morning and afternoon peak hours respectively. The eastbound weaving section and the westbound weaving section are expected to operate at LOS F under the build condition during the morning and afternoon peak hours respectively. Between 2040 No-Build Conditions and 2040 Build Conditions the LOS for weaving sections remains the same (LOS F). Since these weaving sections are on the eastern fringe of study area, it is likely improvements to these weaving sections will have to be addressed as part of SCDOT's Carolina Crossroads project.

### **b. Intersection Analysis**

Capacity analyses for the signalized and unsignalized intersections at the interchanges within the study area were performed. Analyses were performed for existing conditions (existing traffic, intersection traffic control and geometry), 2040 No-Build conditions (2040 traffic, and existing intersection traffic control and geometry), and 2040 Build conditions (2040 traffic and modified intersection traffic control and geometry)

For unsignalized intersections, the intersection operation is represented by the worst approach delay and LOS of all the stop sign controlled approaches to the intersection. For signalized intersections, the intersection operation is represented by the intersection delay and LOS.

At some intersections, there are atypical intersection geometry and/or traffic control which are not compatible with HCM methodologies and procedures. No LOS or delay can be estimated at these atypical intersections.

For the intersections located where no modifications are anticipated at the existing interchanges (Exits 82, 101, and 102), the 2040 No-Build and 2040 Build condition analysis results will be identical since no changes in intersection capacity will be made.

Where the existing interchanges are proposed to be modified as part of the widening project (Exit 85, 91, and 97), the capacity analysis results for the 2040 Build condition alternatives can be found within the section for each of those individual interchanges.

#### Existing Conditions and 2040 No-Build Intersection Analysis

The results of the unsignalized and signalized intersection capacity analyses for existing conditions and the 2040 No-Build conditions are shown in **Table 21**. Specific details concerning the results of the intersection capacity analyses can be found in the discussion for each of the

individual interchanges. The HCM intersection capacity outputs for each intersection are provided in **Appendix K**.

In general, with the forecast increases in traffic and without improvements to the intersections, delay in the 2040 No-Build analyses can be expected to be higher than delay during the Existing Conditions analyses. In some cases, the increases in delay may still result in acceptable LOS being obtained. In other cases, the increases in delay may result in LOS E or LOS F conditions. When these results occur, it may be necessary to provide additional capacity (such as constructing separating left and/or right turn lanes) and/or changes in the traffic control (such as installing traffic signals) to reduce delay and improve the LOS.

Table 21 - Intersection Capacity Analysis Results

Intersection #	Intersection Name	2016 Existing Conditions				2040 No Build Conditions			
		AM Peak		PM Peak		AM Peak		PM Peak	
		LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)
<b>Exit 82</b>									
8201	St. Paul Road (SC 773) at Koom Trestle Road <sup>1</sup>	B	11.9	B	10.3	C	18.0	B	12.6
8211	St. Paul Road (SC 773) at Wilco Hess Drive <sup>1</sup>	B	12.6	B	10.9	C	20.7	B	14.6
8202	St. Paul Road (SC 773) at I-26 WB Ramps <sup>1</sup>	C	19.1	B	12.8	F	392.6	E	44.4
8203	St. Paul Road (SC 773) at I-26 EB Ramps <sup>1</sup>	C	16.3	C	15.7	F	136.0	F	95.3
8204	St. Paul Road (SC 773) at Kibler Bridge Road <sup>1</sup>	B	11.8	A	9.8	C	19.6	B	11.7
<b>Exit 85</b>									
8501	SC 202 at Four Oaks Road <sup>1</sup>	A	9.8	A	9.8	B	11.2	B	11.4
8502	SC 202 at Meadow Brook Road <sup>1</sup>	A	9.1	A	9.7	A	9.8	B	11.0
8503	SC 202 at I-26 WB Off-Ramp EBL Slip Ramp / I-26 WBR Slip Ramp <sup>1</sup>	B	10.5	A	9.6	B	12.6	B	10.8
8513	SC 202 at I-26 WB On-Ramp <sup>1</sup>	A	3.9	A	1.6	A	4.4	A	1.8
8523	SC 202 at I-26 WB Off-Ramp EBR Slip Ramp / I-26 WB Loop Ramp <sup>1</sup>	A	9.1	A	9.0	A	9.8	A	9.7
8504	SC 202 at I-26 WB On-Ramp NBL Slip Ramp / I-26 NBR Slip Ramp <sup>1</sup>	A	5.5	A	1.8	A	6.6	A	2.0
8514	SC 202 at I-26 WB Off-Ramp <sup>1</sup>	B	10.7	A	9.8	B	14.7	B	11.8
8524	SC 202 at I-26 WB On-Ramp SBR Slip Ramp / I-26 EB Loop Ramp <sup>1</sup>	A	0.0	A	0.0	A	0.0	A	0.0
<b>Exit 91</b>									
9101	Columbia Avenue (S-32-48) at Comalander Drive <sup>1</sup>	A	1.1	A	9.9	C	15.3	B	11.5
9102	Columbia Avenue (S-32-48) at I-26 WB Ramps <sup>3</sup>	B	11.7	B	19.1	F	247.4	F	900.0
9103	Columbia Avenue (S-32-48) at I-26 EB Ramps <sup>1,3</sup>	D	28.4	E	42.7	F	900.0	F	900.0
9104	Columbia Avenue (S-32-48) at Ellett Road <sup>1</sup>	F	64.5	E	40.1	err <sup>2</sup>	err <sup>2</sup>	F	1,043.9
9105	Crooked Creek Road at I-26 EB On-Ramps <sup>1</sup>	C	24.6	B	13.4	F	285.3	C	21.6
<b>Exit 97</b>									
9701	Broad River Road (US 176) at Food Lion North Access <sup>1</sup>	E	45.8	F	260.3	F	859.1	err <sup>2</sup>	err <sup>2</sup>
9702	Broad River Road (US 176) at Food Lion South Access	incompatible with HCM 2000 due to free movements							
9712	Broad River Road (US 176) at I-26 WBR Slip Ramp <sup>1</sup>	B	14.2	F	55.5	F	60.9	F	531.7
9703	Broad River Road (US 176) at I-26 WBT / WBL Ramps	F	93.1	D	51.8	F	320.5	F	211.7
9704	Broad River Road (US 176) at I-26 EB Ramps	incompatible with HCM 2000 due to five-legged intersection							
9705	Broad River Road (US 176) at Broad Stone Road	F	214.1	F	198.2	F	8,373.8	F	4,604.9
9706	I-26 WB Ramps at Julius Richardson Road <sup>1</sup>	F	83.0	F	84.6	F	789.9	err <sup>2</sup>	err <sup>2</sup>
9707	I-26 EB Ramps at Rauch-Metz Road <sup>1</sup>	err <sup>2</sup>	err <sup>2</sup>	F	222.6	err <sup>2</sup>	err <sup>2</sup>	err <sup>2</sup>	err <sup>2</sup>
9708	Rauch-Metz Road at Broad Stone Road <sup>1</sup>	B	12.7	B	14.8	C	18.2	D	27.8
9709	Broad River Road (US 176) at Shady Grove Road <sup>1</sup>	E	41.3	F	56.0	B	10.5	B	12.6
<b>Exit 101</b>									
1011	Broad River Road (US 176) at Western Lane	B	16.9	D	39.4	E	56.9	F	145.8
1012	Broad River Road (US 176) at I-26 WB On-Ramp <sup>1</sup>	B	10.6	B	10.7	B	14.1	B	14.9
1013	Broad River Road (US 176) at I-26 EB On-Ramp	A	7.7	A	1.7	E	75.7	A	3.1
1014	Broad River Road (US 176) at Lordship Lane	F	129.8	C	31.6	F	289.9	F	122.9
1015	Broad River Road (US 176) at Royal Tower Drive / Driveway Access <sup>1</sup>	F	901.2	F	577.0	F	1,778.3	F	74.1
<b>Exit 102</b>									
1021	Lake Murray Boulevard (SC 60) at Parkridge Drive / Kinley Road	C	21.7	F	116.4	D	35.8	F	249.4
1022	Lake Murray Boulevard (SC 60) at I-26 WB On-Ramp <sup>1</sup>	B	11.1	B	14.0	C	17.2	C	15.6
1023	Lake Murray Boulevard (SC 60) at I-26 EB On-Ramp <sup>1</sup>	B	11.4	B	12.4	D	28.6	E	44.0
1024	Lake Murray Boulevard (SC 60) at Columbiana Drive	F	206.2	F	275.6	F	438.8	F	566.1

<sup>1</sup> Intersection unsignalized under all scenarios; worst approach LOS and delay reported.  
<sup>2</sup> Queue unable to be processed per HCM 2000 methodology; error reported.  
<sup>3</sup> Values from *Interchange Modification Report: I-26 at S-48 (Columbia Avenue) Interchange Improvements*.

## Exit 82 – SC 773

The analysis results for the existing and 2040 No-Build conditions at Exit 82 for the SC 773 interchange intersections are summarized on **Table 21** and illustrated in **Figure 73**.

### Existing Conditions

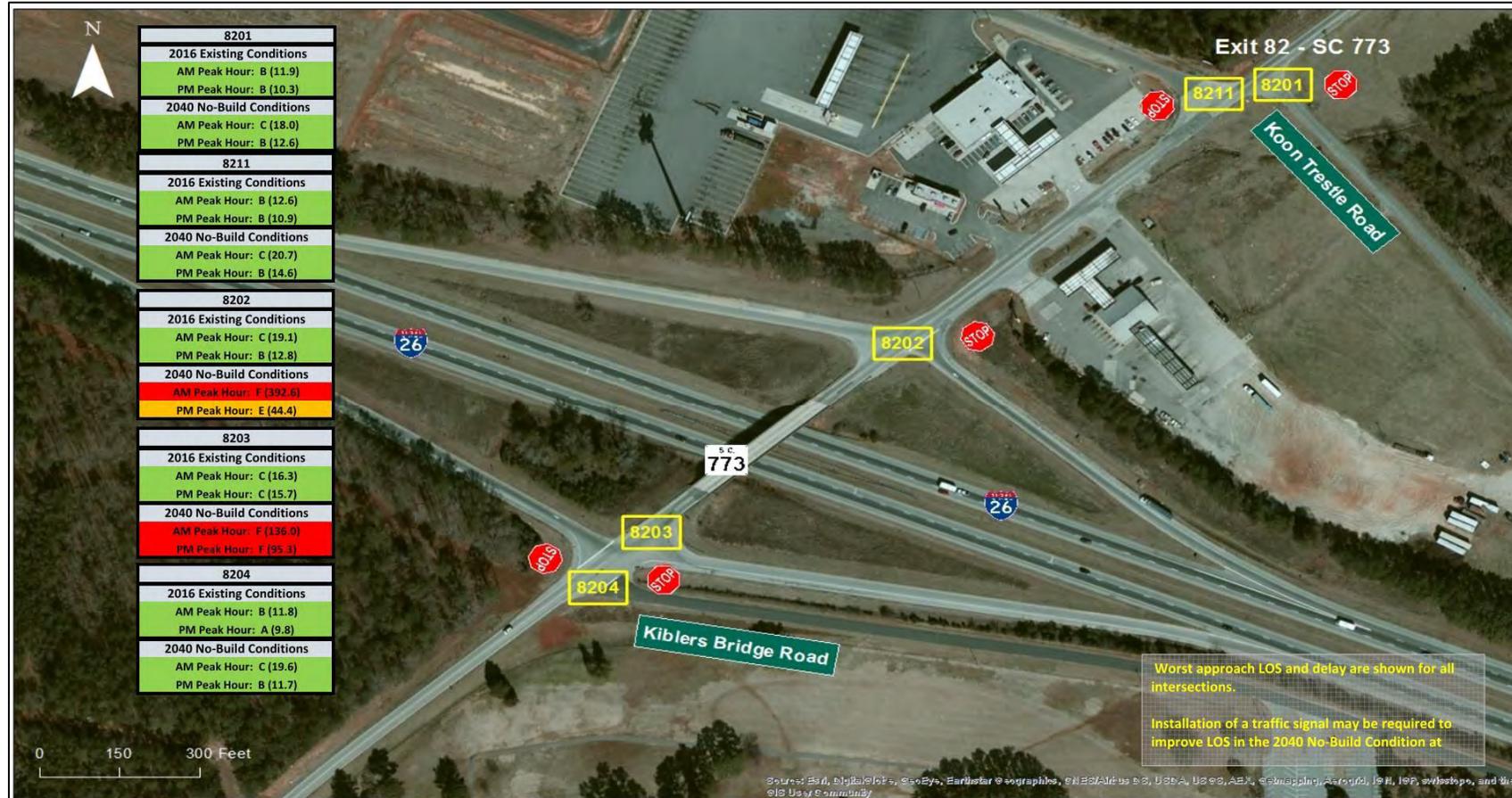
Under the existing conditions at Exit 82, the yield and/or the stop sign controlled approaches at the unsignalized intersections operate at LOS B or better during both the morning and afternoon peak hours due to low volumes. *No improvements are necessary to provide acceptable LOS under existing conditions.*

### 2040 No-Build Conditions

With the forecast increases in traffic and without improvements to the intersections, delay increases on the stop sign controlled approaches. All intersections operate at LOS D or better except the intersection of St. Paul Road (SC 773) with the I-26 westbound and eastbound ramps. The westbound approach of the westbound off-ramps is anticipated to operate at LOS F during the morning peak hour and LOS E during the afternoon peak hour under No-Build conditions. The eastbound approach of the eastbound off-ramp is anticipated to operate at LOS F during both peak hours. The poor operation is attributed to the delay encountered by the shared left-thought-right turn lane at SC-773.

*The operation of the intersection of SC-733 at the eastbound and westbound ramps may require capacity or traffic control improvements, such as the installation of a traffic signal, to provide acceptable LOS during the 2040 No-Build operating conditions.*

Figure 73 - Exit 82 Intersection LOS Summary



## Exit 85 – SC 202

The analysis results for the existing and 2040 No-Build conditions at Exit 85 for the SC-202 interchange intersections are summarized on **Table 21** and illustrated in **Figure 74**.

### Existing Conditions

The stop sign controlled approach intersections along SC 202 at Exit 85 operate at LOS A or B for the morning and afternoon peak hours. *No improvements are necessary to provide acceptable LOS under existing conditions.*

### 2040 No-Build Conditions

With the forecast increases in traffic and without improvements to the intersections, delay increases slightly on the stop sign controlled approaches. However, the approaches are expected to continue to operate at LOS B or better during the morning and afternoon peak hours.

*No improvements should be necessary to provide acceptable LOS during the 2040 No-Build operating conditions at these intersections.*

Figure 74 - Exit 85 Intersection LOS Summary



### Exit 91 – Columbia Avenue (S-32-48)

The Columbia Avenue (S-32-48) interchange is proposed to be modified as outlined in the *Interchange Modification Report: I-26 at S-48 (Columbia Avenue) Interchange Improvements* prepared for SCDOT and Lexington County. The analysis in that report was completed for existing (2014) and 2040 No Build conditions. The analysis results for the existing and 2040 No-Build conditions at Exit 91 for the Columbia Avenue (S-32-48) interchange intersections are summarized on **Table 21** and illustrated in **Figure 75**. The ramp termini LOS results are from the Exit 91 IMR Existing and 2040 analysis.

#### Existing Conditions

The unsignalized intersection of Columbia Avenue at the I-26 eastbound ramps at Exit 91 operate at LOS D for the morning peak hour and E for the afternoon peak hour. The signalized intersection of Columbia Avenue at the I-26 westbound ramps at Exit 91 operate at LOS B for both the morning peak and afternoon peak hours. The intersections adjacent to the interchange operate at LOS C or better during both peak hours. *Improvements to the intersections of Columbia Avenue at the I-26 eastbound ramps, such as the installation of a traffic signal and turn lanes added along Columbia Avenue, are necessary to provide acceptable LOS under existing conditions.*

#### 2040 No-Build Conditions

With the forecast increases in traffic and without improvements to the ramp intersections, delay increases at both the intersections. Both the I-26 eastbound and westbound ramp intersections are expected to operate at LOS F in the morning and afternoon peak hours.

*The operation of the intersection of Columbia Avenue at the eastbound ramps may require capacity or traffic control improvements, such as the installation of a traffic signal and turn lanes added along Columbia Avenue, to provide acceptable LOS during the 2040 No-Build operating conditions. The operation of the intersection of Columbia Avenue at the I-26 westbound ramps may require capacity improvements, such as an additional left turn lane for the I-26 westbound off-ramp approach and signal timing modifications to provide acceptable LOS during the 2040 No-Build operating conditions.*

Figure 75 - Exit 91 Intersection LOS Summary



## Exit 97 – Broad River Road (US 176)

The analysis results for the existing and 2040 No-Build conditions at Exit 97 for the Broad River Road (US 176) interchange intersections are summarized on **Table 21** and illustrated in **Figure 76**.

### Existing Conditions

Under the existing conditions at Exit 97, the atypical intersection configuration and heavy volumes lead to several intersections operating at LOS E or F in both the morning and afternoon peak hours including Broad River Road at Food Lion North Access, Broad River Road at Broad Stone Road, I-26 westbound ramps at Julius Richardson Road, and I-26 eastbound ramps at Rauch-Metz Road.

*For the intersections identified above, several improvements may be necessary to provide acceptable LOS under existing conditions such as:*

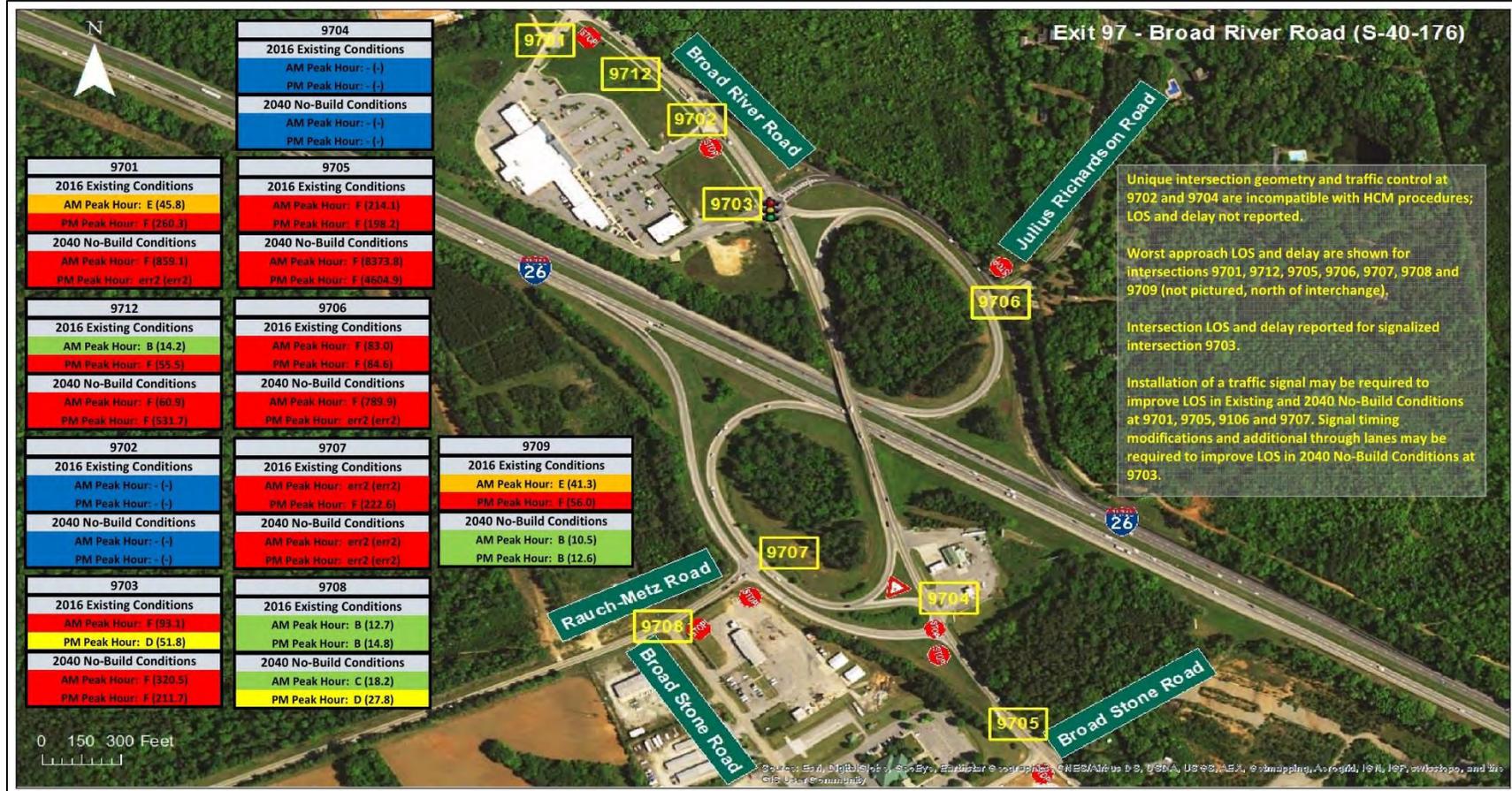
- *Install new traffic signals on Broad River Road at Food Lion North Access and at Broad Stone Road*
- *Provide a left turn lane for the northbound approach onto Rauch-Metz Road.*

### 2040 No-Build Conditions

With the forecast increases in traffic and without improvements to the intersections, delay can be expected to increase on the intersection approaches. Additional intersections are expected to operate at LOS E or F in the morning and afternoon peak hours, in addition to those described in existing conditions, including Broad River Road at the I-26 westbound off-ramp right turn slip ramp, and Broad River Road at I-26 westbound off-ramp intersection opposite the shopping center driveway.

*The operation of the intersections on Broad River Road at the I-26 westbound ramps may require capacity or traffic control improvements, such as an additional through lane on Broad River Road in both directions, to provide acceptable LOS during the 2040 No-Build operating conditions.*

Figure 76 - Exit 97 Intersection LOS Summary



### Exit 101 – Broad River Road (US 76, US 176)

The analysis results for the existing and 2040 No-Build conditions at Exit 101 for the Broad River Road (US 76, US 176) interchange intersections are summarized on **Table 21** and illustrated in **Figure 77**.

#### Existing Conditions

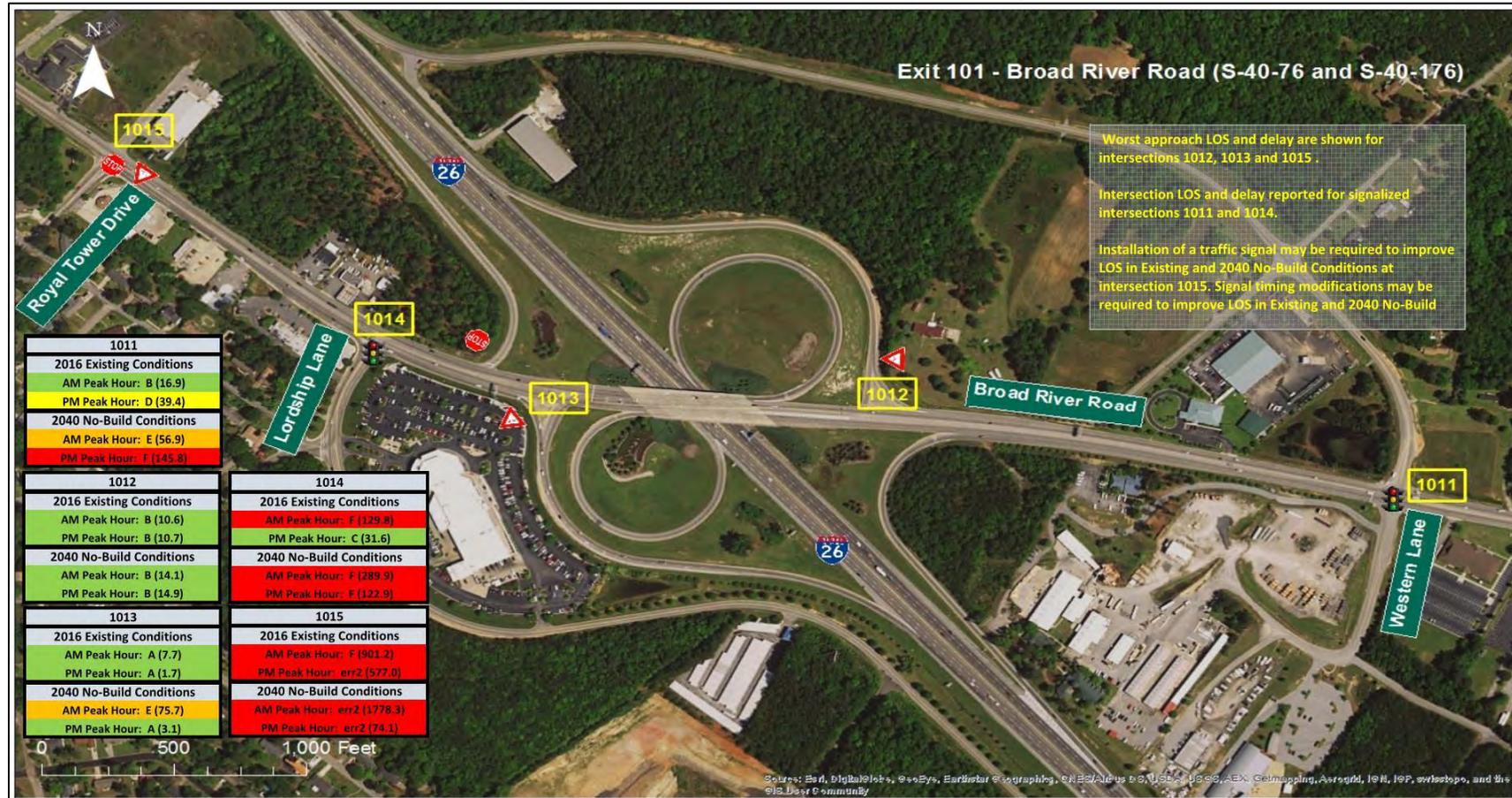
Under the existing conditions at Exit 101, the intersections of Broad River Road operate at LOS D or better during both the morning and afternoon peak hours, except for the intersection of Broad River Road at Royal Tower Drive during the both peak hours and the intersection of Broad River Road at Lordship Lane during the AM peak hour. The intersection of Broad River Road at Royal Tower Drive currently operates at LOS F during the morning and afternoon peak hours due to delay at the stop sign controlled approach of Royal Tower Drive. *Improvements to this particular intersection, such as an installation of a traffic signal, may be necessary to provide acceptable LOS under existing conditions. Signal timing modifications may be necessary to provide acceptable LOS under existing conditions at the intersection of Broad River Road at Lordship Lane.*

#### 2040 No-Build Conditions

With the forecast increases in traffic and without improvements to the intersections, delay increases mainly on the signalized intersections. The signalized intersections of Broad River Road at Lordship Lane and at Western Lane operate at LOS E or LOS F during both peak hours. Similar to existing conditions, the Royal Tower Drive approach continues to operate at LOS F in both peak hours as the northbound approach cannot process the increased traffic. The yield/stop-controlled eastbound and westbound ramps are anticipated to operate at LOS B or better during the afternoon peak hour under No-Build conditions, except for the eastbound ramp intersection, which is expected to operate at LOS E in the morning peak hour. The poor operation at the signalized intersections is attributed to the delay encountered by all movements.

*The operation of the Broad River Road intersections may require capacity or traffic control improvements, such traffic signal timing changes to provide acceptable LOS during the 2040 No-Build operating conditions.*

Figure 77 - Exit 101 Intersection LOS Summary



## Exit 102 – Lake Murray Boulevard (SC 60)

The analysis results for the existing and 2040 No-Build conditions at Exit 102 for the Lake Murray Boulevard (SC 60) interchange intersections are summarized on **Table 21** and illustrated in **Figure 78**.

### Existing Conditions

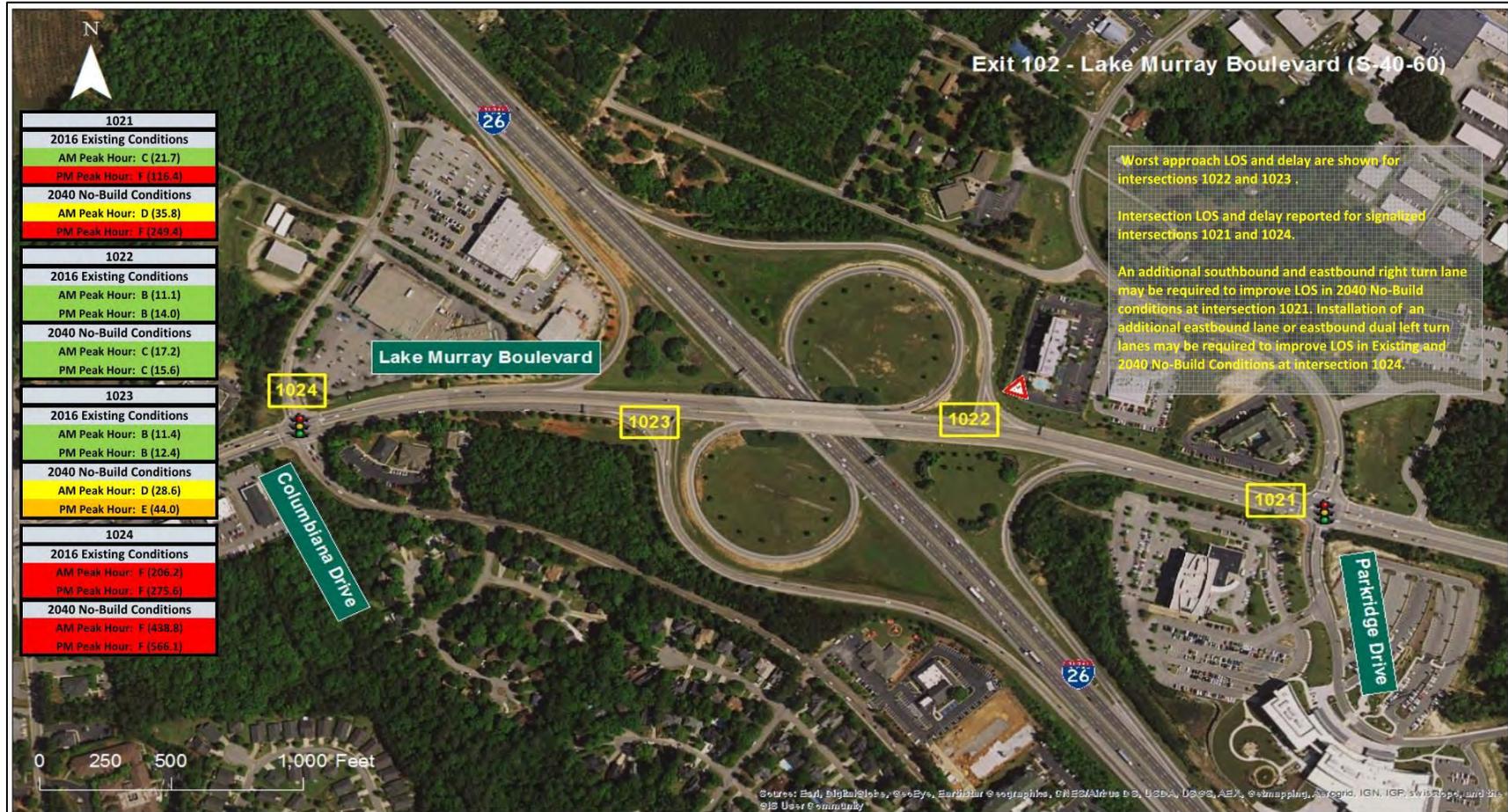
Under the existing conditions at Exit 102, the yield-controlled intersections of Lake Murray Boulevard at both eastbound and westbound I-26 ramps operate at LOS A during both the morning and afternoon peak hours. The signalized intersection of Lake Murray Boulevard at Parkridge Drive/Kinley Road operates at LOS C during the morning peak hour and LOS F during the afternoon peak hour. The intersection of Lake Murray Boulevard at Columbiana Drive currently operates at LOS F during both peak hours. *Improvements to the intersection of Lake Murray Boulevard at Columbiana Drive, such as providing southbound and eastbound right turn lanes, may be necessary to provide acceptable LOS under existing conditions.*

### 2040 No-Build Conditions

With the forecast increases in traffic and without improvements to the intersections, delay increases at the signalized intersections. The signalized intersection of Lake Murray Boulevard at Parkridge Drive/Kinley Road operates at LOS D during the morning peak hour and LOS F during the afternoon peak hour. The signalized intersection of Lake Murray Boulevard at Columbiana Drive operates at LOS F during both peak hours. The yield-controlled eastbound ramp intersection is expected to operate at LOS D and LOS E during the morning and afternoon peak hours respectively. The yield controlled westbound ramp intersection is anticipated to operate at LOS LOS C during both peak hours.

*The operation of the Lake Murray Boulevard intersections may require capacity or traffic control improvements, such as providing an additional eastbound lane approaching the I-26 interchange, and installing eastbound dual left turn lanes at the intersection of Lake Murray Boulevard at Kinley Road to provide acceptable LOS during the 2040 No-Build operating conditions.*

Figure 78 - Exit 102 Intersection LOS Summary



## 2040 Build Intersection Analysis

The results of the unsignalized and signalized intersection capacity analyses for the 2040 Build conditions for Exit 85 and for Exit 97 are shown in **Table 22** and **Table 23**. **Table 24** to **Table 29** summarize the storage length and queuing for 2040 Build conditions for Exit 85 and Exit 97. Specific details concerning the results of the intersection capacity analyses can be found in the discussion for each of the individual interchanges which are proposed to be modified as part of the widening project (Exit 85 and 97). The queuing intersection outputs for each intersection are provided in **Appendix L**.

**Table 22 - Intersection Capacity Analysis Results - 2040 No Build vs 2040 Build Exit 85**

Intersection #	Intersection Name	2040 No Build Conditions				2040 Build Conditions			
		AM Peak		PM Peak		AM Peak		PM Peak	
		LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)
<b>Alternative 1: Diamond</b>									
8501	SC 202 at Four Oaks Road <sup>1</sup>	B	11.2	B	11.4	B	11.4	B	11.8
8502	SC 202 at Meadow Brook Road <sup>1</sup>	A	9.8	B	11.0	intersection removed; shifted to 8501			
8503	SC 202 at I-26 WB Off-Ramp EBL Slip Ramp / I-26 WBR Slip Ramp <sup>1,2</sup>	B	12.6	B	10.8	B	12.8	B	11.5
8513	SC 202 at I-26 WB On-Ramp <sup>1</sup>	A	4.4	A	1.8	intersections removed; shifted to 8503			
8523	SC 202 at I-26 WB Off-Ramp EBR Slip Ramp / I-26 WB Loop Ramp <sup>1,2</sup>	A	9.8	A	9.7	intersections removed; shifted to 8503			
8504	SC 202 at I-26 WB On-Ramp NBL Slip Ramp / I-26 NBR Slip Ramp <sup>1,2</sup>	A	6.6	A	2.0	B	12.1	B	11.1
8514	SC 202 at I-26 WB Off-Ramp <sup>1</sup>	B	14.7	B	11.8	intersections removed; shifted to 8504			
8524	SC 202 at I-26 WB On-Ramp SBR Slip Ramp / I-26 EB Loop Ramp <sup>1,2</sup>	A	0.0	A	0.0	intersections removed; shifted to 8504			
<b>Alternative 1A: Diamond Loop</b>									
8501	SC 202 at Four Oaks Road <sup>2</sup>	B	11.2	B	11.4	B	11.4	B	11.8
8502	SC 202 at Meadow Brook Road <sup>1</sup>	A	9.8	B	11.0	intersection removed; shifted to 8501			
8503	SC 202 at I-26 WB Off-Ramp EBL Slip Ramp / I-26 WBR Slip Ramp <sup>1,3</sup>	B	12.6	B	10.8	B	10.4	A	9.8
8513	SC 202 at I-26 WB On-Ramp <sup>1</sup>	A	4.4	A	1.8	A	3.7	A	1.0
8523	SC 202 at I-26 WB Off-Ramp EBR Slip Ramp / I-26 WB Loop Ramp <sup>1,2</sup>	A	9.8	A	9.7	intersection removed; shifted to 8503			
8504	SC 202 at I-26 WB On-Ramp NBL Slip Ramp / I-26 NBR Slip Ramp <sup>1,2</sup>	A	6.6	A	2.0	B	12.2	B	11.1
8514	SC 202 at I-26 WB Off-Ramp <sup>1</sup>	B	14.7	B	11.8	intersections removed; shifted to 8504			
8524	SC 202 at I-26 WB On-Ramp SBR Slip Ramp / I-26 EB Loop Ramp <sup>1,2</sup>	A	0.0	A	0.0	intersections removed; shifted to 8504			
<b>Alternative 2: Parclo Slip</b>									
8501	SC 202 at Four Oaks Road <sup>2</sup>	B	11.2	B	11.4	B	11.4	B	11.8
8502	SC 202 at Meadow Brook Road <sup>1</sup>	A	9.8	B	11.0	intersection removed; shifted to 8501			
8503	SC 202 at I-26 WB Off-Ramp EBL Slip Ramp / I-26 WBR Slip Ramp <sup>1,2</sup>	B	12.6	B	10.8	A	9.3	A	9.0
8513	SC 202 at I-26 WB On-Ramp <sup>1</sup>	A	4.4	A	1.8	A	3.7	A	1.0
8523	SC 202 at I-26 WB Off-Ramp EBR Slip Ramp / I-26 WB Loop Ramp <sup>1,2</sup>	A	9.8	A	9.7	A	9.6	A	9.5
8504	SC 202 at I-26 WB On-Ramp NBL Slip Ramp / I-26 NBR Slip Ramp <sup>1,2</sup>	A	6.6	A	2.0	A	0.0	A	0.0
8514	SC 202 at I-26 WB Off-Ramp <sup>1</sup>	B	14.7	B	11.8	B	10.3	B	10.3
8524	SC 202 at I-26 WB On-Ramp SBR Slip Ramp / I-26 EB Loop Ramp <sup>1,2</sup>	A	0.0	A	0.0	A	0.0	A	0.0
<b>Alternative 2A: Parclo</b>									
8501	SC 202 at Four Oaks Road <sup>1</sup>	B	11.2	B	11.4	B	11.4	B	11.8
8502	SC 202 at Meadow Brook Road <sup>1</sup>	A	9.8	B	11.0	intersection removed; shifted to 8501			
8503	SC 202 at I-26 WB Off-Ramp EBL Slip Ramp / I-26 WBR Slip Ramp <sup>1,2</sup>	B	12.6	B	10.8	B	11.4	A	10.0
8513	SC 202 at I-26 WB On-Ramp <sup>1</sup>	A	4.4	A	1.8	A	3.7	A	1.0
8523	SC 202 at I-26 WB Off-Ramp EBR Slip Ramp / I-26 WB Loop Ramp <sup>1,2</sup>	A	9.8	A	9.7	A	9.6	A	9.5
8504	SC 202 at I-26 WB On-Ramp NBL Slip Ramp / I-26 NBR Slip Ramp <sup>1,2</sup>	A	6.6	A	2.0	A	0.0	A	0.0
8514	SC 202 at I-26 WB Off-Ramp <sup>1</sup>	B	14.7	B	11.8	B	10.3	B	10.3
8524	SC 202 at I-26 WB On-Ramp SBR Slip Ramp / I-26 EB Loop Ramp <sup>1,2</sup>	A	0.0	A	0.0	A	0.0	A	0.0
<b>Alternative 3: Bowtie</b>									
8501	SC 202 at Four Oaks Road <sup>1</sup>	B	11.2	B	11.4	B	11.4	B	11.8
8502	SC 202 at Meadow Brook Road <sup>1</sup>	A	9.8	B	11.0	intersection removed; shifted to 8501			
8503	SC 202 at I-26 WB Off-Ramp EBL Slip Ramp / I-26 WBR Slip Ramp <sup>1,2,3</sup>	B	12.6	B	10.8	A	6.8	A	6.6
8513	SC 202 at I-26 WB On-Ramp <sup>1</sup>	A	4.4	A	1.8	intersections removed; shifted to 8503			
8523	SC 202 at I-26 WB Off-Ramp EBR Slip Ramp / I-26 WB Loop Ramp <sup>1,2</sup>	A	9.8	A	9.7	intersections removed; shifted to 8503			
8504	SC 202 at I-26 WB On-Ramp NBL Slip Ramp / I-26 NBR Slip Ramp <sup>1,2,3</sup>	A	6.6	A	2.0	B	12.2	A	6.1
8514	SC 202 at I-26 WB Off-Ramp <sup>1</sup>	B	14.7	B	11.8	intersections removed; shifted to 8504			
8524	SC 202 at I-26 WB On-Ramp SBR Slip Ramp / I-26 EB Loop Ramp <sup>1,2</sup>	A	0.0	A	0.0	intersections removed; shifted to 8504			

<sup>1</sup> Intersection unsignalized under all scenarios; worst approach LOS and delay reported.  
<sup>2</sup> Intersection name updated under 2040 Build Conditions.  
<sup>3</sup> HCM 2010 delay and LOS reported for proposed roundabout intersections.

**Table 23 - Intersection Capacity Analysis Results - 2040 No Build vs 2040 Build Exit 97**

Intersection #	Intersection Name	2040 No Build Conditions				2040 Build Conditions				2040 Build Conditions with Improvements			
		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
		LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)
<b>Alternative 1: DDI</b>													
9701	Broad River Road (US 176) at Food Lion North Access <sup>1</sup>	F	859.1	err <sup>2</sup>	err <sup>2</sup>	C	21.5	B	14.9	C	21.5	B	14.9
9702	Broad River Road (US 176) at Food Lion South Access <sup>3</sup>	incompatible with HCM 2000 due to free movements				F	611.4	err <sup>5</sup>	err <sup>5</sup>	A	7.4	B	14.2
9712	Broad River Road (US 176) at I-26 WBR Slip Ramp <sup>1</sup>	F	60.9	F	531.7	intersection removed; shifted to 9713							
9703	Broad River Road (US 176) at I-26 WBT/WBL Ramps	F	320.5	F	211.7	B	16.6	C	21.1	B	10.3	B	10.8
9704	Broad River Road (US 176) at I-26 EB Ramps <sup>2</sup>	incompatible with HCM 2000 due to five-legged intersection				C	21.8	C	22.5	B	17.3	C	24.1
9705	Broad River Road (US 176) at Broad Stone Road <sup>3</sup>	F	8,373.8	F	4,604.9	F	9,323.3	err <sup>5</sup>	err <sup>5</sup>	B	15.3	B	19.3
9706	I-26 WB Ramps at Julius Richardson Road <sup>1</sup>	F	789.9	err <sup>2</sup>	err <sup>2</sup>	intersection removed; shifted to 9709							
9707	I-26 EB Ramps at Rauch-Metz Road <sup>1</sup>	err <sup>2</sup>	err <sup>2</sup>	err <sup>2</sup>	err <sup>2</sup>	intersection removed; shifted to 9705							
9708	Rauch-Metz Road at Broad Stone Road <sup>1</sup>	C	18.2	D	27.8	free-flow under Build Conditions							
9709	Broad River Road (US 176) at Shady Grove Road <sup>2</sup>	B	10.5	B	12.6	F	6,032.1	F	5,129.5	C	26.7	C	29.9
9713	Broad River Road (US 176) at I-26 WBR Slip Ramp	added under Build Conditions				B	14.7	F	541.8	A	1.8	B	10.8
9714	Broad River Road (US 176) at I-26 EBR Slip Ramp <sup>4</sup>					C	16.2	F	601.8	A	0.0	A	0.0
9723	Broad River Road (US 176) at I-26 WBL Slip Ramp					B	14.7	B	14.0	B	14.6	B	18.5
9724	Broad River Road (US 176) at I-26 EBL Slip Ramp <sup>1</sup>					B	11.2	B	12.8	B	11.2	B	12.8
<b>Alternative 2: Parclo</b>													
9701	Broad River Road (US 176) at Food Lion North Access <sup>1</sup>	F	859.1	err <sup>2</sup>	err <sup>2</sup>	F	65.2	D	26.8	C	21.5	B	14.9
9702	Broad River Road (US 176) at Food Lion South Access <sup>3</sup>	incompatible with HCM 2000 due to free movements				F	3,803.7	F	4,497.2	A	6.0	B	14.2
9712	Broad River Road (US 176) at I-26 WBR Slip Ramp <sup>1</sup>	F	60.9	F	531.7	intersection removed; shifted to 9703							
9703	Broad River Road (US 176) at I-26 WBT/WBL Ramps	F	320.5	F	211.7	F	228.2	F	282.7	B	13.4	C	27.9
9704	Broad River Road (US 176) at I-26 EB Ramps <sup>2</sup>	incompatible with HCM 2000 due to five-legged intersection				F	55.6	err <sup>5</sup>	err <sup>5</sup>	A	6.4	B	18.7
9705	Broad River Road (US 176) at Broad Stone Road <sup>3</sup>	F	8,373.8	F	4,604.9	F	9,323.4	F	6,897.4	B	18.3	C	25.0
9706	I-26 WB Ramps at Julius Richardson Road <sup>1</sup>	F	789.9	err <sup>2</sup>	err <sup>2</sup>	intersection removed; shifted to 9709							
9707	I-26 EB Ramps at Rauch-Metz Road <sup>1</sup>	err <sup>2</sup>	err <sup>2</sup>	err <sup>2</sup>	err <sup>2</sup>	intersection removed; shifted to 9705							
9708	Rauch-Metz Road at Broad Stone Road <sup>1</sup>	C	18.2	D	27.8	free-flow under Build Conditions							
9709	Broad River Road (US 176) at Shady Grove Road <sup>2</sup>	B	10.5	B	12.6	F	6,035.6	F	5,181.4	C	25.4	C	29.1
<b>Alternative 3: SPUI</b>													
9701	Broad River Road (US 176) at Food Lion North Access <sup>2</sup>	F	859.1	err <sup>2</sup>	err <sup>2</sup>	F	679.5	F	8,326.3	A	4.6	B	12.6
9702	Broad River Road (US 176) at Food Lion South Access <sup>1</sup>	incompatible with HCM 2000 due to free movements				C	23.8	C	20.9	D	31.6	B	12.6
9712	Broad River Road (US 176) at I-26 WBR Slip Ramp <sup>1</sup>	F	60.9	F	531.7	intersection removed; shifted to 9713							
9703	Broad River Road (US 176) at I-26 WBT/WBL Ramps	F	320.5	F	211.7	intersections removed; shifted to 9710							
9704	Broad River Road (US 176) at I-26 EB Ramps <sup>2</sup>	incompatible with HCM 2000 due to five-legged intersection				F	9,322.8	F	6,693.4	C	24.2	C	23.9
9705	Broad River Road (US 176) at Broad Stone Road <sup>3</sup>	F	8,373.8	F	4,604.9	F	9,322.8	F	6,693.4	C	24.2	C	23.9
9706	I-26 WB Ramps at Julius Richardson Road <sup>1</sup>	F	789.9	err <sup>2</sup>	err <sup>2</sup>	intersection removed; shifted to 9709							
9707	I-26 EB Ramps at Rauch-Metz Road <sup>1</sup>	err <sup>2</sup>	err <sup>2</sup>	err <sup>2</sup>	err <sup>2</sup>	intersection removed; shifted to 9705							
9708	Rauch-Metz Road at Broad Stone Road <sup>1</sup>	C	18.2	D	27.8	free-flow under Build Conditions							
9709	Broad River Road (US 176) at Shady Grove Road <sup>2</sup>	B	10.5	B	12.6	F	4,453.3	F	3,654.6	B	14.7	C	25.7
9710	Broad River Road (US 176) at I-26 LT Slip Ramps	added under Build Conditions				D	51.4	D	48.5	D	51.9	D	44.5
9713	Broad River Road (US 176) at I-26 WBR Slip Ramp					A	2.2	D	44.1	A	5.5	B	12.8
9714	Broad River Road (US 176) at I-26 EBR Slip Ramp <sup>3</sup>					B	13.6	F	237.1	A	8.1	B	15.4

<sup>1</sup> Intersection unsignalized under all scenarios; worst approach LOS and delay reported.  
<sup>2</sup> Intersection signalized under 2040 Build Conditions; otherwise, worst approach LOS and delay reported.  
<sup>3</sup> Intersection signalized under 2040 Build Conditions with Improvements; otherwise, worst approach LOS and delay reported.  
<sup>4</sup> Lane added and YIELD control removed under 2040 Build Conditions with Improvements; zero delay reported per HCM 2000 methodology.  
<sup>5</sup> Delay unable to be processed per HCM 2000 methodology; error reported.

Table 24 - 2040 Build Intersection Queue Lengths Exit 85

Intersection #	Intersection Name	Movement		95th Percentile Queue Length (ft)			
		2040 No Build Conditions	2040 Build Conditions	2040 No Build Conditions		2040 Build Conditions	
				AM Peak	PM Peak	AM Peak	PM Peak
<b>Alternative 1: Diamond</b>							
8501	SC 202 at Four Oaks Road	NBTR	NBL	0	0	0	0
			NBTR	0	0	0	0
		SBLT	SBL	0	0	0	0
			SBTR	-	-	0	0
		-	EBLTR	-	-	0	0
WBLR	WBLTR	0	0	0	0		
8502	SC 202 at Meadow Brook Road	NBLT	-	0	0	intersection removed; shifted to 8501	
		SBTR	-	0	0		
		EBLR	-	0	0		
8503	SC 202 at I-26 WB Off-Ramp EBL Slip Ramp / I-26 WB Ramps <sup>1</sup>	NBT	NBL	0	0	0	0
			NBT	0	0	0	0
		SBT	SBT	0	0	0	0
			SBR	0	0	0	0
		EBL	-	0	0	0	0
-	WBL	-	-	0	25		
-	WBTR	-	-	0	0		
8513	SC 202 at I-26 WB On-Ramp	NBLT	-	0	0	shifted to 8503	
8523	SC 202 at I-26 WB Off-Ramp EBR Slip Ramp	EBR	-	0	25		
8504	SC 202 at I-26 WB On-Ramp NBL Slip Ramp / I-26 EB Ramps <sup>1</sup>	NBLT	NBT	25	0	0	0
			NBR	25	0	0	0
		SBT	SBL	0	0	0	0
			SBT	0	0	0	0
		-	EBLT	-	-	0	0
-	EBR	-	-	0	0		
8514	SC 202 at I-26 WB Off-Ramp	EBL	-	25	25	shifted to 8504	
<b>Alternative 1A: Diamond Loop</b>							
8501	SC 202 at Four Oaks Road	NBTR	NBL	0	0	0	0
			NBTR	0	0	0	0
		SBLT	SBL	0	0	0	0
			SBTR	-	-	0	0
		-	EBLTR	-	-	0	0
WBLR	WBLTR	0	0	0	0		
8502	SC 202 at Meadow Brook Road	NBLT	-	0	0	intersection removed; shifted to 8501	
		SBTR	-	0	0		
		EBLR	-	0	0		
8503	SC 202 at I-26 WB Off-Ramp EBL Slip Ramp / I-26 WB Ramps <sup>1</sup>	EBL	EBL	0	0	0	0
			EBR	0	0	0	25
8513	SC 202 at I-26 WB On-Ramp	NBLT	NBL	0	0	0	0
			NBT	0	0	0	0
		SBTR	SBT	0	0	0	0
			SBR	0	0	0	0
8523	SC 202 at I-26 WB Off-Ramp EBR Slip Ramp	EBR	-	0	25	shifted to 8503	
8504	SC 202 at I-26 WB On-Ramp NBL Slip Ramp / I-26 EB Ramps <sup>1</sup>	NBLT	NBT	25	0	0	0
			NBR	25	0	0	0
		SBT	SBL	0	0	0	0
			SBT	0	0	0	0
		-	EBLT	-	-	0	0
-	EBR	-	-	0	0		
8514	SC 202 at I-26 WB Off-Ramp	EBL	-	25	25	shifted to 8504	

Table 25 - 2040 Build Intersection Queue Lengths Exit 85

Intersection #	Intersection Name	Movement		95th Percentile Queue Length (ft)			
		2040 No Build Conditions	2040 Build Conditions	2040 No Build Conditions		2040 Build Conditions	
				AM Peak	PM Peak	AM Peak	PM Peak
<b>Alternative 2: Parclo Slip</b>							
8501	SC 202 at Four Oaks Road	NBTR	NBL	0	0	0	0
			NBTR	0	0	0	0
		SBLT	SBL	0	0	0	0
			SBTR	0	0	0	0
		-	EBLTR	-	-	0	0
WBLR	WBLTR	0	0	0	0		
8502	SC 202 at Meadow Brook Road	NBLT	-	0	0	Intersection removed; shifted to 8501	
		SBTR	-	0	0		
		EBLR	-	0	0		
8503	SC 202 at I-26 WB Off-Ramp EBL Slip Ramp / I-26 WBR Slip Ramp <sup>1</sup>	EBL	-	0	0	-	-
		-	WBR	-	-	0	0
8513	SC 202 at I-26 WB On-Ramp	NBLT	NBL	0	0	0	0
			NBT	0	0	0	0
		SBTR	SBT	0	0	0	0
			SBR	0	0	0	0
8523	SC 202 at I-26 WB Off-Ramp EBR Slip Ramp	EBR	EBR	0	25	0	25
8504	SC 202 at I-26 WB On-Ramp NBL Slip Ramp / I-26 NBR Slip Ramp <sup>1</sup>	NBLT	NBT	25	0	0	0
			NBR	25	0	0	0
8514	SC 202 at I-26 WB Off-Ramp	EBL	EBL	25	25	0	0
			EBR	25	25	0	0
8524	SC 202 at I-26 WB On-Ramp SBR Slip Ramp / I-26 EB Loop Ramp <sup>1</sup>	SBTR	SBT	0	0	0	0
			SBR	0	0	0	0
<b>Alternative 2A: Parclo</b>							
8501	SC 202 at Four Oaks Road	NBTR	NBL	0	0	0	0
			NBTR	0	0	0	0
		SBLT	SBL	0	0	0	0
			SBTR	0	0	0	0
		-	EBLTR	-	-	0	0
WBLR	WBLTR	0	0	0	0		
8502	SC 202 at Meadow Brook Road	NBLT	-	0	0	Intersection removed; shifted to 8501	
		SBTR	-	0	0		
		EBLR	-	0	0		
8503	SC 202 at I-26 WB Off-Ramp EBL Slip Ramp / I-26 WBR Slip Ramp <sup>1</sup>	EBL	EBL	0	0	0	0
8513	SC 202 at I-26 WB On-Ramp	NBLT	NBL	0	0	0	0
			NBT	0	0	0	0
		SBTR	SBT	0	0	0	0
			SBR	0	0	0	0
8523	SC 202 at I-26 WB Off-Ramp EBR Slip Ramp	EBR	EBR	0	25	0	25
8504	SC 202 at I-26 WB On-Ramp NBL Slip Ramp / I-26 NBR Slip Ramp <sup>1</sup>	NBLT	NBT	25	0	0	0
			NBR	25	0	0	0
8514	SC 202 at I-26 WB Off-Ramp	EBL	EBL	25	25	0	0
			EBR	25	25	0	0
8524	SC 202 at I-26 WB On-Ramp SBR Slip Ramp / I-26 EB Loop Ramp <sup>1</sup>	SBTR	SBT	0	0	0	0
			SBR	0	0	0	0

Table 26 - 2040 Build Intersection Queue Lengths Exit 85

Intersection #	Intersection Name	Movement		95th Percentile Queue Length (ft)			
		2040 No Build Conditions	2040 Build Conditions	2040 No Build Conditions		2040 Build Conditions	
				AM Peak	PM Peak	AM Peak	PM Peak
<b>Alternative 3: Bowtie</b>							
8501	SC 202 at Four Oaks Road	NBTR	NBL	0	0	0	0
			NBTR	0	0	0	0
		SBLT	SBL	0	0	0	0
			SBTR	0	0	0	0
		-	EBLTR	-	-	0	0
WBLR	WBLTR	0	0	0	0		
8502	SC 202 at Meadow Brook Road	NBLT	-	0	0	intersection removed: shifted to 8501	
		SBTR	-	0	0		
		EBLR	-	0	0		
8503	SC 202 at I-26 WB Off-Ramp EBL Slip Ramp / I-26 WB Ramps <sup>1,2</sup>	NBT	NBLT	0	-	25	25
		SBT	SBTR	0	0	25	25
		EBL	-	0	0	-	-
		-	WBLTR	-	0	0	25
8513	SC 202 at I-26 WB On-Ramp	NBLT	-	0	0	shifted to 8503	
8523	SC 202 at I-26 WB Off-Ramp EBR Slip Ramp	EBR	-	0	25		
8504	SC 202 at I-26 WB On-Ramp NBL Slip Ramp / I-26 EB Ramps <sup>1,2</sup>	NBLT	NBTR	25	0	75	25
		SBT	SBLT	0	0	25	25
		-	EBLTR	-	-	25	25
8514	SC 202 at I-26 WB Off-Ramp	EBL	-	25	25	shifted to 8504	
<sup>1</sup> Intersection name updated under 2040 Build Conditions. <sup>2</sup> HCM 2010 delay and LOS reported for proposed roundabout intersections.							

Table 27 - 2040 Build Intersection Queue Lengths Exit 97

Intersection #	Intersection Name	Movement			95th Percentile Queue Length (ft)						Available Storage Length (ft)		
		2040 No Build Conditions	2040 Build Conditions	2040 Build Conditions w/ Improvements	2040 No Build Conditions		2040 Build Conditions		2040 Build Conditions w/ Improvements		2040 No Build	2040 Build	2040 Build Conditions w/ Improvements
					AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak			
<b>Alternative 1: DDI</b>													
9701	Broad River Road (US 176) at Food Lion North Access	NBL	-	-	25	0	-	-	-	-	250	-	-
		NBT <sup>1</sup>	NBT	NBT	0	0	0	0	0	0	525	525	525
		SBT <sup>1</sup>	SBTR	SBTR	0	0	0	0	0	0	1,700	1,700	1,700
		SBR			0	0					250		
		EBLR	-	-	100	err <sup>3</sup>	-	-	-	-	-	-	-
EBR	-	-	-	-	0	0	0	0	-	-	-		
9702	Broad River Road (US 176) at Food Lion South Access	-	NBL	NBL	incompatible with HCM 2000 due to free movements	25	50	25 <sup>m</sup>	75 <sup>m</sup>	-	325	325	
		NBT	NBT	NBT		0	0	25	300 <sup>m</sup>	350	675	675	
		SBT <sup>1</sup>	SBTR	SBTR		0	0	775 <sup>m</sup>	250	525	525	525	
		SBR <sup>1</sup>				-	-	175	err <sup>3</sup>	25	150 <sup>p</sup>	-	-
		EBLR	EBL	EBL		-	-	25	50	-	-	-	
9703	Broad River Road (US 176) at I-26 WBT/WBL Ramps	NBL	-	-	25	75	-	-	-	400	-	-	
		NBT	NBT	NBT	300	400	75 <sup>p</sup>	100	150 <sup>p</sup>	125	400	550	550
		SBL	-	-	25	25	-	-	-	-	350	-	-
		SBTR	SBT	SBT	2,875 <sup>p</sup>	2,100 <sup>p</sup>	525	400	50	25	350	650	650
9704	Broad River Road (US 176) at I-26 EB Ramps	NBLTR	NBT	NBT	incompatible with HCM 2000 due to five-legged intersection		250	275	200	200 <sup>m</sup>	525	875	875
		SBLT	SBT	SBT			200 <sup>m</sup>	400	300 <sup>m</sup>	550 <sup>m</sup>	1,425	550	550
9705	Broad River Road (US 176) at Broad Stone Road	NBLT	NBL	NBL	0	25	25	150	50	100 <sup>p</sup>	500	150	150
		NBLT	NBT	NBT	0	0	0	0	225	100	500	500	500
		SBT	SBT	SBT	0	0	0	0	100	650 <sup>p</sup>	525	725	875
		SBR <sup>4</sup>	SBR	SBR	0	0	0	0	0	0	100	725	725
		EBL	EBL	EBL	err <sup>3</sup>	err <sup>3</sup>	err <sup>3</sup>	err <sup>3</sup>	225	225 <sup>m</sup>	-	-	-
EBR	EBR	EBR	25	325	25	err <sup>3</sup>	25	100	250	250	250		
9709	Broad River Road (US 176) at Shady Grove Road	NBTR	NBT	NBT	0	0	0	0	525	1,225 <sup>p</sup>	1,700	2,225	2,225
		NBTR	NBR	NBR	0	0	0	0	75	50		2,225	2,225
		SBLT	SBL	SBL	0	25	0	25	50	75 <sup>p</sup>	2,150	100	100
		SBLT	SBT	SBT	0	0	0	0	550 <sup>p</sup>	125		2,150	2,150
		WBLR	WBL	WBL	err <sup>3</sup>	err <sup>3</sup>	err <sup>3</sup>	err <sup>3</sup>	425 <sup>p</sup>	150 <sup>p</sup>	-	100	100
WBR	WBR	WBR	150	125	125	75	-	-	-	-			
9713	Broad River Road (US 176) at I-26 WBR Slip Ramp	added under Build Conditions	WBR <sup>1</sup>	WBR <sup>1</sup>	added under Build Conditions		75	2,550	50	525 <sup>p</sup>	added under Build Conditions	1,300	1,300
9714	Broad River Road (US 176) at I-26 EBR Slip Ramp	EBR <sup>1</sup>	EBR <sup>1,2</sup>	50			1,350	0	0	1,400		1,400	
9723	Broad River Road (US 176) at I-26 WBL Slip Ramp	WBL <sup>1</sup>	WBL <sup>1</sup>	275 <sup>p</sup>			325	275 <sup>p</sup>	375 <sup>p</sup>	1,200		1,200	
9724	Broad River Road (US 176) at I-26 EBL Slip Ramp	EBR <sup>1</sup>	EBR <sup>1</sup>	0			25	0	25	1,500		1,500	

Table 28 - 2040 Build Intersection Queue Lengths Exit 97

Intersection #	Intersection Name	Movement			95th Percentile Queue Length (ft)						Available Storage Length (ft)		
		2040 No Build Conditions	2040 Build Conditions	2040 Build Conditions w/ Improvements	2040 No Build Conditions		2040 Build Conditions		2040 Build Conditions w/ Improvements		2040 No Build	2040 Build	2040 Build Conditions w/ Improvements
					AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak			
<b>Alternative 2: Parclo</b>													
9701	Broad River Road (US 176) at Food Lion North Access	NBL	-	-	25	0	-	-	-	-	250	-	-
		NBT	NBT	NBT	0	0	0	0	0	0	525	525	525
		SBT	SBTR	SBTR	0	0	0	0	0	0	1,700	1,700	1,700
		SBR			0	0	0	0	0	0	250		
		EBLR	-	-	100	err <sup>3</sup>	-	-	-	-	-	-	-
EBR	EBR	EBR	0	25	0	0	0	0	-	-	-	-	
9702	Broad River Road (US 176) at Food Lion South Access	-	NBL	NBL	incompatible with HCM 2000 due to free movements	25	50	25 <sup>m</sup>	50 <sup>m</sup>	-	275	275	
		NBT	NBT	NBT		0	0	75	425 <sup>m</sup>	350	675	675	
		SBT	SBTR	SBTR		0	0	750 <sup>g</sup>	450	525	525	525	
		SBR				err <sup>3</sup>	err <sup>3</sup>	25	150	-	-	-	
		-	EBL	EBL		75	200	25	50	-	-	-	-
EBR	EBR	EBR	-	-	-	-	-	-	-	-	-		
9712	Broad River Road (US 176) at I-26 WBR Slip Ramp	WBR	-	-	375	2,000	movement shifted to 9703				1,100	-	-
9703	Broad River Road (US 176) at I-26 WBT/WBL Ramps	NBL	-	-	25	75	-	-	-	-	400	-	-
		NBT	NBT	NBT	300	400	250	700	100	200	400	800	800
		SBL	-	-	25	25	-	-	-	-	350	-	-
		SBTR	SBT	SBT	2,875 <sup>g</sup>	2,100 <sup>g</sup>	3,075 <sup>g</sup>	2,250 <sup>g</sup>	0	300 <sup>g</sup>	350	675	675
		EBL	-	-	25	100	-	-	-	-	-	-	-
		EBTR	-	-	0	100	-	-	-	-	-	-	-
		WBL	WBL <sup>1</sup>	WBL <sup>1</sup>	1,875 <sup>g</sup>	2,025 <sup>g</sup>	1,025 <sup>g</sup>	1,425 <sup>g</sup>	225	500	850	1,700	1,700
		WBT	-	-	25	150	-	-	-	-	850	-	-
-	WBR <sup>1</sup>	WBR <sup>1</sup>	-	-	275	2,300 <sup>g</sup>	75	700 <sup>g</sup>	-	1,700	1,700		
9704	Broad River Road (US 176) at I-26 EB Ramps	NBLTR	NBT	NBT	incompatible with HCM 2000 due to five-legged intersection	0	0	50	250 <sup>m</sup>	525	875	875	
		SBLT	SBT	SBT		0	0	50	250 <sup>m</sup>	1,425	800	800	
		EBLT	EBL <sup>1</sup>	EBL <sup>1</sup>		75	err <sup>3</sup>	50	275	650	1,600	1,600	
		EBR	EBR	EBR <sup>1</sup>		100	err <sup>3</sup>	50	300	650	275	1,600	
		WBLTR	-	-		-	-	-	-	-	-	-	-
9705	Broad River Road (US 176) at Broad Stone Road	NBLT	NBLT	NBL	0	25	25	125	50	100 <sup>g</sup>	500	500	150
		NBT		0	0	275	650 <sup>g</sup>	100	500				
		SBT	SBT	SBT	0	0	0	0	275	650 <sup>g</sup>	525	875	875
		SBR	SBR	SBR	0	0	0	0	25	75	100	175	875
		EBL	EBL	EBL	err <sup>3</sup>	err <sup>3</sup>	err <sup>3</sup>	err <sup>3</sup>	225	225 <sup>g</sup>	-	-	-
EBR	EBR	EBR	25	325	25	500	25	100	250	250	250		
9709	Broad River Road (US 176) at Shady Grove Road	NBTR	NBTR	NBT	0	0	0	0	500	1,250 <sup>g</sup>	1,700	1,700	2,225
		NBR		0	0	0	0	50	0	2,225			
		SBLT	SBL	SBL	0	25	0	25	50	75 <sup>g</sup>	2,150	2,150	100
		SBT	0	0	550 <sup>g</sup>	125	2,150	2,150					
		WBLR	WBL	WBL	err <sup>3</sup>	err <sup>3</sup>	err <sup>3</sup>	err <sup>3</sup>	425 <sup>g</sup>	150 <sup>g</sup>	-	100	100
WBR	175	175	125	75	-	-	-	-					

Table 29 - 2040 Build Intersection Queue Lengths Exit 97

Intersection #	Intersection Name	Movement			95th Percentile Queue Length (ft)						Available Storage Length (ft)		
		2040 No Build Conditions	2040 Build Conditions	2040 Build Conditions w/ Improvements	2040 No Build Conditions		2040 Build Conditions		2040 Build Conditions w/ Improvements		2040 No Build	2040 Build	2040 Build Conditions w/ Improvements
					AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak			
<b>Alternative 3: SPUI</b>													
9701	Broad River Road (US 176) at Food Lion North Access	NBL	NBLT	NBL	25	0	25	50	50 <sup>m</sup>	125 <sup>n</sup>	250	1,200	250
		NBT	NBT	NBT	0	0	25	50	25	300	525	1,200	1,200
		SBT	SBTR	SBTR	0	0	0	0	350	150	1,700	1,700	1,700
		SBR	SBR	SBR	0	0	0	0	0	0	250	1,700	1,700
		EBLR	EBL	EBL	100	err <sup>3</sup>	100	err <sup>3</sup>	50	200 <sup>n</sup>	-	-	-
9702	Broad River Road (US 176) at Food Lion South Access	NBT	NBT	NBT	incompatible with HCM 2000 due to free movements		0	0	0	0	350	675	675
		SBT	SBTR	SBTR			0	0	0	0	525	525	525
		SBR	SBR	SBR			25	50	25	25	-	-	-
		EBR	EBR	EBR			25	50	25	25	-	-	-
9705	Broad River Road (US 176) at Broad Stone Road	NBLT	NBL	NBL	0	25	25	150	75	100 <sup>n</sup>	500	150	150
		NBLT	NBT	NBT	0	0	0	0	275	100	500	500	500
		SBT	SBT	SBT	0	0	0	0	275	675 <sup>n</sup>	525	725	725
		SBR	SBR	SBR	0	0	0	0	0	75	100	150	150
		EBL	EBL	EBL	err <sup>3</sup>	err <sup>3</sup>	err <sup>3</sup>	err <sup>3</sup>	300	225 <sup>n</sup>	-	-	-
9709	Broad River Road (US 176) at Shady Grove Road	NBTR	NBT	NBT	0	0	0	0	325	1,225 <sup>n</sup>	1,700	1,700	1,700
		NBTR	NBR	NBR	0	0	0	0	25	25	1,700	1,700	1,700
		SBLT	SBL	SBL	0	25	0	25	25	75 <sup>n</sup>	2,150	100	100
		SBLT	SBT	SBT	0	25	0	0	400	125	2,150	2,150	2,150
		WBLR	WBL	WBL	err <sup>3</sup>	err <sup>3</sup>	err <sup>3</sup>	err <sup>3</sup>	175	50	-	-	-
9710	Broad River Road (US 176) at I-26 LT Slip Ramps	added under Build Conditions	NBL	NBL	added under Build Conditions	250	225	325	150	250	250	250	250
			NBT	NBT		225 <sup>n</sup>	250 <sup>n</sup>	250	175	1,225	1,225		
			SBL	SBL		725 <sup>n</sup>	225	825 <sup>n</sup>	350 <sup>n</sup>	250	250		
			SBT	SBT		100	250	150	325	950	950		
			EBL <sup>1</sup>	EBL <sup>1</sup>		25	125	50	125	1,375	1,375		
			WBL <sup>1</sup>	WBL <sup>1</sup>		325 <sup>n</sup>	475 <sup>n</sup>	375 <sup>n</sup>	475 <sup>n</sup>	2,075	2,075		
			WBR <sup>1</sup>	WBR <sup>1</sup>		25	675 <sup>n</sup>	50	575	2,175	2,175		
9713	Broad River Road (US 176) at I-26 WBR Slip Ramp		EBR <sup>1</sup>	EBR <sup>1</sup>	50	875	25	400 <sup>n</sup>	1,875	1,875			
9714	Broad River Road (US 176) at I-26 EBR Slip Ramp		EBR <sup>1</sup>	EBR <sup>1</sup>	50	875	25	400 <sup>n</sup>	1,875	1,875			

<sup>1</sup> Storage length measured to I-26 diverge point.  
<sup>2</sup> Lane added and YIELD control removed under 2040 Build Conditions with Improvements; zero queue reported per HCM 2000 methodology.  
<sup>3</sup> Queue unable to be processed per HCM 2000 methodology; error reported.  
<sup>n</sup> 95th-percentile volume exceeds capacity, queue may be longer.  
<sup>m</sup> Volume for 95th-percentile queue is metered by upstream signal.

Exit 82 - SC-773

The SC 773 interchange is not expected to be modified as part of the I-26 widening project. Therefore, the results of the 2040 Build analyses within the Exit 82 interchange area will be the same results of the 2040 No Build analysis (see **Figure 73**).

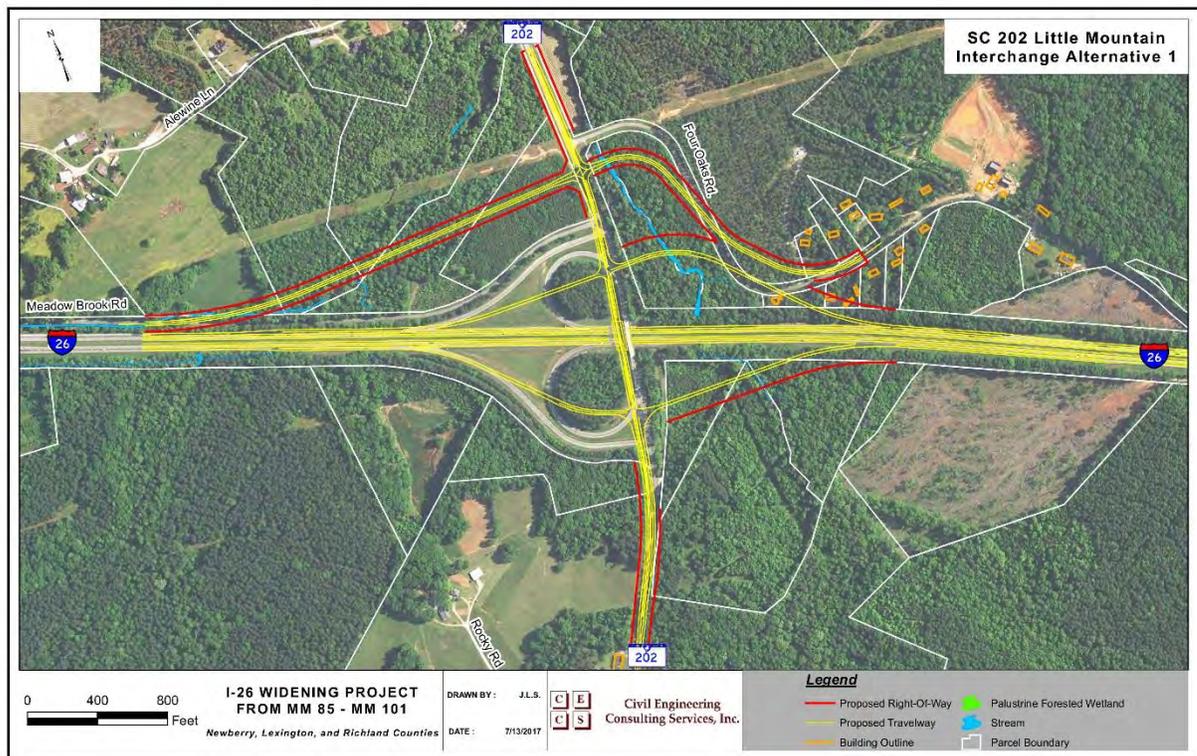
Exit 85 - SC 202

The SC 202 interchange is expected to be modified as part of the I-26 widening project. 2040 Build analyses for the intersections within the Exit 85 interchange area were performed for three alternatives.

Alternative 1

The conceptual design of Alternative 1 is shown in **Figure 79**.

**Figure 79 - Exit 85: Improvement Alternative 1 Diamond**



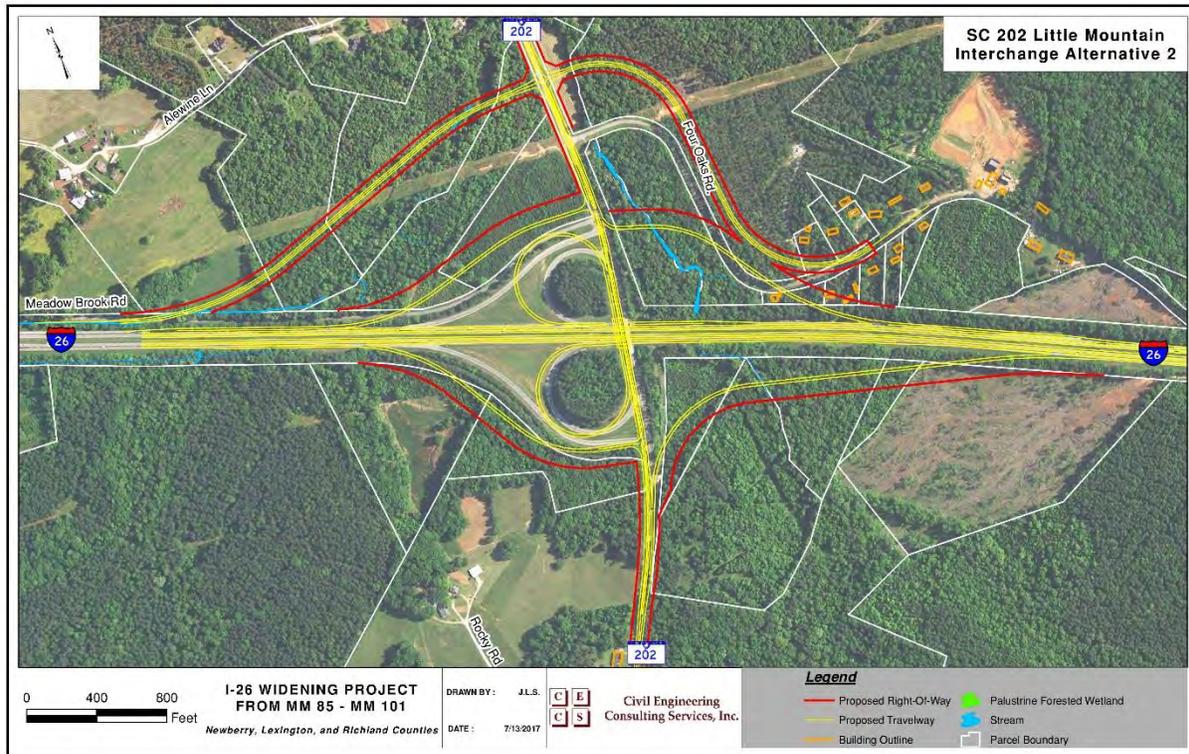
Alternative 1 replaces the existing Exit 85 interchange with a diamond interchange. All intersections would remain stop-controlled under the 2040 Build conditions. **Figure 88** shows the 2040 Build Volumes for Alternative 1. As can be seen in **Table 22** and **Table 24**, the LOS and

queuing results are very similar for the 2040 No Build and 2040 Build scenarios. All intersections within the interchange operate at LOS A or B in both the AM and PM peak hours.

Alternative 2

The conceptual design of Alternative 2 is shown in **Figure 80**.

**Figure 80 - Exit 85: Improvement Alternative 2 Partial Cloverleaf**



Alternative 2 replaces the existing Exit 85 interchange with a partial cloverleaf. This alternative would shift two left turn movements to right turn movements, potentially increasing the safety of the ramp termini. **Figure 90** shows the 2040 Build Volumes for Alternative 2. As can be seen in **Table 22** and **Table 25**, the LOS and queuing results are very similar for the 2040 No Build and 2040 Build scenarios. All intersections within the interchange operate at LOS A or B in both the AM and PM peak hours.

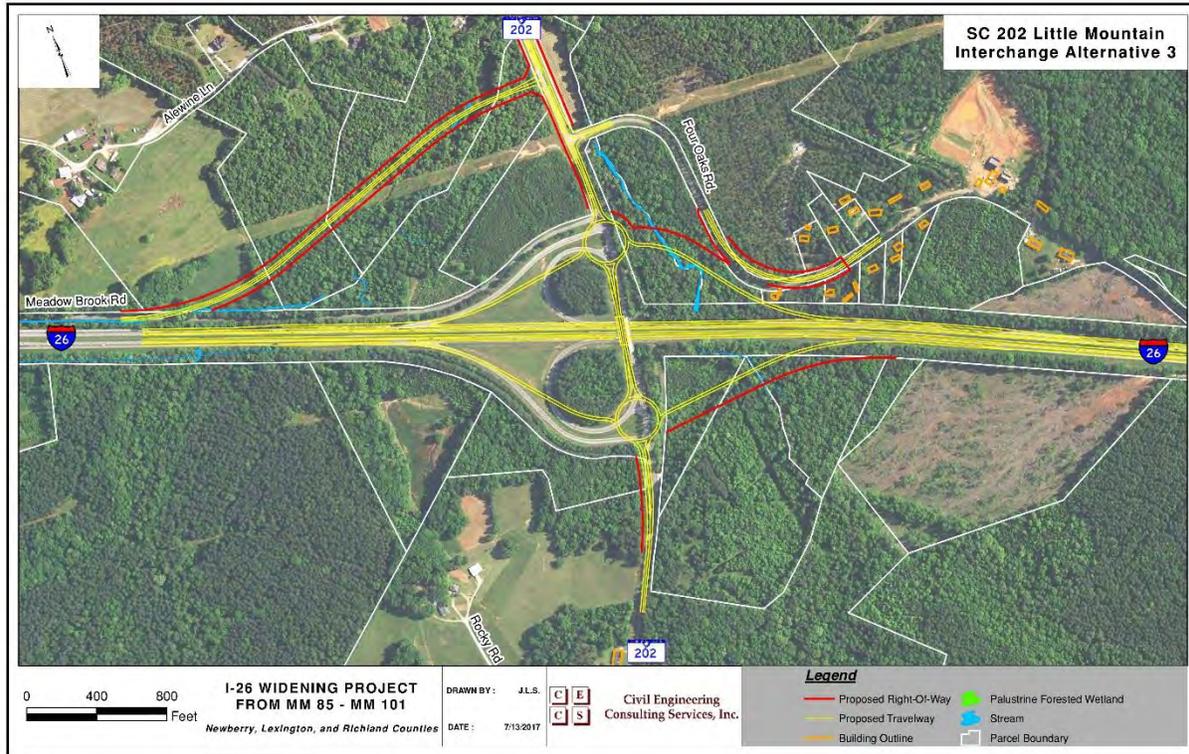
Alternative 3

The conceptual design of Alternative 3 is shown in **Figure 81**.

Alternative 3 replaces the existing Exit 85 interchange with a diamond interchange. Under this alternative, the ramp termini intersections would operate as roundabouts, minimizing stops

along the corridor. **Figure 92** shows the 2040 Build Volumes for Alternative 3. As can be seen in **Table 22** and **Table 26**, the LOS and queuing results are very similar for the 2040 No Build and 2040 Build scenarios.

**Figure 81 - Exit 85: Improvement Alternative 3 Bowtie**



### Revised Alternatives

As part of the refinement of alternatives, Alternative 1A and Alternative 2A were developed.

The conceptual design of Alternative 1A is shown in **Figure 82** and the conceptual design for Alternative 2A is shown in **Figure 83**.

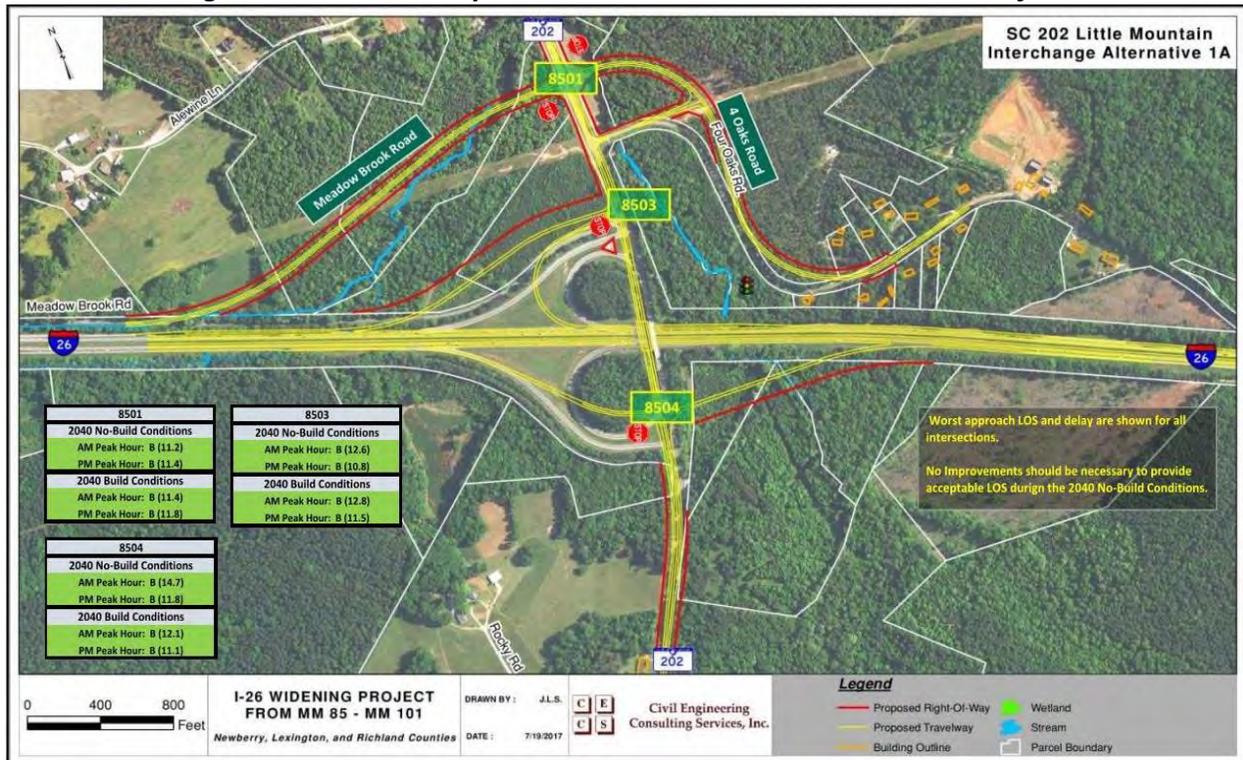
### Alternative 1-A

In order to minimize impacts, the westbound off-ramp has been changed to a loop ramp for Alternative 1A. **Figure 89** shows the 2040 Build Volumes for Alternative 1A. As can be seen in **Table 22** and **Table 24**, the LOS and queuing results are very similar for the 2040 No Build and 2040 Build scenarios.

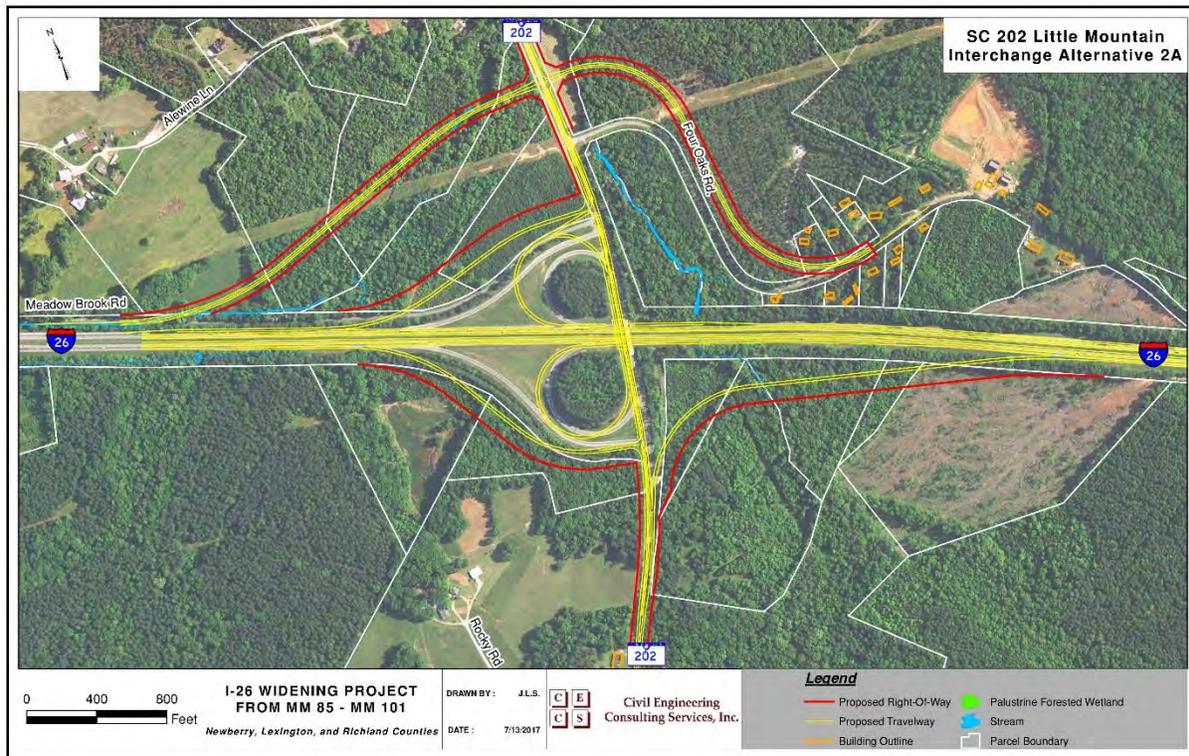
Alternative 2-A

In order to minimize impacts, the westbound off-ramp has been combined with the loop ramp for Alternative 2A. **Figure 91** shows the 2040 Build Volumes for Alternative 2A. As can be seen in **Table 22** and in **Table 25**, the LOS and queuing results are very similar for the 2040 No Build and 2040 Build scenarios.

**Figure 82 - Exit 85: Improvement Alternative 1A Diamond Modified**



**Figure 83 - Exit 85: Improvement Alternative 2A Partial Cloverleaf Modified**



**Exit 91 - Columbia Avenue (S-32-48)**

The Columbia Avenue (S-32-48) interchange is expected to be modified to a DDI configuration. As part of the *Interchange Modification Report, I-26 at S-48 (Columbia Avenue) Interchange Improvements*, three build alternatives were evaluated, a DDI, a ParClo, and Dual Roundabout. The preferred alternative from the IMR is the DDI. **Figure 84** shows the proposed design of the DDI.

**Table 30** summarizes the analysis completed by the S-48 (Columbia Avenue) Corridor Improvement Project. The DDI would improve operations along the S-28 corridor in both the AM and PM peak hours for the 2040 Build condition with the most significant improvement being in the eastbound direction in the AM peak hour, from LOS F to C, and in the westbound direction in the PM peak hour, from LOS F to C. In addition, VISSIM analysis completed as part of the IMR showed that the intersection LOS at each of the ramp termini are anticipated to operate at LOS C or better in the 2040 Build condition as compared to LOS E or F in the 2040 No Build condition.



### Alternative 1

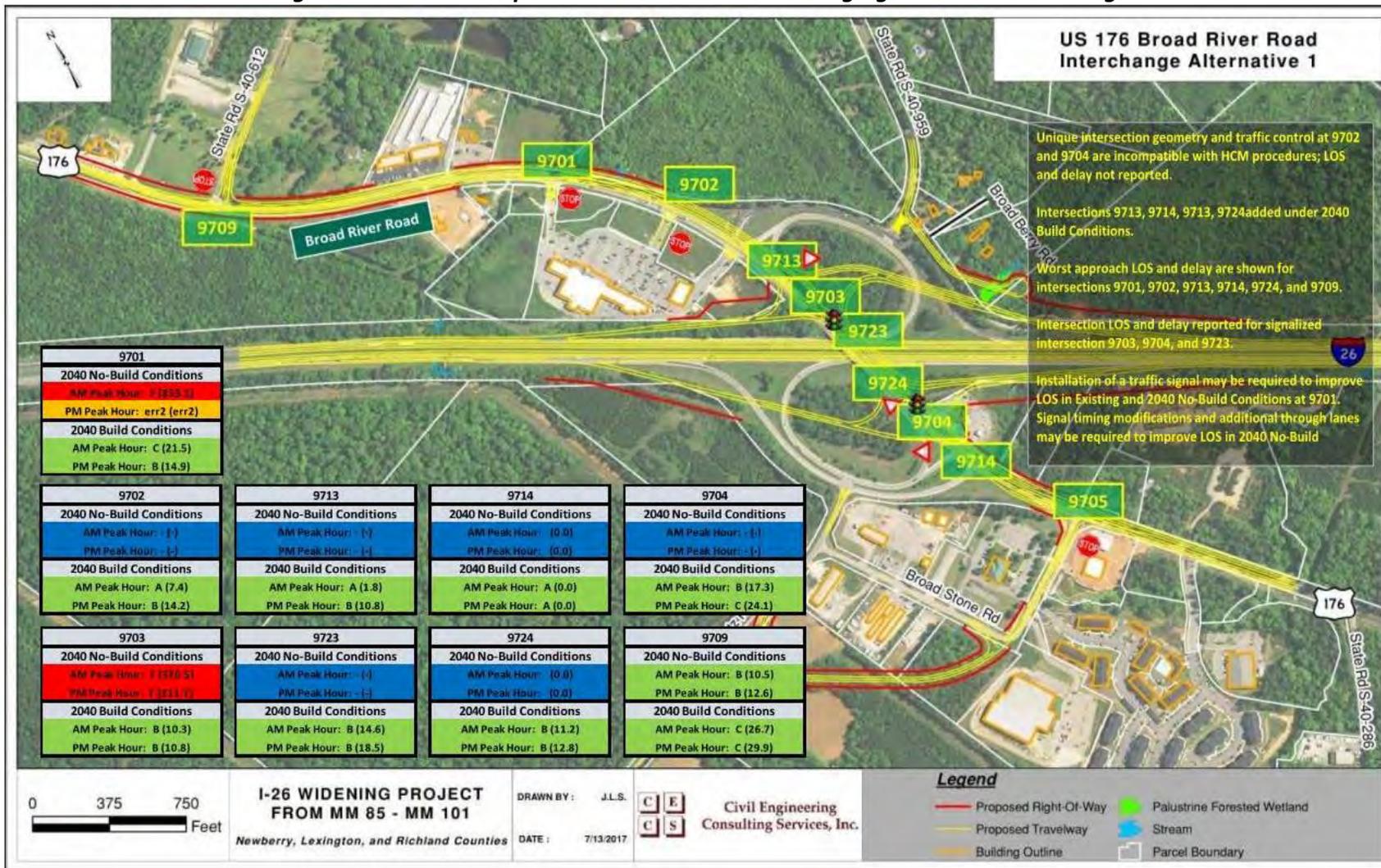
The conceptual design of Alternative 1 is shown in **Figure 85**.

Alternative 1 replaces the existing Exit 97 interchange with a diverging diamond interchange. Other elements of the alternative concept include:

- Eliminating access to Julius Richardson Road from the westbound ramps, shifting Julius Richardson Road traffic to West Shady Grove Road
- Eliminating access to Rauch-Metz Road from the eastbound ramps, shifting Rauch-Metz Road traffic to Broad Stone Road
- Eliminating the existing intersection of Broad River Road and the I-26 westbound ramps/shopping center access
- Widening Broad River Road between Broad Stone Road and the Food Lion North Access

**Figure 93** shows the 2040 Build Volumes for Alternative 2. **Table 23** and **Table 27** present the LOS and queuing results for the 2040 Build Conditions. Improvements to the original concept were made including the turn lane lengths, number of approach lanes, number of lanes on Broad River Road, and signal phasing to obtain acceptable LOS results. This is represented under the 2040 Build Conditions with Improvements which shows the intersections of Broad River Road and the I-26 ramps improving from LOS E or F to LOS C or better. **Table 27** shows the queuing analysis as well as the necessary turn lane lengths for the 2040 Build conditions with Improvements.

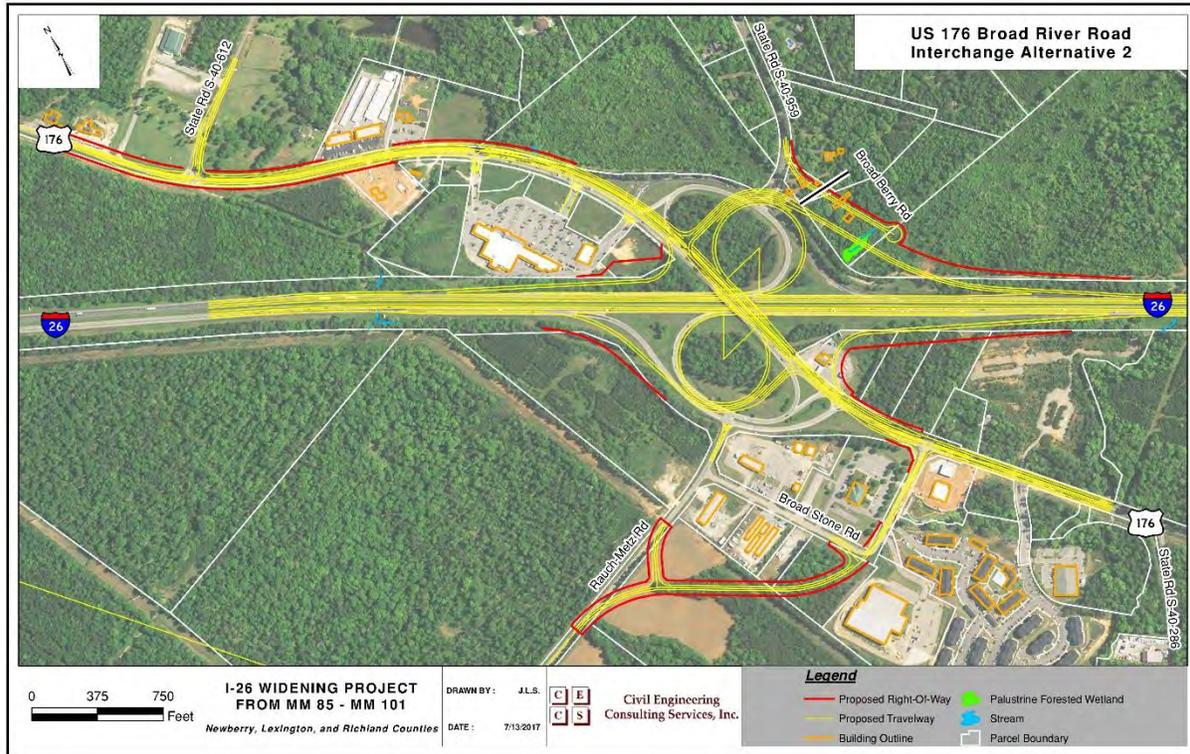
Figure 85 - Exit 97: Improvement Alternative 1 Diverging Diamond Interchange



Alternative 2

The conceptual design of Alternative 2 is shown in **Figure 86**.

**Figure 86 - Exit 97: Improvement Alternative 2 Partial Cloverleaf**



Alternative 2 replaces the existing Exit 97 interchange with a partial cloverleaf interchange. Other elements of the alternative concept include:

- Eliminating access to Julius Richardson Road from the westbound ramps, shifting Julius Richardson Road traffic to West Shady Grove Road
- Eliminating access to Rauch-Metz Road from the eastbound ramps, shifting Rauch-Metz Road traffic to Broad Stone Road
- Eliminating the existing eastbound and westbound ramp intersections with Broad River Road
- Widening Broad River Road between Broad Stone Road and the Food Lion North Access

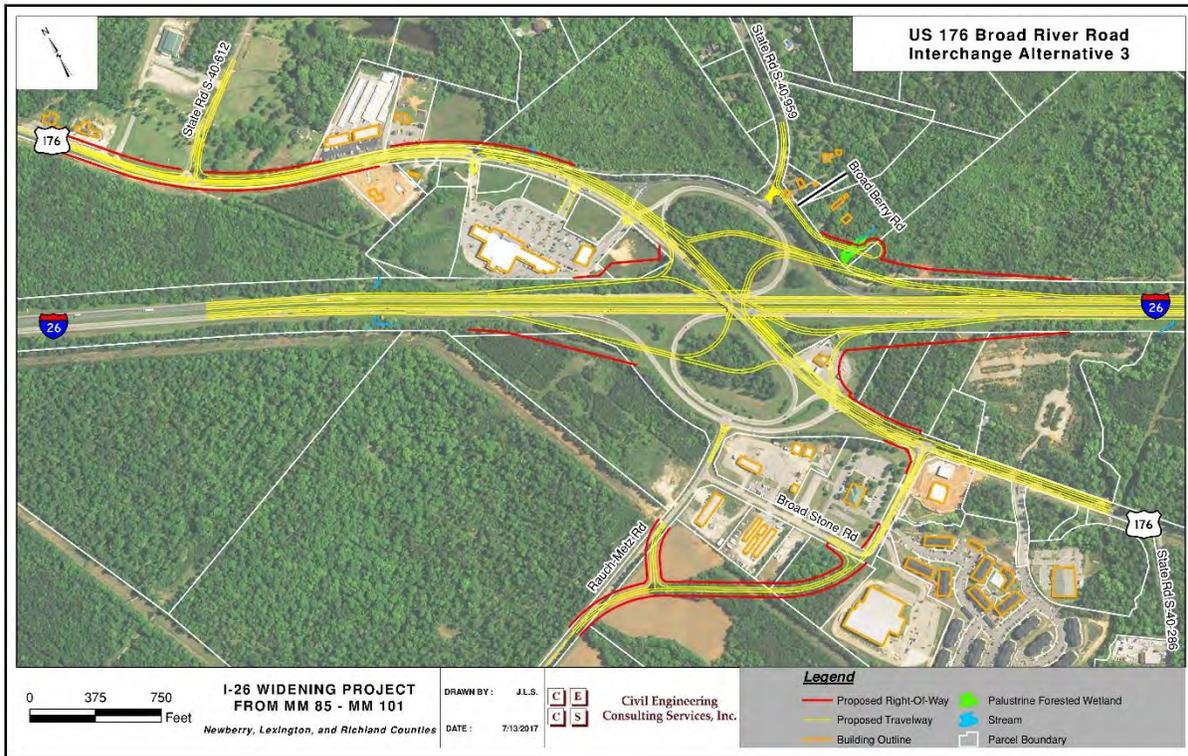
**Figure 94** shows the 2040 Build Volumes for Alternative 1. **Table 23** and **Table 28** present the LOS and queuing results for the 2040 Build Conditions. Improvements to the original concept were made including the turn lane lengths, number of approach lanes, and signal phasing to obtain acceptable LOS results. This is represented under the 2040 Build Conditions with Improvements which shows the intersections of Broad River Road and the I-26 ramps improving from LOS E or

F to LOS C or better. **Table 28** shows the queuing analysis as well as the necessary turn lane lengths for the 2040 Build conditions with Improvements.

Alternative 3

The conceptual design of Alternative 3 is shown in **Figure 87**.

**Figure 87 - Exit 97: Improvement Alternative 3 SPUI**



Alternative 3 replaces the existing Exit 97 interchange with a Single Point Urban Interchange (SPUI). Other elements of the alternative concept include:

- Eliminating access to Julius Richardson Road from the westbound ramps, shifting Julius Richardson Road traffic to West Shady Grove Road
- Eliminating access to Rauch-Metz Road from the eastbound ramps, shifting Rauch-Metz Road traffic to Broad Stone Road
- Eliminating the existing intersection of Broad River Road and the I-26 westbound ramps/shopping center access
- Widening Broad River Road between Broad Stone Road and the Food Lion North Access

**Figure 95** shows the 2040 Build Volumes for Alternative 3. **Table 23** and **Table 29** present the LOS and queuing results for the 2040 Build Conditions. Improvements to the original concept were made including the turn lane lengths, number of approach lanes, and signal phasing to obtain acceptable LOS results. This is represented under the 2040 Build Conditions with Improvements

which shows the intersections of Broad River Road and the I-26 ramps improving from LOS E or F to LOS D or better. **Table 29** shows the queuing analysis as well as the necessary turn lane lengths for the 2040 Build conditions with Improvements.

#### Exit 101 – Broad River Road (US 76, US 176)

The Broad River Road (US 76, US 176) interchange is not expected to be modified as part of the I-26 widening project. Therefore, the results of the 2040 Build analyses within the Exit 101 interchange area will be the same results of the 2040 No Build analysis (see **Figure 77**).

#### Exit 102 – Lake Murray Boulevard (SC 60)

The Lake Murray Boulevard (SC 60) interchange is not expected to be modified as part of the I-26 widening project. Therefore, the results of the 2040 Build analyses within the Exit 102 interchange area will be the same results of the 2040 No Build analysis (see **Figure 78**).

Figure 88- 2040 Estimated Peak Hour Turning Movement Volumes: Exit 85 Alternative 1

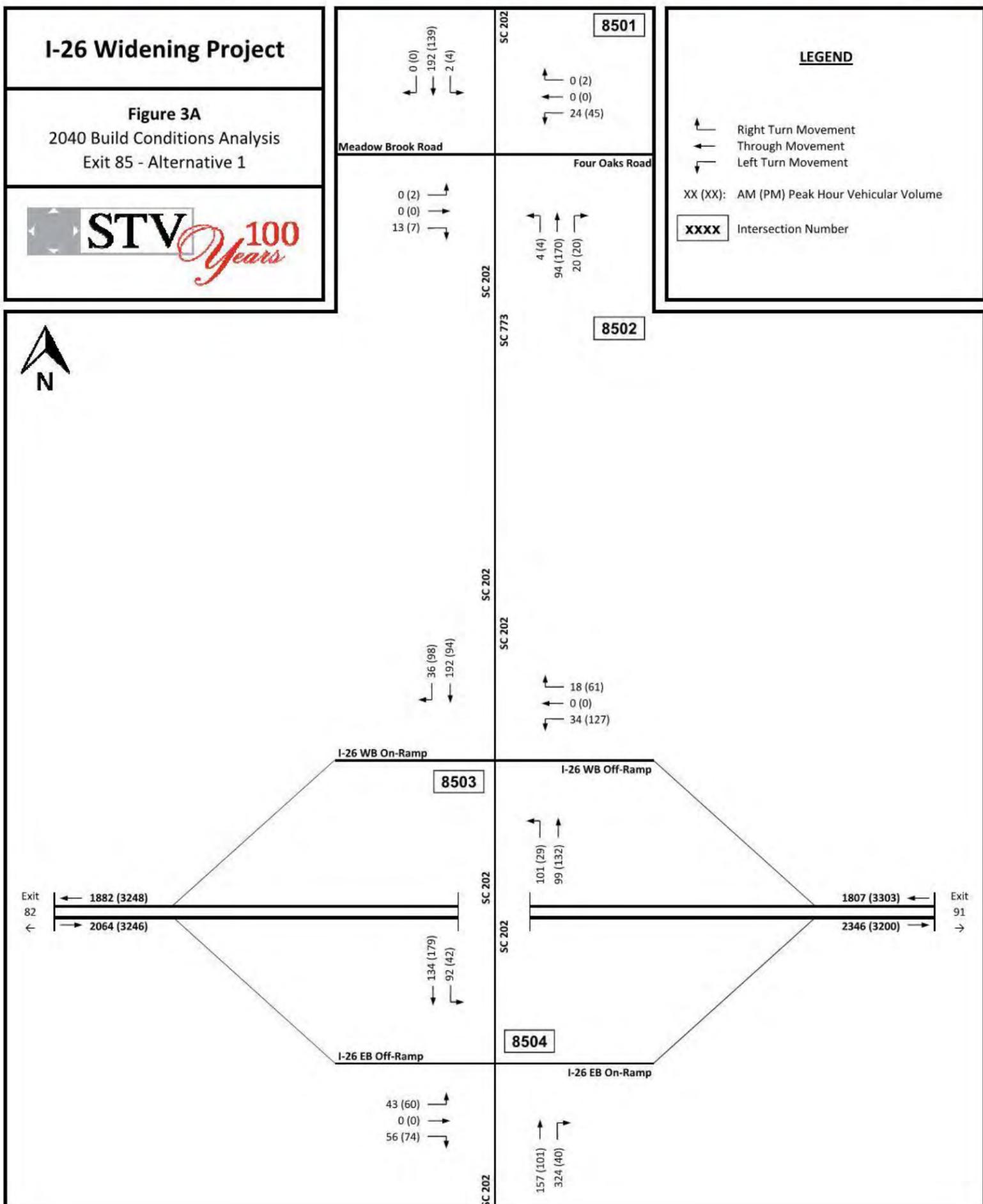


Figure 89- 2040 Estimated Peak Hour Turning Movement Volumes: Exit 85 Alternative 1A

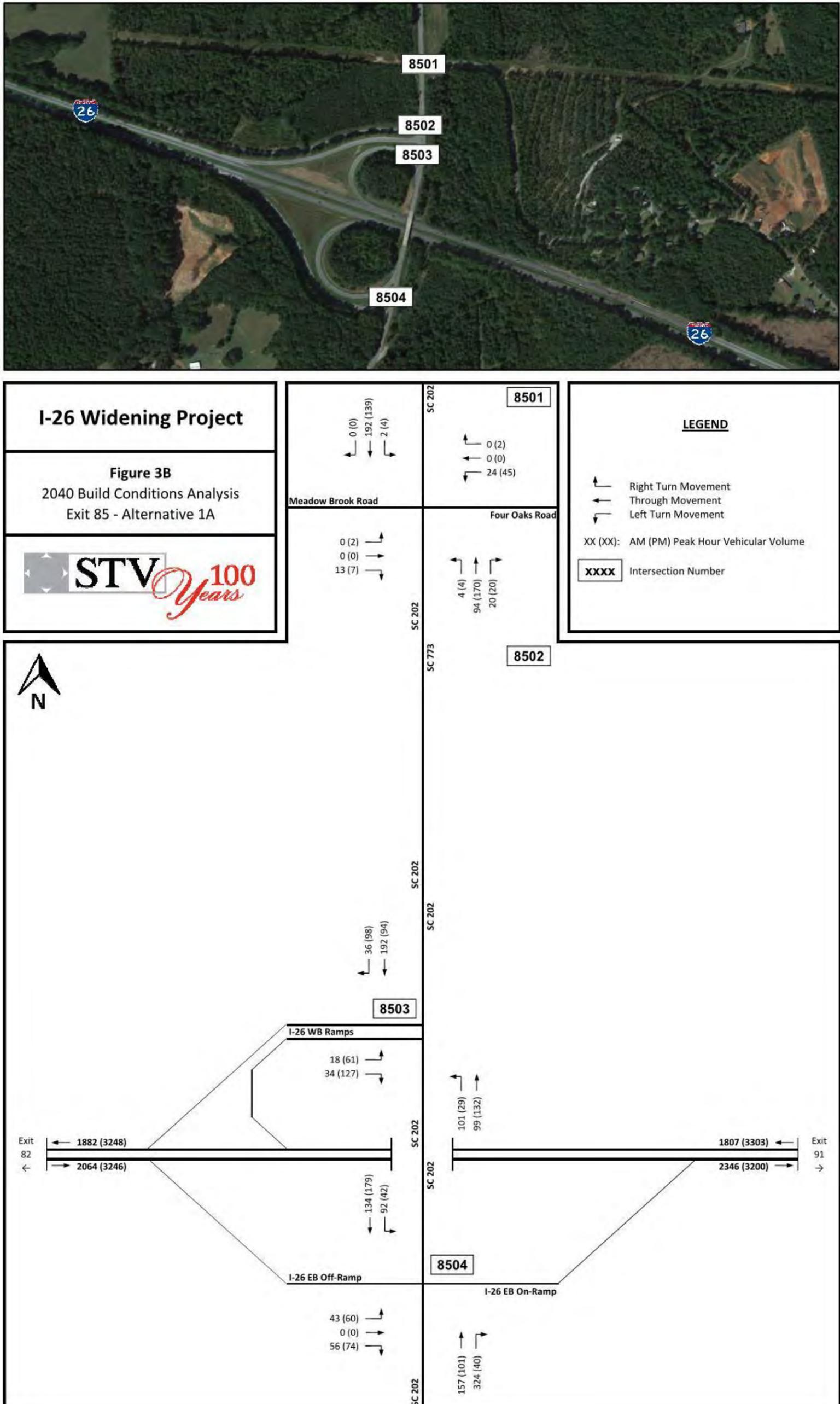


Figure 90- 2040 Estimated Peak Hour Turning Movement Volumes: Exit 85 Alternative 2

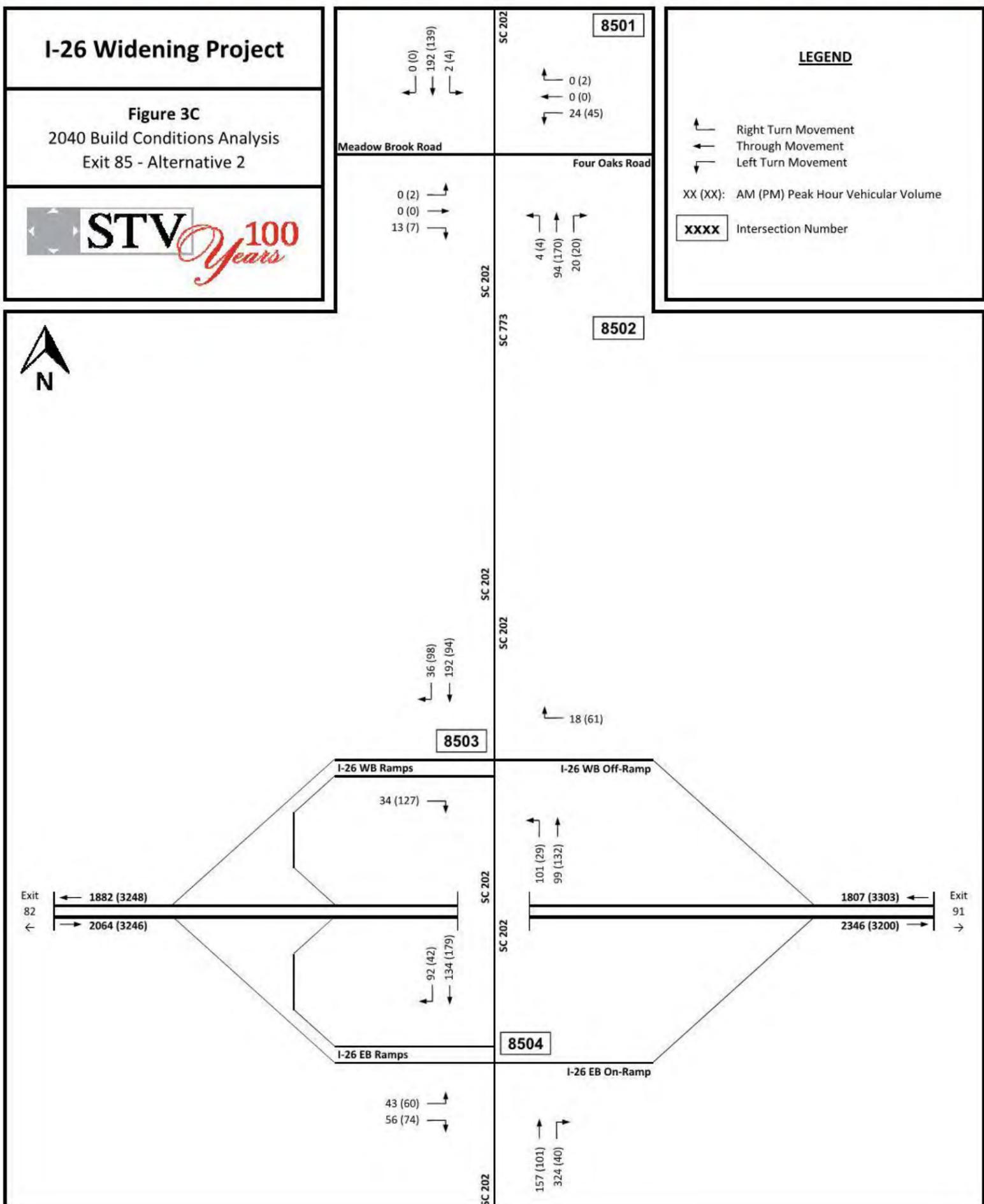




Figure 92- 2040 Estimated Peak Hour Turning Movement Volumes: Exit 85 Alternative 3

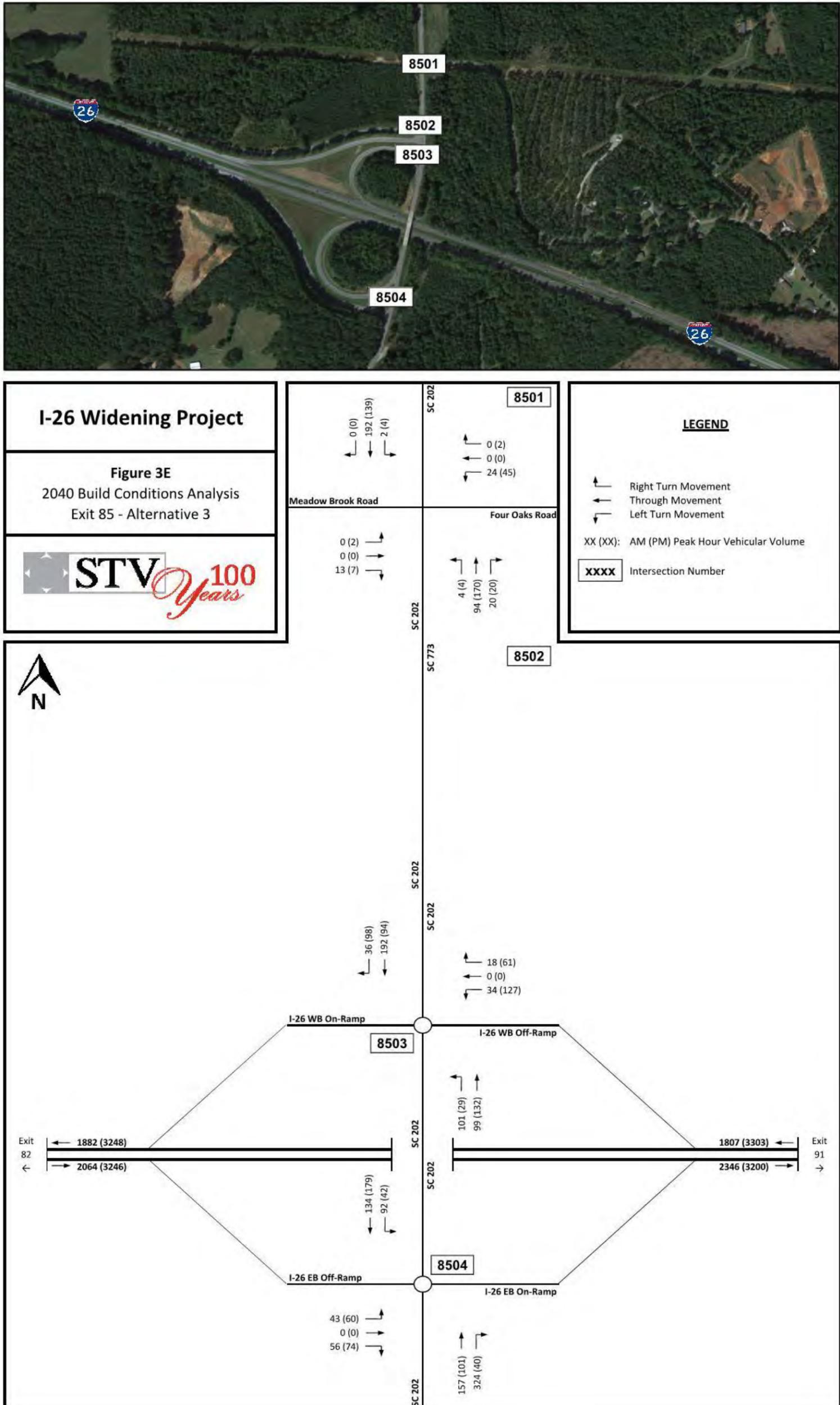


Figure 93- 2040 Estimated Peak Hour Turning Movement Volumes: Exit 97 Alternative 1

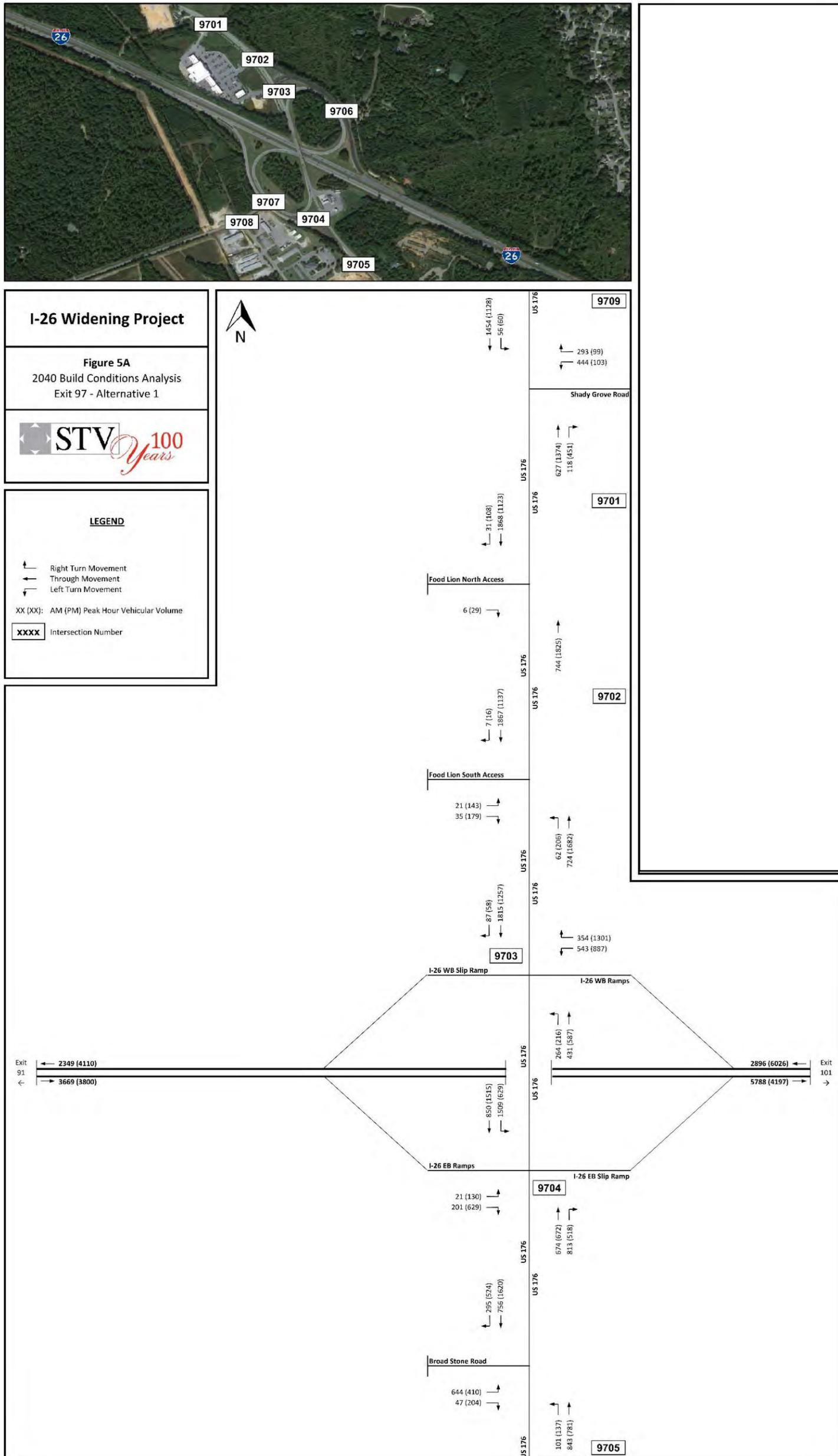


Figure 94- 2040 Estimated Peak Hour Turning Movement Volumes: Exit 97 Alternative 2

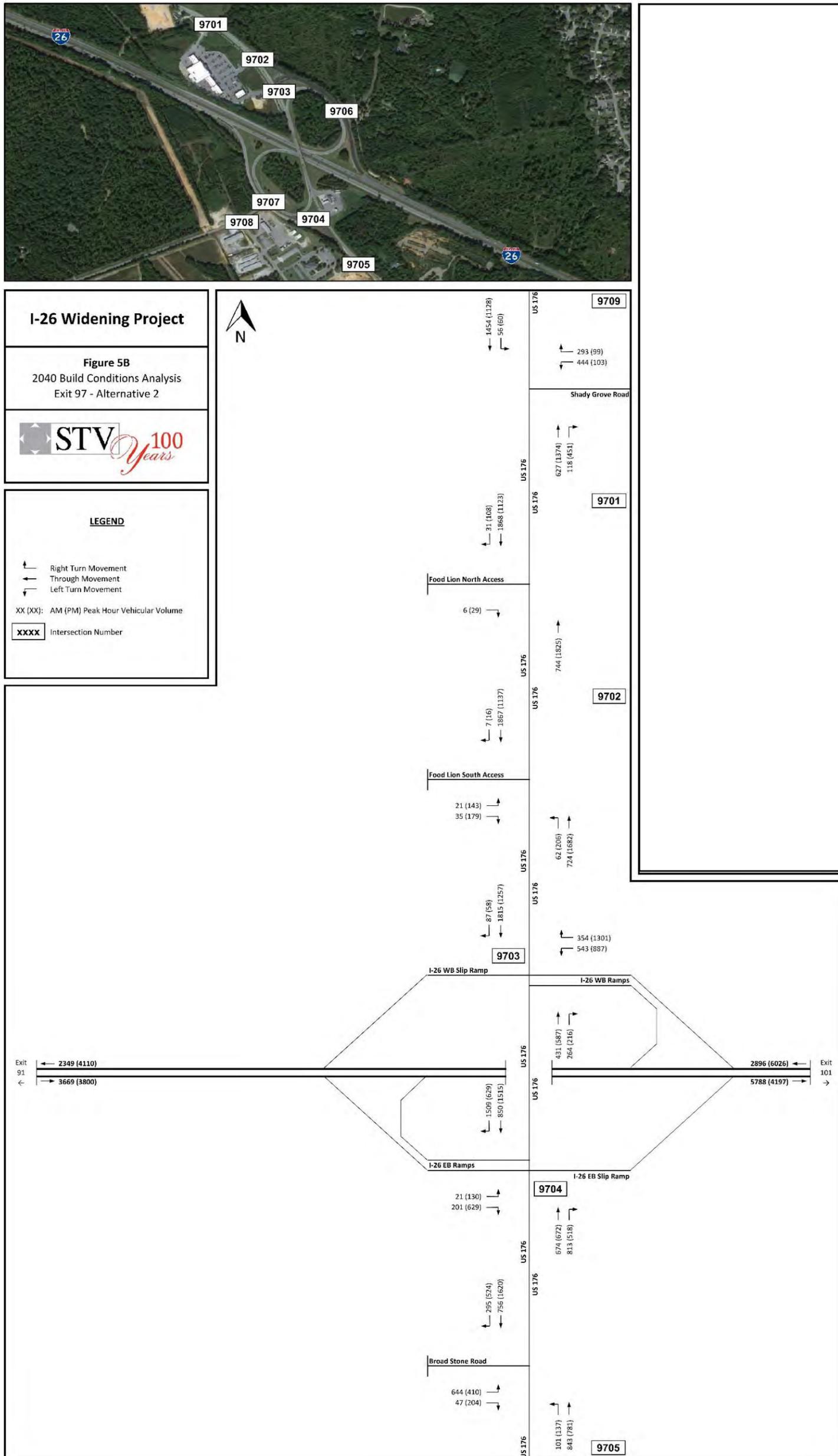
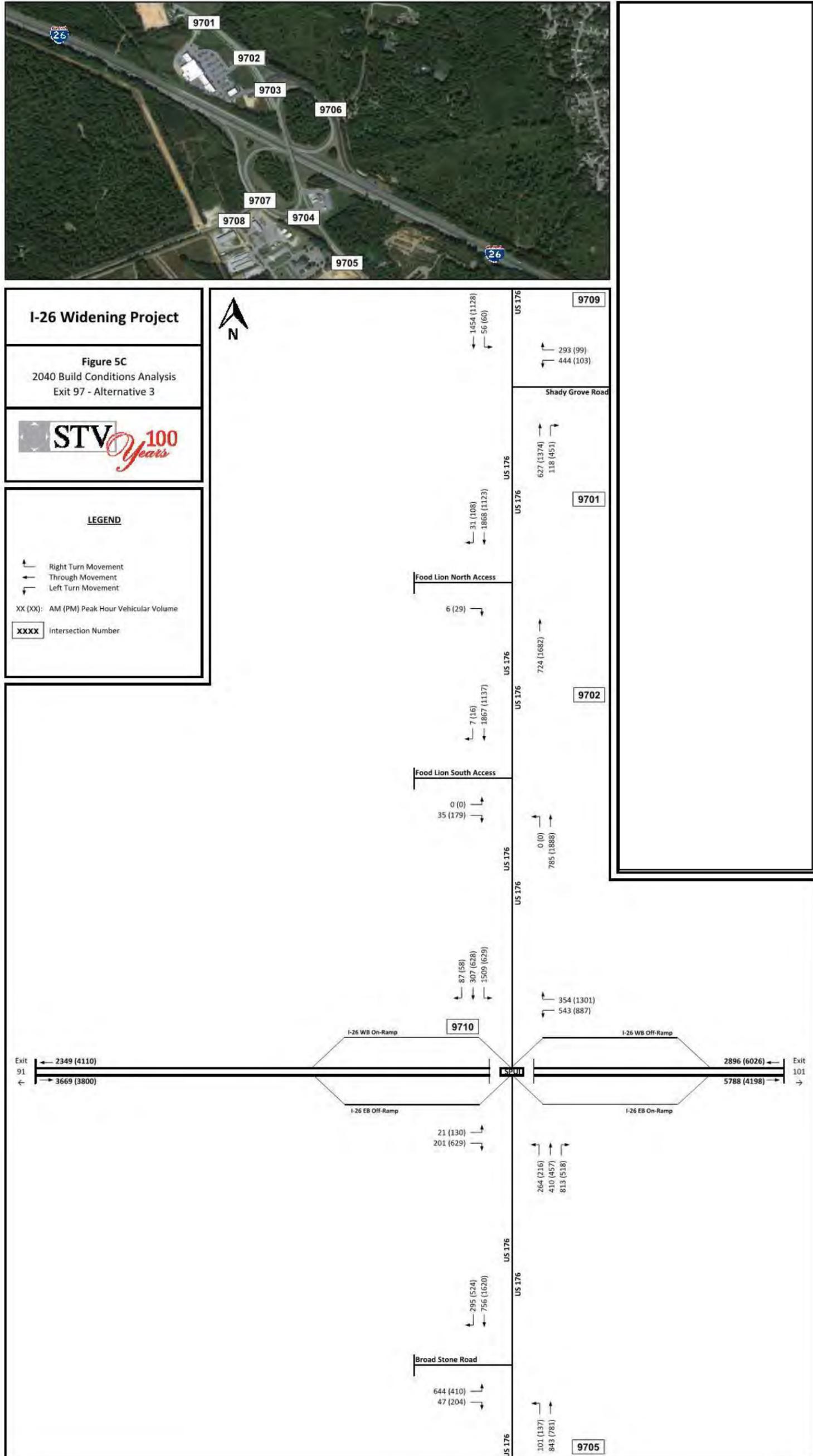


Figure 95- 2040 Estimated Peak Hour Turning Movement Volumes: Exit 97 Alternative 3



## TransModeler Network Analysis

TransModeler, a microsimulation software, was used to analyze the existing, no-build, and final build alternative freeway networks. A TransModeler microsimulation model consists of a large amount of component database and executable files that are run through the TransModeler software. The model then is initiated within TransModeler through a single project file. The main components of the model are network files, traffic control and signal timing plans, vehicle detector layout and configuration, trip tables for both autos and trucks, traffic counts, and parameter files. This section illustrates how to develop these main components for creating a base year model of existing conditions. The microsimulation model was developed for the 20-mile interstate section of the project and was based on a calibrated base model for the area.

There are several limitations of using HCS, which is a macroscopic, deterministic model that uses HCM methodologies. The HCS analysis may show differing conditions than existing operations and conditions in the field because it does not consider upstream and downstream traffic impacts and is unable to model interactions between the two. The HCS model is a spot check at a certain location; therefore upstream and downstream operations are not taken into consideration and have no effect on the analyses. This is not the case for actual conditions, as upstream or downstream congestion may have direct impacts at a specific segment causing a ripple effect. TransModeler evaluates each segment and lane by taking into consideration vehicle interaction and driver behaviors, as well as the operation impacts for both the upstream and downstream traffic conditions.

## Building Base Model Network and Calibration

The base network 20-mile study area of I-26 originated from the Columbia traffic microsimulation model developed for use in the I-20/26/77 Corridor Management Plan study. However, the Exit 82 and Exit 85 interchanges were not part of the model and were developed based on aerial images. The existing signal timings were confirmed based on SCDOT data. Similar to the Columbia model, each simulation was run for one hour and a 30 minute preload period to load the network. Page 64 of the FHWA Guidelines outlines the microsimulation model calibration criteria developed by WDOT, which includes three metrics: traffic flow, travel times, and visual audits. Formulas for the first two metrics verify that the criteria thresholds are not violated, while satisfaction of the third depends on engineering judgement.

Appendix B: Confidence Intervals of the FHWA Guidelines suggests that, to account for the stochastic nature of traffic and to ensure that the mean statistics taken from the model are within an acceptable confidence interval of the true mean, each model should be run a certain number of randomly seeded runs. Based on the standard deviation of a sample of link speeds and flows from the TransModeler networks, it was determined that at least ten (10) simulation runs per model are required to maintain a 95% confidence interval.

Model calibration deals with refining the model’s operation through observation of the simulation and detection of probable anomalies in the output and trip tables. The parameters are modified through an iterative process so that observed traffic conditions, like travel speeds and link flows, are more accurately matched to predefined criteria.

Existing traffic flows on the mainline segments and interchange ramps were compared to the average traffic flows from the microsimulation runs at the same locations for both AM and PM peak periods. FHWA Guidelines suggest an overall comparison of the total simulation flow to the total count volume. In addition, it divides the volumes into three categories and proposes different criteria for each. It also suggests calculating the GEH statistics, its formula shown below:

$$GEH = \sqrt{\frac{(E - V)^2}{\frac{E + V}{2}}}$$

In which:

E = model estimated volume

V = field count

The comparison of all the mainline and ramp count locations for the AM and PM peak hour scenarios are shown in **Table 31** inclusive of the calibration targets and flow statistics. As the table shows, the flow statistics satisfied the range of criteria targets for each volume category.

The GEH statistic is a universal measure to compare simulation input and output data. The GEH output tables for each segment and ramp are also provided as an attachment in **Appendix M**.

**Table 31 – Traffic Flow Calibration Statistics - TransModeler Existing Network**

Hourly flows, Model Versus Observed	Target	AM Peak Hour		PM Peak Hour	
		Total Links	% of Cases	Total Links	% of Cases
Individual Link Flows					
Within 15%, for 700 veh/h <Flow< 2700 veh/h	> 85% of cases	14	100%	15	100%
Within 100 veh/h, for Flow < 700 veh/h	> 85% of cases	24	100%	22	100%
Within 400 veh/h, for Flow > 2700 veh/h	> 85% of cases	4	100%	5	100%
Average Link Flows Criteria Compliance	>85% of cases	42	100%	42	100%
Sum of All Links		42		42	
Sum of Link Flow	Within 5% of sum of all link counts		41,038		51,314.0
Sum of Counts			41,396		50,540
Abs(Flow - Counts)/Counts			0.86%		1.53%
Links within 15% of Observed Travel Speeds	>85% of cases	14	93%	14	86%
Links with GEH Statistic < 5	>85% of cases	42	100%	41	98%

The INRIX speed data in addition to observations of queueing and speed along the I-26 corridor from the I-20/I-26/I-77 Corridor Management Planning Study was used to calibrate the base model. The FHWA Guidelines also suggest comparing the modeled vehicle travel speeds to those collected in the field; the modeled speeds should fall within 15% of the existing ones to consider a model calibrated. Travel speeds for specific routes, however, are not provided in TransModeler outputs; rather, travel speeds are obtained from the simulation and compared with the model input speeds. **Table 32** provides a summary of the network segments and the percentage of which met the 15% threshold.

**Table 32 – Speed Calibration Summary - TransModeler Existing Network**

AM Peak Hour			
EB Segments	Within 15%	WB Segments	Within 15%
east of Exit 102 (Lake Murray Blvd)	-27.8	east of Exit 102 (Lake Murray Blvd)	TRUE
Exit 102 to Exit 101 (Broad River Road)	TRUE	Exit 102 to Exit 101 (Broad River Road)	TRUE
Exit 101 to Exit 97 (Broad River Road)	TRUE	Exit 101 to Exit 97 (Broad River Road)	TRUE
Exit 97 to Exist 91 (Columbia Ave)	TRUE	Exit 97 to Exist 91 (Columbia Ave)	TRUE
Exit 91 to Exit 85 (HWY 202)	TRUE	Exit 91 to Exit 85 (HWY 202)	TRUE
Exit 85 to Exit 82 (St Pauls Road)	TRUE	Exit 85 to Exit 82 (St Pauls Road)	TRUE
west of Exit 82 (St Pauls Road)	TRUE	west of Exit 82 (St Pauls Road)	TRUE
<b>85% Target</b>	<b>92.86%</b>		
PM Peak Hour			
EB Segments	Within 15%	WB Segments	Within 15%
east of Exit 102 (Lake Murray Blvd)	TRUE	east of Exit 102 (Lake Murray Blvd)	78.6
Exit 102 to Exit 101 (Broad River Road)	TRUE	Exit 102 to Exit 101 (Broad River Road)	TRUE
Exit 101 to Exit 97 (Broad River Road)	TRUE	Exit 101 to Exit 97 (Broad River Road)	27.0
Exit 97 to Exist 91 (Columbia Ave)	TRUE	Exit 97 to Exist 91 (Columbia Ave)	TRUE
Exit 91 to Exit 85 (HWY 202)	TRUE	Exit 91 to Exit 85 (HWY 202)	TRUE
Exit 85 to Exit 82 (St Pauls Road)	TRUE	Exit 85 to Exit 82 (St Pauls Road)	TRUE
west of Exit 82 (St Pauls Road)	TRUE	west of Exit 82 (St Pauls Road)	TRUE
<b>85% Target</b>	<b>85.71%</b>		

### Existing and No-Build Network Conditions

The existing condition and 2040 no-build condition TransModeler analysis was performed using the existing number of freeway lanes present on the segments within the study area, similar to the HCS analysis. One TransModeler simulation network was used for existing and no-build. The only difference between the existing and No-Build condition is the input trip table volumes and a proposed widening project along Broad River Road. The 2040 no-build condition volumes were developed using the 1.5/2.0/2.5 percent annual growth rate in traffic. The existing truck percentages for the model were developed utilizing classification counts along the mainline along with intersection counts along the arterials. These inputs were combined to develop an OD

matrix for both medium and heavy trucks. These truck volumes were then scaled up to 2040 volumes by the same proportions as the overall volume growth.

The densities for the I-26 segments were obtained from the TransModeler output files. In calculating density, TransModeler automatically determines the segments and lanes within the influence area for freeway, merge and diverge analysis and applies the HCM methodology to each segment, considering only the vehicles within the influence area.

As mentioned previously, HCS is a macroscopic/deterministic model, while TransModeler is microscopic behavior-based multi-purpose traffic simulation program. TransModeler, therefore, accounts for the interaction between the passenger cars and other types of vehicles in the traffic stream while HCS does not. In TransModeler, the density is calculated at each time step of the simulation, for the entire peak hour, over a number of iterations, it is considered to be a more accurate measure of the density.

It should be noted that due to the high demand volumes the microsimulation network was not able to accommodate all of the demand volume in the Existing and No-Build simulations. There was extensive queuing outside of the network in the No-Build at the finish of the peak hour simulation for both the morning and afternoon peak hours. The queuing outside the network in the Existing was more minimal, mainly seen in the afternoon peak hour.

### **Basic Freeway Segment Analysis**

The Basic Freeway Segment Analysis outputs are provided in **Appendix N** and a summary of results is shown in **Table 33**.

***Table 33 - Freeway Segment Capacity Analysis TransModeler Results***

Segment	Existing Conditions				2040 No Build Conditions			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>
<b>I-26 Eastbound</b>								
west of Exit 82	B	12.4	C	18.7	B	17.6	C	23.2
Exit 82 to Exit 85	B	13.9	C	20.0	C	20.4	C	25.6
Exit 85 to Exit 91	B	16.7	C	20.5	F	104.9	F	99.6
Exit 91 to Exit 97	C	23.2	C	23.7	C	21.7	F	78.2
Exit 97 to Exit 101	E	35.9	C	25.5	D	32.2	C	20.1
Exit 101 to Exit 102	D	26.6	B	17.9	D	27.9	B	17.0
east of exit 102	D	33.1	C	25.9	E	35.5	C	24.6
<b>I-26 Westbound</b>								
east of exit 102	C	23.4	F	75.6	E	42.6	F	117.9
Exit 102 to Exit 101	B	14.5	E	35.2	C	21.5	F	113.9
Exit 101 to Exit 97	C	22.2	F	54.7	D	31.5	F	115.3
Exit 97 to Exit 91	C	19.0	D	27.8	E	36.6	C	24.5
Exit 91 to Exit 85	B	15.3	C	24.5	B	13.2	B	15.1
Exit 85 to Exit 82	B	15.2	C	23.4	A	10.9	B	13.6
west of Exit 82	B	14.2	C	21.4	A	10.5	B	12.5

<sup>1</sup> Per Highway Capacity Manual 2010 criteria.

<sup>2</sup> Density expressed as passenger cars/per mile/per lane.

The analysis results for the freeway segments, summarized in **Table 33**, indicate the following:

### 2016 Existing Conditions

Using the design hour volumes for the morning and afternoon peak hours, the analysis results indicate that:

- During the morning peak hour, the eastbound freeway segment between Exit 97 and 101 operates at LOS E. All other segments operate at LOS D or better.
- During the afternoon peak hour, westbound freeway segments from the east of Exit 102 to Exit 97 operate at LOS E or F. All other freeway segments operate at LOS D or better.

### 2040 No-Build Conditions

With traffic volumes projected to increase within the corridor at an annual rate of between 1.5 to 2.5 percent per year, and if I-26 is not widened, the increased traffic volumes traveling on the existing interstate capacity will result in increased density and reductions of freeway segment LOS.

Using the design hour volumes for the morning and afternoon peak hours, the analysis results indicate that:

- During the morning peak hour, the eastbound segment from Exit 85 to Exit 91 operates at LOS F, while the segment east of Exit 101 operates at LOS E. The westbound segments east of Exit 102 and between Exits 97 and 91 operate at LOS E. All other freeway segments operate at LOS D or better.

- During the afternoon peak hour, the westbound freeway segments between east of Exit 102 to Exit 97 operate at LOS F. In the eastbound direction, freeway segments operate at LOS F between exits 85 and 97. All other freeway segments operate at LOS C or better.

### Ramp Merge Analysis

The Ramp Merge Analyses outputs are provided in **Appendix O** and the summary results are shown in **Table 34**. The merge analysis results for the eastbound on-ramp at Exit 101 and the westbound on-ramp from Exit 102 are summarized in these tables even though they are the entry legs of existing weaving sections between Exits 101 and 102.

**Table 34 - Ramp Merge Capacity Analysis TransModeler Results**

Segment	Existing Conditions				2040 No Build Conditions			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>
<b>I-26 Eastbound</b>								
Exit 82 On-ramp	A	9.1	B	14.2	B	14.0	B	17.8
Exit 85 Loop On	B	17.0	B	17.5	D	30.9	D	26.5
Exit 91 On-ramp	B	16.9	B	16.6	B	14.4	B	13.0
Exit 97 Loop	E	40.6	C	20.2	D	31.9	B	16.1
Exit 101	D	26.6	B	17.9	D	27.9	B	17.0
Exit 102	E	36.1	C	25.9	F	46.1	D	26.9
<b>I-26 Westbound</b>								
Exit 102	B	14.5	E	35.2	C	21.5	F	113.9
Exit 101	B	12.1	F	119.2	B	17.0	F	155.7
Exit 97 Loop	B	13.4	C	20.3	B	17.5	B	16.2
Exit 91 On-ramp	A	10.5	B	17.7	A	10.0	B	11.3
Exit 85 On ramp	B	11.5	C	18.7	A	9.3	B	11.1
Exit 82 On-ramp	A	9.6	B	14.6	A	7.5	A	8.6

<sup>1</sup> Per Highway Capacity Manual 2010 criteria.

<sup>2</sup> Density expressed as passenger cars/per mile/per lane.

The analysis results for the ramp merge areas, summarized in **Table 34**, indicate the following:

2016 Existing Conditions

Using the design hour volumes for the morning and afternoon peak hours, the analysis results indicate that:

- During the morning peak hour, eastbound ramp merge areas at the Exit 97 loop on-ramp and the Exit 102 on-ramp operate at LOS E. All other ramp merge areas operate at LOS D or better.
- During the afternoon peak hour, ramp merge areas at Exit 101 and Exit 102 operate at LOS F or E respectively. All other ramp merge areas operate at LOS D or better.

2040 No-Build Conditions

With traffic volumes projected to increase within the corridor at an annual rate of between 1.5 to 2.5 percent per year, and if I-26 is not widened, the increased traffic volumes traveling on the existing interstate capacity will result in increased density and will reduce the merge area LOS.

Using the design hour volumes for the morning and afternoon peak hours, the analysis results indicate that:

- During the morning peak hour, the eastbound ramp merge area from Exit 102 operates at LOS F. All other ramp merge areas operate at LOS D or better.
- During the afternoon peak hour, westbound ramp merge areas at Exits 102 and 101 operate at LOS F. All other ramp merge areas operate at LOS D or better.

### Ramp Diverge Analysis

The Ramp Diverge Analyses are also provided in **Appendix O** and the summary results are shown in **Table 35**. The merge analysis results for the eastbound off-ramp at Exit 102 and the westbound off-ramp to Exit 101 are summarized in these tables even though they are the exit legs of existing weaving sections between Exits 101 and 102.

The analysis results for the ramp diverge areas, summarized in **Table 35**, indicate the following:

#### 2016 Existing Conditions

Using the design hour volumes for the morning and afternoon peak hours, the analysis results indicate that:

- During the morning peak hour, all ramp diverge areas operate at LOS D or better.
- During the afternoon peak hour, the westbound ramp diverge areas from Exit 102 to Exit 97 operate at LOS E or F. All other ramp diverge areas operate at LOS C or better.

**Table 35 - Ramp Diverge Capacity Analysis TransModeler Results**

Segment	Existing Conditions				2040 No Build Conditions			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>
<b>I-26 Eastbound</b>								
Exit 82 to Exit 85	A	10.6	B	15.6	B	15.3	C	19.8
Exit 85	B	11.8	B	16.1	B	17.9	C	22.1
Exit 91	B	12.3	B	15.5	F	137.5	F	123.3
Exit 97	B	17.2	B	16.9	E	38.3	F	133.5
Exit 101	D	28.9	C	20.9	D	27.2	B	16.7
Exit 101 Loop	C	18.1	B	13.8	B	17.1	B	11.9
Exit 102	D	26.6	B	17.9	D	27.9	B	17.0
Exit 102 Loop	C	24.2	B	17.0	C	24.0	B	16.1
<b>I-26 Westbound</b>								
Exit 102	D	28.5	F	71.0	F	54.8	F	125.2
Exit 102 Loop	C	18.3	E	35.1	E	40.2	F	97.2
Exit 101	B	14.5	E	35.2	C	21.5	F	113.9
Exit 101 Loop	B	14.1	F	56.8	C	20.0	F	138.7
Exit 97	B	16.1	E	40.9	C	24.7	F	86.7
Exit 91	B	14.0	C	19.9	F	130.2	F	106.2
Exit 85 Loop Off	B	13.8	C	21.8	B	13.0	B	15.2
Exit 82 to Exit 85	B	11.5	B	17.6	A	8.8	B	11.0

<sup>1</sup> Per Highway Capacity Manual 2010 criteria.

<sup>2</sup> Density expressed as passenger cars/per mile/per lane.

#### 2040 No-Build Conditions

With traffic volumes projected to increase within the corridor at an annual rate of between 1.5 to 2.5 percent per year, and if I-26 is not widened, the increased traffic volumes traveling on the existing interstate capacity will result in increased density and will reduce the diverge area LOS.

Using the design hour volumes for the morning and afternoon peak hours, the analysis results indicate that:

- During the morning peak hour, the eastbound ramp diverge area at Exits 91 and 97 are expected to operate at LOS F and E respectively. In the westbound direction, the diverge areas for Exits 102 and 91 operate at LOS F, and the diverge area for the loop exit ramp at Exit 102 operates at LOS E. All other ramp diverge areas operate at LOS D or better.
- During the afternoon peak hour, the eastbound ramp diverge areas at Exits 91 and 97 operate at LOS F. All westbound ramp diverge areas from Exit 102 to Exit 91 operate at LOS F. All other ramp diverge areas operate at LOS C or better.

## VI. FINAL PREFERRED ALTERNATIVE NETWORK CONDITIONS

The final build alternative network was identified based on the preferred alternative improvements selected for each interchange. Though traffic operations were a consideration in the evaluation of alternatives, other factors, such as construction costs, business and residential relocations, and environmental impacts were used to identify the preferred alternatives. As outlined in the *I-26 Widening Environmental Assessment (MM 85 to MM 101)*, the preferred alternatives for the interchange improvements are as follows

- Exit 85: Alternative 1A was recommended as the preferred alternative for reasons which include:
  - Alternative 1A meets the purpose and need
  - Alternative 1A has the lowest overall construction cost
  - Alternative 1A does not require any residential or commercial relocations
  - Alternative 1A results in the lowest impact to streams making it the least environmentally damaging practicable alternative
- Exit 97: Alternative 1 was recommended as the preferred alternative for reasons which include:
  - Alternative 1 would impact the least amount of streams and wetlands making this the least environmentally damaging practicable alternative
  - Alternative 1 requires the least amount of new right-of-way and has the lowest overall estimated construction cost
  - Alternative 1 would also reduce congestion and provide a safer interchange, satisfying the project purpose and need

The Final Build AM and PM TransModeler models for the I-26 study area were developed by modifying the 2040 No-Build models to incorporate the widening of I-26 from two to three lanes in each direction between Exit 85 and Exit 97 and two to four lanes in each direction between Exit 97 and Exit 101 as well as the preferred alternatives for each interchange. Synchro was used to

input the recommended signal timing information into the network for the arterial intersections. Each simulation was run for one hour with 30 minutes of seeding time to load the network. 10 simulation runs for were compiled for both the AM and PM peak periods. It should be noted that there was some queuing outside the network observed at the end of the morning and afternoon simulation runs due to the high demand volumes at Exits 101 and 102.

### Basic Freeway Segment Analysis

The Basic Freeway Segment Analysis outputs for the Final Build conditions are provided in **Appendix N** and a summary of results compared to Existing and No Build conditions is shown in **Table 36**.

With the widening of I-26 to accommodate the projected increase in traffic volume within the corridor, the increased traffic volumes traveling on the widened interstate capacity will result in most segment densities in the 2040 Build condition being comparable to those in existing conditions.

**Table 36 – Final Freeway Segment Capacity Analysis TransModeler Results**

Segment	Existing Conditions				2040 No Build Conditions				2040 Build Conditions			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>
<b>I-26 Eastbound</b>												
west of Exit 82	B	12.4	C	18.7	B	17.6	C	23.2	B	17.7	C	23.2
Exit 82 to Exit 85	B	13.9	C	20.0	C	20.4	C	25.6	C	20.1	C	25.4
Exit 85 to Exit 91	B	16.7	C	20.5	F	104.9	F	99.6	B	15.9	B	16.7
Exit 91 to Exit 97	C	23.2	C	23.7	C	21.7	F	78.2	C	21.1	C	21.8
Exit 97 to Exit 101	E	35.9	C	25.5	D	32.2	C	20.1	D	26.2	C	18.2
Exit 101 to Exit 102	D	26.6	B	17.9	D	27.9	B	17.0	D	34.0	C	21.6
east of exit 102	D	33.1	C	25.9	E	35.5	C	24.6	D	34.2	D	27.3
<b>I-26 Westbound</b>												
east of exit 102	C	23.4	F	75.6	E	42.6	F	117.9	C	25.1	F	77.1
Exit 102 to Exit 101	B	14.5	E	35.2	C	21.5	F	113.9	B	16.9	D	30.2
Exit 101 to Exit 97	C	22.2	F	54.7	D	31.5	F	115.3	B	15.1	D	26.5
Exit 97 to Exit 91	C	19.0	D	27.8	E	36.6	C	24.5	B	16.1	C	23.5
Exit 91 to Exit 85	B	15.3	C	24.5	B	13.2	B	15.1	A	10.1	B	17.1
Exit 85 to Exit 82	B	15.2	C	23.4	A	10.9	B	13.6	B	14.9	C	25.2
west of Exit 82	B	14.2	C	21.4	A	10.5	B	12.5	B	13.6	C	22.0

<sup>1</sup> Per Highway Capacity Manual 2010 criteria.

<sup>2</sup> Density expressed as passenger cars/per mile/per lane.

The analysis results for the ramp merge areas, summarized in **Table 36**, indicate the following:

- Under Build conditions during the morning peak hour:
  - All freeway segments operate at LOS C or better except the eastbound segments east of Exit 97 which operate at LOS D.
- Under Build conditions during the afternoon peak hour:
  - The eastbound freeway segment east of Exit 102 operates at LOS D while the remaining eastbound freeway segments operate at LOS C or better.

- The westbound freeway segment east of Exit 102 operates at LOS F while the remaining westbound segments operate at LOS D or better.

It should be noted that under the Build conditions, the three lane portion of I-26 extends just west of Exit 85 where it remains two lanes in both directions.

### Ramp Merge Analysis

The summary of the Ramp Merge Analyses results for the Build condition, compared to the Existing and No-Build conditions are shown in **Table 37**. The outputs for the Final Build condition analyses are provided in **Appendix O**.

With the widening of I-26 to accommodate the projected increase in traffic volume within the corridor, the increased traffic volumes in most merge areas in the 2040 Build condition will have densities comparable to those in existing conditions. However, several merge areas are projected to experience increased densities and worse LOS than those experienced under existing conditions, even with the widening to three and four lanes.

**Table 37 – Final Ramp Merge Capacity Analysis TransModeler Results**

Segment	Existing Conditions				2040 No Build Conditions				2040 Build Conditions			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>
<b>I-26 Eastbound</b>												
Exit 82 On-ramp	A	9.1	B	14.2	B	14.0	B	17.8	B	14.6	C	18.1
Exit 85 Loop On	B	17.0	B	17.5	D	30.9	D	26.5	B	12.7	B	13.3
Exit 91 On-ramp	B	16.9	B	16.6	B	14.4	B	13.0	B	17.2	B	17.4
Exit 97 Loop	E	40.6	C	20.2	D	31.9	B	16.1	C	23.5	B	15.5
Exit 101	D	26.6	B	17.9	D	27.9	B	17.0	D	34.0	C	21.6
Exit 102	E	36.1	C	25.9	F	46.1	D	26.9	F	51.2	D	30.8
<b>I-26 Westbound</b>												
Exit 102	B	14.5	E	35.2	C	21.5	F	113.9	B	16.9	D	30.2
Exit 101	B	12.1	F	119.2	B	17.0	F	155.7	B	13.9	C	24.8
Exit 97 Loop	B	13.4	C	20.3	B	17.5	B	16.2	B	12.1	B	17.9
Exit 91 On-ramp	A	10.5	B	17.7	A	10.0	B	11.3	A	8.3	B	13.8
Exit 85 On ramp	B	11.5	C	18.7	A	9.3	B	11.1	A	9.3	B	14.9
Exit 82 On-ramp	A	9.6	B	14.6	A	7.5	A	8.6	A	9.7	B	15.3

<sup>1</sup> Per Highway Capacity Manual 2010 criteria.

<sup>2</sup> Density expressed as passenger cars/per mile/per lane.

The analysis results for the ramp merge areas, summarized in **Table 37**, indicate the following:

- Under Build conditions during the morning peak hour:
  - The eastbound and westbound merge areas operate at LOS C or better except for the eastbound merge area at Exit 101, which operates at LOS D, and the eastbound merge area at Exit 102, which operates at LOS F.
- Under Build conditions during the afternoon peak hour:

- The eastbound and westbound merge areas operate at LOS C or better except for the eastbound and westbound merge areas at Exit 102, which operates at LOS D.

It should be noted that under the Build conditions, I-26 is not widened in the merge areas at Exit 82 and remains at two lanes.

**Ramp Diverge Analysis**

The summary of the Ramp Diverge Analyses results for the Build condition, compared to the Existing and No-Build conditions are shown in **Table 38**. The outputs for the Final Build condition analyses are provided in **Appendix O**.

With the widening of I-26 to accommodate the projected increase in traffic volume within the corridor, the increased traffic volumes in most diverge areas in the 2040 Build condition will have densities comparable to those in existing conditions. However, several diverge areas are projected to experience increased densities and worse LOS than those experienced under existing conditions.

**Table 38 – Final Ramp Diverge Capacity Analysis TransModeler Results**

Segment	Existing Conditions				2040 No Build Conditions				2040 Build Conditions			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>
<b>I-26 Eastbound</b>												
Exit 82 to Exit 85	A	10.6	B	15.6	B	15.3	C	19.8	B	14.7	C	18.9
Exit 85	B	11.8	B	16.1	B	17.9	C	22.1	B	12.3	B	14.3
Exit 91	B	12.3	B	15.5	F	137.5	F	123.3	B	14.3	B	14.8
Exit 97	B	17.2	B	16.9	E	38.3	F	133.5	B	18.0	C	18.7
Exit 101	D	28.9	C	20.9	D	27.2	B	16.7	D	32.3	C	22.4
Exit 101 Loop	C	18.1	B	13.8	B	17.1	B	11.9	C	24.3	B	17.0
Exit 102	D	26.6	B	17.9	D	27.9	B	17.0	D	34.0	C	21.6
Exit 102 Loop	C	24.2	B	17.0	C	24.0	B	16.1	D	29.9	C	21.6
<b>I-26 Westbound</b>												
Exit 102	D	28.5	F	71.0	F	54.8	F	125.2	D	30.1	F	63.1
Exit 102 Loop	C	18.3	E	35.1	E	40.2	F	97.2	C	24.3	E	39.2
Exit 101	B	14.5	E	35.2	C	21.5	F	113.9	B	16.9	D	30.2
Exit 101 Loop	B	14.1	F	56.8	C	20.0	F	138.7	B	17.9	D	32.6
Exit 97	B	16.1	E	40.9	C	24.7	F	86.7	C	21.8	E	39.4
Exit 91	B	14.0	C	19.9	F	130.2	F	106.2	C	19.5	C	23.6
Exit 85 Loop Off	B	13.8	C	21.8	B	13.0	B	15.2	A	9.7	B	16.0
Exit 82 to Exit 85	B	11.5	B	17.6	A	8.8	B	11.0	B	11.6	C	18.5

<sup>1</sup> Per Highway Capacity Manual 2010 criteria.

<sup>2</sup> Density expressed as passenger cars/per mile/per lane.

The analysis results for the ramp merge areas, summarized in **Table 38**, indicate the following:

- Under Build conditions during the morning peak hour:
  - The eastbound and westbound off-ramps operate at LOS D or better.
- Under Build conditions during the afternoon peak hour:

- The diverge areas for the eastbound off-ramps will operate at LOS C or better.
- The diverge areas for the westbound off-ramp at Exit 102 operates at LOS F. The westbound loop off-ramp at Exit 102 and the off-ramp at Exit 97 operate at LOS E. The remaining westbound diverge areas will operate at LOS D or better.

## VII. CONCLUSIONS AND RECOMMENDATIONS

The analysis results support the need to widen I-26 to provide three mainline lanes in each direction between Exit 85 and Exit 97 and four lanes from Exit 97 to Exit 101 to accommodate predicted 2040 design year traffic volumes.

The three interchange concepts evaluated at Exit 85 and at Exit 97 resulted in generally comparable predicted traffic operations in the 2040 Build scenario. Therefore, other considerations, such as construction cost, environmental impacts, constructability, and maintenance of traffic during construction were considered in identifying the preferred interchange improvement alternatives.

At Exit 85, Alternative 1a was selected as the Preferred Alternative because it meets the purpose and need, has the lowest overall construction cost, does not require any residential or commercial relocations, requires the lowest acreage of new right-of-way, and results in the lowest impact to streams making it the least environmentally damaging practicable alternative. Therefore, this alternative was selected as the Preferred Alternative.

At Exit 91, the DDI concept was selected as the preferred alternative in the *Interchange Modification Report, I-26 at S-48 (Columbia Avenue) Interchange Improvements*.

At Exit 97, Alternative 1 would impact the least amount of streams and wetlands, when compared to the remaining build alternatives, making this the least environmentally damaging practicable alternative. It also requires the least amount of new right-of-way and has the lowest overall estimated construction cost. The diverging diamond would also reduce congestion and provide a safer interchange, satisfying the project purpose and need. The intersections of Broad River Road and the I-26 ramps would be improved from LOS E or F to LOS C or better. Because of these reasons, Alternative 1 was selected as the Preferred Alternative.

# **APPENDIX B**

## **Exit 85 IMR**

**Interchange Modification Report**  
**Interstate 26 Exit 85 – SC 202**  
**Newberry County, SC**

**Prepared For:**  
**South Carolina Department of Transportation**



Prepared By:

STV Incorporated  
140 Stoneridge Drive, Suite 450  
Columbia, SC 29210



September 2017

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## EXECUTIVE SUMMARY

The South Carolina Department of Transportation (SCDOT) proposes multiple improvements to the I-26 corridor from mile marker 85 – SC 202 to mile marker 101 – Broad River Road (US 176) designed to increase capacity, upgrade interchanges to meet design requirements, and expand vertical clearance at overpass bridges. Specifically, SCDOT proposes widening I-26 from four to six lanes from Exit 85 – SC 202 to Exit 97 - Broad River Road (US 176) and from four to eight lanes from Exit 97 - Broad River Road (US 176) to Exit 101 - Broad River Road (US 176). Along the project area, interchanges at Exit 85 – SC 202, Exit 91 – Columbia Avenue (S-48), and Exit 97 - Broad River Road (US 176) will be improved to bring them to compliance with design requirements.

Throughout nearly all of the study area, I-26 currently provides two lanes in each direction. From Exit 82 southeastward, the two lane section is maintained, until it is widened from two to three lanes approaching Exit 101.

The proposed project has two primary purposes: increase roadway capacity to address the projected traffic volumes and improve geometric deficiencies along the mainline and at several interchanges and overpasses in this section of I-26 by bringing them to compliance with current state and federal design standards. The secondary purpose is to improve safety which will be enhanced by improving the geometric design of the facility.

This interchange modification report (IMR) presents information for the proposed interchange modifications at Exit 85 – SC 202 located in Newberry County, SC. Today, this interchange is a partial cloverleaf interchange. Both the eastbound and westbound off- and on-ramps are located on the north side of the interchange. There is also a closely spaced frontage road (Meadow Brook Road) near the intersection of SC 202 and the westbound ramps.

Information discussed in the report is derived from the following reports: *Interstate 26 Widening Traffic Analysis Report: I-26 Widening Project MM 85-MM 101*, *Accident Analysis Report: I-26 Widening Project MM 85-MM 101*, and *Interstate 26 Widening and Improvements Mile Marker 85-101 Environmental Assessment*.

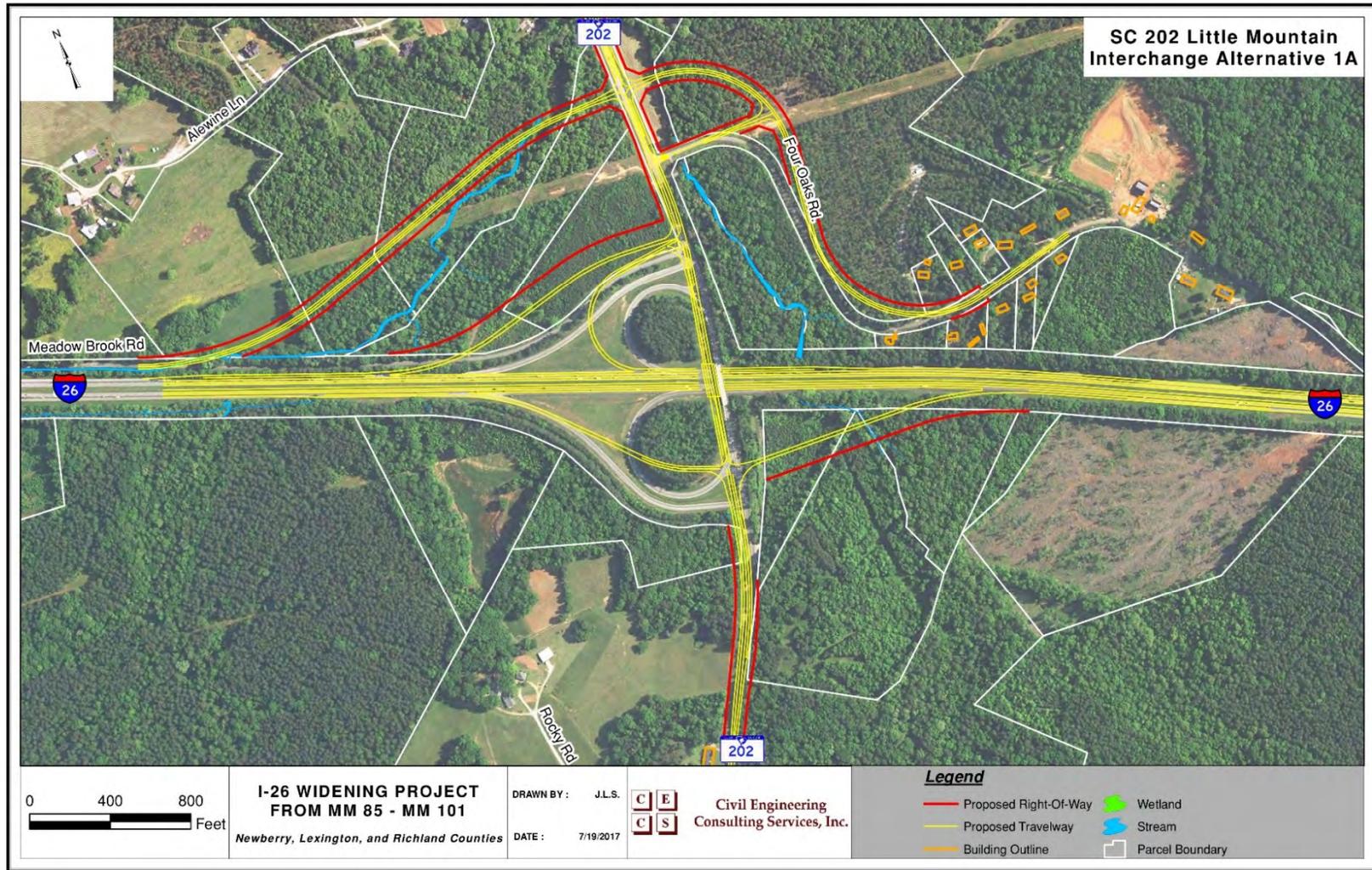
Five alternatives were developed for Exit 85. The five build alternatives at Exit 85 consist of:

- Alternative 1: Diamond Interchange – this concept would replace the existing interchange configuration with a diamond interchange. The eastbound and westbound off-ramp approaches to the ramp termini intersections would be controlled by STOP signs.
- Alternative 1A: Diamond Loop Interchange – this concept is similar to Alternative 1 but replaces the diamond ramp in the northeast quadrant with a loop ramp in the northwest quadrant.

- Alternative 2: Partial Cloverleaf (ParClo) Interchange – this concept would add a westbound off-ramp for traffic traveling to the north on SC 202, and eastbound on-ramp for traffic traveling from the south on SC 202 to the existing interchange configuration, along with adjustments to acceleration and deceleration lane lengths for the existing ramps. The eastbound and westbound off-ramp approaches to the ramp termini intersections would be controlled by STOP signs.
- Alternative 2A: ParClo Modified – this concept would be similar to Alternative 2 but would remove the ramp in the northeast quadrant and shift that movement to the loop ramp in the northwest quadrant.
- Alternative 3: Dual Roundabout (Bowtie) Interchange – this concept would eliminate the westbound loop off-ramp and eastbound loop on-ramp and provide for a diamond interchange with roundabouts instead of STOP sign controlled intersections at the ramp termini.

The Preferred Alternative that was selected for Exit 85 was Alternative 1A. Other elements of Alternative 1A include the relocation of Meadow Brook Road and 4 Oaks Road to provide further separation from the interchange ramps. Alternative 1a was selected as the Preferred Alternative because it meets the purpose and need, has the lowest overall construction cost, does not require any residential or commercial relocations, requires the lowest acreage of new right-of-way, and results in the lowest impact to streams making it the least environmentally damaging practicable alternative. Therefore, this alternative was selected as the Preferred Alternative. Alternative 1A is shown in Figure E-1.

Based on the traffic analysis of the Preferred Alternative 1A, no additional improvements are necessary.



Source: Figure 82, Interstate 26 Widening Traffic Analysis Report  
**Figure E-1. Preferred Alternative 1A**

## I. Introduction

I-26 is an east-west interstate highway that begins at the junction of U.S. Route 11W and U.S. Route 23 in Kingsport, Tennessee. From this origin, I-26 runs generally southeastward through Tennessee, North Carolina, and South Carolina, where it ends at U.S. Route 17 in Charleston, South Carolina.

Along its nearly 306 mile length, I-26 provides access to Johnson City, Tennessee; Asheville, North Carolina; and Spartanburg, Columbia and Charleston, South Carolina.

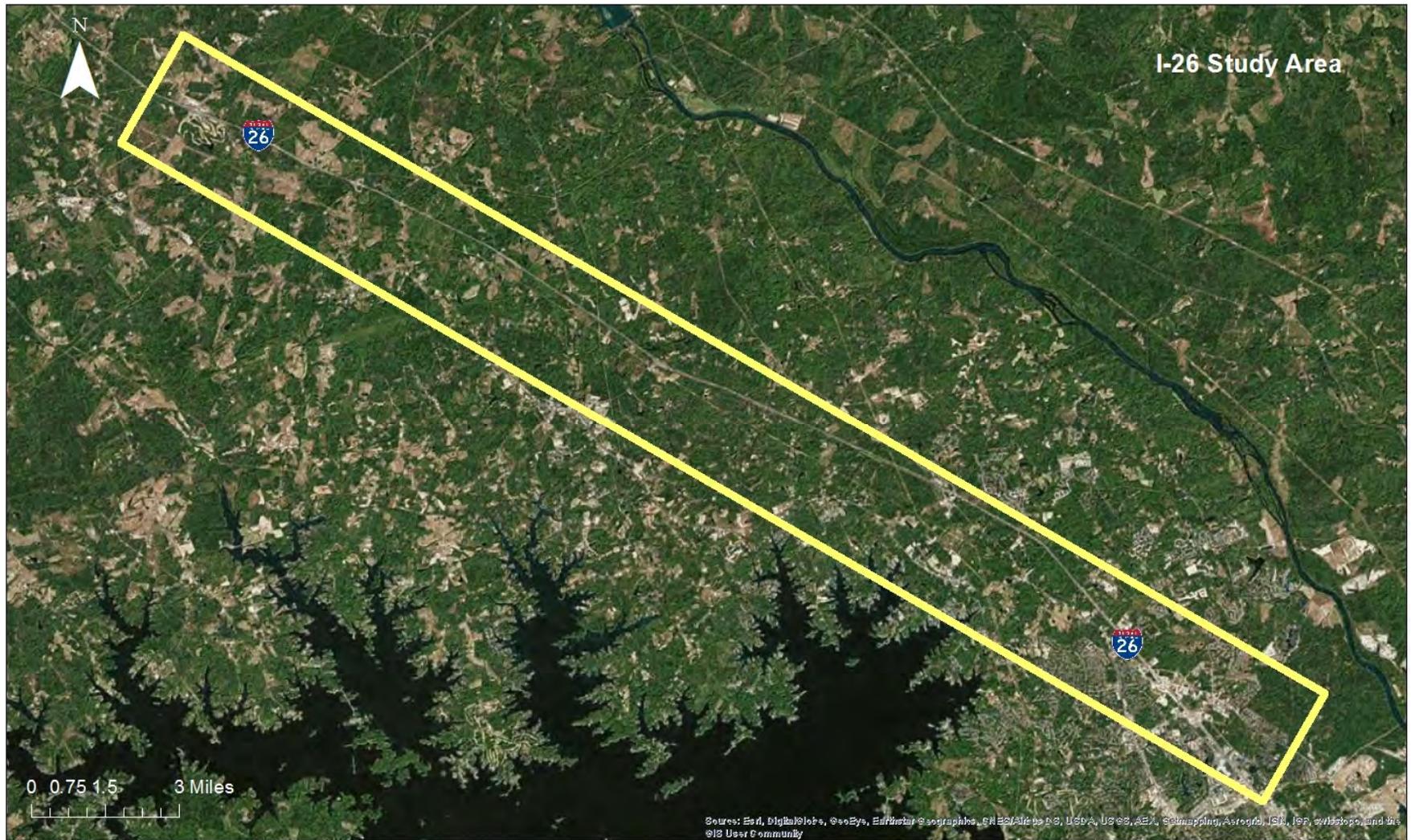
In South Carolina, I-26 covers about 221 miles, and provides connections to I-95 south of Providence, to I-77 south of Cayce, to I-20 west of Columbia, and to I-85 north-west of Spartanburg. The portion of I-26 under study in the *Interstate 26 Widening Traffic Analysis Report: I-26 Widening Project MM 85-MM 101* is located west of Columbia, generally between Exit 82 and Exit 102. Exit 85 is located on the west end of the study area.

In the vicinity of Exit 85, I-26 currently provides two lanes in each direction. The posted speed limit on I-26 in the vicinity of Exit 85 is 70 miles per hour.

In general, interstate routes can be characterized as having either level, rolling, or mountainous terrain. Consistent with the Mainline Study, the portion of I-26 adjacent to Exit 85 is characterized as having a rolling terrain.

Information discussed in the report is derived from the following projects reports: *Interstate 26 Widening Traffic Analysis Report: I-26 Widening Project MM 85-MM 101* (Mainline Study), *Accident Analysis Report: I-26 Widening Project MM 85-MM 101* (Accident Analysis), and *Interstate 26 Widening and Improvements Mile Marker 85-101 Environmental Assessment*.

The I-26 Mainline Study evaluated multiple improvements to the I-26 corridor designed to increase capacity, upgrade interchanges to meet design requirements, and expand vertical clearance at overpass bridges and/or replace them. The study considered widening I-26 from two to three lanes from approximately 1.6 miles west of Exit 85 to about 2,200 feet west of Exit 101 and examined modifications to interchanges at Exit 85 (SC 202), Exit 91 (S-32-48/Columbia Avenue) and Exit 97 (US 176/Broad River Road). To provide sufficient coverage to prepare interchange modification reports, the I-26 Mainline Study included the existing interchanges at Exits 82, 101 and 102. **Figure 1** depicts the study area for the overall I-26 Widening project.



Source: Figure 1, *Interstate 26 Widening Traffic Analysis Report*  
**Figure 1. Interstate 26 Widening Study Area**

## II. Exit 85 – SC 202

Exit 85 is a partial cloverleaf interchange with a loop on-ramp in the southwest quadrant and a loop off-ramp in the northwest quadrant. The existing configuration of the Exit 85 interchange is shown in **Figure 2**.

### Existing Conditions

The westbound loop off-ramp is approximately 860 feet long with a 415 feet long parallel deceleration lane (with a parallel length of approximately 190 feet). The off-ramp has a 30 mph posted advisory speed limit, and widens from a single lane to provide a separate left turn lane and a separate right turn lane that are separated from each other by a grass island. The left turn lane provides approximately 40 feet of storage upstream of the stop line and is controlled by a STOP sign. The right turn lane provides approximately 110 feet of storage upstream of the stop line and is controlled by a yield sign.

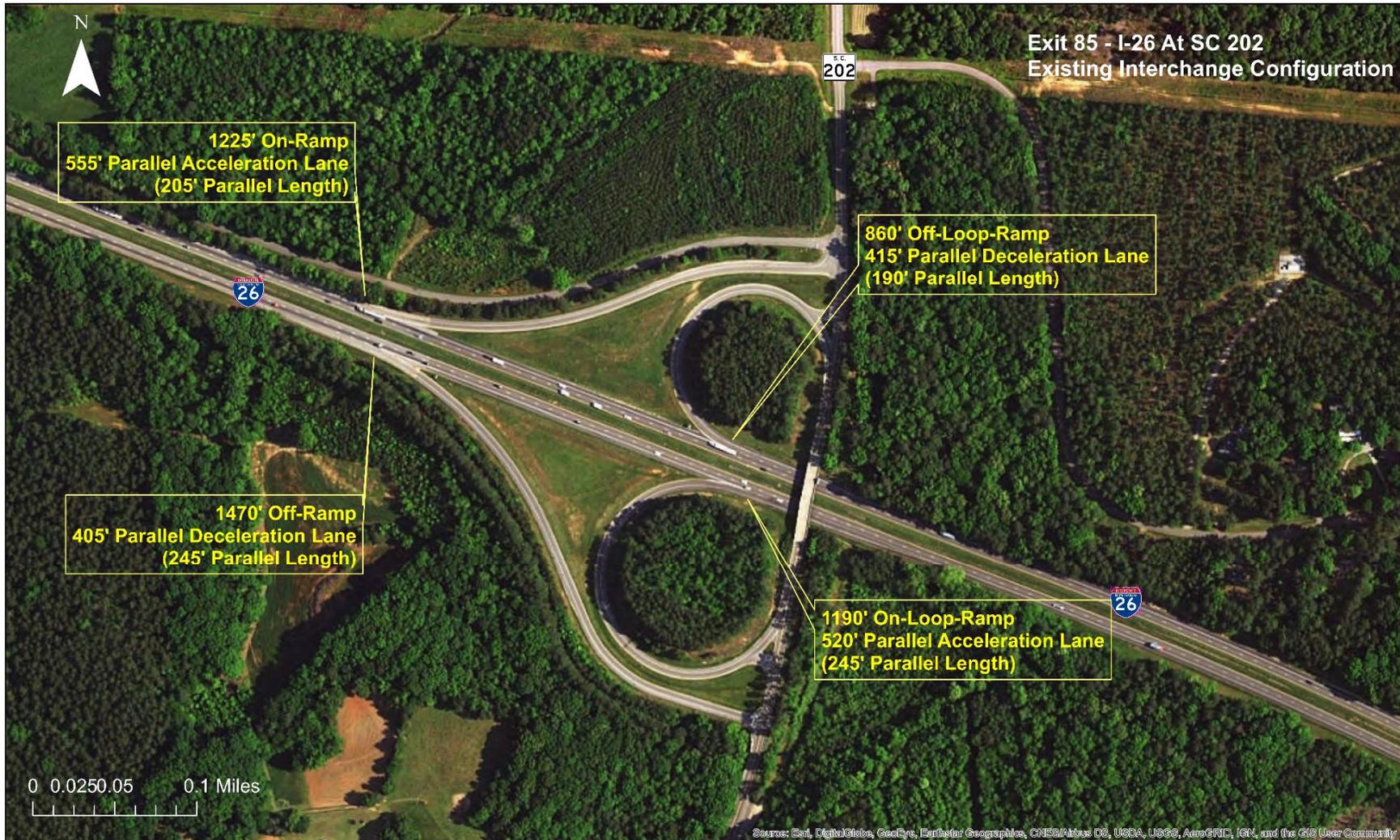
The westbound on-ramp is a single lane ramp approximately 1,225 feet long that merges into I-26 with a 555 feet long parallel acceleration lane (with a parallel length of approximately 205 feet). The ramp accepts the southbound right turn and the northbound left turn traffic from SC 202. No control is provided to either of these movements. The westbound on-ramp is adjacent to Meadow Brook Road, which is located to the north of the on-ramp and separated by approximately 45 feet.

The westbound loop off-ramp and on-ramp are separated by approximately 980 feet.

The eastbound off-ramp is approximately 1,470 feet long with a 405 feet long parallel deceleration lane (with a parallel length of approximately 245 feet). The off-ramp has a 40 mph posted advisory speed limit. The off-ramp remains a single lane until it intersects with SC 202. At the intersection traffic can make left or right turn. Both movements are controlled by the STOP signs.

The eastbound on-ramp is a single lane loop ramp approximately 1,190 feet long that merges into I-26 with a 520 feet long parallel acceleration lane (with a parallel length of approximately 245 feet). The ramp accepts the southbound right turn and the northbound left turn traffic from SC 202. Northbound left turning traffic and southbound right turning traffic are separated by a grass median; the northbound left turn traffic entering the on-ramp has to yield to the southbound right turn traffic.

The eastbound off-ramp and loop on-ramp are separated by approximately 1,050 feet.



Source: Figure 12, *Interstate 26 Widening Traffic Analysis Report*

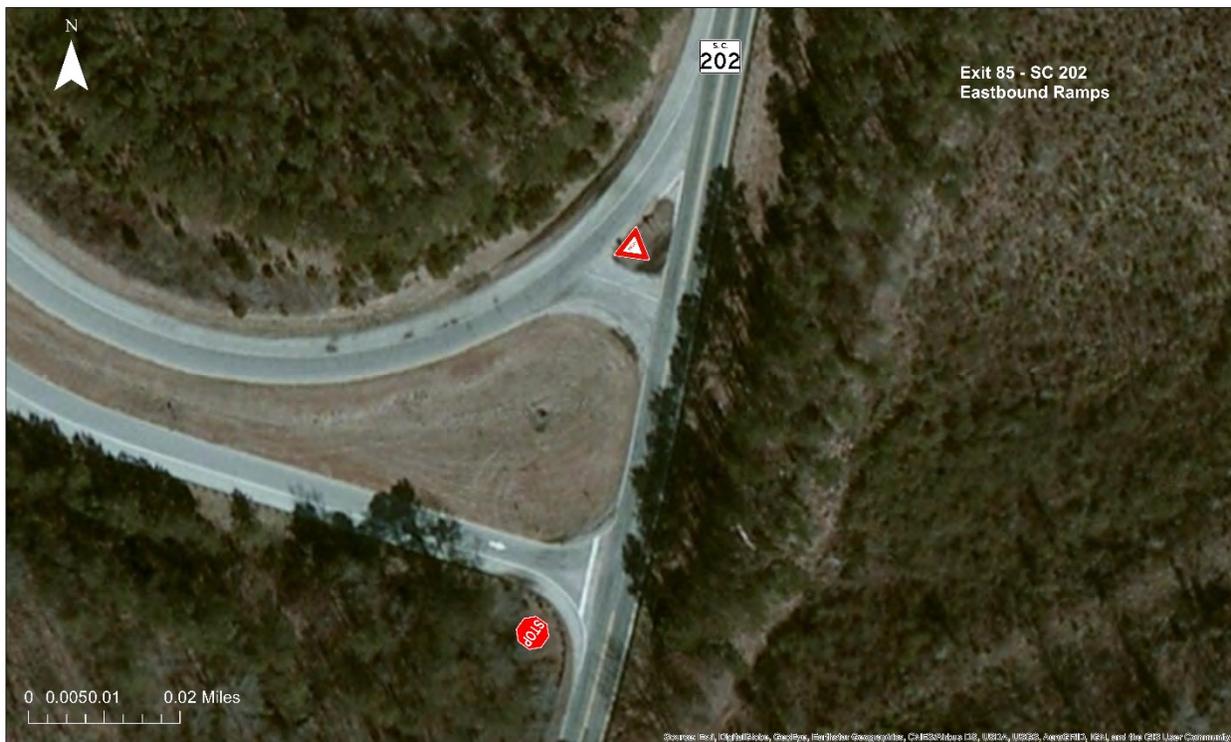
**Figure 2. Existing Interchange**

The exit is signed “SC 202” using the state route shields, along with the text “Pomaria” and “Little Mtn” in the westbound direction. In the eastbound direction, the SC 202 state route shield is shown along with the text “Little Mtn”.

The section of I-26 in the vicinity of Exit 85 currently consists of a four-lane interstate with a grassed median for most of its length. The existing right-of-way is approximately 50 feet to either side of the center line (100 feet total).

SC 202 is a two lane roadway with a posted 45 mph speed limit in the vicinity of the interchange. The SC 202 bridge crossing I-26 is two lanes wide. No dedicated turn lanes are provided for northbound left turn traffic from SC 202 merging into the eastbound loop on-ramp. However, there is a small island at the point of its merging with southbound right turn traffic from SC 202. Left turn traffic onto the eastbound loop on-ramp has to yield to southbound right turn traffic.

At the westbound on-ramp intersection, no vehicle storage turn lanes are provided for northbound left turn traffic or the southbound right turn traffic from SC 202. However, there is a wider section of pavement between the westbound on-ramp and Meadow Brook Road that could be used as a southbound right turn lane onto the ramp. The eastbound ramp intersection is shown in **Figure 3**. The westbound ramp intersection is shown in **Figure 4**.



Source: Figure 13, *Interstate 26 Widening Traffic Analysis Report*  
**Figure 3. Exit 85: SC 202 at Eastbound Ramps**

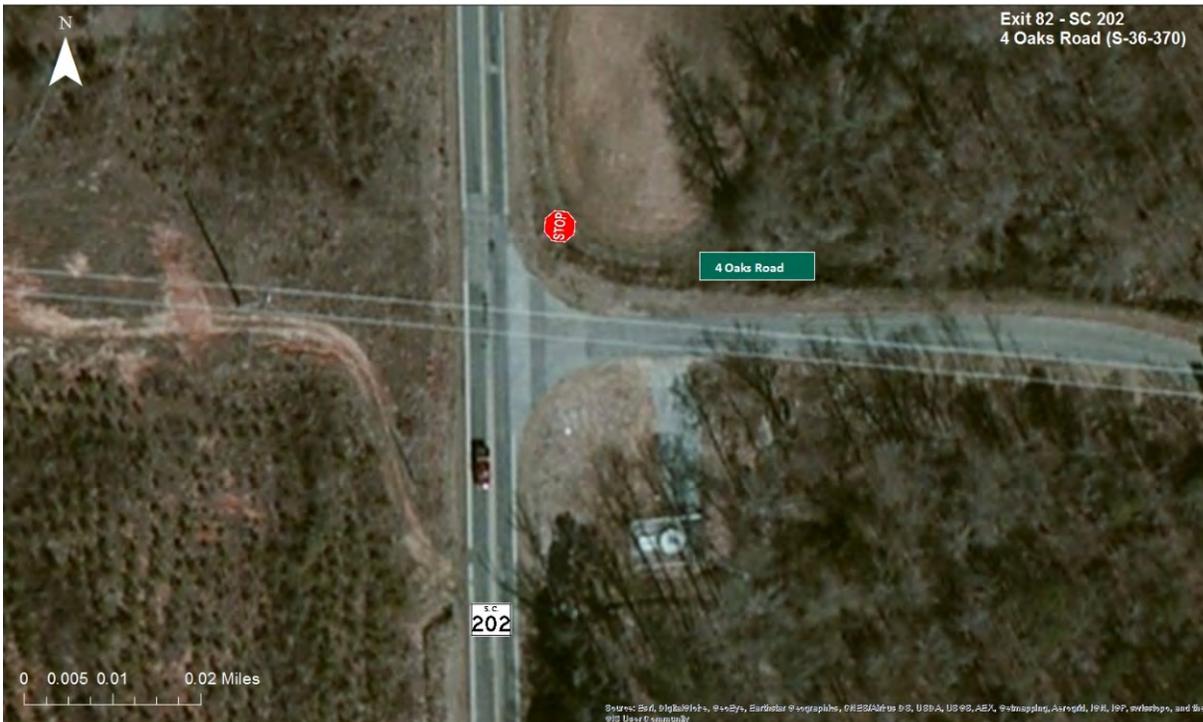


Source: Figure 14, *Interstate 26 Widening Traffic Analysis Report*  
**Figure 4. Exit 85: SC 202 at Westbound Ramps**

Two intersections are located in the vicinity of the interchange. The intersection of SC 202 with Meadow Brook Road (S-36-811) is located about 60 feet north of the westbound on-ramp. The intersection of 4 Oaks Road (S-36-370) is located approximately 520 feet north of the westbound on-ramp.

Meadow Brook Road is a local undivided road without a posted speed limit. Meadow Brook Road is located approximately 60 feet north of the westbound on-ramp intersection, and runs westward and dead-ends in about 1.64 miles. At its intersection with SC 202, the eastbound approach of Meadow Brook Road is controlled by a STOP sign. The existing configuration of the SC 202 intersection with Meadow Brook Road is shown in **Figure 4**.

4 Oaks Road is a local undivided road without a posted speed limit (although at the curves on the roadway, there are posted advisory speed limit signs of 25 and 30 mph). 4 Oaks Road is located approximately 520 feet north of the westbound on-ramp intersection, and runs eastward and dead-ends in 1.51 miles. At its intersection with SC 202, the westbound approach of 4 Oaks Road is controlled by a STOP sign. The existing configuration of SC 202 intersection with 4 Oaks Road is shown in **Figure 5**.



Source: Figure 15, *Interstate 26 Widening Traffic Analysis Report*  
**Figure 5. Exit 85: SC 202 at 4 Oaks Road**

### Purpose and Need

The proposed project has two primary purposes: increase roadway capacity to address the projected increased traffic volumes and improve geometric deficiencies along the mainline and at several interchanges and overpasses in this section of I-26 by bringing them into compliance with current state and federal design standards. The secondary purpose is to improve safety, which will be enhanced by improving the geometric design of the facility.

The needs for this project were identified through a comprehensive review of previous studies along with the analysis of current data compiled for this study. This includes information in the I-26 Widening Traffic Analysis Report and the I-26 Accident Analysis Report, as well as information collected through meetings with SCDOT; federal, state and local agencies; project stakeholders, and the public.

### Conceptual Design

The SC 202 interchange is expected to be modified as part of the I-26 Widening project. Analyses evaluating 2040 Build conditions for the intersections within the Exit 85 interchange area were initially performed for three alternatives. After the initial analysis, two additional alternatives were developed.

Three alternatives were initially developed for Exit 85.

- Alternative 1 replaces the existing Exit 85 interchange with a full diamond interchange. All intersections would remain STOP-controlled under the 2040 Build conditions. The conceptual design of Alternative 1 is shown in **Figure 6**.
- Alternative 2 replaces the existing Exit 85 interchange with a partial cloverleaf interchange. This alternative would shift two left turn movements to right turn movements, potentially increasing the safety of the ramp termini. The conceptual design of Alternative 2 is shown in **Figure 7**.
- Alternative 3 replaces the existing Exit 85 interchange with a diamond interchange with roundabouts at the ramp termini intersections. The conceptual design of Alternative 3 is shown in **Figure 8**.

As part of the refinement of the original alternatives, Alternative 1A and Alternative 2A were developed.

- In Alternative 1A, the westbound off-ramp in Alternative 1 has been replaced with a westbound loop off-ramp in order to minimize impacts to natural features. The conceptual design of Alternative 1A is shown in **Figure 9**.
- In Alternative 2A, the westbound off-ramp for traffic traveling to the north on SC 202 in Alternative 2 is eliminated. Instead of a westbound directional loop off-ramp for traffic traveling to the south on SC 202, a loop off-ramp that combines both movements to SC 202 is provided. The conceptual design for Alternative 2A is shown in **Figure 10**.

Each Alternative included relocating Meadow Brook Road to increase its distance from the westbound ramp intersection, and most of the alternatives included relocating 4 Oaks Road.

Alternative 1a was selected as the Preferred Alternative because it meets the purpose and need, has the lowest overall construction cost, does not require any residential or commercial relocations, requires the lowest acreage of new right-of-way, and results in the lowest impact to streams making it the least environmentally damaging practicable alternative.

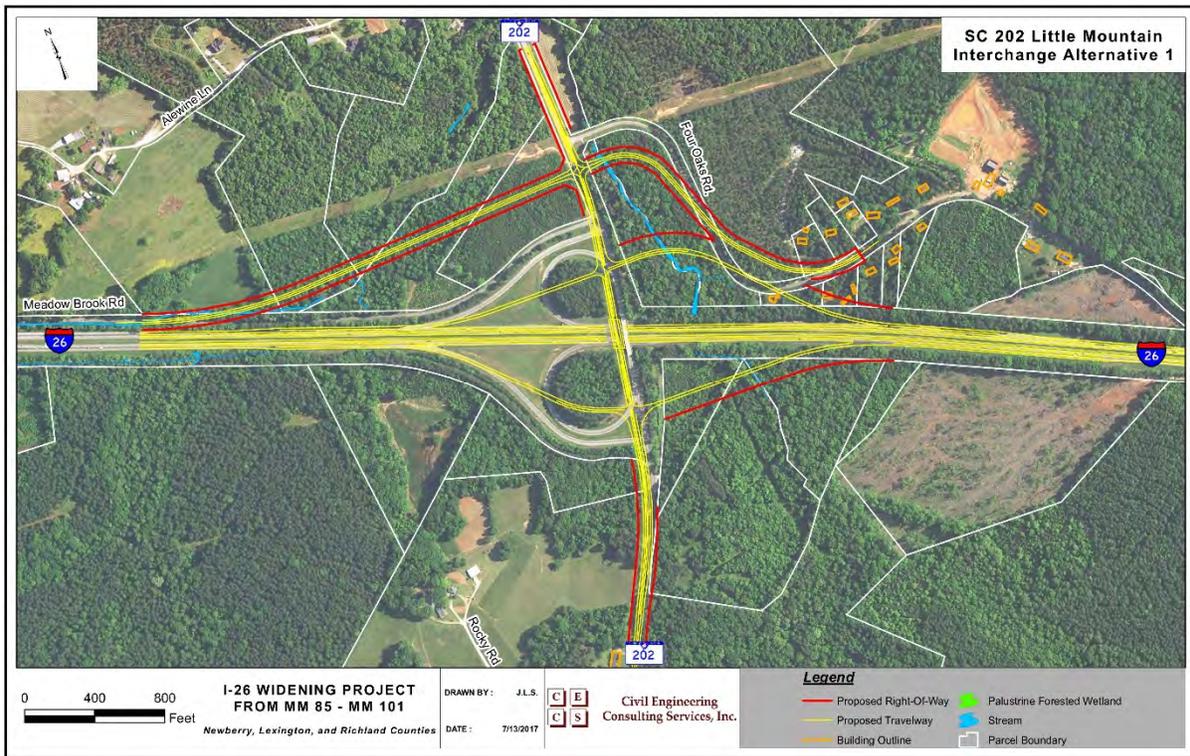


Figure 6. Improvement Alternative 1 Diamond

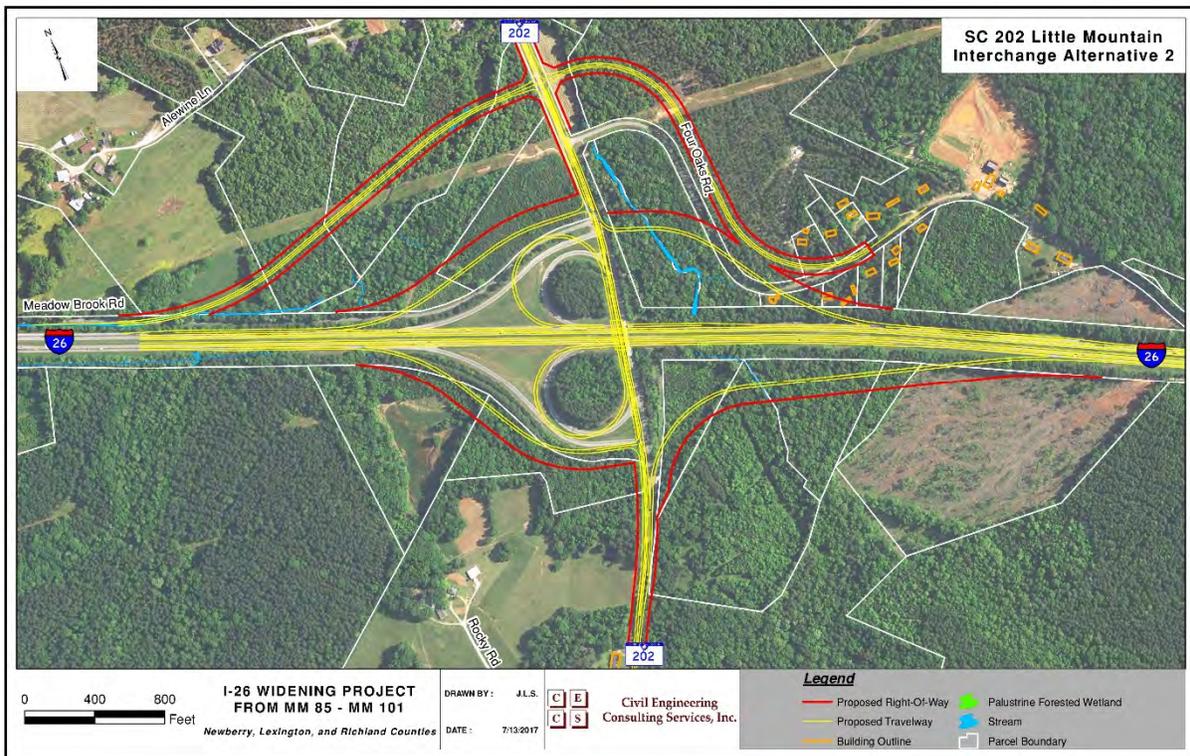
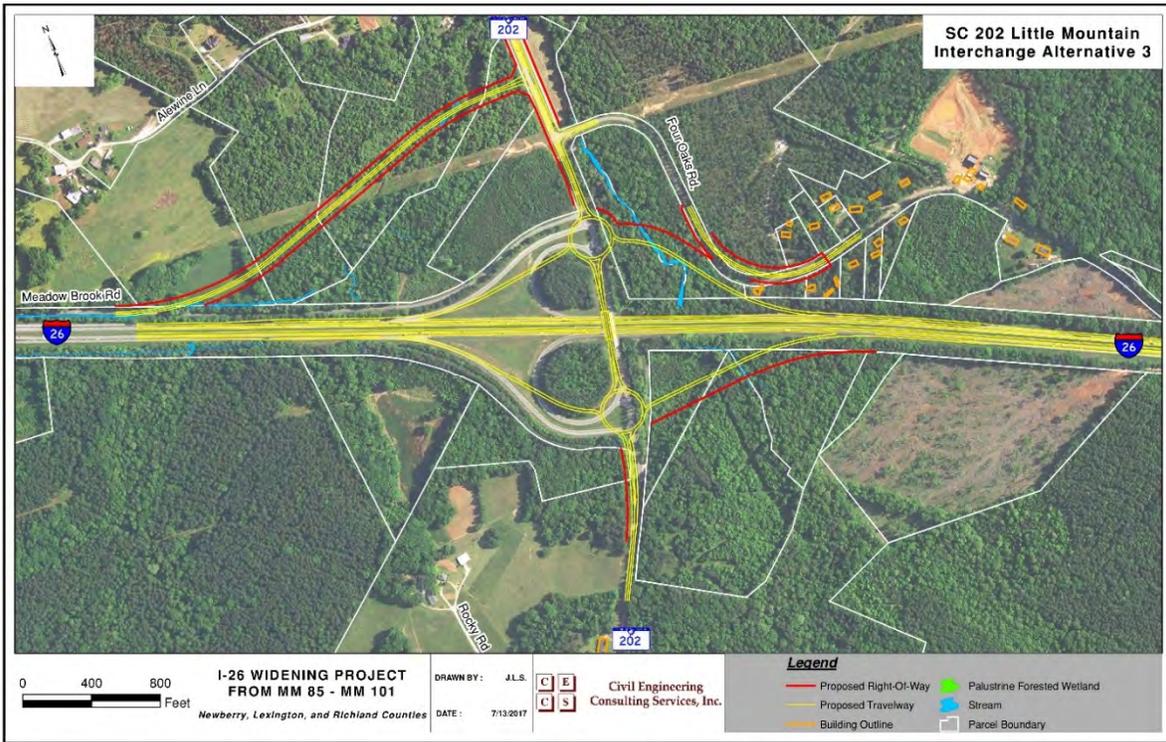
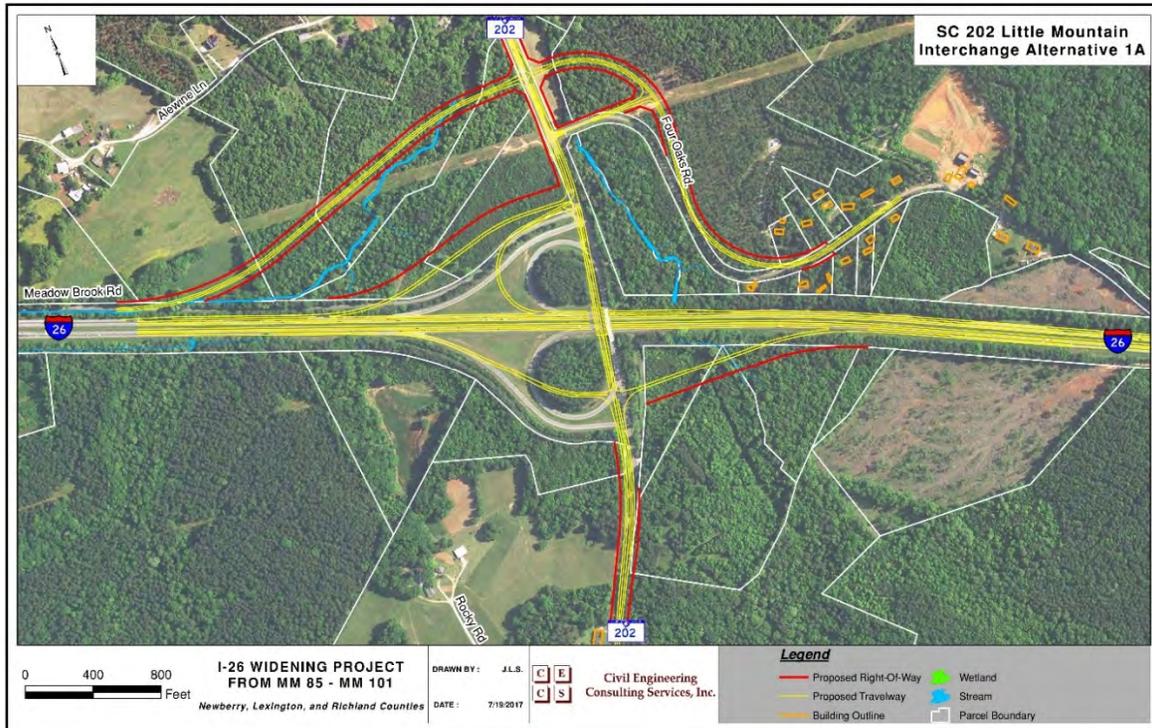


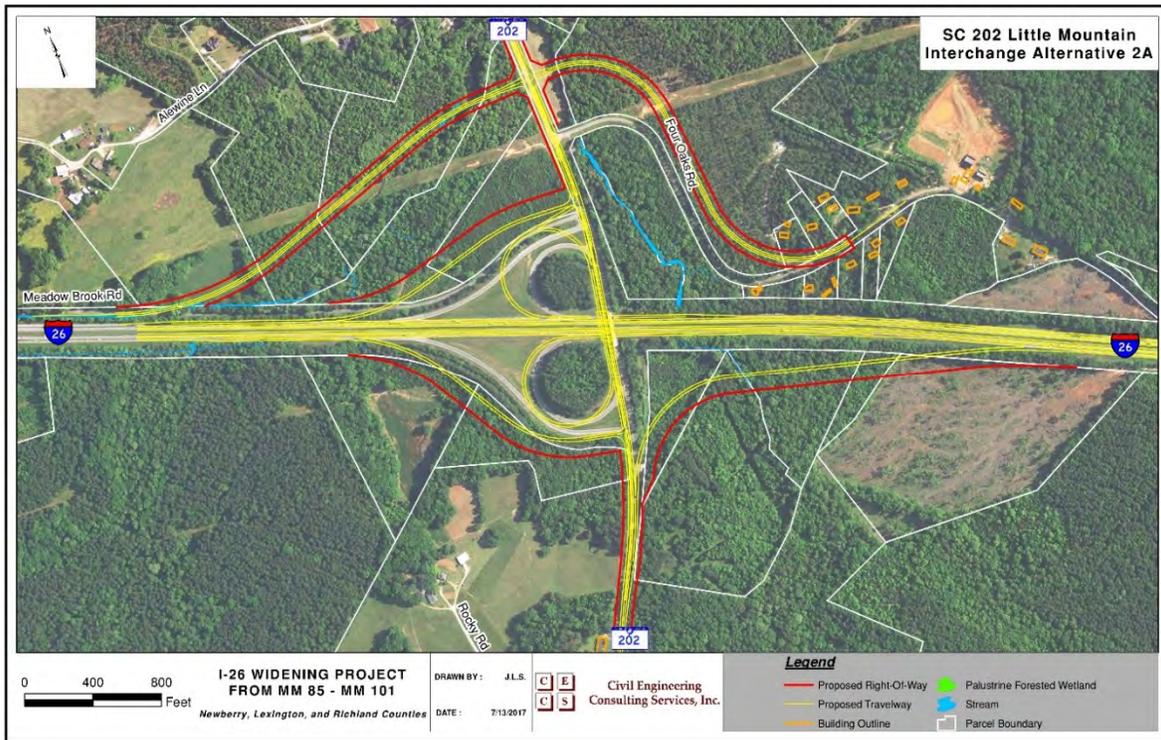
Figure 7. Improvement Alternative 2 Partial Cloverleaf



**Figure 8. Improvement Alternative 3 Bowtie**



**Figure 9. Improvement Alternative 1A Diamond Loop**



**Figure 10. Improvement Alternative 2A Partial Cloverleaf Modified**

Intersection Modification Report Applicant

The interchange policy is administered by the Federal Highway Administration (FHWA). Therefore, FHWA is required to approve all new access or changes in access points pursuant to this policy.

As the owner and operator of the Interstate System, SCDOT is responsible for submitting a formal request to the FHWA in the form of an IMR that documents the analysis, the rationale for the proposed change in access, and the recommended action.

SCDOT is the sponsoring agency for the I-26 Widening project. The contact information for the I-26 Exit 85 IMR study is provided below:

Michael L. Hood, P.E., DBIA  
Assistant Program Manager, Design-Build Group  
SC Department of Transportation  
955 Park St., Columbia, SC 29201

### III. Study Area

In South Carolina, I-26 covers about 221 miles, and provides connections to I-95 south of Providence, to I-77 south of Cayce, to I-20 west of Columbia, and to I-85 north-west of Spartanburg. Within the study area shown on **Figure 1**, I-26 crosses portions of Newberry, Lexington and Richland Counties.

#### Demographics

According to the 2010 Census, Newberry County has approximately 37,500 residents, Lexington County has approximately 262,500 residents and Richland County has approximately 384,500. The counties have seen a steady increase in population since the 1950's. Between 2000 and 2010, Newberry county saw a 3.7% increase in population, Lexington County saw a 17.7% increase in population and Richland County saw a 16.6% increase in population.

According to the South Carolina Revenue and Fiscal Affairs Office, Newberry County is expected to continue to see gradual population growth between 2010 and 2030,<sup>1</sup> while Lexington County is expected to see more significant population growth by 2030. The same source estimates Richland County's population will continue to grow but possibly at a slower rate than from 2000 to 2010. **Table 1** presents population growth and projections for the three counties.

**Table 1: Population Growth in the I-26 PSA**

County	2000 Population	2010 Population	2030 Population	2000 – 2010 % Growth	2010 – 2030 % Growth
Newberry	36,108	37,508	39,800	3.7%	5.6%
Lexington	216,014	262,391	333,200	17.7%	21.3%
Richland	320,677	384,504	456,000	16.6%	15.7%

Source: [http://www.sccommunityprofiles.org/census/proj\\_c2010.html](http://www.sccommunityprofiles.org/census/proj_c2010.html)

<sup>1</sup> S.C. Revenue and Fiscal Affairs Office, *County Population Projections 2000-2030*, [http://www.sccommunityprofiles.org/census/proj\\_c2010.html](http://www.sccommunityprofiles.org/census/proj_c2010.html)

## Land Use

The I-26 Widening project corridor is located primarily within unincorporated areas of Newberry, Lexington, and Richland counties, but includes small portions of the towns of Irmo and Chapin. Existing land uses are primarily forested land and commercial businesses with areas of rural residential and light industrial operations. The closest incorporated municipalities are the City of Columbia to the southeast; the town of Irmo to the southwest; the Town of Chapin to the southwest; the Town of Little Mountain to the south and the Town of Newberry to the northwest.

Along the mainline of I-26, land uses consist mainly of forested land but become increasingly mixed with commercial and residential properties moving from west to east towards Columbia. An industrial park (Chapin Business and Technology Park) and a planned residential/ commercial neighborhood is located southwest of Exit 91. The industrial park has infrastructure and zoning in place but no buildings as of yet. The adjacent residential/ commercial area is in the planning stages.

Property in the study area surrounding Exit 85 – SC 202 is largely undeveloped. Land use appears to be forested and cleared land with no commercial businesses and low density residential parcels further from the interchange. There is potential for increased development at the interchange due to the presence of developable land at each interchange. The interchange improvements would provide interstate access consistent with current design standards that could be attractive for future development.

With anticipated population growth and the corridor's proximity to Columbia, residential, commercial and industrial development are expected to continue within the project study area, for the No-Build and the Preferred Alternative.

Along the mainline of I-26 in the project study area, the land use consists mainly of forested land with areas of commercial, residential, and light industrial uses. The proposed widening of the mainline is not expected to change land uses along the mainline of the interstate.

## Transportation System

The Project study area roadway transportation system is part of the I-26 Widening study depicted in **Figure 1**. This region of Lexington, Newberry and Richland counties is accessed via I-26, which is an east-west freeway connecting Columbia with its suburbs in northwest direction.

For this IMR, a focused roadway system was evaluated. It consisted of I-26 mainline with its merge and diverge areas and the Exit 85 - SC 202 interchange. Specifically, I-26 westbound and eastbound mainline segments at Exit 85 – SC 202 were evaluated for traffic conditions during

different hours of the day. This study area is a subset of the broader study area that was analyzed during the Interstate 26 Widening Traffic Analysis Report.

## IV. Methodology

### Scenarios Analyzed

In March 2017 STV Incorporated prepared the I-26 Widening Traffic Analysis Report that included the following scenarios:

- Existing Conditions
- 2040 No-Build Conditions
- 2040 Build Conditions

Analyses were performed for existing conditions (existing traffic, intersection traffic control and geometry), 2040 No-Build conditions (2040 traffic, and existing intersection traffic control and geometry) and 2040 Build conditions (2040 traffic and modified intersection traffic control and geometry reflecting the reasonable interchange improvement alternative). The Exit 85 alternatives were compared against one another to determine which best met the purpose and need with the least impacts.

The 2040 No-Build Alternative for the Exit 85 interchange represents the existing interchange configuration, intersection traffic control and geometric conditions with no changes to those conditions. Many of the impacts associated with the construction of the interchanges would not occur, but the interchanges would continue to be out of conformance with current state and federal design standards. This would not satisfy the purpose and need for the project.

There were three initial Reasonable Alternatives developed for Exit 85. These alternatives share many common features. They all would meet the purpose and need for the project by bringing the interchange into compliance with current state and federal design requirements. As part of a refinement of the design alternatives, two additional Reasonable Alternatives were developed. These alternatives were revisions to Alternatives 1 and 2 which removed the impacts in the northeast quadrant of the interchange. The safety at the interchange will be improved by providing on and off ramps that separate the interstate traffic from local traffic, and which will be long enough to allow traffic to merge onto the interstate and to store traffic that is exiting the interstate during peak hours. Alternative 1A was recommended as the Preferred Alternative for Exit 85. Alternative 1A combined features of Alternative 1 and Alternative 2. Therefore, the other alternatives were not carried forward in this document and Alternative 1A was analyzed for the 2040 Build Conditions for Exit 85.

The interchanges adjacent to Exit 85 are Exit 82 and Exit 91. Exit 82 – SC 773 is located approximately 3.15 miles northwest of Exit 85. Exit 91 – Columbia Avenue is to the southeast of Exit 85 and is located approximately 5.85 miles away. The interaction of the modifications proposed at Exit 85 with the adjacent interchanges at Exits 82 and 91 were initially analyzed as part of the I-26 Widening Traffic Analysis Report.

By replacing the substandard ramps and modifying the existing interchange to meet current design standards, the proposed modified interchange with SC 202 is anticipated to contribute to an improvement in traffic safety and provide space for the construction of an additional travel lane in each direction along I-26. The proposed improvements should mitigate the existing factors identified in the Accident Analysis as contributing to a high occurrence of rear-end collisions in the area, including short ramps and merge/diverge areas as well as a narrow clear zone at and adjacent to the overpass for SC 202.

The Preferred Alternative of the interchange design also provides space for the construction of an additional travel lane in each direction along I-26. Altogether, these design provisions would enhance the operational efficiency and safety of the corridor, thereby increasing capacity and improving levels of service in the long term.

### Traffic Forecasts

A proposed average annual growth rate was estimated based on a comparison of the historic AADT growth rates (for 1996 and 2015) and the South Carolina Statewide Model (SCSWM) average annual growth rates for each of the segments. These proposed growth rates were applied to all mainline, ramp and arterial turning movement volumes within the study area to generate the design year peak hour volumes for use in the alternatives analysis. In setting the growth rate, an annual percentage that is comparable to, but higher than the observed growth rates, is often desirable, so a conservative analysis of future traffic conditions may be attained.

Many of the segments in the study area had estimated growth rates exceeding 1.00 percent per year based on the statewide model. Historic data of all segments exceeded 2.00 percent per year. Given the long term historic growth in the corridor, the growth rate falls in a range from 1.5 percent (based on the model assignments) to 2.5 percent per year (based on the long term growth rate from 1996 – 2015). Based on discussions with SCDOT it was determined that a growth rate of 2.0 percent would be used from US 176 (Broad River Road) to the east of SC 202, and a growth rate of 2.5 percent would be used from SC 202 to the west.

### Traffic Analysis

A series of capacity analyses were performed based on the methodologies and guidelines contained in the Transportation Research Board's publication *HCM 2010 Highway Capacity*

**Manual** (HCM). Various analysis and simulation software packages based on the HCM were used in performing the analyses. These included:

- McTrans' *HCS 2010* (Version 6.3)
  - Freeway Segments
  - Ramp Merge/Diverge Areas
  - Weaving Segments
- Trafficware's *Synchro* (Version 9.1.910.24)
  - Unsignalized Intersections
  - Signalized Intersections
- Caliper's *TransModeler* (Version 4.0 Build 6020)
  - Network Simulation
  - Freeway Segments
  - Ramp Merge/Diverge Areas

The analysis methodologies contained in the HCM for the various facility types and users describe the operational conditions in terms of a Level of Service (LOS). The HCM defines LOS as

*"...a quality measure describing operations conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience. Six LOS are defined for each type of facility that has analysis procedures available. Letters designate each level, from A to F, with LOS A representing the best operating conditions and LOS F the worst. Each level of service represents a range of operating conditions and the driver's perception of those conditions. Safety is not included in the measures that establish service levels."*

The following discussions and tables describe the HCM LOS criteria for freeway segments, ramp merge/diverge segments, weaving segments, and unsignalized intersections.

#### *Freeway Segments*

The HCM characterizes the capacity of a basic freeway segment *"...by three performance measures: density in passenger cars per mile per lane (pc/mi/ln), space mean speed in miles per hour (mi/h), and the ratio of demand flow rate to capacity (v/c). Each of these measures is an indication of how well traffic is being accommodated by the basic freeway segment."*

**Table 2** shows the HCM LOS criteria for basic freeway segments. LOS F occurs when either the segment density exceeds 45 pc/mi/ln or when the segment v/c ratio exceeds 1.0 (regardless of the segment density).

**Table 2. Freeway Segment LOS Criteria**

Basic Freeway Segments	
LOS	Density (pc/mi/ln)
A	< 11
B	> 11-18
C	> 18-26
D	> 26-35
E	> 35-45
F	> 45 v/c > 1.0

Source: Table 12 – Interstate 26 Widening Traffic Analysis Report

### Weaving Segments

Weaving segments occur where two or more streams of traffic traveling in the same direction are able to cross each other without traffic control devices. This typically occurs where a merge segment is followed by a diverge segment within a relative short distance (usually less than 2,800 feet). The LOS of a weaving segment is also related to the density of the segment. Regardless of the density, the weaving segment is considered to operate at LOS F when the v/c exceeds 1.0. **Table 3** shows the HCM LOS criteria for Freeway Weaving Segments.

**Table 3. Weaving Segment LOS Criteria**

Freeway Weaving Segments	
LOS	Density (pc/mi/ln)
A	< 10
B	> 10-20
C	> 20-28
D	> 28-35
E	> 35
F	v/c > 1.0

Source: Table 13 – Interstate 26 Widening Traffic Analysis Report

### Ramp Merge and Diverge Areas

Ramp-freeway junctions occur when merging maneuvers occur (on-ramps) or when diverging maneuvers occur (off-ramps). The operation of these merge and diverge areas are affected by a number of factors, including the operation of the adjacent freeway segment and the proximity and flow on adjacent ramps. Typically, the influence area of the ramps is 1,500 feet upstream of a diverge point and downstream from a merge point. As with freeway segments and weaving segments, the LOS of a merge or diverge area is related to the density of the segment. Regardless of the density, the merge or diverge areas are considered to operate at LOS F when the freeway demand exceeds the capacity of the upstream freeway segment (at diverge areas) or the

downstream freeway segment (at merge areas), as well as when the ramp demand exceeds the ramp capacity. **Table 4** shows the HCM LOS criteria for Ramp Merge and Diverge areas.

**Table 4. Merge/Diverge LOS Criteria**

Ramp Merge and Diverge Areas	
LOS	Density (pc/mi/ln)
A	< 10
B	> 10-20
C	> 20-28
D	> 28-35
E	> 35
F	$v/c > 1.0$

Source: Table 14 – *Interstate 26 Widening Traffic Analysis Report*

### Unsignalized Intersections

The LOS for unsignalized intersections is based on the average control delay per vehicle. Since major street traffic is seldom controlled by STOP signs (except at intersections with ALL-WAY STOP control or in special circumstances), major street traffic generally will experience virtually no delay. Most of the delay will be encountered by traffic on approaches controlled by STOP signs. Under certain conditions, delay will also be encountered by left turning traffic on the major street waiting for appropriate sized gaps in the opposing traffic flow to complete their turn. Therefore, the delay experienced by STOP controlled movements and major street left turns, rather than the entire average intersection delay, are used to identify the critical LOS at these intersections. **Table 5** shows the HCM LOS criteria for unsignalized intersections.

**Table 5. Unsignalized Intersection LOS Criteria**

Unsignalized Intersections	
LOS	Control Delay (sec/vehicle)
A	< 10
B	> 10-15
C	> 15-25
D	> 25-35
E	> 35-50
F	> 50

Source: Table 15 – *Interstate 26 Widening Traffic Analysis Report*

## V. Traffic Volumes

The traffic volumes used in the analysis for Exit 85 consisted of Existing (2016) conditions, and Future (2040) No-Build and Build conditions.

### Existing 2016 Traffic Volumes

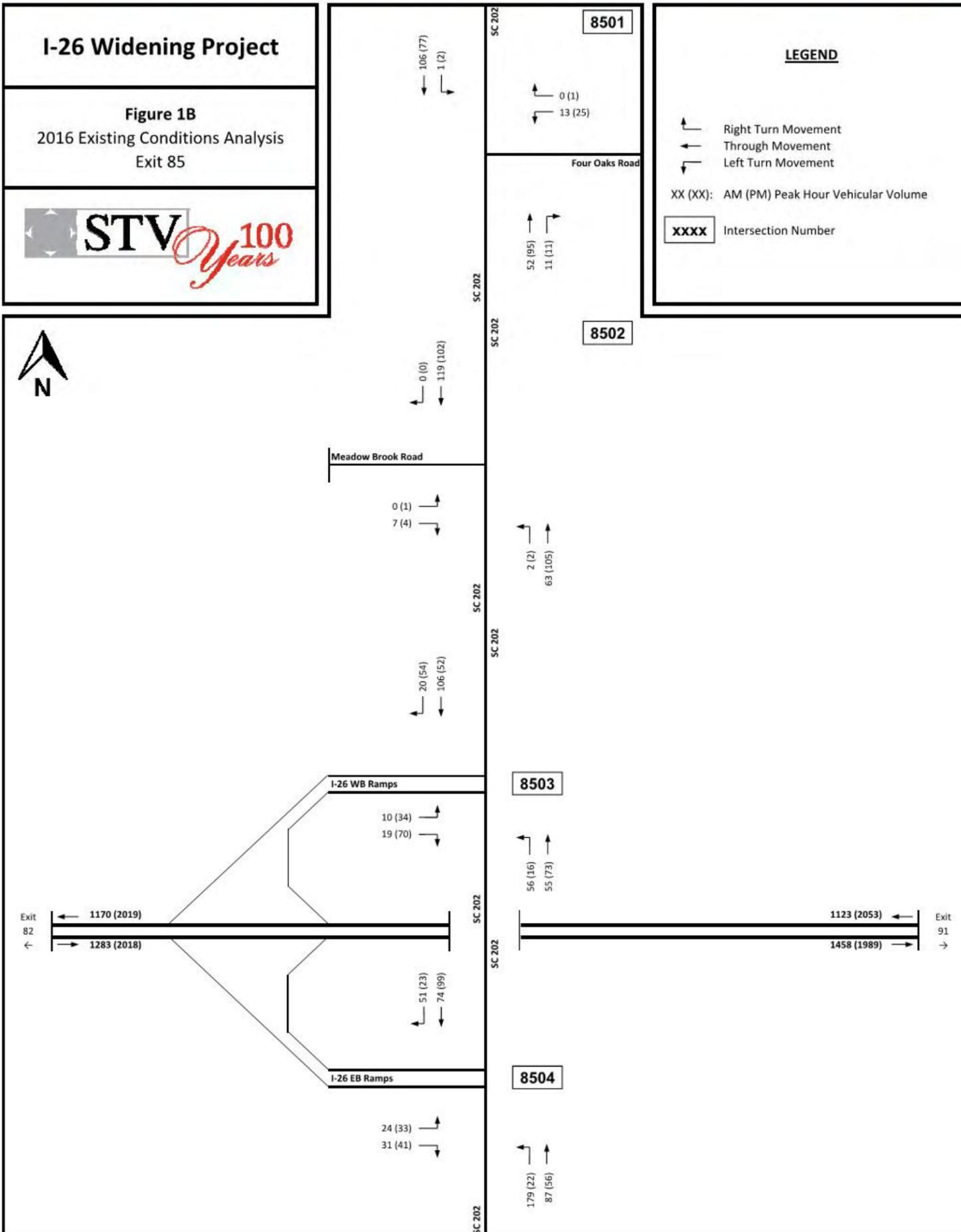
Turning movement traffic count data were obtained for a number of ramp termini and other adjacent intersections within the Exit 85 interchange area from 7:00 to 9:00 AM and from 4:00 to 6:00 PM on Tuesday, August 23, 2016. The turning movement count data, which are provided in **Appendix A**, included:

- SC 202 & S-36-811 (Meadow Brook Road)
- SC 202 & S-36-370 (Four Oaks Road)

Turning movement counts conducted for 12 hours between 7:00 AM and 7:00 PM on Tuesday, August 23, 2016 at the following locations:

- SC 202 & I-26 westbound ramps
- SC 202 & I-26 eastbound ramps

The turning movement traffic count data were evaluated and reviewed. The morning and afternoon peak hour volumes at each of the ramp termini and the adjacent intersections at each interchange were identified and were balanced between intersections. The balanced morning and afternoon peak hour volumes for the interchange are shown in **Figure 11**.



Source: Figure 58, *Interstate 26 Widening Traffic Analysis Report*  
**Figure 11. Existing Peak Hour Turning Movement Volumes**

## 2040 Traffic Volumes

Turning movement volumes for the 2040 design year at Exit 85 were derived by applying the 2.5 percent annual growth rate to the existing turning movement volumes at the various intersections. The 2040 estimated peak hour turning movement volumes shown on the existing (No-Build) network are presented in **Figure 12** and on the Preferred Alternative 1A in **Figure 13**.

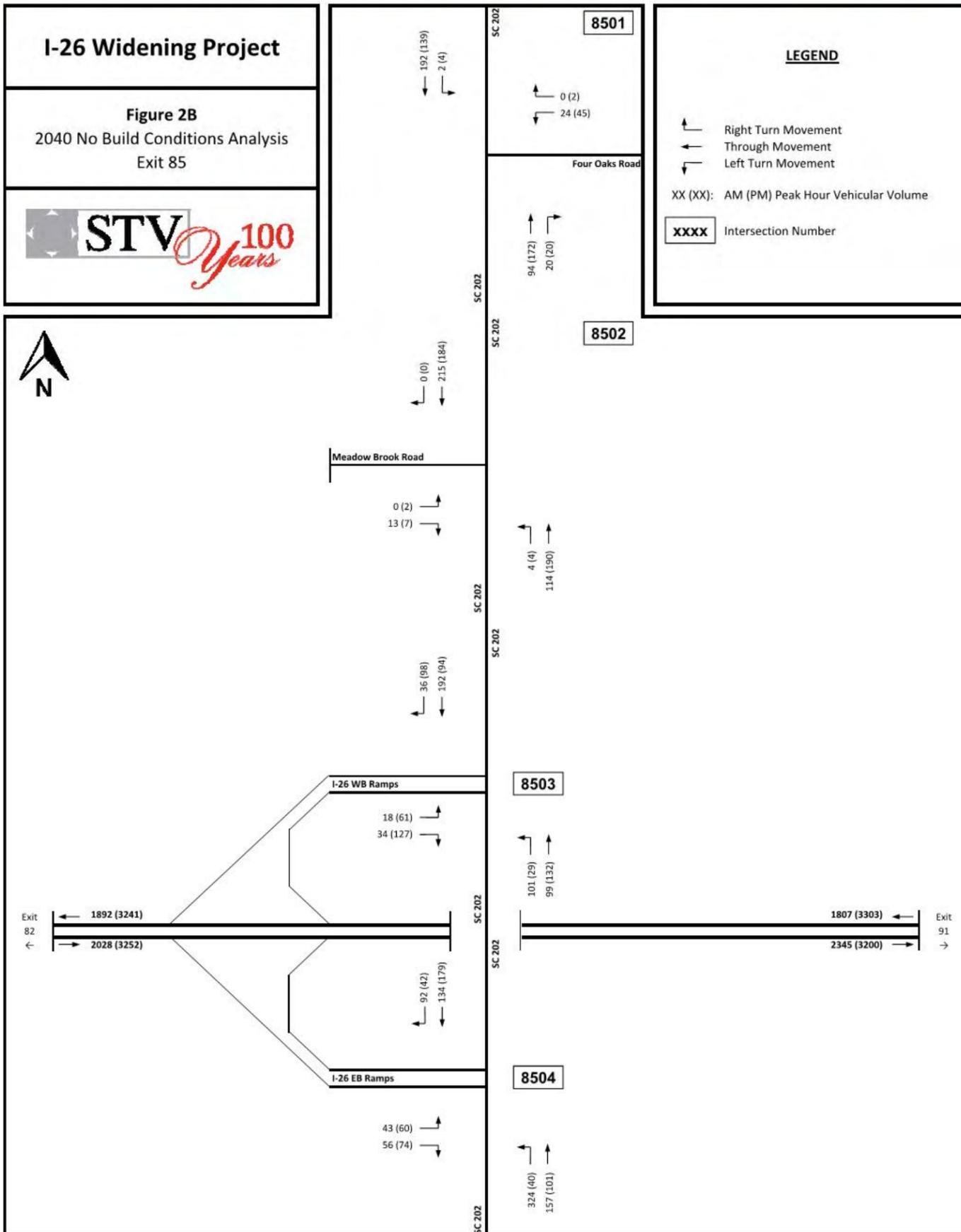
## VI. Traffic Operations

### Freeway and Ramp Merge/Diverge Segment Analysis

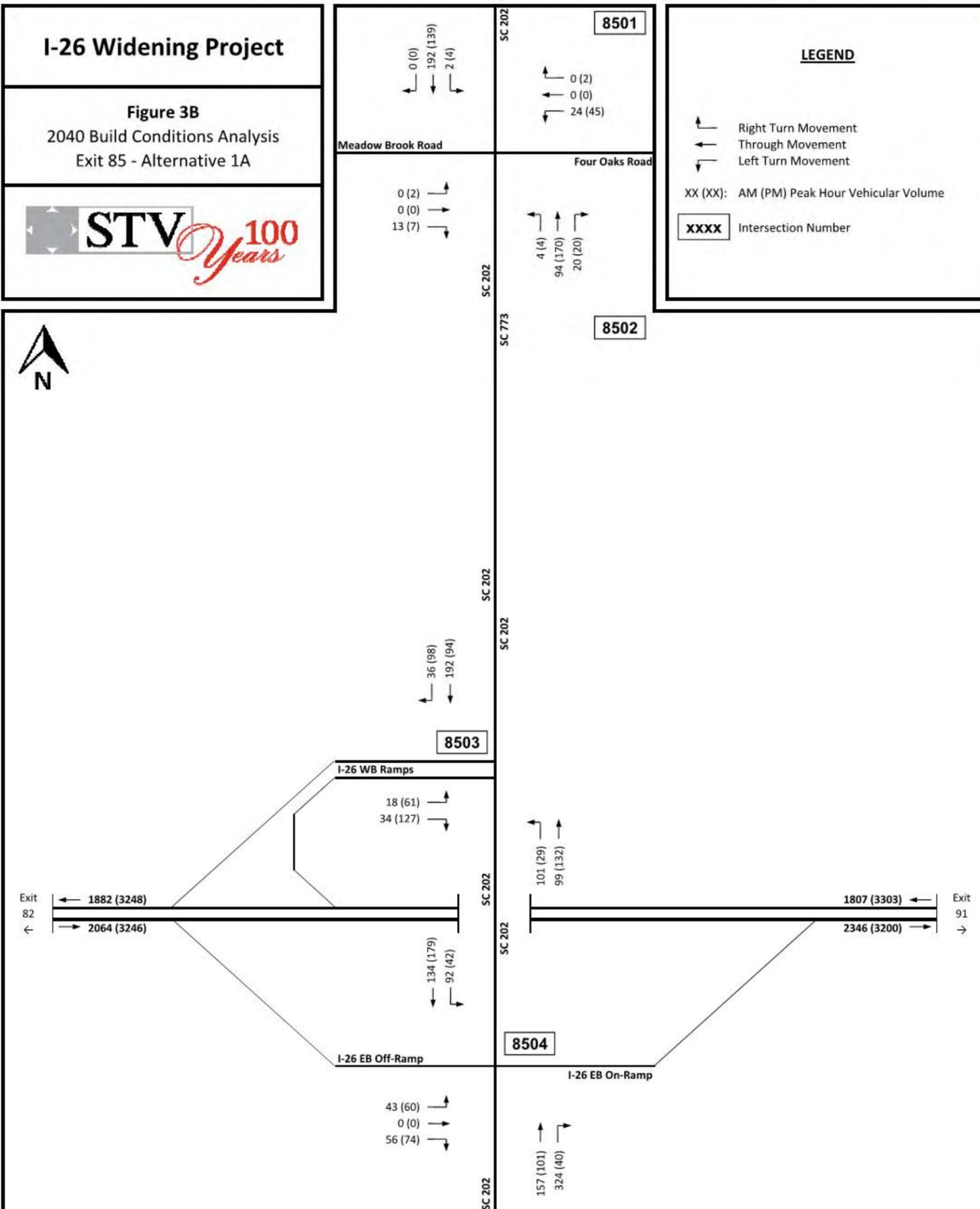
The analysis of basic freeway segments within the study area were performed for existing conditions, future (2040) No-Build conditions and future (2040) Build conditions. The following criteria were identified through discussions with SCDOT and used for various inputs within the freeway segment analysis:

- The 10<sup>th</sup> highest hour volumes based on the P-0112 ATR count station data for the eastbound AM design hour, and the P-0015 ATR count station data for the eastbound PM and westbound AM and PM design hours, balanced through the system, were used for the freeway segment mainline volumes.
- To develop future (2040) traffic volumes, a growth rate of 2.0 percent was applied to existing volumes from US 176 (Broad River Road) to the east of SC 202, and a growth rate of 2.5 percent was applied to existing volumes from SC 202 to the west.
- A peak hour factor of 0.90 was used for freeway segments and ramp areas.
- The proportion of trucks and buses traveling on the freeway segments and ramp movements, based on SCDOT data, is 23 percent.
- Based on the grades through the study area, the terrain was selected as “Rolling” instead of “Level” or “Mountainous”.
- Free-flow speed was set at the posted speed limit along the segment.

The existing conditions and 2040 No-Build conditions analyses were performed using the existing number of freeway lanes present on the segments within the study area. The 2040 Build conditions analyses were performed assuming I-26 would provide three lanes in each direction. The Basic Freeway Segment Analysis outputs are provided in **Appendix B** and a summary of results is shown in **Table 6**. The results of the ramp merge and diverge analyses for Exit 85 are shown in **Table 7** and **Table 8**, respectively.



Source: Figure 64, *Interstate 26 Widening Traffic Analysis Report*  
**Figure 12. 2040 Estimated Peak Hour Turning Movement Volumes**



Source: Figure 89, Interstate 26 Widening Traffic Analysis Report  
Figure 13. 2040 Estimated Peak Hour Turning Movement Volumes Preferred Alternative 1A

**Table 6 - Freeway Segment Capacity Analysis Results**

Basic Freeway Segment Analysis Results															
Direction	Segment	Existing # of lanes	Future # of lanes	AM Peak Hour						PM Peak Hour					
				2016 Existing		2040 No-Build		2040 Build		2016 Existing		2040 No-Build		2040 Build	
				LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density
WB	Exit 91-85	2	3	B	12.0	B	14.4	A	9.6	C	19.1	D	27.7	B	17.3
WB	Exit 85-82	2	2	B	12.5	B	15.3	B	15.3	C	18.8	D	26.9	D	26.9
EB	Exit 82-85	2	2	B	12.9	C	22.1	C	22.1	C	19.2	D	27.5	D	27.5
EB	Exit 85-91	2	3	B	14.7	D	26.2	B	16.6	C	18.9	D	26.8	B	16.9

**Table 7 - Ramp Merge Capacity Analysis Results**

Freeway Merge Analysis Results													
Direction	Merge Location	AM Peak Hour						PM Peak Hour					
		2016 Existing		2040 No-Build		2040 Build		2016 Existing		2040 No-Build		2040 Build	
		LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density
WB	Exit 85	B	15.6	B	18.7	B	12.5	C	22.5	D	29.8	B	19.1
EB	Exit 85 Loop	B	17.9	D	28.8	B	19.5	C	23.0	D	30.1	B	19.1

**Table 8 - Ramp Diverge Capacity Analysis Results**

Freeway Diverge Analysis Results													
Direction	Diverge Location	AM Peak Hour						PM Peak Hour					
		2016 Existing		2040 No-Build		2040 Build		2016 Existing		2040 No-Build		2040 Build	
		LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density
WB	Exit 85	B	14.9	B	17.8	B	13.0	C	23.5	D	31.8	C	21.8
EB	Exit 85	B	16.2	C	26.8	B	18.7	B	23.7	D	31.7	C	21.7

The analysis results for the freeway segments in the westbound and in the eastbound direction between Exit 82 and Exit 91 for the 2016 Existing Conditions that are summarized in **Table 6**, indicate the following:

- During the morning peak hour, the freeway segments operate at LOS B;
- During the afternoon peak hour, the freeway segments operate at LOS C.

With traffic volumes projected to increase in the vicinity of Exit 85 at an annual rate of between 2.0 and 2.5 percent per year, and if I-26 is not widened, the increased traffic volumes traveling on the existing interstate capacity will result in increased density and reductions of freeway segment LOS.

- During the 2040 No-Build morning peak hour, the eastbound segment between Exit 85 and 91 is expected to operate at LOS D. The remaining segments will operate at LOS C or better;
- During the 2040 No-Build afternoon peak hour, all of the freeway segments are expected to operate at LOS D.

The additional capacity provided by the construction of an additional, third lane on I-26 through the Exit 85 area will result in generally comparable LOS in the morning and afternoon peak hours compared to the Existing Conditions, and improved LOS over the 2040 No-Build condition. The 2040 Build analysis results indicate that:

- During the morning peak hour, all freeway segments operate at LOS C or better;
- During the afternoon peak hour, the two lane freeway segments west of Exit 85 operate at LOS D. The three lane freeway segments east of Exit 85 operate at LOS B.

The Ramp Merge Analyses outputs are provided in **Appendix C** and the summary results are shown in **Table 7**. The analysis results for the ramp merge areas, indicate the following:

Using the design hour volumes for the morning and afternoon peak hours, the analysis results for the 2016 Existing Conditions indicate that:

- During the morning peak hour, the Exit 85 merge areas operate at LOS B;
- During the afternoon peak hour, the Exit 85 merge areas operate at LOS C.

With traffic volumes projected to increase on the merge areas at Exit 85 at an annual rate of between 2.0 and 2.5 percent per year and if I-26 is not widened, the increased traffic volumes traveling on the existing merge ramps capacity will result in increased density and will reduce the LOS of the merge areas.

- During the morning peak hour, the Exit 85 merge areas operate at LOS D or better;
- During the afternoon peak hour, the Exit 85 merge areas operate at LOS D.

The additional capacity provided by the construction of a third lane in each direction along I-26 in the westbound and eastbound directions from Exit 82 to Exit 91 will lower densities in the ramp diverge areas, thus, it will result in comparable LOS in the morning and afternoon peak hours compared to the Existing Conditions and improved LOS over the 2040 No-Build condition, especially during the afternoon peak hour. The 2040 Build analysis results indicate that:

- During the morning peak hour, the Exit 85 merge areas operate at LOS B;
- During the afternoon peak hour, the Exit 85 merge areas operate at LOS B.

The Ramp Diverge Analyses are also provided in **Appendix C** and the summary results are shown in **Table 8**.

The analysis results for the ramp diverge areas, indicate the following:

Using the design hour volumes for the morning and afternoon peak hours, the analysis results for 2016 Existing Conditions indicate that:

- During the morning peak hour, the Exit 85 diverge areas operate at LOS B;
- During the afternoon peak hour, the Exit 85 diverge areas operate at LOS C or better.

With traffic volumes projected to increase adjacent to Exit 85 at an annual rate of between 2.0 and 2.5 percent per year and if I-26 is not widened, the increased traffic volumes traveling on the existing diverge ramps capacity will result in increased density and will reduce the diverge area LOS at the off-ramps.

- During the morning peak hour, the Exit 85 diverge areas operate at LOS C or better;
- During the afternoon peak hour, the Exit 85 diverge areas operate at LOS D.

The additional capacity provided by the construction of a third lane in each direction along I-26 will lower densities in the ramp diverge areas, resulting in substantial improvement in LOS compared to the 2040 No-Build condition, with LOS comparable to those experienced under 2016 Existing conditions. The 2040 Build analysis results indicate that:

- During the morning peak hour, the Exit 85 diverge areas operate at LOS B;
- During the afternoon peak hour, the Exit 85 diverge areas operate at LOS C.

#### Existing and 2040 No Build Intersection Analysis

Capacity analyses for the unsignalized intersections at the interchanges within the study area were performed. Analyses were performed for existing conditions (existing traffic, intersection traffic control and geometry), 2040 No-Build conditions (2040 traffic, and existing intersection traffic control and geometry), and 2040 Build conditions (2040 traffic and modified intersection traffic control and geometry).

For unsignalized intersections, the intersection operation is represented by the worst approach delay and LOS of all the STOP sign controlled approaches to the intersection.

The results of the unsignalized intersection capacity analyses for existing conditions and the 2040 No-Build conditions are shown in **Table 9** and **Figure 14**. The HCM intersection capacity outputs for each intersection are provided in **Appendix D**.

Under existing conditions, the STOP sign controlled approaches at the unsignalized intersections along SC 202 at Exit 85 operate at LOS A or B for the morning and afternoon peak hours. *No improvements are necessary to provide acceptable LOS under existing conditions.*

In general, with the forecast increases in traffic and without improvements to the intersections, delay in the 2040 No-Build analyses can be expected to be higher than delay during the Existing Conditions analyses. However, the approaches are expected to continue to operate at LOS B or better during the morning and afternoon peak hours.

*No improvements should be necessary to provide acceptable LOS during the 2040 No-Build operating conditions at these intersections.*

**Table 9- Intersection Capacity Analysis Results**

Intersection #	Intersection Name	2016 Existing Conditions				2040 No Build Conditions			
		AM Peak		PM Peak		AM Peak		PM Peak	
		LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)
<b>Exit 85</b>									
8501	SC 202 at Four Oaks Road <sup>1</sup>	A	9.8	A	9.8	B	11.2	B	11.4
8502	SC 202 at Meadow Brook Road <sup>1</sup>	A	9.1	A	9.7	A	9.8	B	11.0
8503	SC 202 at I-26 WB Off-Ramp EBL Slip Ramp / I-26 WBR Slip Ramp <sup>1</sup>	B	10.5	A	9.6	B	12.6	B	10.8
8513	SC 202 at I-26 WB On-Ramp <sup>1</sup>	A	3.9	A	1.6	A	4.4	A	1.8
8523	SC 202 at I-26 WB Off-Ramp EBR Slip Ramp / I-26 WB Loop Ramp <sup>1</sup>	A	9.1	A	9.0	A	9.8	A	9.7
8504	SC 202 at I-26 WB On-Ramp NBL Slip Ramp / I-26 NBR Slip Ramp <sup>1</sup>	A	5.5	A	1.8	A	6.6	A	2.0
8514	SC 202 at I-26 WB Off-Ramp <sup>1</sup>	B	10.7	A	9.8	B	14.7	B	11.8
8524	SC 202 at I-26 WB On-Ramp SBR Slip Ramp / I-26 EB Loop Ramp <sup>1</sup>	A	0.0	A	0.0	A	0.0	A	0.0
<sup>1</sup> Intersection unsignalized under all scenarios; worst approach LOS and delay reported. <sup>2</sup> Queue unable to be processed per HCM 2000 methodology; error reported. <sup>3</sup> Values from <i>Interchange Modification Report: I-26 at S-48 (Columbia Avenue) Interchange Improvements</i> .									

Source: Table 21 – *Interstate 26 Widening Traffic Analysis Report*

## 2040 Build Intersection Analysis – Preferred Alternative 1A

The SC 202 interchange is expected to be modified as part of the I-26 Widening project. In the Interstate 26 Widening Report, Alternative 1A, which replaces the existing interchange with a Diamond interchange with a loop ramp in the northeast quadrant, was chosen as the Preferred Alternative.

Other elements of the alternative concept include:

- Relocating the intersection of Meadow Brook Road and SC 202 to provide greater separation from the westbound ramps.
- Realigning Meadow Brook Road.

Capacity analysis for the unsignalized intersections of the Preferred Alternative were performed for the 2040 Final Build conditions which included the 2040 traffic volumes and the Preferred Alternative geometry at the Exit 85 interchange.

For the Preferred Alternative, all intersections operate at LOS A or LOS B. The Preferred Alternative did not require any traffic control improvements to provide an acceptable LOS.

The results of the unsignalized intersection capacity analyses for the 2040 Build Preferred Alternative 1A are shown in **Table 10** and **Figure 15**. Queuing results for the 2040 No-Build and Build conditions are shown in **Table 11**.



Source: Figure 74, *Interstate 26 Widening Traffic Analysis Report*  
Figure 14. Exit 85 – SC 202 Interchange Intersection LOS Summary

**Table 10- Intersection Capacity Analysis Results - 2040 Base vs 2040 Build Exit 85**

Intersection #	Intersection Name	2040 No Build Conditions				2040 Build Conditions			
		AM Peak		PM Peak		AM Peak		PM Peak	
		LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)
<b>Alternative 1A: Diamond Loop</b>									
8501	SC 202 at Four Oaks Road <sup>1</sup>	B	11.2	B	11.4	B	11.4	B	11.8
8502	SC 202 at Meadow Brook Road <sup>1</sup>	A	9.8	B	11.0	intersection removed; shifted to 8501			
8503	SC 202 at I-26 WB Off-Ramp EBL Slip Ramp / I-26 WBR Slip Ramp <sup>1,2</sup>	B	12.6	B	10.8	B	10.4	A	9.8
8513	SC 202 at I-26 WB On-Ramp <sup>1</sup>	A	4.4	A	1.8	A	3.7	A	1.0
8523	SC 202 at I-26 WB Off-Ramp EBR Slip Ramp / I-26 WB Loop Ramp <sup>1,2</sup>	A	9.8	A	9.7	intersection removed; shifted to 8503			
8504	SC 202 at I-26 WB On-Ramp NBL Slip Ramp / I-26 NBR Slip Ramp <sup>1,2</sup>	A	6.6	A	2.0	B	12.2	B	11.1
8514	SC 202 at I-26 WB Off-Ramp <sup>1</sup>	B	14.7	B	11.8	intersections removed; shifted to 8504			
8524	SC 202 at I-26 WB On-Ramp SBR Slip Ramp / I-26 EB Loop Ramp <sup>1,2</sup>	A	0.0	A	0.0				
<sup>1</sup> Intersection unsignalized under all scenarios; worst approach LOS and delay reported. <sup>2</sup> Intersection name updated under 2040 Build Conditions. <sup>3</sup> HCM 2010 delay and LOS reported for proposed roundabout intersections.									

Source: Table 22 – *Interstate 26 Widening Traffic Analysis Report*

**Table 11. 2040 Build Intersection Queue Lengths Exit 85**

Intersection #	Intersection Name	Movement		95th Percentile Queue Length (ft)			
		2040 No Build Conditions	2040 Build Conditions	2040 No Build Conditions		2040 Build Conditions	
				AM Peak	PM Peak	AM Peak	PM Peak
<b>Alternative 1A: Diamond Loop</b>							
8501	SC 202 at Four Oaks Road	NBTR	NBL	0	0	0	0
			NBTR	0	0	0	0
		SBLT	SBL	0	0	0	0
			SBTR	0	0	0	0
		-	EBLTR	-	-	0	0
WBLR	WBLTR	0	0	0	0		
8502	SC 202 at Meadow Brook Road	NBLT	-	0	0	intersection removed; shifted to 8501	
		SBTR	-	0	0		
		EBLR	-	0	0		
8503	SC 202 at I-26 WB Off-Ramp EBL Slip Ramp / I-26 WB Ramps <sup>1</sup>	EBL	EBL	0	0	0	0
			EBR	0	0	0	25
8513	SC 202 at I-26 WB On-Ramp	NBLT	NBL	0	0	0	0
			NBT	0	0	0	0
		SBTR	SBT	0	0	0	0
			SBR	0	0	0	0
8523	SC 202 at I-26 WB Off-Ramp EBR Slip Ramp	EBR	-	0	25	shifted to 8503	
8504	SC 202 at I-26 WB On-Ramp NBL Slip Ramp / I-26 EB Ramps <sup>1</sup>	NBLT	NBT	25	0	0	0
			NBR	0	0	0	0
		SBT	SBL	0	0	0	0
			SBT	0	0	0	0
		-	EBLT	-	-	0	0
	EBR	-	-	0	0		
8514	SC 202 at I-26 WB Off-Ramp	EBL	-	25	25	shifted to 8504	

<sup>1</sup> Intersection name updated under 2040 Build Conditions.

<sup>2</sup> HCM 2010 delay and LOS reported for proposed roundabout intersections.

Source: Table 24, *Interstate 26 Widening Traffic Analysis Report*

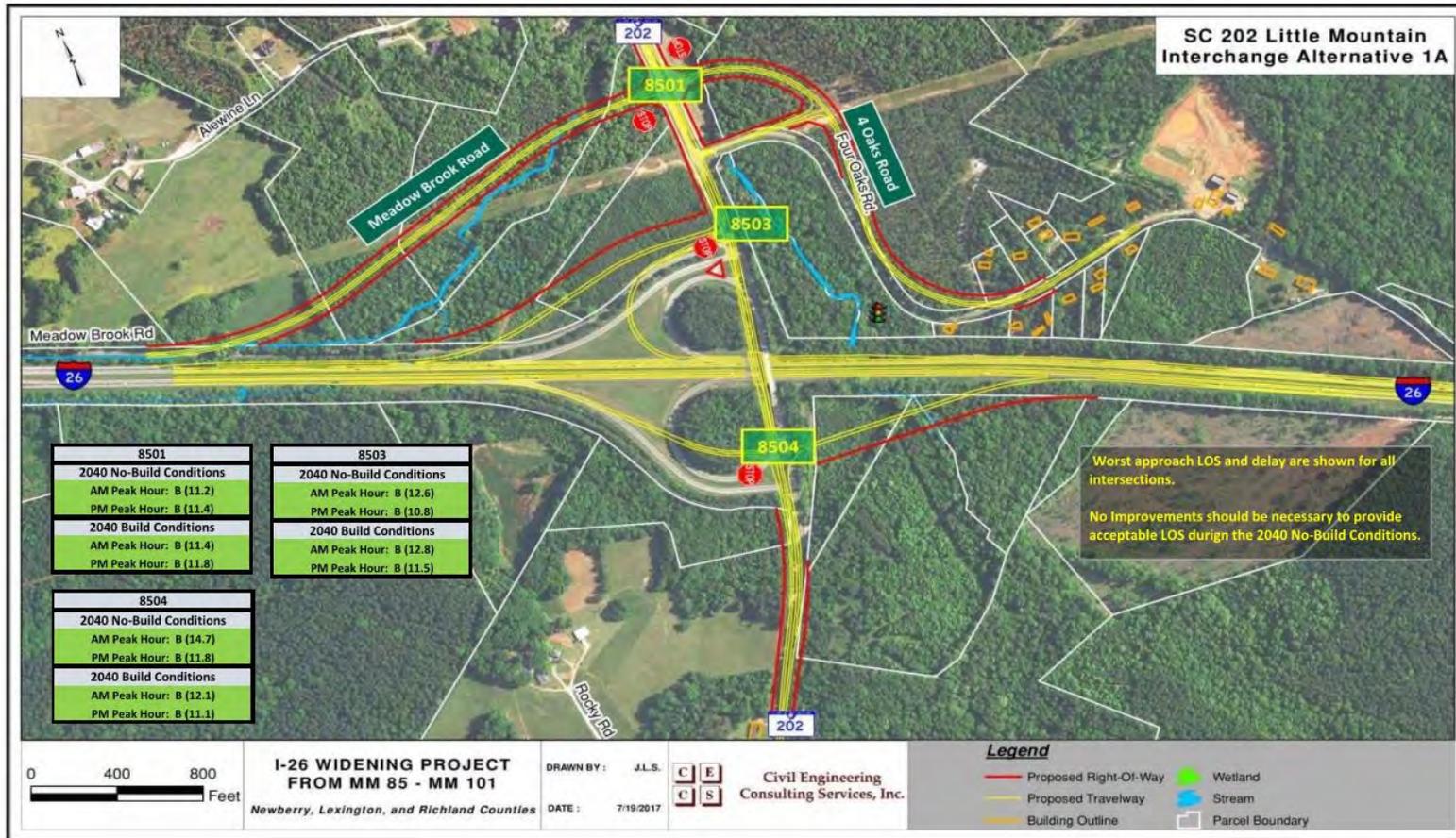


Figure 15. Exit 85 – SC 202 Interchange Intersection LOS Summary Preferred Alternative 1A

## TransModeler Network Analysis

TransModeler, a microsimulation software, was used to analyze the Existing, No-Build, and Build alternative freeway networks. A TransModeler microsimulation model consists of a large amount of component database and executable files that are run through the TransModeler software. The model then is initiated within TransModeler through a single project file. The main components of the model are network files, traffic control and signal timing plans, vehicle detector layout and configuration, trip tables for both autos and trucks, traffic counts, and parameter files. This section illustrates how to develop these main components for creating a base year model of existing conditions. The microsimulation model was developed for the 20-mile interstate section of the project and was based on a calibrated base model for the area.

There are several limitations of using HCS, which is a macroscopic, deterministic model that uses HCM methodologies. The HCS analysis may show differing conditions than existing operations and conditions in the field because it does not consider upstream and downstream traffic impacts and is unable to model interactions between the two. The HCS model is a spot check at a certain location; therefore upstream and downstream operations are not taken into consideration and have no effect on the analyses. This is not the case for actual conditions, as upstream or downstream congestion may have direct impacts at a specific segment causing a ripple effect. TransModeler evaluates each segment and lane by taking into consideration vehicle interaction and driver behaviors, as well as the operational impacts for both the upstream and downstream traffic conditions.

The existing conditions and 2040 No-Build conditions TransModeler analysis was performed using the existing number of freeway lanes present on the segments within the study area, similar to the HCS analysis. Therefore, the same TransModeler simulation network was used for existing and No-Build conditions. The only difference between the existing and No-Build conditions is the input trip table volumes and a proposed widening project along Broad River Road. The 2040 No-Build conditions volumes were developed using the growth rates determined based on discussions with SCDOT. It was determined that a growth rate of 1.5 percent would be used from the east end of the study area to east of US 176 (Broad River Road), 2.0 percent would be used from US 176 (Broad River Road) to the east of SC 202, and a growth rate of 2.5 percent would be used from SC 202 to the west. The existing truck percentages for the model were developed utilizing classification counts along the mainline along with intersection counts along the arterials. These inputs were combined to develop an Origin-Destination (OD) matrix for both medium and heavy trucks. These truck volumes were then scaled up to 2040 volumes by the same proportions as the overall volume growth.

The 2040 Build AM and PM TransModeler models for the 20-mile study area of I-26 were developed by modifying the 2040 No-Build models to incorporate the widening of I-26 in each direction as well as the Preferred Alternatives for each interchange. Synchro was used to input the recommended traffic signal timing information into the network for the arterial intersections. Each simulation was run for one hour with 30 minutes of seeding time to load the network. 10 repetitions were used for both the AM and PM peak periods.

The Basic Freeway Segment Analysis outputs for the existing conditions, 2040 No-Build conditions, and the Preferred Alternative 1A Build conditions are provided in **Appendix E** and a summary of results is shown in **Table 12**.

The widening of I-26 extends to Exit 85 to accommodate the projected increase in traffic volume within the corridor. This widening will result in segment densities adjacent to Exit 85 in the 2040 Build condition being comparable to those in existing conditions.

The analysis results for the freeway segment analysis for the Existing Conditions, summarized in **Table 12**, indicate the following:

- During the morning peak hour, all freeway segments operate at LOS B or better.
- During the afternoon peak hour, all freeway segments operate at LOS C or better.

With traffic volumes projected to increase within the corridor at an annual rate of 2.0 to 2.5 percent per year and if I-26 is not widened, the increased volumes traveling on the existing interstate during the 2040 No-Build conditions will result in increased density and reductions of freeway segment LOS. However, due to unprocessed volume from upstream queuing, the No-Build conditions may appear better than the Existing conditions in some locations.

- During the 2040 No-Build morning peak hour, the eastbound segment from Exit 85 to 91 is expected to operate at LOS F. All other segments are expected to operate at LOS C or better.
- During the 2040 No-Build afternoon peak hour, the eastbound segment from Exit 85 to 91 is expected to operate at LOS F. All other segments are expected to operate at LOS C or better.

The additional capacity provided by the construction of a third lane in each direction along I-26 will result in substantial improvement in LOS compared to the 2040 No-Build condition, with LOS comparable to those experienced under existing conditions. The 2040 Build analysis results indicate that:

- During the morning peak hour, all freeway segments operate at LOS C or better.
- During the afternoon peak hour, all freeway segments operate at LOS C or better.

**Table 12: Basic Freeway Segment Analysis TransModeler Results**

Segment	Existing Conditions				2040 No Build Conditions				2040 Build Conditions			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>
<b>I-26 Eastbound</b>												
Exit 82 to Exit 85	B	13.9	C	20.0	C	20.4	C	25.6	C	20.1	C	25.4
Exit 85 to Exit 91	B	16.7	C	20.5	F	104.9	F	99.6	B	15.9	B	16.7
<b>I-26 Westbound</b>												
Exit 91 to Exit 85	B	15.3	C	24.5	B	13.2	B	15.1	A	10.1	B	17.1
Exit 85 to Exit 82	B	15.2	C	23.4	A	10.9	B	13.6	B	14.9	C	25.2

<sup>1</sup> Per Highway Capacity Manual 2010 criteria.  
<sup>2</sup> Density expressed as passenger cars/per mile/per lane.

**Table 13: Freeway Merge Analysis TransModeler Results**

Segment	Existing Conditions				2040 No Build Conditions				2040 Build Conditions			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>
<b>I-26 Eastbound</b>												
Exit 85 Loop On	B	17.0	B	17.5	D	30.9	D	26.5	B	12.7	B	13.3
<b>I-26 Westbound</b>												
Exit 85 On ramp	B	11.5	C	18.7	A	9.3	B	11.1	A	9.3	B	14.9

<sup>1</sup> Per Highway Capacity Manual 2010 criteria.  
<sup>2</sup> Density expressed as passenger cars/per mile/per lane.

**Table 14: Freeway Diverge Analysis TransModeler Results**

Segment	Existing Conditions				2040 No Build Conditions				2040 Build Conditions			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>
I-26 Eastbound												
Exit 85	B	11.8	B	16.1	B	17.9	C	22.1	B	12.3	B	14.3
I-26 Westbound												
Exit 85 Loop Off	B	13.8	C	21.8	B	13.0	B	15.2	A	9.7	B	16.0

<sup>1</sup> Per Highway Capacity Manual 2010 criteria.  
<sup>2</sup> Density expressed as passenger cars/per mile/per lane.

The summary of the Ramp Merge Analyses results for the Build condition, compared to the Existing and No-Build conditions, is shown in **Table 13**. The outputs for the Build conditions analyses are provided in **Appendix F**.

The widening of I-26 to three lanes to the west side of Exit 85 will result in the Exit 85 merge areas in the 2040 Build condition having densities comparable to those in existing conditions.

The analysis results for the ramp merge areas, summarized in **Table 13**, indicate the following:

Using the design hour volumes for the morning and afternoon peak hours, the analysis results for the Existing conditions indicate that:

- During the morning peak hour, the Exit 85 eastbound and westbound ramp merge areas operate at LOS B
- During the afternoon peak hour, the Exit 85 eastbound and westbound ramp merge areas operate at LOS C or better

With traffic volumes projected to increase within the corridor for 2040 No-Build conditions and if I-26 is not widened, the increased traffic volumes traveling on the existing interstate capacity will result in increased density and could reduce the merge area LOS. However, due to unprocessed volume from upstream queuing, the No-Build conditions may appear better than the Existing conditions in some locations.

- During the 2040 No-Build morning peak hour, the eastbound ramp merge at Exit 85 is expected to operate at LOS D. The westbound ramp merge at Exit 85 is expected to operate at LOS A.
- During the 2040 No-Build afternoon peak hour, the eastbound ramp merge at Exit 85 is expected to operate at LOS D. The westbound ramp merge at Exit 85 is expected to operate at LOS B.

The additional capacity provided by the construction of a third lane in each direction along I-26 will result in improvement in LOS compared to the 2040 No-Build condition, with LOS comparable to those experienced under existing conditions. The 2040 Build analysis results indicate that:

- During the morning peak hour, the Exit 85 eastbound and westbound ramp merge areas operate at LOS B or better.
- During the afternoon peak hour, the Exit 85 eastbound and westbound ramp merge areas operate at LOS B.

The summary of the Ramp Diverge Analyses results for the Build conditions, compared to the Existing and No-Build conditions, are shown in **Table 14**. The outputs for the Build conditions analyses are also provided in **Appendix F**.

The widening of I-26 to three lanes to the west side of Exit 85 will result in the Exit 85 diverge areas in the 2040 Build condition having densities comparable to those in existing conditions.

The analysis results for the ramp diverge areas, summarized in **Table 14**, indicate the following:

Using the design hour volumes for the morning and afternoon peak hours, the analysis results for the Existing conditions indicate that:

- During the morning peak hour, the Exit 85 eastbound and westbound ramp diverge areas operate at LOS B.
- During the afternoon peak hour, the Exit 85 eastbound and westbound ramp diverge areas operate at LOS C or better.

With traffic volumes projected to increase within the corridor for 2040 No-Build conditions and if I-26 is not widened, the increased traffic volumes traveling on the existing interstate capacity will result in increased density and could reduce the LOS at the diverge areas. However, due to unprocessed volume from upstream queuing, the No-Build conditions may appear better than the Existing conditions in some locations.

- During the morning peak hour, the Exit 85 eastbound and westbound ramp diverge areas operate at LOS B
- During the afternoon peak hour, the Exit 85 eastbound and westbound ramp diverge areas operate at LOS C or better

The additional capacity provided by the construction of a third lane in each direction along I-26 will result in improvement in LOS compared to the 2040 No-Build condition, with LOS comparable to those experienced under existing conditions. The 2040 Build analysis results indicate that:

- During the morning peak hour, the Exit 85 eastbound and westbound ramp diverge areas operate at LOS B or better.
- During the afternoon peak hour, the Exit 85 eastbound and westbound ramp diverge areas operate at LOS B.

## VII. Interchange Justification

A policy statement for justifying the need for additional or modified access to the existing sections of an Interstate System was first published in the Federal Register on October 22, 1990 entitled “Access to the Interstate System”. It was then modified and updated on February 11, 1998, on August 27, 2009 and on May 22, 2017. The objectives of this policy are to ensure that all new or revised access points do not adversely impact the operations and safety of the Interstate System, and all new or revised access points have been vetted through a systematic evaluation process.

In order to explain the intent and requirements of this new policy, U. S. Department of Transportation Federal Highway Administration published a Memorandum on May 22, 2017. This FHWA Guide was followed in preparing the current Interchange Modification Report (IMR) for the I-26/Exit 85 Interchange in Newberry County, South Carolina.

### Policy Point 1

**An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (23 CFR 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access should include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request should also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).**

The intent of the Policy Point 1 is to require detailed operational and safety analysis of the relevant interstate segments and provide a comparison of the No-Build and Build conditions that are anticipated to occur through the design year of the project.

The analysis of the interstate facility and Exit 85 is an extension of the previous project-wide traffic operations and safety analysis as summarized in the *I-26 Widening Traffic Analysis Report* and the *I-26 Widening Project MM 85 – MM 101 Traffic Safety Analysis Report*.

The analysis of the interstate facility includes the portion of I-26 between SC 773 interchange (Exit 82) and the Columbia Avenue (S-32-48) interchange (Exit 91), including the proposed modification of SC 202 interchange (Exit 85). The analysis was performed using methodologies and procedures outlined in the Transportation Research Board's *Highway Capacity Manual* and used the HCS-2010 analysis and TransModeler simulation model software.

The analysis of the 2040 Build conditions of the Preferred Alternative (Alternative 1A) illustrates that the project would not have any significant negative impact on the safety and on the operation of the facilities within the project area. The analysis shows Interstate 26 mainline operations and ramp merge/diverge areas are estimated to operate at LOS D or better during the 2040 morning and afternoon peak hours. Without the proposed improvement, the freeway segments and ramp merge/diverge areas would operate between LOS A to LOS F during the 2040 No-Build morning peak hour, and between LOS B to LOS F during the 2040 No-Build afternoon peak hour.

Exit 82, the interchange adjacent to Exit 85, is not expected to be modified as part of the I-26 Widening project. Exit 91 (Columbia Avenue) is expected to be modified to provide a Diverging Diamond Interchange. The DDI concept was evaluated and selected as the Preferred Alternative in the *Interchange Modification Report, I-26 at S-48 (Columbia Avenue) Interchange Improvements*.

Exit 82 - SC 773 is located approximately 3.15 miles northwest of the Exit 85 interchange. Exit 91 - Columbia Avenue (S-32-48) is located approximately 5.85 miles southeast of the Exit 85 interchange. With interchange spacing exceeding 3 miles to the next adjacent interchange from Exit 85, there are no anticipated operational concerns related to the spacing between interchanges. Sufficient distance exists between upstream and downstream merging/diverging areas at the adjacent interchanges to eliminate the influence of traffic movements within these areas, and analysis shows the freeway segments are projected to operate at LOS D or better.

The Accident Analysis Report identifies rear end collisions and no collision with motor vehicle as the most frequent types of crashes within the study area. The report also identifies driving too fast for conditions as the main cause of rear end crashes. The presence of median barriers and guardrail fences are noted as the first harmful event for no collision with motor vehicle crashes. The Accident Analysis Report points out that the geometric conditions resulting from merge/diverge areas of loop ramps seem to play a role in the frequency of the crashes and that merging distance at on-ramps and diverging distances at off-ramps should be improved to SCDOT

standards where these standards are not already met. Study area hot spots along the interchange arterials include frequent crashes at Exit 91 along Columbia Avenue at business driveways to the west of the eastbound off-ramp intersection. It is anticipated that access controls implemented as part of the proposed Exit 91 DDI interchange improvement will address these concerns.

Modifying interchanges to eliminate loop ramps at Exit 85 may also reduce crashes on the segments adjacent to the loop ramps. By replacing the substandard ramps and modifying the existing interchange to meet current design standards, the proposed interchanges with SC 202 and with Columbia Avenue are anticipated to contribute to an improvement in traffic safety.

The Preferred Alternative (Alternative 1A) of the interchange design also provides space for the construction of an additional travel lane in each direction along I-26. Altogether, these design provisions would enhance the operational efficiency and safety of the corridor, thereby increasing capacity and improving levels of service in the long term.

Pedestrian facilities are not incorporated into the design due to the rural nature of the interchange area.

#### Policy Point 2

**The proposed access connects to a public road only and will provide for all traffic movements. Less than “full interchanges” may be considered on a case-by-case basis for applications requiring special access, such as managed lanes (e.g., transit, HOVs, HOT lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.**

The intent of the Policy Point 2 is to require implementation of an interchange design for the new access that allows for all relevant movements for general purpose traffic, whenever feasible.

The existing SC 202 interchange is a partial cloverleaf interchange that provides for all traffic movements. Because of its unconventional orientation, all ramps are located on the west side of the interchange. Spacing between the existing ramps are short. In addition, two-way Meadow

Brook Road runs parallel to the westbound on-ramp and ties in SC 202 70 feet north of westbound on-ramp and SC 202 intersection.

As illustrated in the design concept for the Preferred Alternative, the proposed modification of Exit 85 would continue to provide full access for all traffic movements. It would shift ramp movements away from the two-way frontage roads directly to intersections with SC 202, and provide ramps that meet or exceed current design standards, improving access to SC 202 and the surrounding roadway network.

# **APPENDIX C**

## **Exit 91 IMR**

# INTERCHANGE MODIFICATION REPORT



**I-26 AT S-48 (COLUMBIA AVENUE)  
INTERCHANGE IMPROVEMENTS  
LEXINGTON COUNTY, SOUTH CAROLINA  
PROJECT No. R4035500-121734.01  
PROJECT ID P042383**

**DECEMBER 2016**

**PREPARED FOR:  
SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION  
&  
LEXINGTON COUNTY**



# INTERCHANGE MODIFICATION REPORT

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**DECEMBER 2016**

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12-16-16



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## 1.0 EXECUTIVE SUMMARY

To obtain approval from the Federal Highway Administration (FHWA), the following Interstate 26 at S-48 (Columbia Avenue) Interchange Modification Report (IMR) was developed for the South Carolina Department of Transportation (SCDOT). The I-26 at S-48 (Columbia Avenue) diamond interchange is located at Exit 91 in Lexington County, South Carolina. The S-48 (Columbia Avenue) portion of the interchange is just within the Town of Chapin limits, which is located approximately 20 miles northwest of Columbia, SC.

The purpose of the project is to improve operational efficiency and safety of the existing interchange and to accommodate future volumes. The current interchange design is approaching capacity as a two-lane bridge along with no turn lanes to / from S-48 and is functionally obsolete. Operation is expected to worsen with more daily traffic volumes based on past census data indicating the population has been increasing by approximately twenty (20) percent per decade since 1990. With this anticipated growth along with the recently approved Chapin Technology Park and a planned commercial development north of the interchange, modifications to the existing diamond interchange are needed.

The traffic analysis included the evaluation of Existing year 2014, Future year 2020, and Future year 2040 traffic volumes during the AM and PM peak hours. The future year analyses included a No-Build Alternative with the existing interchange / intersection layout and three Build Alternatives:

1. Diverging Diamond Interchange
2. Partial Clover Leaf
3. Dual Roundabout

Geometric design improvements to the adjacent intersections to the interchange are also addressed in this Interchange Modification Report (IMR). Plans to realign Crooked Creek Road (S-232), currently intersecting with the I-26 Eastbound On Ramp, and Ellett Road (less than 50 feet from the I-26 Westbound Ramps) are expected to be realigned directly with S-48 approximately 1000 feet to the south under signal control. This report focuses on the interchange; however, plans are being conducted along S-48 (Columbia Avenue) to widen the existing two-lane highway to five-lanes. Traffic volumes used in this IMR were referenced from the S-48 (Columbia Avenue) Corridor Improvement Project Traffic Study dated October 17, 2016.

Adjacent interchanges Exit 85 (SC 202) and Exit 97 (US 176) were also studied even though both interchanges are more than 5 miles from the study interchange. As expected, Exit 97 (14 miles from Columbia and more developed) carries more traffic than the Exit 85, which is rural and 12 additional miles further away from Columbia. It should be noted, that there an I-26 widening project underway that extends from Exit 85 to Exit 101 which also includes some interchange improvements.

Analysis using Synchro 9.1 indicated that interchange alternatives 1 and 2 operated at an acceptable level-of-service (LOS) C; however, the diverging diamond interchange was selected based its minimal right-of-way acquisition and impact to future development as opposed to other study alternatives. The preferred alternative was also modeled using the microsimulation software VISSIM 7.0. Alternative 3 (dual roundabouts) did not provide an acceptable level-of-service (see **Appendix N**); therefore, it should be not be considered as a viable alternative.

Operation at Exit 97 (US 176 east of the study interchange) is expected to fail by 2040 with no improvements to the interchange. Consideration for widening of I-26 and a review of the interchange is recommended to accommodate projected traffic volumes. Operation at Exit 85 (SC 202 west of the study interchange) is expected to operate an acceptable level-of-service during the year 2040 with its existing design. **Figure 15** summarizes the Level-of-Service and delay for the projected 2040 preferred alternative.

This study recommends the best alternative to meet current and future surrounding area needs for Lexington County, South Carolina. SCDOT will submit this report for a validation of engineering and operational feasibility. Final approval of the IMR will be requested once all National Environmental Policy Act (NEPA) requirements have been met.

## 2.0 INTRODUCTION

### 2.1 BACKGROUND

Interstate 26 is a rolling four-lane East-West highway that is divided by a grassy median. The study area for the proposed project begins at Exit 85 (SC 202) and ends at Exit 97 (US 176). The interchange of emphasis in this report is Exit 91, which provides access to S-48 (Columbia Avenue) in Chapin, South Carolina. S-48 is a two lane minor arterial with future widening plans to accommodate future growth as part of this project. The approved Chapin Technology Park (a phased 2019 and 2024 Build-out) is approximately 1 mile south of the interchange and the planned commercial development just north of the interchange (northwest quadrant) was included in the traffic projections. The existing interchange at S-48 currently has minor queuing issues at the signalized I-26 westbound ramp and is expected to be over capacity based on the projected annual growth in the area and the added traffic volumes from the two large developments. The preferred alternative is to replace the existing diamond interchange design with a diverging diamond interchange (DDI) and to realign Crooked Creek Road and Ellett Road 1000 feet south of interchange under signal control improving the access management of S-48.

### 2.2 SCOPE

This report focuses on traffic analysis of existing and future conditions and provides recommendations for mitigating Level-of Service (LOS) and queuing. AECOM was tasked with studying traffic conditions in the vicinity of the proposed project during the weekday AM and PM peak hours for three scenarios:

- 2014 Existing: An analysis of existing conditions in the year 2014.
- 2020/2040 No-Build: An analysis of conditions in the years 2020 and 2040 with no changes to the interchange.
- 2020/2040 Project Build-Out: An analysis of conditions in the years 2020 and 2040 if a an interchange is modified, S-48 is widened to 5 lanes to the south, and Crooked Creek Road and Ellett Road are realigned 1000 feet to the south.

This study includes an analysis of the existing adjacent interchanges to the east and west of the proposed interchange modification of Exit 91. To the east is Exit 97 and to the west is Exit 85.

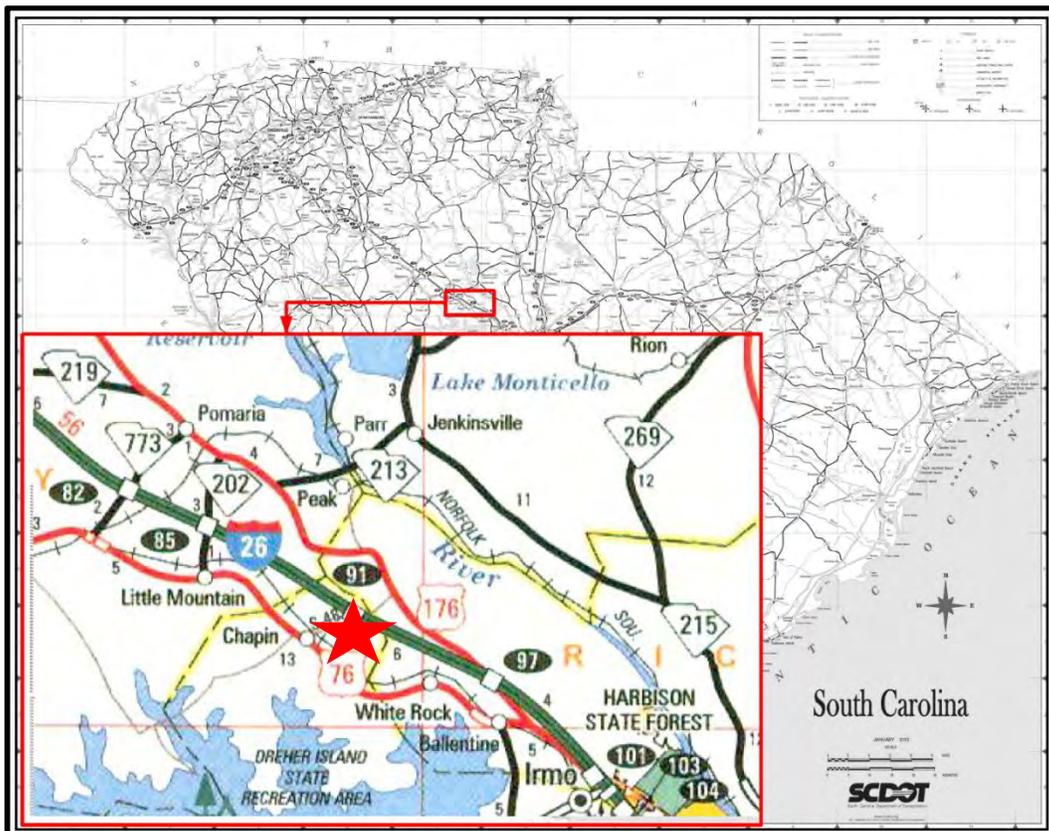
The scope of this interchange modification study included the following tasks:

1. Field visits to the study area were performed to collect data on the existing conditions such as lane configurations/geometry and current traffic control measures. Traffic counts and signal timing information at the interchanges were obtained from SCDOT.
2. Existing conditions of the interchanges were studied by utilizing the existing traffic volumes. Levels of service of the intersections at each interchange were determined using Synchro 9.1. I-26 freeway and interchange on / off ramps (segments, merges, and diverges, and off-ramps) were analyzed High Capacity Software 2010. VISSIM 7.0 was also used to model the entire network.

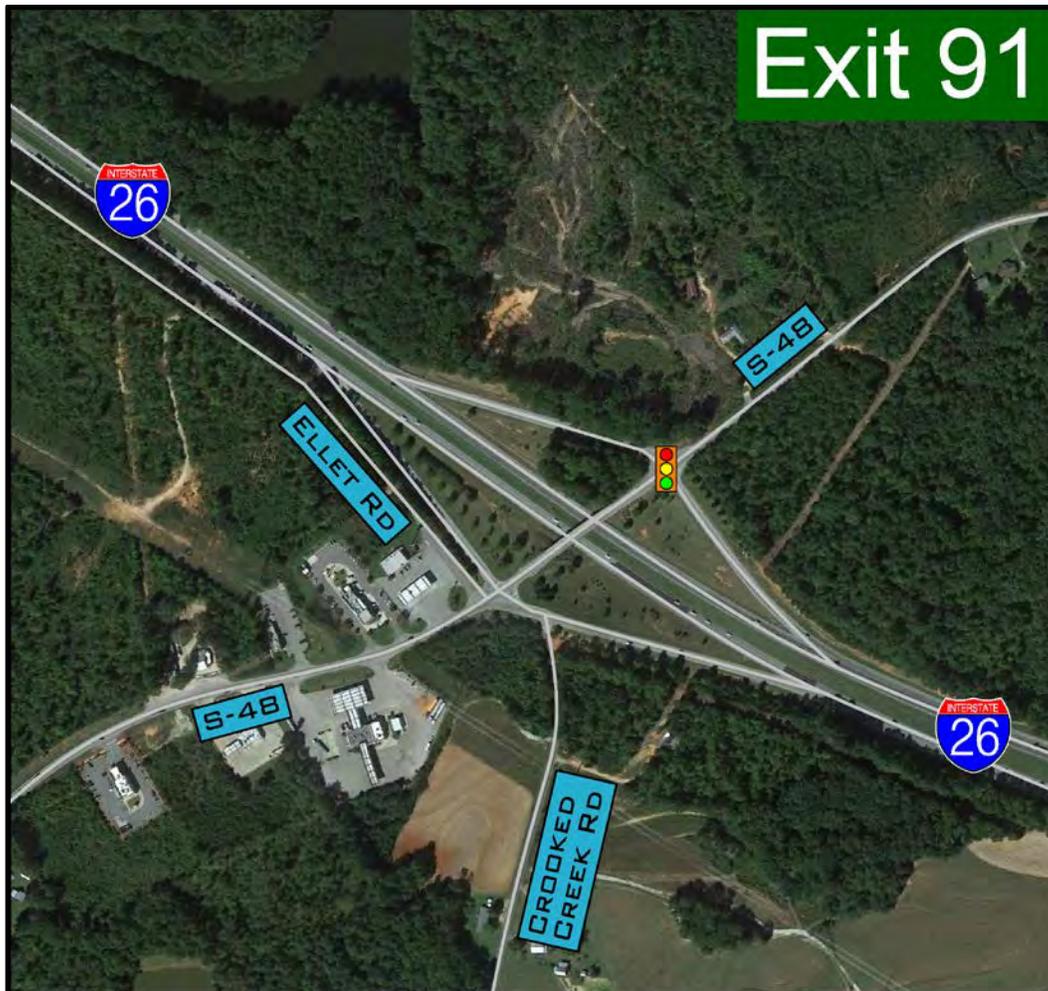
3. Two future design years were examined in this report. Build and No-Build scenarios were analyzed for the years 2020 and 2040. The No-Build scenario analyzed the conditions in both design years in which no modifications were made to the interchange or adjacent freeway and interchanges. The Build scenario analyzed the future conditions in both build years if the interchange modification and widening of S-48 (Columbia Avenue) were constructed. Adjacent merge and diverge areas (freeway segments, on-ramps, and off-ramps) were analyzed under the future design year (2020/2040) conditions of the study area.
4. The future design year conditions were analyzed for three (3) different interchange alternative scenarios. Adjacent merge and diverge areas (freeway segments, on-ramps, and off-ramps) were analyzed under the future design year (2020/2040) conditions of the study area. Only the preferred alternative was also modeled using VISSIM 7.0.

### 2.3 STUDY AREA

The study area is located in Lexington County, South Carolina. Specifically, the S-48 (Columbia Avenue) Widening project is located in the Town of Chapin, South Carolina. The study area of the IMR begins to the west of S-48 at Exit 85 of I-26 and ends to the east at Exit 97. The interchange of I-26 at S-48 is Exit 91. I-26 is an east-west four (4) lane freeway with two (2) travel lanes in each direction. The location of the project is shown in **Figure 1A** and **Figure 1B**.



**Figure 1A – Project Location**



**Figure 1B – Interchange Study Area**

## 2.4 PURPOSE AND NEED STATEMENT

The purpose of this IMR is to study the impact of the modification of the interchange at Exit 91 on I-26 near Chapin, South Carolina. Chapin is located in Lexington County, northwest of Columbia. The population of Lexington County has been steadily increasing. In the 1990 Census, the population of Lexington County was 167,611. This grew to 216,014 (28.9% increase) in the 2000 Census and then reached 262,391 (21.5% increase) in 2010. Due to continual and anticipated growth in the area, improvements to the existing roadway network should be reviewed. This report is aimed at the potential improvements to the interchange from I-26 to Columbia Avenue in Chapin. The existing interchange is currently over capacity and the Frontage Road connection with S-48 and Crooked Creek Road connection with the I-26 EB On Ramp should be realigned for safety to meet SCDOT's latest criteria for access management. With new developments and construction in Chapin, such as the S-48 (Columbia Avenue) widening, there is a need for to modify the interchange to be able to accommodate this growth in terms of both capacity and safety.

## 2.5 EXISTING CONDITIONS FOR STUDY AREA

Currently S-48 is a 2-lane undivided minor arterial roadway with a 35 mile per hour (mph) posted speed limit that runs from US 76 at its intersection with S-51 (Amick Ferry Road) to the I-26 interchange. In the study area, I-26 is a 4-lane divided freeway with a 70 mph posted speed limit running in the east-west direction.

The AM peak hour studied was from 7:30-8:30 AM and the PM peak hour was from 4:45 – 5:45 PM based on the peak hour turning movement traffic counts. Heavy truck percentage for the peak hours varied; however, 4% was used for I-26 and 2% was used on the other studied roadways. It should be noted that SCDOT records indicate the daily heavy truck percentage on S-48 is 7% while I-26 is approximately 15%. Descriptions of the interchanges and a complete list of the study area are described below and shown in **Figure 2**:

1. I-26 Eastbound Ramps at S-48
2. I-26 Westbound Ramps at S-48
3. I-26 Eastbound Ramps at SC 202
4. I-26 Westbound Ramps at SC 202
5. I-26 Eastbound Ramps/ Exxon Driveway at US 176
6. I-26 Westbound Ramps at US 176

### Exit 85

Approximately 6 miles to the west of Exit 91 on I-26 is Exit 85, a folded diamond/partial cloverleaf interchange. This interchange provides access to SC 202, a north-south 2-lane undivided roadway with a bridge over I-26. The eastbound off-ramp from I-26 is a stop controlled intersection where vehicles have the ability to turn left or right on to SC 202. The westbound off-ramp also has a stop controlled left turn onto SC 202 while the right turn from the ramp is yield controlled. A frontage road (Meadow Brook Road), less than 100 feet north of the I-26 westbound ramps, runs parallel to I-26 westbound, which is accessible from SC 202.

### Exit 91

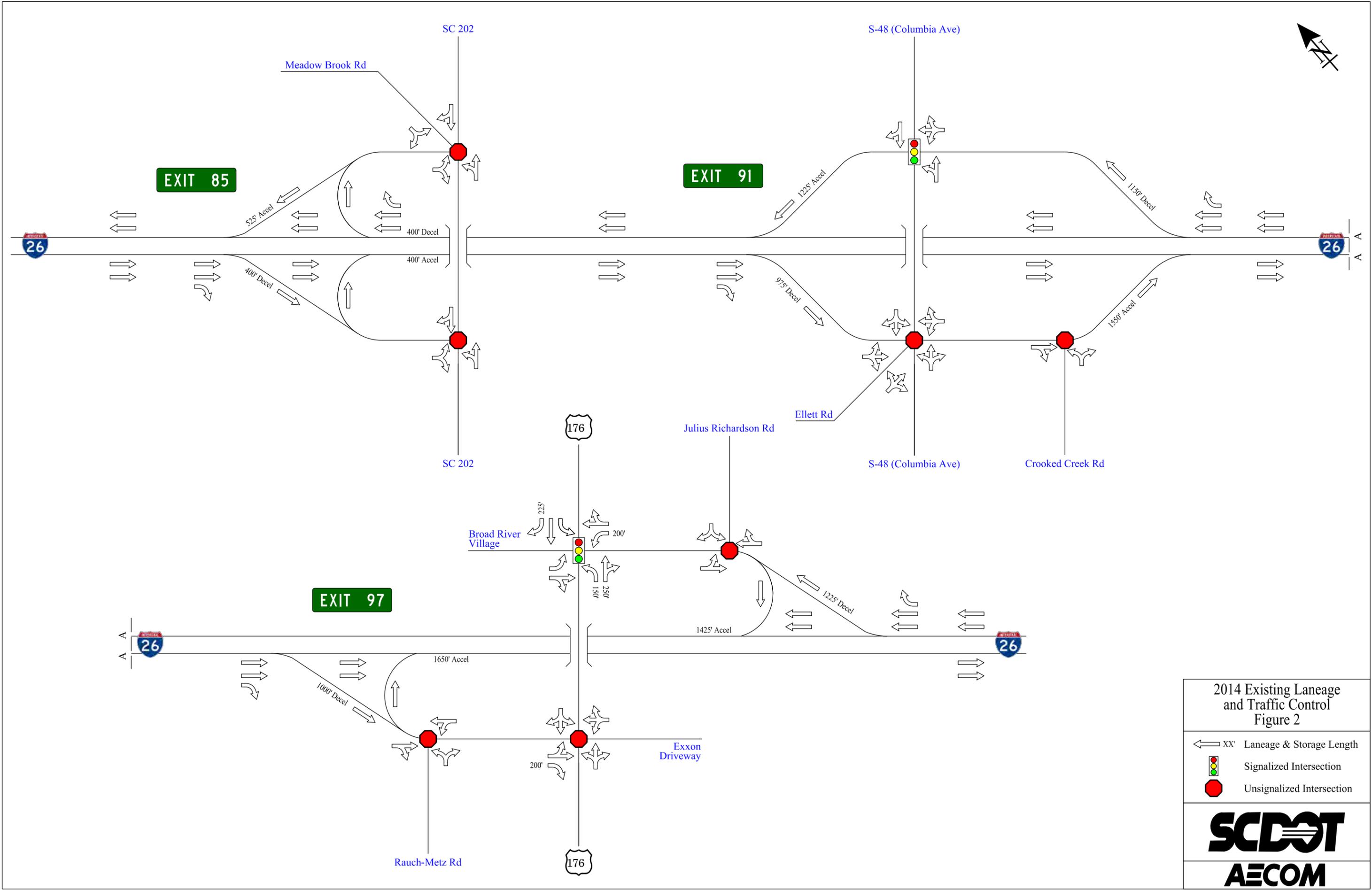
The interchange that intersects with S-48 is Exit 91 as a diamond interchange. This interchange provides access to S-48, which leads directly into Chapin. The eastbound off-ramp provides stop controlled access to S-48. The westbound off-ramp is signalized at the intersection with S-48. A frontage road (Ellett Road) intersects with S-48 approximately 50 feet to the southwest of the eastbound off-ramp. This road runs parallel to I-26 eastbound to the west of S-48. The eastbound on-ramp has access to Crooked Creek Road located on the ramp. There are multiple fast food restaurants and gas stations located west of the interchange on S-48.

### Exit 97

Approximately 6 miles to the east of Exit 91 on I-26 is Exit 97. This interchange is a partial cloverleaf design for I-26 westbound and eastbound on ramp movements. The interchange

provides access to US 176, which has access to many residential developments near the interstate. The eastbound off-ramp leads to an intersection with US 176 that is stop controlled coming off the ramp. In addition to the intersection with US 176, the ramp intersects with Rauch Metz Road about half the distance between I-26 and US 176. Traffic traveling from Rauch Metz Road has the option to turn left to access the on-ramp to I-26 eastbound or turn right and head toward the intersection with US 176. The I-26 eastbound loop on-ramp also provides for vehicles to turn left onto Rauch Metz Road.

The I-26 westbound off-ramp intersects with US 176 at a signalized intersection. Through and left turn lane traffic approach the signal while the right turning traffic approaches a yield before continuing onto US 176. There is a driveway leading to a shopping center (Broad River Village) across from the off/on ramps at the signalized intersection.



2014 Existing Laneage and Traffic Control  
Figure 2

- XX' Laneage & Storage Length
- Signalized Intersection
- Unsignalized Intersection



### 3.0 OPERATIONAL ANALYSIS

#### 3.1 ANALYSIS METHODOLOGY

The highway capacity analyses performed are based on methodologies from the Highway Capacity Manual (HCM 2010). Traffic modeling software used in the capacity analyses were Synchro 9.1 and SimTraffic 9.0, (Build 908, Rev 56), and VISSIM 7.0 for intersection analyses.

The traffic carrying ability of a roadway is described by levels of service (LOS) that range from LOS A to LOS F. LOS A represents unrestricted maneuverability and operating speeds. LOS B represents reduced maneuverability and operating speeds. LOS C represents restricted maneuverability and operating speeds closer to the speed limit. LOS D represents severely restricted maneuverability and unstable, low operating speeds. LOS E represents operating conditions at or near the capacity level. LOS F represents breakdown conditions characterized by stop and go travel. A visual representation of each LOS is shown below.



The Highway Capacity Manual (HCM) 2010 defines LOS at an unsignalized intersection by average control delay per vehicle, which includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. Several factors affect the controlled delay for unsignalized intersections, such as availability and distribution of gaps in the conflicting traffic stream, critical gaps, and follow-up time for a vehicle in the queue. The Highway Capacity Manual explains that drivers perceive that a signalized intersection is designed to carry higher traffic volumes and therefore expect to experience greater delays at signalized intersections. Unsignalized intersections are assigned a LOS for each minor movement. Typically, LOS C is

considered the minimum acceptable level of service at an intersection for a suburban area. **Table 1** presents LOS thresholds for unsignalized intersections.

**Table 1: LOS Thresholds for Unsignalized Intersections**

Level of Service	Average Control Delay (sec/veh)
A	≤ 10.0
B	> 10.0 and ≤ 15.0
C	> 15.0 and ≤ 25.0
D	> 25.0 and ≤ 35.0
E	> 35.0 and ≤ 50.0
F	> 50.0

LOS for a signalized intersection is defined in terms of average control delay per vehicle, which is composed of initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. A single LOS describes a signalized intersection. **Table 2** presents LOS thresholds for signalized intersections.

**Table 2: LOS Thresholds Signalized Intersections**

Level of Service	Average Control Delay (sec/veh)
A	≤ 10.0
B	> 10.0 and ≤ 20.0
C	> 20.0 and ≤ 35.0
D	> 35.0 and ≤ 55.0
E	> 55.0 and ≤ 80.0
F	> 80.0

A basic freeway segment can be characterized by three performance measures: density in terms of passenger cars per mile per lane, speed in terms of mean passenger-car speed, and volume to capacity (v/c) ratio. Each of these measures is an indication of how well traffic flow is being accommodated by the freeway. The measure used to provide an estimate of level of service is density. **Table 3** defines the traffic density conditions at each level of service.

Traffic flow within a basic freeway segment can vary greatly depending on the conditions constricting flow at upstream and downstream bottleneck locations. Bottlenecks can be created by ramp merges or weaving segments, lane drops, maintenance and construction activities, accidents, and objects in the roadway.

**Table 3: LOS Thresholds for Freeway Segments**

Level of Service	Density Range (pc/mi/ln)
A	≤ 11.0
B	> 11.0 and ≤ 18.0
C	> 18.0 and ≤ 26.0
D	> 26.0 and ≤ 35.0
E	> 35.0 and ≤ 45.0
F	> 45.0

A ramp is a length of roadway providing an exclusive connection between two highway facilities. On freeways, all entering and exiting maneuvers take place on ramps that are designed to facilitate smooth merging of on-ramp vehicles into the freeway traffic stream and smooth diverging of off-ramp vehicles from the freeway traffic stream onto the ramp.

A ramp consists of three geometric elements of interest: the ramp-freeway junction, the ramp roadway, and the ramp street junction. The ramp freeway junction is typically designed to permit high-speed merging and diverging with varying acceleration and deceleration lanes. Ramp roadways can vary between locations in terms of number of lanes, design speeds, grades, and horizontal curvature. The design of ramp roadways is seldom a source of operational difficulty unless a traffic incident causes disruption along the length of the ramp. Ramp-street terminal problems can cause queuing along the length of ramp, but this is generally not related to the design of the ramp roadway. **Table 4** defines the traffic density conditions at each level of service.

**Table 4: LOS Thresholds for Merge / Diverge Areas**

Level of Service	Density Range (pc/mi/ln)
A	≤ 10.0
B	> 10.0 and ≤ 20.0
C	> 20.0 and ≤ 28.0
D	> 28.0 and ≤ 35.0
E	> 35.0
F	Demand Exceeds Capacity

### 3.2 TRAFFIC VOLUMES

Traffic volumes were for this IMR were referenced from the S-48 (Columbia Avenue) Corridor Improvement Project Traffic Study dated 10-17-16. In summary, the 2014 existing traffic volumes were grown at a linear rate of 1.25% to obtain the base Opening Year (2020) and Design Year (2040) traffic projections. After these projections were complete, a traffic study for the Chapin Technology Park and Chapin Commerce Village Development became available. These two developments are significant in size and impact the S-48 corridor and interchange. At the direction of Lexington County and SCDOT, additional traffic volumes were added to the base volumes to be conservative and to better estimate the turning movement volumes to / from S-48. Additional volumes were generated using:

- Chapin Technology Park (120 acre industrial park, 450 single family houses, and 350,000 SF of commercial). Based on the final traffic study submitted and approved by SCDOT on October 13, 2015 for the Chapin Technology Park, the opening year is 2019. These new trips were added to the Opening Year (2020). The Chapin Technology Park is not expected to be complete until 2024 as these trips at full build-out were added to the Design Year (2040). The Technology Park is located north of Columbia Avenue near Woodthrush Road.
- Chapin Commerce Village (132,000 SF Specialty Retail, 8,350 SF Quality Restaurant, 8,350 SF General Office, 4,500 SF Fast Food Restaurant with Drive-Through, 8,350 High Turn-Over (Sit-Down) Restaurant, 4,050 SF Fast Food Restaurant with Drive-Through, 4,950 SF Convenience Market with Gasoline Pumps, 8,350 SF Quality Restaurant, 120 Room Hotel, 8,350 Quality Restaurant, and 4,050 SF General Office Building ). This development has not had a traffic study and is only in the early planning stages. It is located just east of I-26 along S-48 (Columbia Avenue).

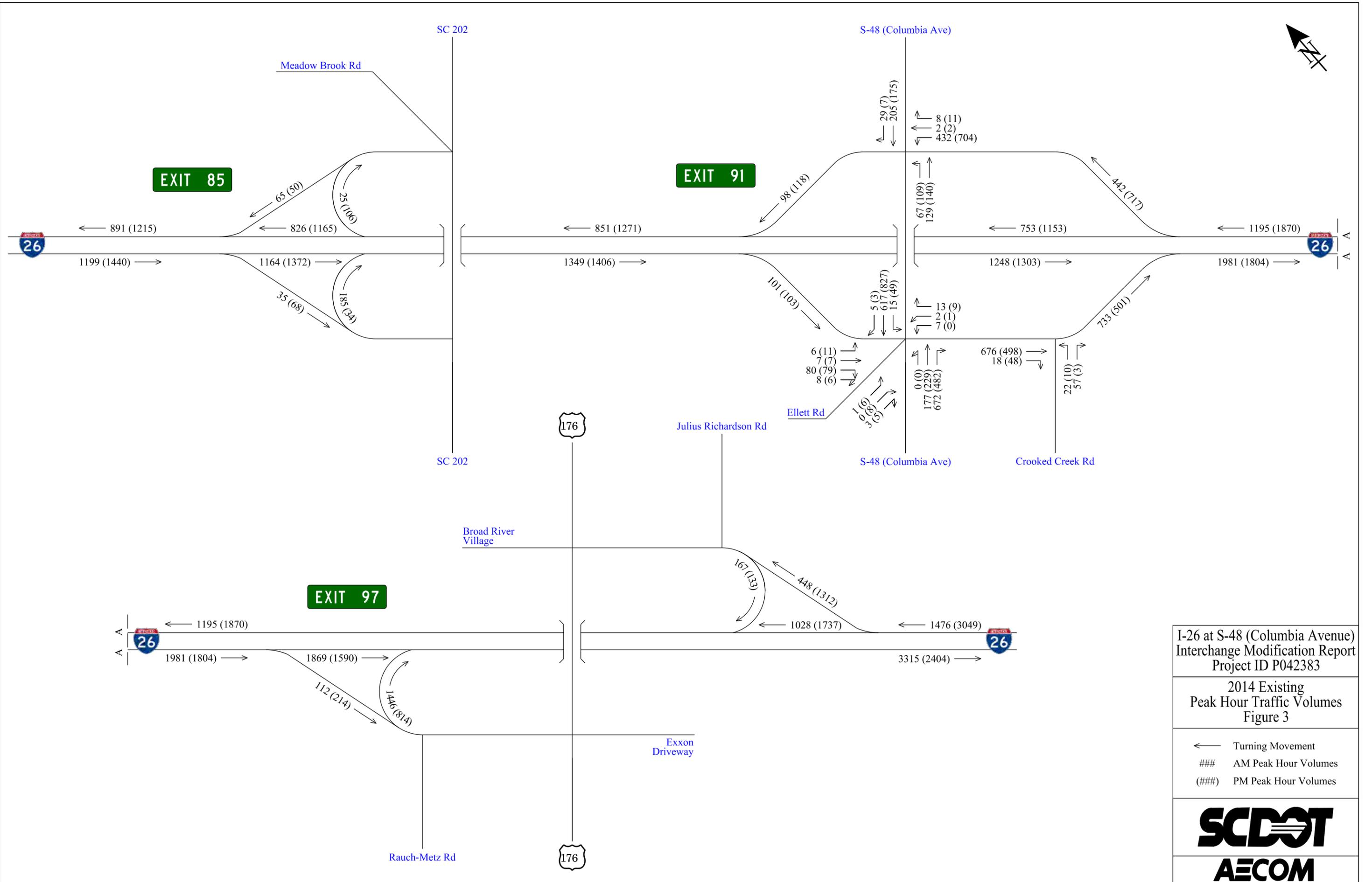
A complete memo describing the methodology with traffic figures can be referenced in **Appendix A**.

The memo does not provide volumes along I-26, therefore, AECOM used an I-26 traffic count located just east Exit 91 and determined other sections along I-26 in the study area by balancing with the known ramp volumes at Exit 85 and Exit 97. The raw traffic counts are located in **Appendix B**. Finalized traffic volumes (balanced) for all study scenarios are displayed in **Figures 3-9**.

### **3.3 CRASH ANALYSIS**

Crash data collected over the last 3.4 years show low crash rates along I-26 within the Exit 91 interchange area. There was a total 40 crashes with 75 percent of the crashes consisting of either running off the road or rear end. Of the 40 crashes, 8 people were injured with 1 fatality. The one fatality appears to be pedestrian related occurring during the dusk hours. The crash data also indicates that there were 8 rear-end collisions between the on / off ramps (stack 6) over the 3.4 year period which may be attributed to queuing from the westbound off-ramp extending onto the interstate. Crash summaries can be found in **Appendix C**.

The preferred Alternative Diverging Diamond Interchange design is not expected change the existing diamond interchange as the ramp design and number of lanes on the freeway are expected to remain the same. A modification to the S-48 interchange is not expected to have a significant adverse effect on safety on I-26 but is expected to improve the safety on S-48 at the ramps with the fewer conflict points.



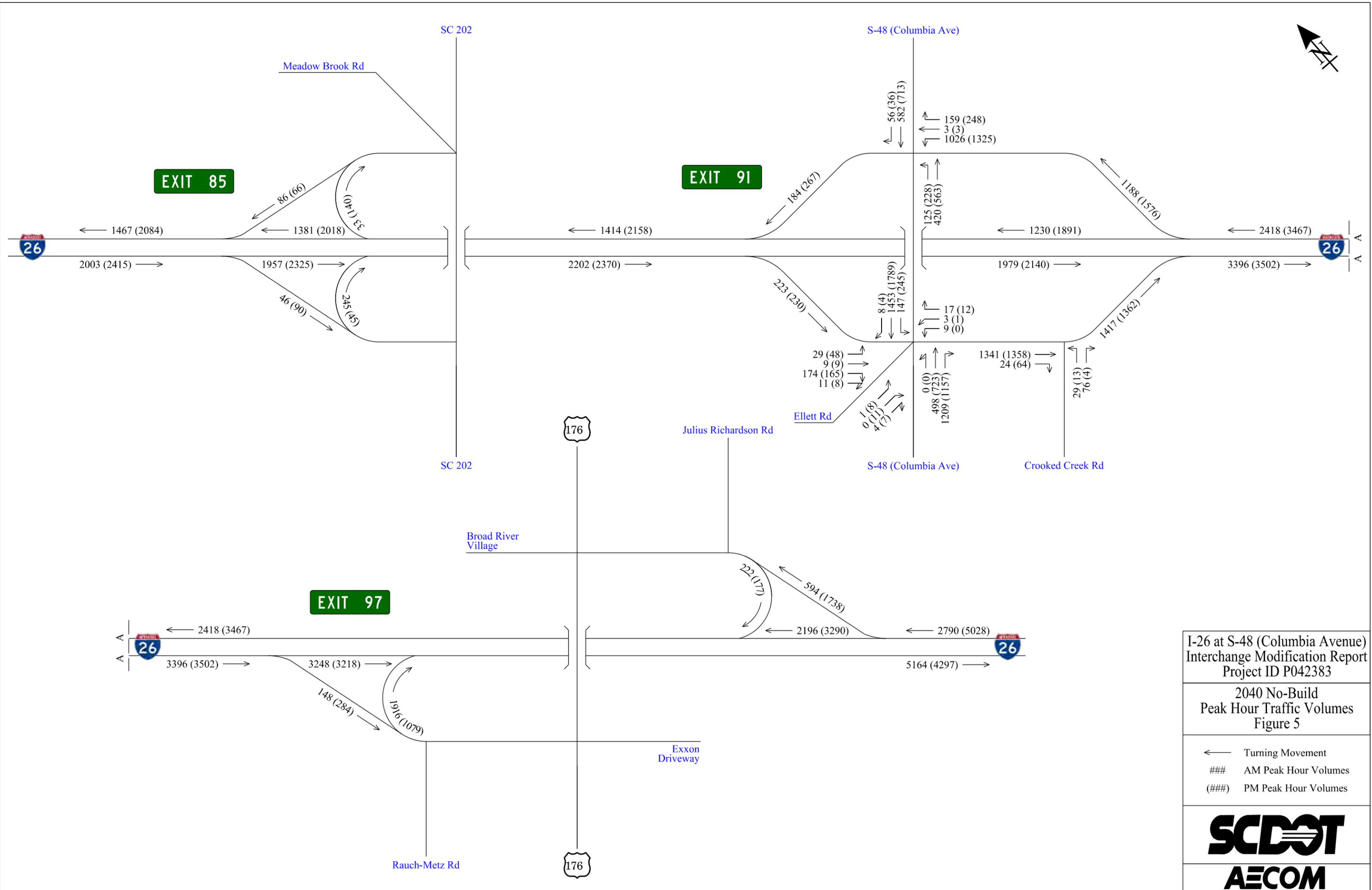
I-26 at S-48 (Columbia Avenue)  
Interchange Modification Report  
Project ID P042383

2014 Existing  
Peak Hour Traffic Volumes  
Figure 3

- ← Turning Movement
- ### AM Peak Hour Volumes
- (###) PM Peak Hour Volumes







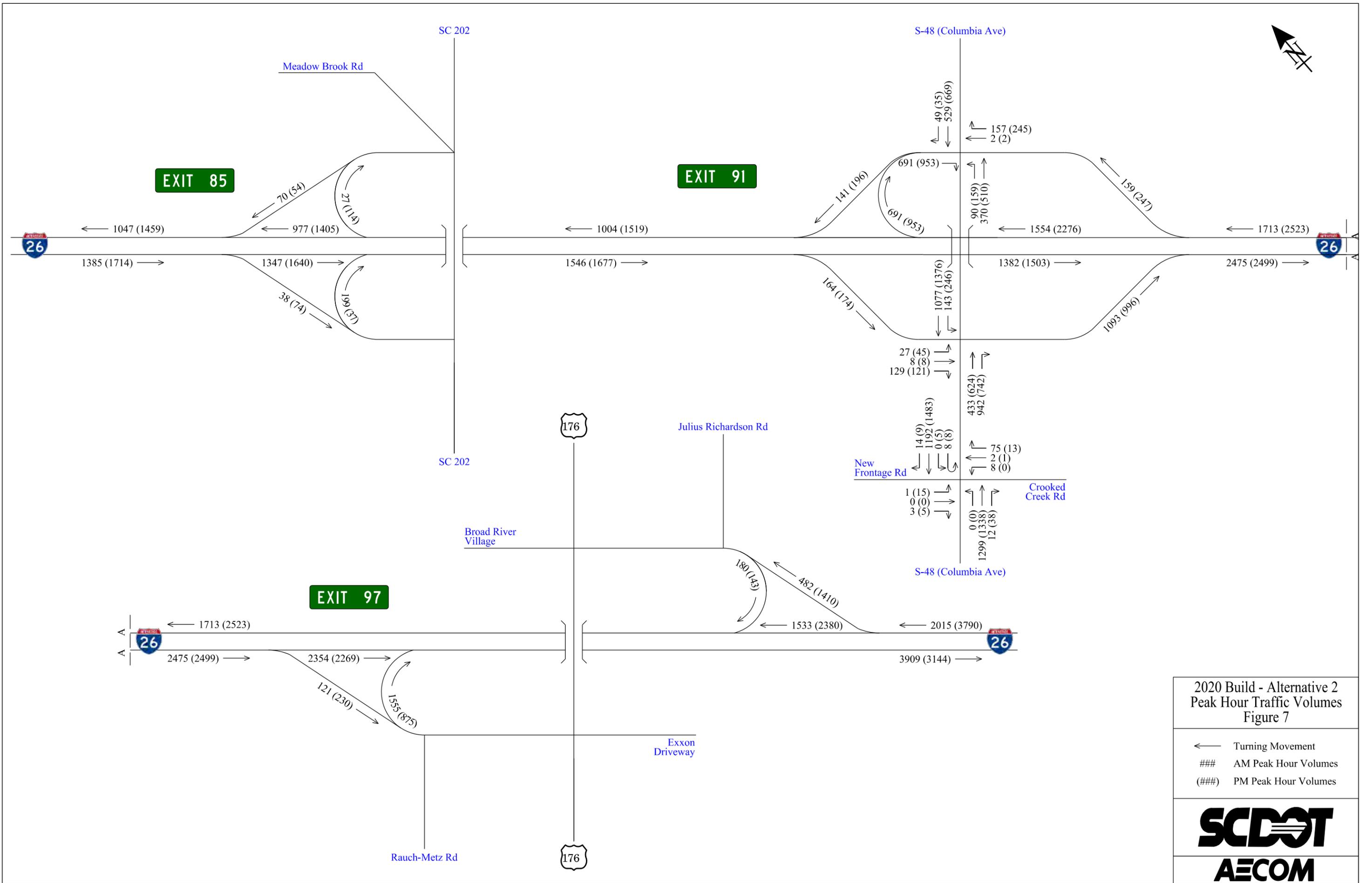
I-26 at S-48 (Columbia Avenue)  
Interchange Modification Report  
Project ID P042383

2040 No-Build  
Peak Hour Traffic Volumes  
Figure 5

← Turning Movement  
### AM Peak Hour Volumes  
(###) PM Peak Hour Volumes







**EXIT 85**

**EXIT 91**

**EXIT 97**

SC 202

S-48 (Columbia Ave)

176

176

Meadow Brook Rd

Julius Richardson Rd

Broad River Village

New Frontage Rd

Crooked Creek Rd

Rauch-Metz Rd

Exxon Driveway

← 1047 (1459)

→ 1385 (1714)

← 70 (54)

← 27 (114)

← 977 (1405)

→ 1347 (1640)

← 38 (74)

← 199 (37)

← 1004 (1519)

→ 1546 (1677)

← 164 (174)

← 141 (196)

← 691 (953)

← 27 (45)

← 8 (8)

← 129 (121)

← 14 (9)

← 1192 (1483)

← 0 (5)

← 8 (8)

← 1 (15)

← 0 (0)

← 3 (5)

← 49 (35)

← 529 (669)

← 157 (245)

← 2 (2)

← 90 (159)

← 370 (510)

← 1077 (1376)

← 143 (246)

← 433 (624)

← 942 (742)

← 75 (13)

← 2 (1)

← 8 (0)

← 0 (0)

← 1299 (1338)

← 12 (38)

← 1713 (2523)

→ 2475 (2499)

← 1554 (2276)

→ 1382 (1503)

← 159 (247)

→ 1093 (996)

← 1713 (2523)

→ 2475 (2499)

→ 2354 (2269)

← 121 (230)

← 155 (875)

← 180 (143)

← 482 (1410)

← 1533 (2380)

← 2015 (3790)

→ 3909 (3144)

S-48 (Columbia Ave)





### 3.4 EXISTING 2014 TRAFFIC ANALYSIS

The results of the Existing 2014 intersection analysis using Synchro 9.1 indicate that S-48 at I-26 eastbound ramp is currently operating LOS D in the AM Peak hour and LOS E during PM for the minor street approaches. The westbound off ramp under signal control is operating at LOS B; however, queues from the signal may extend onto I-26.

**Table 5** summarizes the LOS and delay for each of study intersections with detailed Synchro reports found in **Appendix D**.

**Table 5: Existing 2014 Intersection LOS and Delay**

ID	Intersection	Traffic Control	Approach	HCM 2010 Level of Service (LOS)		Control Delay (sec/veh)	
				AM	PM	AM	PM
<b>Exit 91 (I-26 at S-48)</b>							
1	I-26 Eastbound Off Ramp / Crook Creek Road at S-48	Unsignalized	WB (AM)* EB (PM)*	D	E	28.4	42.7
2	I-26 Westbound Ramps at S-48	Signalized	-	B	B	11.7	19.1

\*Since vehicles from Crooked Creek Road can access the I-26 eastbound on ramp to S-48 (Columbia Avenue), the worst of the two minor approaches was reported.

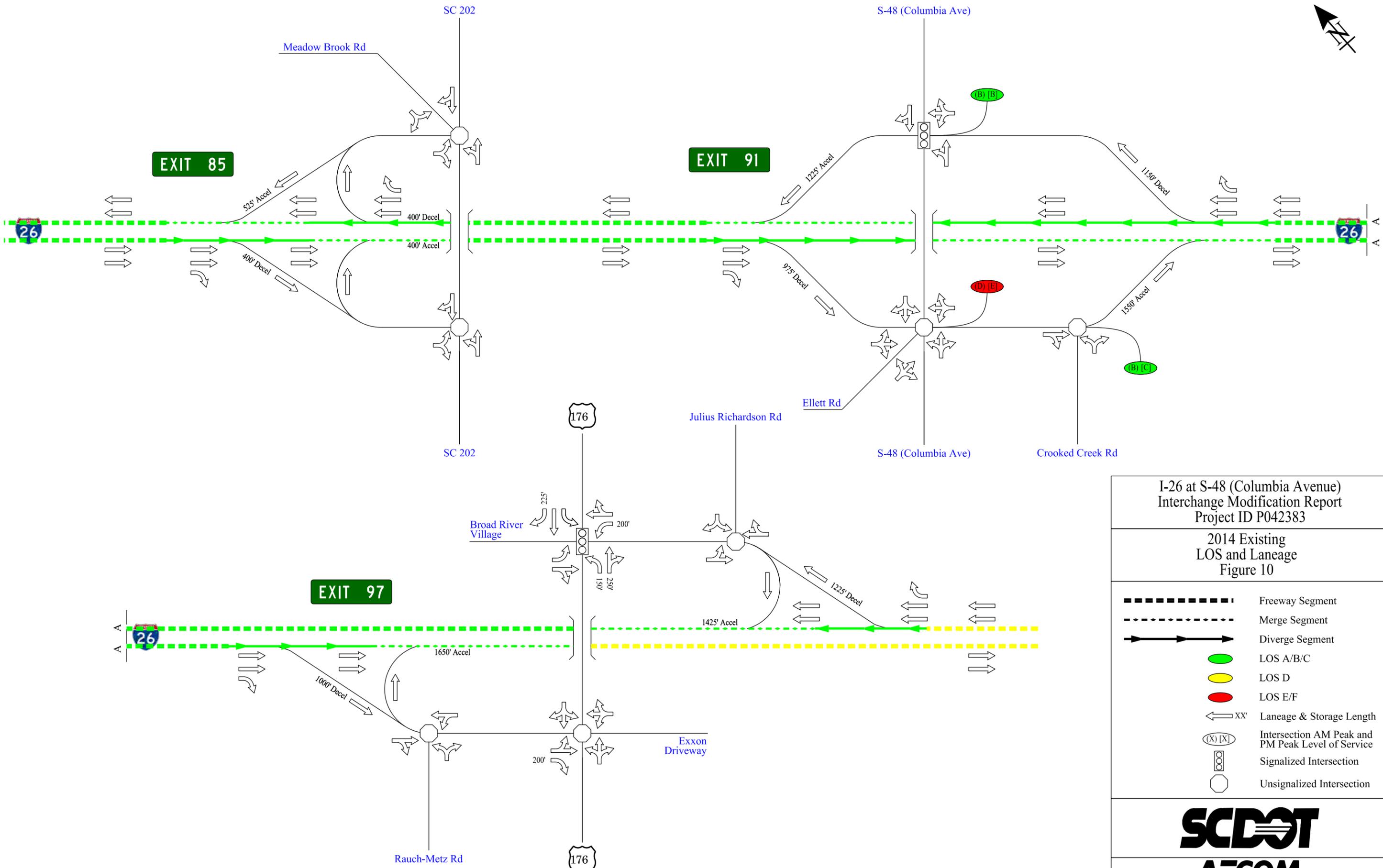
The results of the Existing 2014 Freeway / Merge / Diverge analysis using Highway Capacity Software (HCS) 2010 indicate that just east of Exit 97 (US 176), I-26 is operating at LOS D in the AM peak hour (eastbound) and during the PM peak hour (westbound). All other freeway segment / merge / diverge analyses are operating at LOS C or better.

**Table 6** summarizes the LOS and density for each merge / diverge area with detailed HCS reports found in **Appendix E**.

**Table 6: Existing 2014 Freeway / Merge / Diverge LOS and Density**

Approach	Description	HCM 2010 Level of Service (LOS)		Density (pc/mi/ln)	
		AM	PM	AM	PM
<b>Freeway Segment</b>					
Eastbound	West of Exit 85	A	B	9.4	11.3
	Between Exit 85 and Exit 91	A	B	10.6	11.0
	Between Exit 91 and Exit 97	B	B	15.6	14.2
	East of Exit 97	D	C	30.0	19.4
Westbound	East of Exit 97	B	D	11.6	26.4
	Between Exit 91 and Exit 97	A	B	9.4	14.7
	Between Exit 85 and Exit 91	A	A	6.7	10.0
	West of Exit 85	A	A	7.0	9.5
<b>Merge Area</b>					
Eastbound	EB Exit 85 On-Ramp	B	B	15.2	15.9
	EB Exit 91 On-Ramp	B	B	13.7	12.2
	EB Exit 97 On-Ramp	C	B	25.4	17.5
Westbound	WB Exit 97 On-Ramp	A	B	7.4	13.6
	WB Exit 91 On-Ramp	A	A	5.5	9.4
	WB Exit 85 On-Ramp	B	B	10.3	13.3
<b>Diverge Area</b>					
Eastbound	EB Exit 85 Off-Ramp	B	B	12.8	15.2
	EB Exit 91 Off-Ramp	A	A	9.1	9.7
	EB Exit 97 Off-Ramp	B	B	15.3	13.5
Westbound	WB Exit 97 Off-Ramp	A	C	8.2	24.1
	WB Exit 91 Off-Ramp	A	B	5.3	12.2
	WB Exit 85 Off-Ramp	A	B	9.3	13.5

**Figure 10** shows the LOS for the Existing 2014 conditions.



**I-26 at S-48 (Columbia Avenue)  
Interchange Modification Report  
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**2014 Existing  
LOS and Laneage  
Figure 10**

	Freeway Segment
	Merge Segment
	Diverge Segment
	LOS A/B/C
	LOS D
	LOS E/F
	Laneage & Storage Length
	Intersection AM Peak and PM Peak Level of Service
	Signalized Intersection
	Unsignalized Intersection

### 3.5 NO-BUILD 2020 TRAFFIC ANALYSIS

The 2020 No-Build scenario analyzes the conditions if there were no improvements made to the interchange. The results of the No-Build 2020 intersection analysis using Synchro 9.1 indicate that S-48 at I-26 is expected to operate at LOS F in the AM and PM peak hours.

**Table 7** summarizes the LOS and delay for each of study intersections with detailed Synchro reports found in **Appendix F**.

**Table 7: No-Build 2020 Intersection LOS and Delay**

ID	Intersection	Traffic Control	Approach	HCM 2010 Level of Service (LOS)		Control Delay (sec/veh)	
				AM	PM	AM	PM
Exit 91 (I-26 at S-48)							
1	I-26 Eastbound Off Ramp / Crook Creek Road at S-48	Unsignalized	WB (AM)* EB (PM)*	F	F	900+	900+
2	I-26 Westbound Ramps at S-48	Signalized	-	F	F	126.0	433.7

\*Since vehicles from Crooked Creek Road can access the I-26 eastbound on ramp to S-48 (Columbia Avenue), the worst of the two minor approaches was reported.

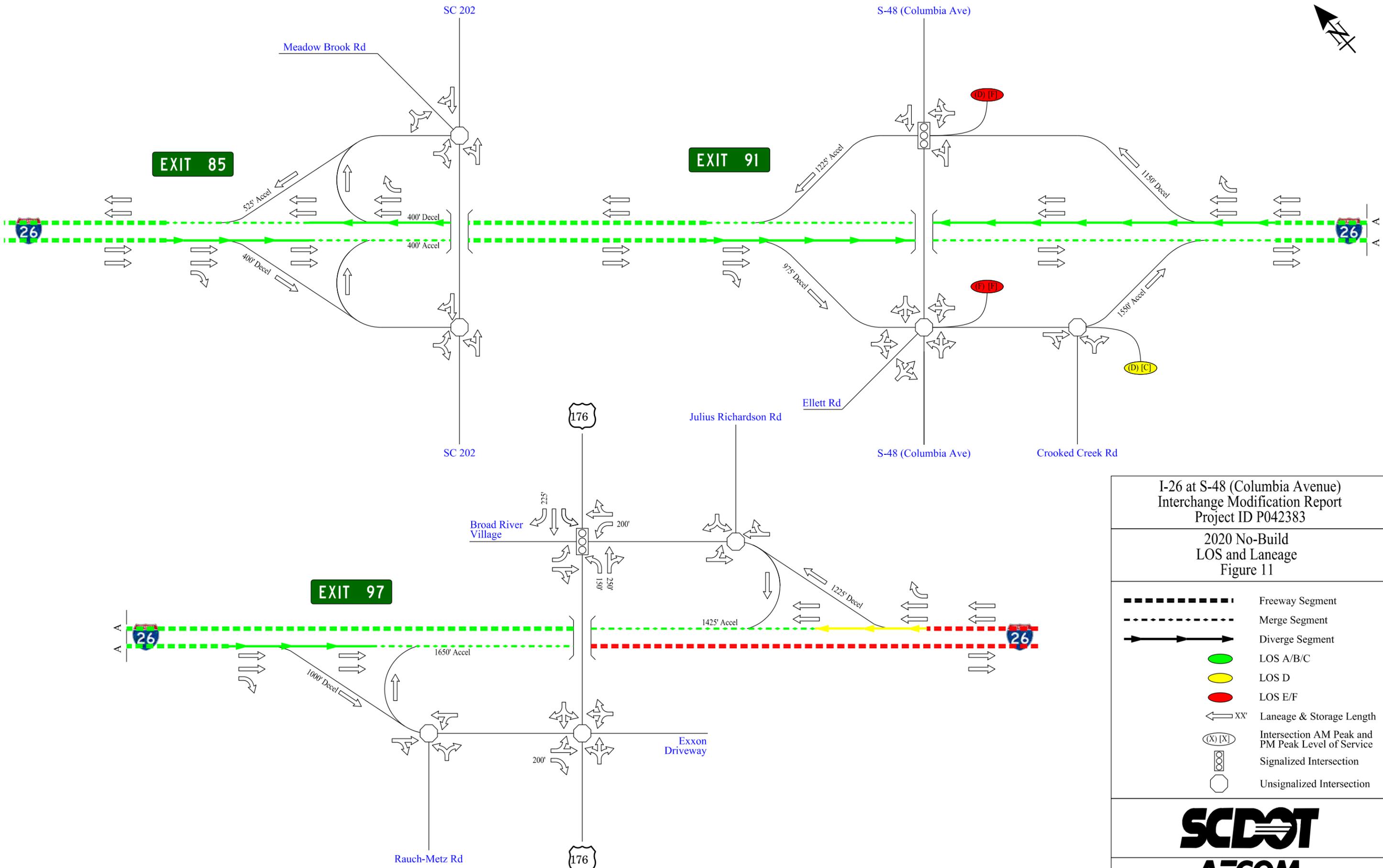
The results of the 2020 No-Build Freeway / Merge / Diverge analysis using Highway Capacity Software (HCS) 2010 indicate that just east of Exit 97 (US 176), I-26 is expected to operate at LOS E in the AM peak hour (eastbound) and during the PM peak hour (westbound). In addition the I-26 eastbound merge area from Exit 97 is expected to operate at LOS D along with the I-26 westbound diverge area during the PM peak hour. All other freeway segment / merge / diverge analyses are operating at LOS C or better.

**Table 8** summarizes the LOS and density for each merge / diverge area with detailed HCS reports found in **Appendix G**.

**Table 8: No-Build 2020 Freeway / Merge / Diverge LOS and Density**

Approach	Description	HCM 2010 Level of Service (LOS)		Density (pc/mi/ln)	
		AM	PM	AM	PM
<b>Freeway Segment</b>					
Eastbound	West of Exit 85	A	B	10.9	13.5
	Between Exit 85 and Exit 91	B	B	12.1	13.2
	Between Exit 91 and Exit 97	C	C	20.1	20.3
	East of Exit 97	E	D	40.9	27.6
Westbound	East of Exit 97	B	E	15.9	38.4
	Between Exit 91 and Exit 97	B	C	13.5	20.5
	Between Exit 85 and Exit 91	A	B	7.9	11.9
	West of Exit 85	A	B	8.2	11.5
<b>Merge Area</b>					
Eastbound	EB Exit 85 On-Ramp	B	B	17.0	18.3
	EB Exit 91 On-Ramp	B	B	18.0	18.2
	EB Exit 97 On-Ramp	D	C	30.8	24.3
Westbound	WB Exit 97 On-Ramp	B	B	12.1	19.6
	WB Exit 91 On-Ramp	A	B	6.9	11.6
	WB Exit 85 On-Ramp	B	B	11.7	15.5
<b>Diverge Area</b>					
Eastbound	EB Exit 85 Off-Ramp	B	B	14.7	18.0
	EB Exit 91 Off-Ramp	B	B	11.1	12.5
	EB Exit 97 Off-Ramp	C	C	20.3	20.6
Westbound	WB Exit 97 Off-Ramp	B	D	13.6	31.6
	WB Exit 91 Off-Ramp	B	B	10.6	18.8
	WB Exit 85 Off-Ramp	B	B	10.8	16.0

**Figure 11** shows the LOS for the No-Build 2020 conditions.



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2020 No-Build  
LOS and Laneage  
Figure 11

	Freeway Segment
	Merge Segment
	Diverge Segment
	LOS A/B/C
	LOS D
	LOS E/F
	Laneage & Storage Length
	Intersection AM Peak and PM Peak Level of Service
	Signalized Intersection
	Unsignalized Intersection

**SCDOT**  
**AECOM**

### 3.6 NO-BUILD 2040 TRAFFIC ANALYSIS

The 2040 No-Build scenario analyzes the conditions if there were no improvements made to the interchange. The results of the No-Build 2040 intersection analysis using Synchro 9.1 indicate that S-48 at I-26 is expected to continue to operate at LOS F in the AM and PM peak hours.

**Table 9** summarizes the LOS and delay for each of study intersections with detailed Synchro reports found in **Appendix H**.

**Table 9: No-Build 2040 Intersection LOS and Delay**

ID	Intersection	Traffic Control	Approach	HCM 2010 Level of Service (LOS)		Control Delay (sec/veh)	
				AM	PM	AM	PM
Exit 91 (I-26 at S-48)							
1	I-26 Eastbound Off Ramp / Crook Creek Road at S-48	Unsignalized	WB (AM)* EB (PM)*	F	F	900+	900+
2	I-26 Westbound Ramps at S-48	Signalized	-	F	F	247.4	900+

\*Since vehicles from Crooked Creek Road can access the I-26 eastbound on ramp to S-48 (Columbia Avenue), the worst of the two minor approaches was reported.

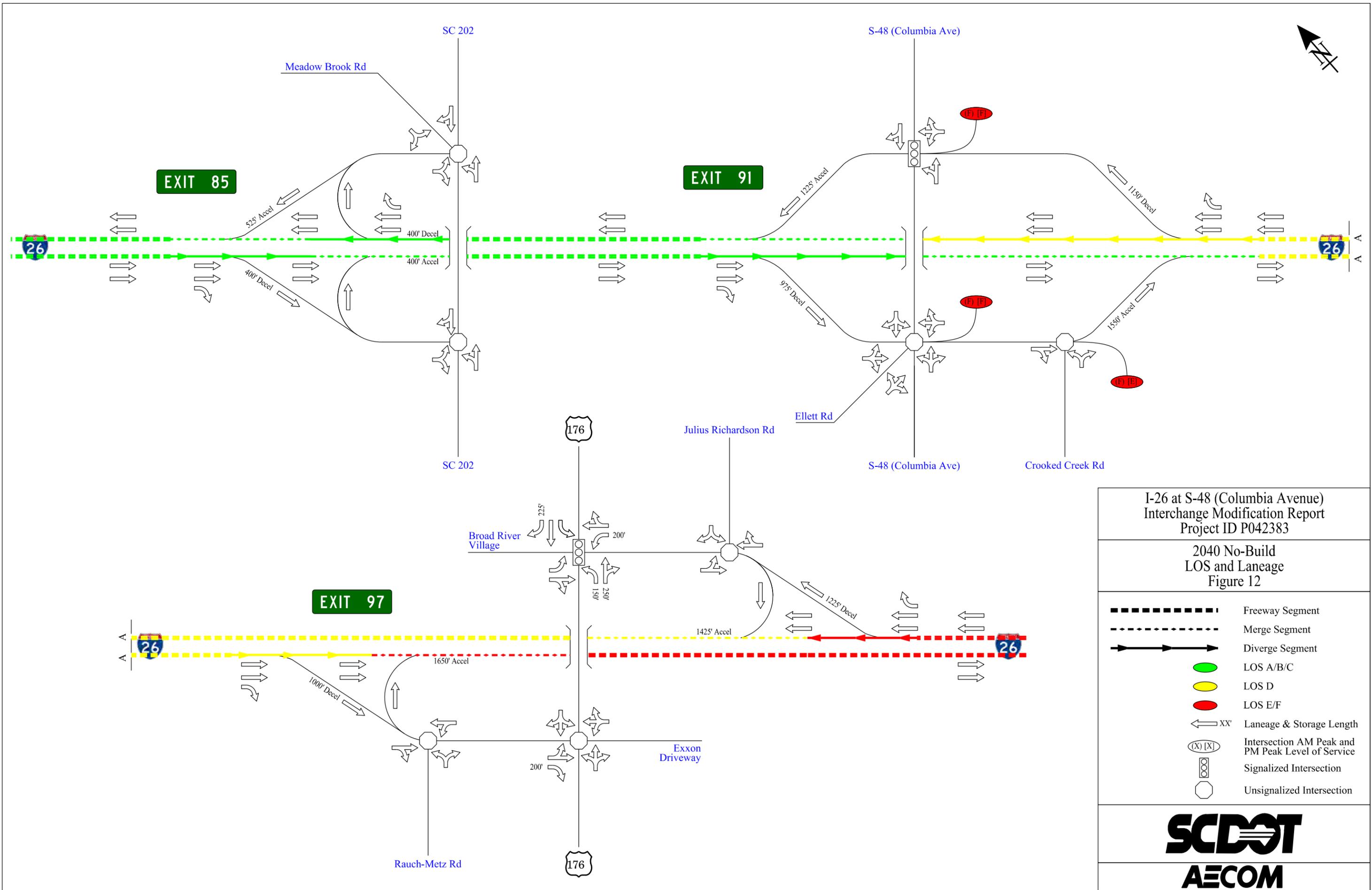
The results of the 2040 No-Build Freeway / Merge / Diverge analysis using Highway Capacity Software (HCS) 2010 indicate that just east of Exit 97 (US 176), I-26 is expected to operate at LOS F in the AM and PM peak hours. Between Exit 91 and Exit 97, the freeway is expected to operate at LOS D in the AM peak hour (eastbound) and PM peak hour (westbound). The PM hour diverge at Exit 91 is also LOS D. In addition the I-26 eastbound merge area from Exit 97 is expected to operate at LOS F along with the I-26 westbound diverge area during the PM peak hour. All other freeway segment / merge / diverge analyses are operating at LOS C or better.

**Table 10** summarizes the LOS and density for each merge / diverge area with detailed HCS reports found in **Appendix I**.

**Table 10: No-Build 2040 Freeway / Merge / Diverge LOS and Density**

Approach	Description	HCM 2010 Level of Service (LOS)		Density (pc/mi/ln)	
		AM	PM	AM	PM
<b>Freeway Segment</b>					
Eastbound	West of Exit 85	B	C	15.8	19.5
	Between Exit 85 and Exit 91	B	C	17.5	19.1
	Between Exit 91 and Exit 97	D	D	31.3	33.0
	East of Exit 97	F	F	105.3	50.3
Westbound	East of Exit 97	C	F	23.3	91.3
	Between Exit 91 and Exit 97	C	D	19.5	32.4
	Between Exit 85 and Exit 91	B	B	11.1	17.1
	West of Exit 85	B	B	11.5	16.5
<b>Merge Area</b>					
Eastbound	EB Exit 85 On-Ramp	C	C	23.0	24.7
	EB Exit 91 On-Ramp	C	C	26.2	27.2
	EB Exit 97 On-Ramp	F	F	42.0	34.7
Westbound	WB Exit 97 On-Ramp	B	D	18.6	28.3
	WB Exit 91 On-Ramp	B	B	10.6	17.4
	WB Exit 85 On-Ramp	B	C	15.6	21.3
<b>Diverge Area</b>					
Eastbound	EB Exit 85 Off-Ramp	C	C	20.9	25.1
	EB Exit 91 Off-Ramp	B	B	17.8	19.5
	EB Exit 97 Off-Ramp	D	D	29.7	30.7
Westbound	WB Exit 97 Off-Ramp	C	F	21.5	44.2
	WB Exit 91 Off-Ramp	B	D	17.7	28.3
	WB Exit 85 Off-Ramp	B	C	15.0	22.5

**Figure 12** shows the LOS for the 2040 No-Build Conditions



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2040 No-Build  
LOS and Laneage  
Figure 12

- Freeway Segment
- Merge Segment
- Diverge Segment
- LOS A/B/C
- LOS D
- LOS E/F
- Laneage & Storage Length
- Intersection AM Peak and PM Peak Level of Service
- Signalized Intersection
- Unsignalized Intersection



### 3.7 BUILD 2020 TRAFFIC ANALYSIS

The 2020 Build scenario analyzes the conditions for three-interchange alternatives at Exit 91. For all three Alternatives, the following changes were included in the 2020 Build scenario:

- A New Frontage Road approximately 1000 feet to the south of the I-26 eastbound ramps was included to carry the traffic of the proposed Chapin Technology Park. The new Frontage Road was assumed to be a signalized intersection.
- Ellet Road (old frontage road) was removed in the Build scenario. In the Build scenario, Ellet Road traffic redistributed and added to the New Frontage Road traffic.
- Crooked Creek Road was realigned to connect to the New Frontage Road intersection with S-48. In the Build scenario, it will not have direct access to the I-26 EB on ramp. Crooked Creek Road traffic was redistributed and added to the Frontage Road traffic.

The results of the Build 2020 analysis using Synchro 9.1 indicate that two of three alternatives are expected to operate at LOS C or better. Alternative 1 (DDI) is expected to have signals at both ramps; therefore, the LOS is balanced at both intersections to obtain proper signals timing. Alternative 2 (Partial Cloverleaf) has an expected LOS A at the I-26 eastbound ramps because no signal is recommended at the I-26 westbound ramps and signal can operate independently. Alternative 3 (Dual Roundabouts) is expected to operate at LOS F for the westbound ramps during the PM peak hour; therefore, it should not be considered as a viable alternative.

**Table 11** summarizes the LOS and delay for each of study intersections with detailed Synchro reports found in **Appendix J and K**. Detailed Sidra output reports are found in **Appendix N**.

**Table 11: Build 2020 Intersection LOS and Delay**

ID	Intersection	Traffic Control	Approach	HCM 2010 Level of Service (LOS)		Control Delay (sec/veh)	
				AM	PM	AM	PM
Exit 91 (I-26 at S-48) – Diverging Diamond Interchange – Alt 1							
1	I-26 Eastbound Ramps at S-48	Signalized	-	C	C	20.9	22.3
21	I-26 WB Ramps at S-48	Signalized	-	B	C	17.2	23.6
22	S-48 at I-26 WB Off Ramp	Signalized	-	C	B	20.5	16.9
Exit 91 (I-26 at S-48) – Partial Cloverleaf – Alt 2							
1	I-26 Eastbound Ramps at S-48	Signalized	-	A	A	4.1	4.7
2	S-48 at I-26 WB Off Ramp	Unsignalized	WB	B	C	12.7	19.8

The results of the 2020 Build Freeway / Merge / Diverge analysis using Highway Capacity Software (HCS) 2010 indicate that just east of Exit 97 (US 176), I-26 is expected to operate at LOS E in the AM peak hour (eastbound) and during the PM peak hour (westbound). In addition

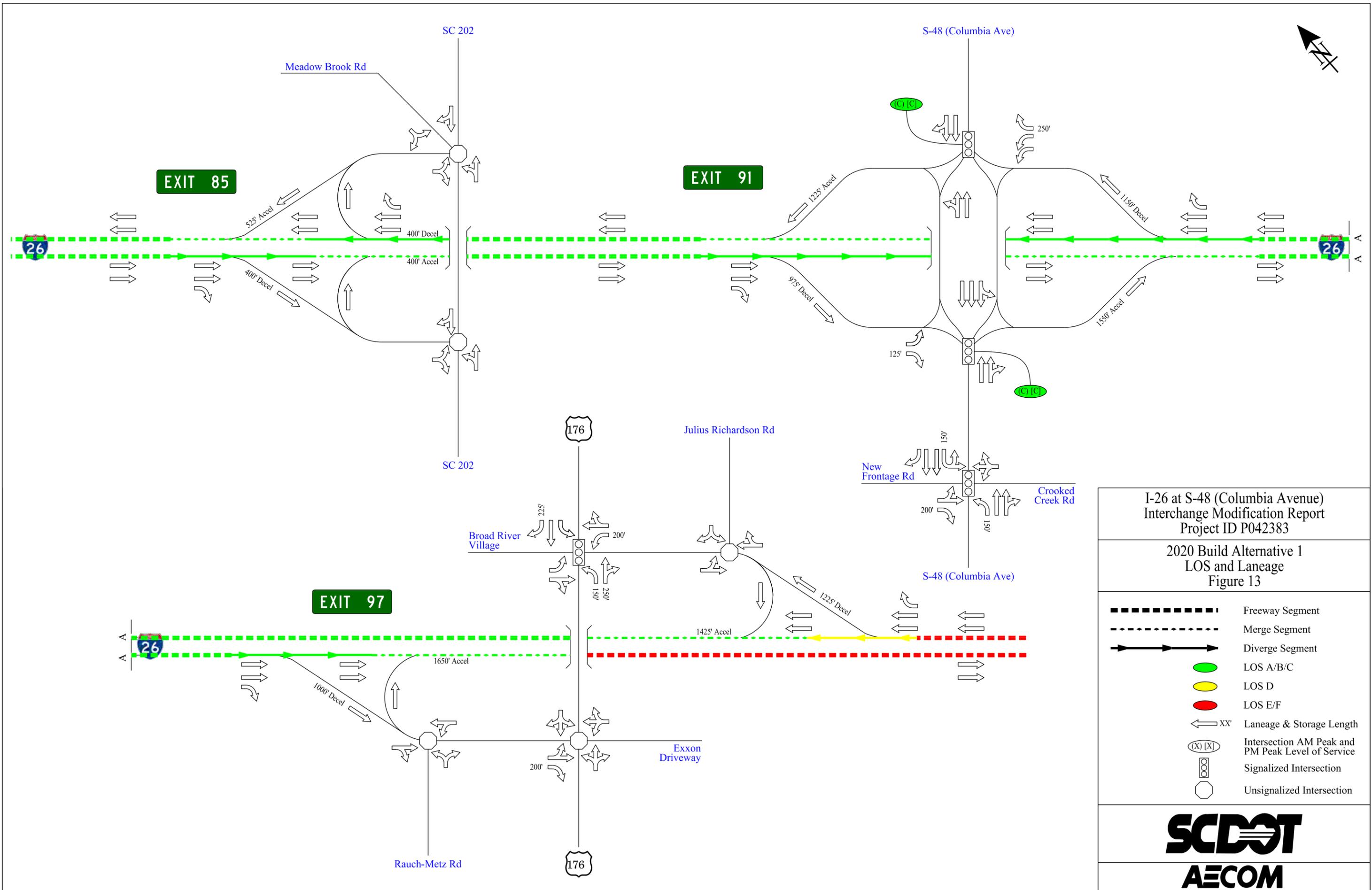
the I-26 eastbound merge area from Exit 97 is expected to operate at LOS D along with the I-26 westbound diverge area during the PM peak hour. All other freeway segment / merge / diverge analyses are operating at LOS C or better.

**Table 12** summarizes the LOS and density for each merge / diverge area with detailed HCS reports found in **Appendix G**.

**Table 12: Build 2020 Freeway / Merge / Diverge LOS and Density**

Approach	Description	HCM 2010 Level of Service (LOS)		Density (pc/mi/ln)	
		AM	PM	AM	PM
<b>Freeway Segment</b>					
Eastbound	West of Exit 85	A	B	10.9	13.5
	Between Exit 85 and Exit 91	B	B	12.1	13.2
	Between Exit 91 and Exit 97	C	C	20.1	20.3
	East of Exit 97	E	D	40.9	27.6
Westbound	East of Exit 97	B	E	15.9	38.4
	Between Exit 91 and Exit 97	B	C	13.5	20.5
	Between Exit 85 and Exit 91	A	B	7.9	11.9
	West of Exit 85	A	B	8.2	11.5
<b>Merge Area</b>					
Eastbound	EB Exit 85 On-Ramp	B	B	17.0	18.3
	EB Exit 91 On-Ramp	B	B	18.0	18.2
	EB Exit 97 On-Ramp	D	C	30.8	24.3
Westbound	WB Exit 97 On-Ramp	B	B	12.1	19.6
	WB Exit 91 On-Ramp	A	B	6.9	11.6
	WB Exit 85 On-Ramp	B	B	11.7	15.5
<b>Diverge Area</b>					
Eastbound	EB Exit 85 Off-Ramp	B	B	14.7	18.0
	EB Exit 91 Off-Ramp	B	B	11.1	12.5
	EB Exit 97 Off-Ramp	C	C	20.3	20.6
Westbound	WB Exit 97 Off-Ramp	B	D	13.6	31.6
	WB Exit 91 Off-Ramp – Alt 1	B	B	10.6	18.8
	WB Exit 91 Off-Ramp – Alt 2	B	B	10.6	16.3
	WB Exit 91 Off Loop Ramp – Alt 2	A	B	9.0	18.8
	WB Exit 85 Off-Ramp	B	B	10.8	16.0

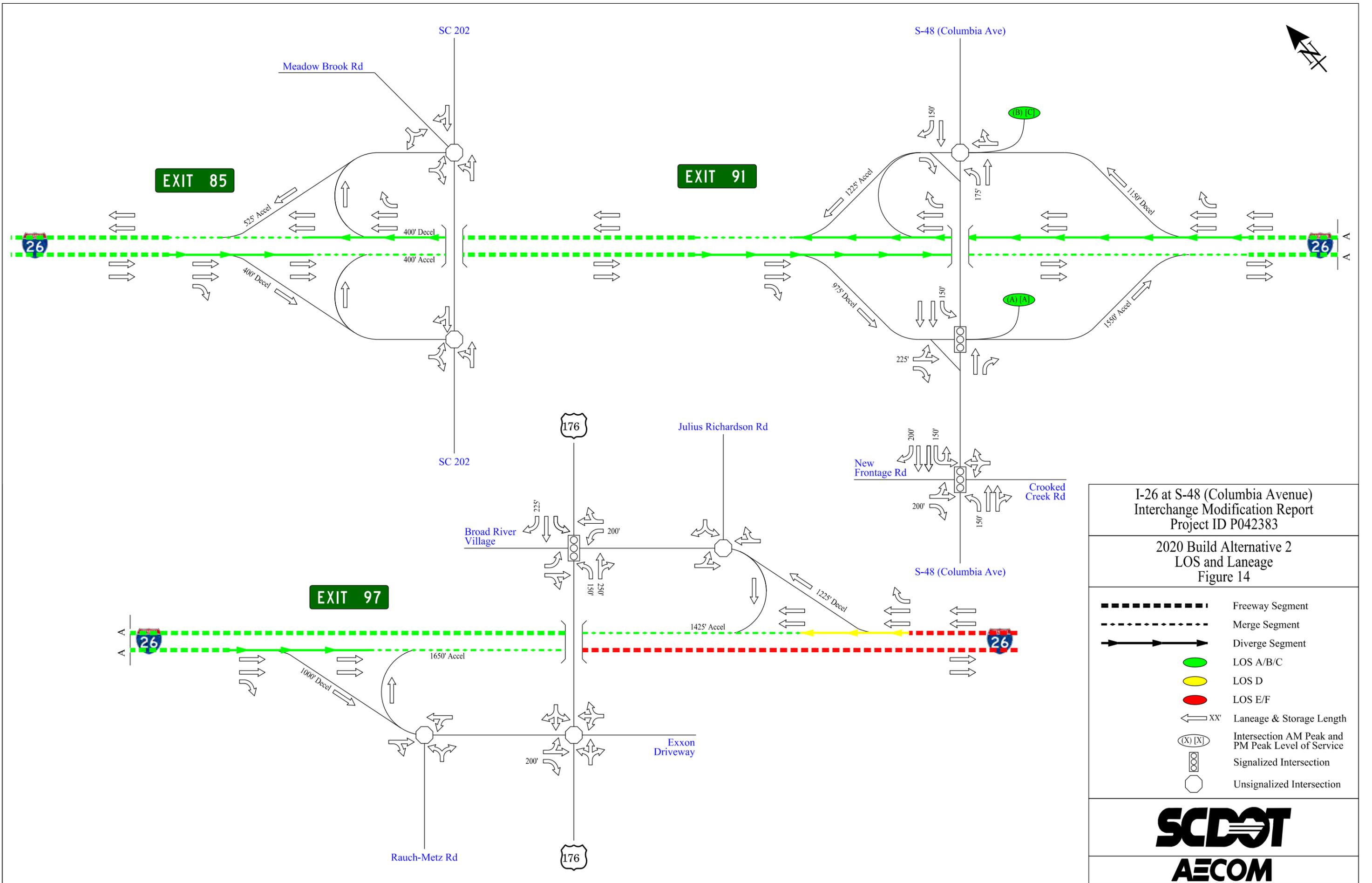
Figure 13 and 14 shows the LOS for the 2020 Build Conditions for Alternative 1 and 2.



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2020 Build Alternative 1  
LOS and Laneage  
Figure 13

	Freeway Segment
	Merge Segment
	Diverge Segment
	LOS A/B/C
	LOS D
	LOS E/F
	Laneage & Storage Length
	Intersection AM Peak and PM Peak Level of Service
	Signalized Intersection
	Unsignalized Intersection



**EXIT 85**

**EXIT 91**

**EXIT 97**

I-26 at S-48 (Columbia Avenue)  
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2020 Build Alternative 2  
LOS and Laneage  
Figure 14

- Freeway Segment
- Merge Segment
- Diverge Segment
- LOS A/B/C
- LOS D
- LOS E/F
- Laneage & Storage Length
- Intersection AM Peak and PM Peak Level of Service
- Signalized Intersection
- Unsignalized Intersection



### 3.8 BUILD 2040 TRAFFIC ANALYSIS

The 2040 Build scenario analyzes the conditions for three-interchange alternatives at Exit 91. For three Alternatives, the following changes were included in the 2040 Build scenario:

- A New Frontage Road approximately 1000 feet to the south of the I-26 eastbound ramps was included to carry the traffic of the proposed Chapin Technology Park. The new Frontage Road was assumed to be a signalized intersection.
- Ellet Road (old frontage road) was removed in the Build scenario. In the Build scenario, Ellet Road traffic redistributed and added to the New Frontage Road traffic.
- Crooked Creek Road was realigned to connect to the New Frontage Road intersection with S-48. In the Build scenario, it will not have direct access to the I-26 EB on ramp. Crooked Creek Road traffic was redistributed and added to the Frontage Road traffic.

The results of the Build 2040 analysis using Synchro 9.1 indicate that two of three alternatives are expected to operate at LOS C or better. Alternative 1 (DDI) is expected to have signals at both ramps; therefore, the LOS is balanced at both intersections to obtain proper signals timing. Alternative 2 (Partial Cloverleaf) has an expected LOS A at the I-26 eastbound ramps because no signal is recommended at the I-26 westbound ramps and signal can operate independently. Alternative 3 (Dual Roundabouts) is expected to operate at LOS F for the westbound ramps during the PM peak hour; therefore, it should not be considered as a viable alternative.

**Table 13** summarizes the LOS and delay for each of study intersections with detailed Synchro reports found in **Appendix L and M**. Detailed Sidra output reports are found in **Appendix N**.

**Table 13: Build 2040 Intersection LOS and Delay**

ID	Intersection	Traffic Control	Approach	HCM 2010 Level of Service (LOS)		Control Delay (sec/veh)	
				AM	PM	AM	PM
Exit 91 (I-26 at S-48) – Diverging Diamond Interchange – Alt 1							
1	I-26 Eastbound Ramps at S-48	Signalized	-	C	C	24.3	25.1
21	I-26 WB Ramps at S-48	Signalized	-	C	C	26.6	29.2
22	S-48 at I-26 WB Off Ramp	Signalized	-	B	B	19.4	16.9
Exit 91 (I-26 at S-48) – Partial Cloverleaf – Alt 2							
1	I-26 Eastbound Ramps at S-48	Signalized	-	A	A	4.2	5.0
2	S-48 at I-26 WB Off Ramp	Unsignalized	WB	B	C	13.3	21.0

The results of the 2040 Build Freeway / Merge / Diverge analysis using Highway Capacity Software (HCS) 2010 indicate that just east of Exit 97 (US 176), I-26 is expected to operate at LOS F in the AM and PM peak hours. Between Exit 91 and Exit 97, the freeway is expected to

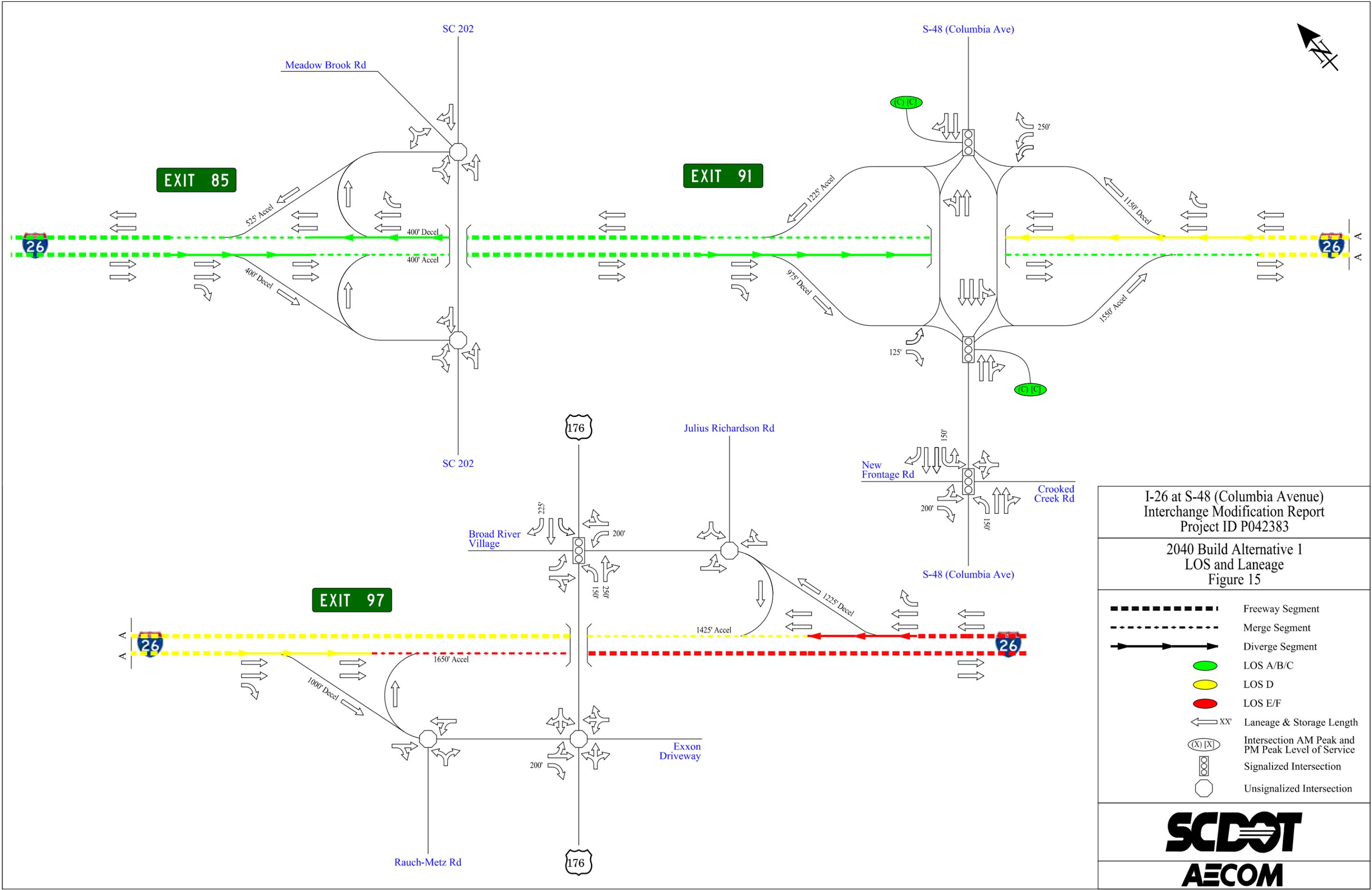
operate at LOS D in the AM peak hour (eastbound) and PM peak hour (westbound). The PM hour diverge at Exit 91 is also LOS D. In addition the I-26 eastbound merge area from Exit 97 is expected to operate at LOS F along with the I-26 westbound diverge area during the PM peak hour. All other freeway segment / merge / diverge analyses are operating at LOS C or better.

**Table 14** summarizes the LOS and density for each merge / diverge area with detailed HCS reports found in **Appendix I**.

**Table 14: Build 2040 Freeway / Merge / Diverge LOS and Density**

Approach	Description	HCM 2010 Level of Service (LOS)		Density (pc/mi/ln)	
		AM	PM	AM	PM
<b>Freeway Segment</b>					
Eastbound	West of Exit 85	B	C	15.8	19.5
	Between Exit 85 and Exit 91	B	C	17.5	19.1
	Between Exit 91 and Exit 97	D	D	31.3	33.0
	East of Exit 97	F	F	105.3	50.3
Westbound	East of Exit 97	C	F	23.3	91.3
	Between Exit 91 and Exit 97	C	D	19.5	32.4
	Between Exit 85 and Exit 91	B	B	11.1	17.1
	West of Exit 85	B	B	11.5	16.5
<b>Merge Area</b>					
Eastbound	EB Exit 85 On-Ramp	C	C	23.0	24.7
	EB Exit 91 On-Ramp	C	C	26.2	27.2
	EB Exit 97 On-Ramp	F	F	42.0	34.7
Westbound	WB Exit 97 On-Ramp	B	D	18.6	28.3
	WB Exit 91 On-Ramp	B	B	10.6	17.4
	WB Exit 85 On-Ramp	B	C	15.6	21.3
<b>Diverge Area</b>					
Eastbound	EB Exit 85 Off-Ramp	C	C	20.9	25.1
	EB Exit 91 Off-Ramp	B	B	17.8	19.5
	EB Exit 97 Off-Ramp	D	D	29.7	30.7
Westbound	WB Exit 97 Off-Ramp	C	F	21.5	44.2
	WB Exit 91 Off-Ramp – Alt 1	B	D	17.7	28.3
	WB Exit 91 Off- Ramp – Alt 2	B	A	10.6	6.7
	WB Exit 91 Off Loop Ramp – Alt 2	B	C	16.1	25.8
	WB Exit 85 Off-Ramp	B	C	15.0	22.5

**Figure 15 and 16** shows the LOS for the 2040 Build Conditions for Alternative 1 and 2.

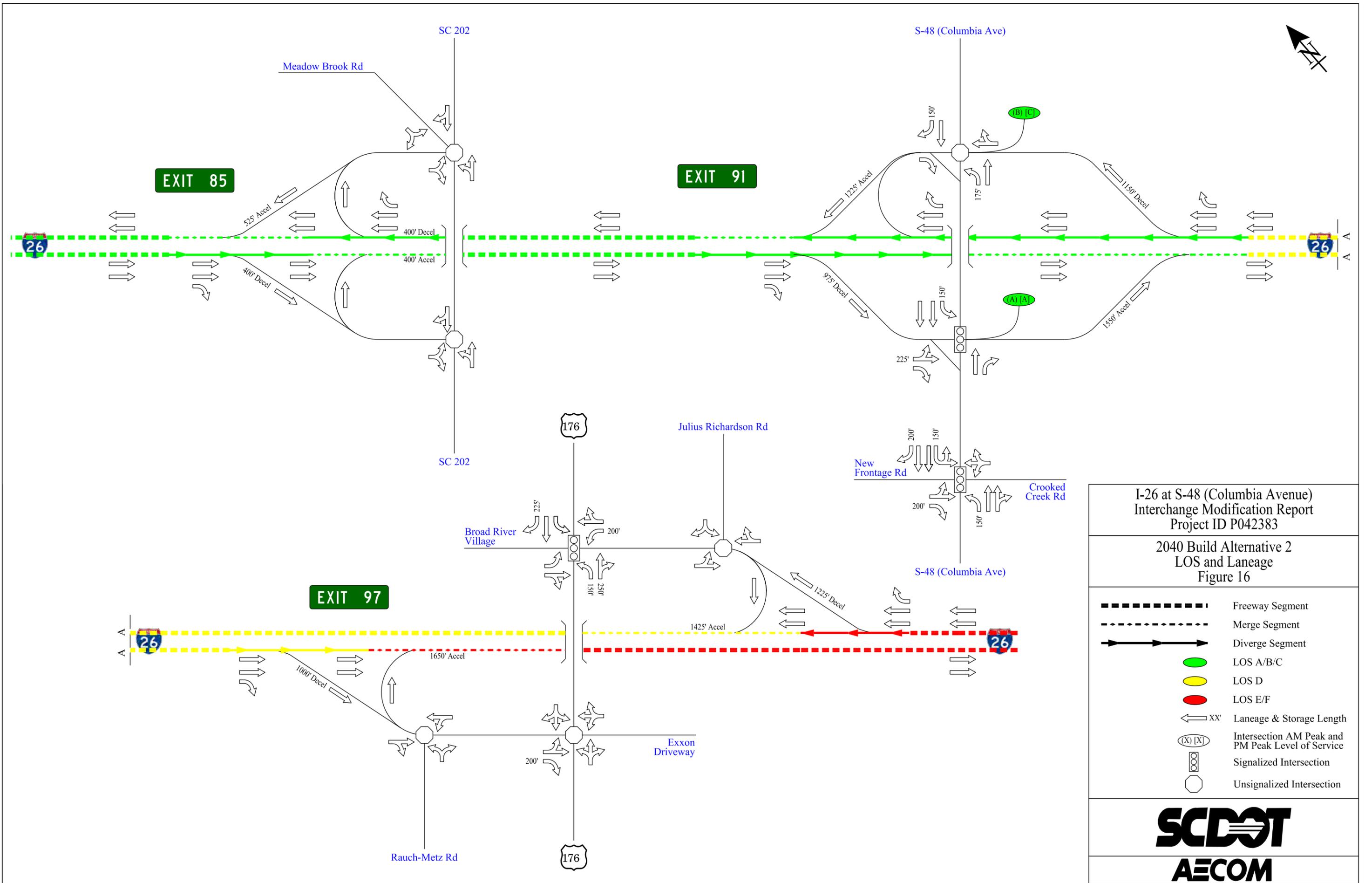


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2040 Build Alternative 1  
LOS and Laneage  
Figure 15

- Freeway Segment
- Merge Segment
- Diverge Segment
- LOS A/B/C
- LOS D
- LOS E/F
- XX' Laneage & Storage Length
- Intersection AM Peak and PM Peak Level of Service
- Signalized Intersection
- Unsignalized Intersection





I-26 at S-48 (Columbia Avenue)  
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2040 Build Alternative 2  
LOS and Laneage  
Figure 16

- Freeway Segment
- Merge Segment
- Diverge Segment
- LOS A/B/C
- LOS D
- LOS E/F
- XX' Laneage & Storage Length
- (X) [X] Intersection AM Peak and PM Peak Level of Service
- ⏸ Signalized Intersection
- ⬡ Unsignalized Intersection



## 4.0 VISSIM ANALYSIS

Simulation modeling is a very useful tool for designing improvements to the roadway system. It enables engineers and planners to predict and compare the outcomes of both No-Build and Build alternatives. For this project VISSIM 7.0 software was selected for the traffic operational analysis due to its powerful multi-model modeling capabilities. VISSIM is stochastic traffic simulation software that uses the psycho-physical driver behavior model developed by R. Wiedemann. It combines a perceptual model of the driver with a vehicle model. Every driver with his or her specific behavior characteristics is assigned to a specific vehicle. As a result, the driver behavior corresponds to the technical capabilities of his vehicle. In addition, the optional 3D visualization capability makes it easier to visualize the traffic flow patterns in the corridor. As a result the analyst can see the issues in the model and propose the appropriate solution

### 4.1 MODEL DEVELOPMENT

The following subsections summarize the data collection, field observations, traffic assignment, and other relevant inputs that were required for the development of the VISSIM models. First, the existing condition models were developed and calibrated, which then served as the base for the development of the future year No-Build and Build model networks.

#### 4.1.1 Geometric Data

To assist in coding of the model network, aerial photography was obtained using VISSIM 7's built-in Bing Maps aerial feature. In addition, Google Maps was also used to for the geometrical information of the study corridor. Lane configurations were initially taken from the aerial pictures and confirmed with the field observations.

Grades (gradient) are an important element of the microsimulation models as they directly impact the vehicle acceleration and deceleration parameters. It is particularly very important for a heavy truck's acceleration and deceleration travelling at the higher speed. The field observations data suggested that grades are very slight in the study area. The study team utilized United States Geological Survey (USGS)<sup>1</sup> data to obtain grades for the model segments.

#### 4.1.2 Traffic Control Data

##### 4.1.2.1 Signal Controllers

VISSIM can model signalized intersections using either the built-in fixed-time control or various other external signal control logic formats. Among the available external logic formats is the Ring Barrier Controller (RBC), which was used in this model at the signalized intersection. The settings on this controller type are saved to an external data file with the extension \*.rbc.

---

<sup>1</sup> <http://viewer.nationalmap.gov/basic/>

It should be noted that in the 2014, 2020 No-Build and 2040 No-Build scenarios the signals were coded as RBC – Actuated Uncoordinated.

For the 2020 and 2040 Build AM and PM scenarios, the signals on S-48 (Columbia Avenue) interchange (DDI) were coded as RBC- Actuated Coordinated. In addition, the signal at I-26 WB On & Off Ramps and US-176 are coded as Actuated Uncoordinated.

#### 4.1.2.2 *Signal Timings*

Traffic signal timing plans for the two signalized intersections; I-26 westbound On-Off Ramps & Columbia Avenue intersection and I-26 WB On-Off Ramps & Columbia Avenue intersection were obtained from the South Carolina Department of Transportation. However, the plans only had minimum, maximum, yellow, red times and phase information. Based on this, 2014 AM and PM peak hour Synchro models were developed and optimized to calculate the splits and cycle lengths. Split and cycle length information was entered into the VISSIM models.

Similarly, 2020 and 2040 AM and PM peak hour No-Build and Build synchro models were developed to obtain the signal timing information, which was then used in the VISSIM models.

#### 4.1.2.3 *Stop Signs*

Stop controlled intersections are modeled in VISSIM using a combination of stop signs and priority rules. The stop sign and stop line of the priority rule define the location at which vehicles must stop. The amount of time a vehicle is stopped is determined by the time distribution assigned to the respective vehicle class. In the absence of time distributions, a vehicle will stop for one time step. Priority rules are implemented to establish the minimum gap time and headway at which the stopped vehicle may proceed into the receiving traffic stream. Stop and yield signs were coded based on the aerial data.

#### 4.1.3 *Speed Data*

The posted speed limits data on the roadways were collected from Google Maps' street view function. For the existing year model calibration, the average speed data for section along the interstate corridor was collected from INRIX. This data was used to develop the desired speed distribution for the I-26 segments. The desired speed distribution for the turning vehicles at an intersection was assumed to be 17 MPH and 14 MPH for cars and heavy vehicles respectively with a 1.5 MPH of standard deviation.

**Table 15: Speed Distribution**

SD No	Speed Limit (MPH)	Min	Max	15%	85%
3	15	10	20		
5	25	20	30		
7	35	30	40		
8	40	35	45		
9	45	40	50		
10	50	45	55		
15	65	40	75	60	70
18	65	60	85	70	78.8

Desired Speed Decision points are used for permanent speed changes within the network and are coded at locations where the speed change would typically occur (location of speed signs).

A new series of desired speed distributions are assigned to each vehicle class at the Desired Speed Decision point. Therefore, as a vehicle passes over a decision point, its speed is adjusted according to the new distribution.

Reduced Speed Areas were used to model short sections with reduced speeds (curves or turns). Similar to the Desired Speed Decision points, a new set of desired speed distributions (in this case 'reduced' speeds) are assigned to each vehicle class to account for slower speeds within the reduced speed area. However, unlike the Desired Speed Decision Point, when encountering a Reduced Speed Area, each vehicle begins to decelerate in advance to reach the lower desired speed as it enters the defined area. After leaving the reduced speed area, the vehicle returns to its actual desired speed.

The Reduced Speed Areas coded in the model correspond to turns (left and right) and locations that because of their geometry will impose a mandatory reduction on the speed of vehicles, independently of their originally desired speed.

#### 4.1.4 Traffic Input

VISSIM supports two different forms of vehicle assignments; Dynamic and Static. In dynamic assignment, the vehicle travels from its origin to designation based on the best available route. Parking lots are used as the origin and destination points and generally there are multiple routes between each origin and destination.

Static assignment assumes that the vehicle will follow an assigned path or route from its origin to destination irrespective of the friction or cost. Route is a sequence of links and connectors from a routing decision point to the destination(s).

The study corridor does not have multiple routes option i.e. for a vehicle there is only one route available to travel between any origin and destination. Hence, it was determined that the static assignment would be the most suitable to replicate the existing conditions. Each vehicle input source on I-26 and cross-streets had its routing decision point. Route stretched to each on and off-ramp followed by another routing decision (origin) to eventually take the vehicles through interchange to reach its destination. No vehicles are taken out or added to the network automatically; therefore, it is important that balanced volume flows are entered.

#### *4.1.4.1 Traffic Composition*

The default vehicle types available in VISSIM are Car, HGV (truck), Bus, Tram (transit), Bike, and Pedestrian. These can be used to define traffic composition for a microsimulation model. For the purpose of this study, only two default vehicle types; Car and HGV (truck) were utilized. Traffic compositions are the proportions of each vehicle type present in each of the vehicle input sources. Vehicle Inputs are time variable traffic volumes entered at the source node. For the modeling purpose, I-26 (East and West ends of the model) and the cross-streets were defined as source nodes.

#### *4.1.4.2 Exiting Condition Volumes*

The 2014 Existing Condition AM and PM peak hour turning movement volumes were developed from the (2014) collected counts. Most of the collected approach and receiving volumes were balanced. However, at some locations where the approach and receiving volumes were off, minor adjustments were done to get the balanced volumes. No vehicles were taken out or added to the network automatically; therefore, it was important that balanced volume flows were entered.

#### *4.1.4.3 2020 and 2040 No-Build and Build Volumes*

It was assumed that in 2020 or 2040 the traffic pattern i.e. origin and destination would remain unchanged between the No-Build and Build scenarios. Hence, the No-Build and Build condition traffic volumes were kept consistent.

#### *4.1.5 Driving behavior Parameters*

During the simulation, the driver behavior parameters are used to guide the vehicles through the model network. VISSIM uses five driving behavior models, out of which only two; Urban (Motorized) and Freeway (Free Lane Selection) were used for the development of the base year model network. The Urban (Motorized) parameter was used to model surface streets within the network. The Freeway (Free Lane Selection) parameter was used to model the freeway facilities within the project network.

#### 4.1.5.1 Data Limitations

There were a few limitations associated with the collected data. Limitations and relevant logical solution are listed below:

- Traffic Signal Data:
  - Signal plans were obtained from the SCDOT, however, the signal timing, splits and offsets were not available.
    - VISSIM (RBC controller) requires various signal parameter inputs. Using the information provided in the signal plan, Synchro models were developed to develop and optimized to generate the splits and timings.
    - Using the base year Synchro model, 2020 and 2040 No-Build Synchro models and signal timing data were developed.
  
- Grade/Elevation Data:
  - Grade or Elevation is an important component of microsimulation as it can have a significant impact on the acceleration and deceleration parameter of a vehicle, especially on the heavy trucks. As mentioned in the **Section 4.2** elevation data was obtained from the United States Geological Survey (USGS) and grades were calculated using the best engineering judgement. Grades were then applied to the model segments.
  
- Traffic Volumes:
  - At some locations, including on I-26 mainline, traffic counts were not available such as west of Exit 91. The only 24-hour traffic count on I-26 that was conducted just east of Exit 91.
    - Using the engineering judgement, logical existing and future traffic volumes were back calculated and balanced.

## 4.2 BASE YEAR MODEL CALIBRATION AND VISUAL VALIDATION

In order to achieve logical microsimulation results, it is imperative to calibrate and validate the model using observed field data. It should be noted that there are no universally accepted or definitive methods for performing model calibration and validation. The responsibility lies with the modeler to adopt and implement a suitable procedure depending upon the scope and budget of the project that will provide an acceptable level of confidence in the model results. Once the calibration targets are achieved, the same parameters can then be applied to the future year models.

4.2.1 Calibration Criteria

To ensure satisfactory calibration of the model, standards were used to establish targets regarding traffic flows and travel times. The targets of this calibration effort were set at the values included in Traffic Analysis Toolbox Volume III –Guidelines for Applying Traffic Microsimulation Modeling Software<sup>2</sup> published by the Federal Highway Administration (FHWA) shown below:

Criteria and Measures	Calibration Acceptance Targets
<b>Hourly Flows, Model Versus Observed</b>	
Individual Link Flows	
Within 15%, for 700 veh/h < Flow < 2700 veh/h	> 85% of cases
Within 100 veh/h, for Flow < 700 veh/h	> 85% of cases
Within 400 veh/h, for Flow > 2700 veh/h	> 85% of cases
Sum of All Link Flows	Within 5% of sum of all link counts
GEH Statistic < 5 for Individual Link Flows*	> 85% of cases
GEH Statistic for Sum of All Link Flows	GEH < 4 for sum of all link counts
<b>Travel Times, Model Versus Observed</b>	
Journey Times, Network	
Within 15% (or 1 min, if higher)	> 85% of cases
<b>Visual Audits</b>	
Individual Link Speeds	
Visually Acceptable Speed-Flow Relationship	To analyst's satisfaction
Bottlenecks	
Visually Acceptable Queuing	To analyst's satisfaction

GEH measure is a formula used in traffic modeling to compare two sets of traffic volumes (Observed and Modeled). Its mathematical formulation is similar to the Chi-Squared test, but it is not a true statistical test but rather an empirical formula. The formulation for the GEH Statistic is as follows:

$$GEH = \sqrt{\frac{2 * (M - O)^2}{(M + O)}}$$

Where M represents model estimate volume and O represents field counts.

<sup>2</sup> [http://ops.fhwa.dot.gov/trafficanalysisitools/tat\\_vol3/vol3\\_guidelines.pdf](http://ops.fhwa.dot.gov/trafficanalysisitools/tat_vol3/vol3_guidelines.pdf), page64

This statistic is typically used to offset the discrepancies that occur when using only simple percentages, as traffic volumes vary over a wide range. In other words, if using only percentages, small absolute discrepancies have no impact on large volumes but a large percent impact in smaller numbers, and vice versa. It has been shown that for traffic volumes smaller than 10,000 a five percent variation yields smaller numbers than a GEH of five. Beyond 10,000, five percent differences keep growing linearly whereas GEH=5 follows a decaying curve.

Based on the scope and purpose of this study it was determined that base year model calibration will be based on the link flows, travel time and speed criteria. For the link volume calibration, 2014 traffic counts and turning movements were used to compare with the model link volumes.

For the link speed comparison, it was recommended to use the INRIX speed data against the model link speeds. In the study area, INRIX only provided speeds on the I-26 links, therefore only I-26 model link speeds were used for the calibration and validation purposes. Data collection points were placed on I-26 corridor in areas upstream and downstream of merge and diverge at the locations of the INRIX speed data collection.

#### 4.2.2 Simulation Setting and Random Seed Variation

The AM peak hour model was set run from 7:00-8:30 AM with 30 minutes of seeding time. Hence, the actual analysis period was 7:30-8:30AM. Similarly, the PM peak hour model was set to run from 4:15 – 5:45PM with 30 minutes of seeding time. The actual PM analysis period was from 4:45 – 5:45PM. The model was ran ten times starting with a random seed at five with five seed increments. Simulation parameter settings are pictorially shown on the following page.

#### 4.2.3 Visual Validation

Visual validation of the models is an imperative step in the development and calibration of the model. It is essential for the modeler to perform a thorough visual validation to eliminate any coding errors and achieving logical results.

After coding, the models were ran and visually inspected multiple times. The errors pertaining to the lane change decision, yield, conflict area, etc. were then addressed to achieve realistic vehicle movements. The validation process was performed for all the existing, no-build and build models.

**Simulation Settings - AM**

**Simulation Parameters**

Comment:

---

Period:  Simulation seconds

Start Time:  [hh:mm:ss]

Start Date:  [DD.MM.YYYY]

---

Simulation resolution:  Time step(s) / Sim. sec.

Random Seed:

---

Number of runs:

Random seed increment:

Dynamic assignment volume increment:  %

---

Simulation speed:  1000.0 Sim. sec. / s  
 maximum  
 Retrospective synchronization

Break at:  Simulation seconds

Number of cores:

**Simulation Settings - PM**

**Simulation Parameters**

Comment:

---

Period:  Simulation seconds

Start Time:  [hh:mm:ss]

Start Date:  [DD.MM.YYYY]

---

Simulation resolution:  Time step(s) / Sim. sec.

Random Seed:

---

Number of runs:

Random seed increment:

Dynamic assignment volume increment:  %

---

Simulation speed:  1000.0 Sim. sec. / s  
 maximum  
 Retrospective synchronization

Break at:  Simulation seconds

Number of cores:

#### 4.2.4 Calibration Results

2014 Existing Condition AM and PM peak hour models were run with the VISSIM's default simulation parameters settings. It was observed that with the default simulation parameters the models' link volumes were within the desired ranges for the calibration. However, the model link speeds were less than the observed INRIX speeds on the I-26 links. Hence, some minor adjustments to the desired speed distribution and speed curve were performed to account for the higher speeds observed in the INRIX data.

##### 4.2.4.1 Link Volumes and Speed

A model is assumed to be reasonably calibrated, if:

- Link flows satisfy modeled versus observed flow thresholds for 85% of the individual links.
- Sum of all link flows is within 5% of sum of all link counts.
- 85% of the network link flows have a GEH less than 5.
- Model link speeds fall within  $\pm 2.5$  MPH of INRIX Speeds.

Table 16 and 17 shows overall calibration results under AM and PM peak hours.

**Table 16: 2014 AM Peak Hour Calibration Results**

Calibration Summary			
Speed Data			
MOE Criteria	Target	Actual	Calibrated
Within Acceptable Range ( $\pm 5$ MPH of INRIX Speed)	90%	100.0%	Calibrated
Within Desirable Range ( $\pm 2.5$ MPH of INRIX Speed)	75%	100.0%	Calibrated
Flow (Count) Data			
MOE Criteria	Target	Actual	Calibrated
Individual Link Flow	85%	99.1%	Calibrated
Sum of All Link Flows	5%	1.4%	Calibrated
GEH Individual Link	85%	98.0%	Calibrated
GEH - All Links	5.00	2.40	Calibrated

**Table 17: 2014 PM Peak Hour Calibration Results**

Calibration Summary			
Speed Data			
MOE Criteria	Target	Actual	Calibrated
Within Acceptable Range ( $\pm 5$ MPH of INRIX Speed)	90%	100.0%	Calibrated
Within Desirable Range ( $\pm 2.5$ MPH of INRIX Speed)	75%	100.0%	Calibrated
Flow (Count) Data			
MOE Criteria	Target	Actual	Calibrated
Individual Link Flow	85%	100.0%	Calibrated
Sum of All Link Flows	5%	1.2%	Calibrated
GEH Individual Link	85%	100.0%	Calibrated
GEH - All Links	5.00	2.26	Calibrated

4.2.4.2 Travel Time

A model is reasonably calibrated when the modeled travel times are within 15% (or one minute if higher) of the average field collected travel time for 85% of the cases. **Table 18** shows the AM and PM peak hour travel time calibration results.

**Table 18: Travel Time Calibration Results**

Time	Percentage	Calibrated
7:30 AM - 8:30 AM	100%	Calibrated
4:45 PM - 5:45 PM	100%	Calibrated

*Percentage of Travel Times within 15% (or one minute)*

### 4.3 MEASURES OF EFFECTIVENESS

#### 4.3.1 95<sup>th</sup> Percentile (Worst Case) Methodology

For the AM and PM peak hourly analysis, *95 percent Worst Case Result method*<sup>3</sup> as described in the FHWA Tool Box was utilized for the worst case (density) determination. The equation below shows the 95th percentile density equation:

$$95 \text{ percent Worst Result} = M + 1.64 * S$$

Where,

M = Mean observed result (weighted density) in the model runs;

S = Standard deviation of the result (weighted density) in the model runs

Weighted delay results from the 10 batch runs were compiled by each intersection. Further, average and standard deviation in the model runs were calculated. The resultant weighted delay was calculated utilizing the 95 percent worst case result method. Error! Reference source not found. **Table 19** below shows the 95th percentile delay calculation method.

**Table 19: 95th Percentile Calculation Method**

Time	Calibrated
Model Runs	Intersection Average Delay
Run 1	D1
Run 2	D2
Run 3	D3
...	...
Run 10	D16
Average Wt. Delay ( $D_a$ )	$D_a = (D1+D2+D3+.....+D10) / 10$
St. Deviation ( $S_d$ )	$S_d = \text{Stand. Dev } (D1, D2, D3, \dots, D10)$

<sup>3</sup> [http://ops.fhwa.dot.gov/trafficanalysisstools/tat\\_vol3/Vol3\\_Guidelines.pdf](http://ops.fhwa.dot.gov/trafficanalysisstools/tat_vol3/Vol3_Guidelines.pdf) page 77

#### 4.3.2 Delay Reporting for Stop and Signal Controlled Intersections

##### *Stop Controlled Intersection*

Most of the stop controlled intersections in the study corridor are “1-Way Stop”. Because the main approach is generally a free-flow with heavy traffic movement, the stop controlled movement is weighted out. As a result, even though the stop controlled approach operated at LOS E or F but overall the intersection reported as operating at LOS D or better. It was determined that for stop controlled intersections, worst approach delay should be reported.

##### *Signalized (or Signal Controlled Intersection)*

For the signal controlled intersections, the 95th percentile of the overall (weighted) delays were calculated.

MOEs for the all the No-Build and Build models are compiled in the following subsections.

#### 4.3.3 2014 Existing Condition AM and PM Peak Hour MOEs

After the existing conditions VISSIM model was calibrated, the measures of effectiveness (MOEs) for existing conditions were obtained for the AM and PM peak hours.

**Table 20** shows the intersection delay and Level of Service for the both the peak periods.

**Table 20: 2014 Existing AM / PM Peak Hour Delay and LOS (VISSIM)**

Intersection	2014 Existing Condition					
	Exit #	Intersection Traffic Controller	AM		PM	
			Avg. Delay (Sec. / Veh.)	LOS*	Avg. Delay (Sec. / Veh.)	LOS*
S-48 and I-26 WB Ramps	91	Signalized	14.1	B	19.5	B
S-48 and I-26 EB Ramps		Stop	14.5	B	19.7	C

\*Delay and LOS for the stop controlled intersection is the worst case approach delay and LOS observed. It is not the overall delay and LOS for the stop controlled intersection.

#### 4.3.4 2020 No-Build AM and PM Peak Hour MOEs

**Table 21** shows the intersection delay and level of service for the AM and PM peak hours under 2020 No-Build scenario.

**Table 21: 2020 No-Build AM / PM Peak Hour Delay and LOS (VISSIM)**

Intersection	2020 No-Build Condition					
	Exit #	Intersection Traffic Controller	AM		PM	
			Avg. Delay (Sec. / Veh.)	LOS*	Avg. Delay (Sec. / Veh.)	LOS*
S-48 and I-26 WB Ramps	91	Signalized	51.6	D	81.0	F
S-48 and I-26 EB Ramps		Stop	>300.0	F	>300.0	F
*Delay and LOS for the stop controlled intersection is the worst case approach delay and LOS observed. It is not the overall delay and LOS for the stop controlled intersection.						

4.3.5 2020 Build (DDI) AM and PM Peak Hour MOEs

In addition to the DDI project, the following changes were included in the 2020 Build scenario:

- A New Frontage was included to carry the traffic of the proposed future developments. It was connected to the Columbia Avenue around Shell Gas Station, south of the I-26 EB Ramps intersection. It coded and analyzed as a signalized intersection.
- Ellet Road was removed in the built scenario. In the build scenario, Ellet Road traffic redistributed and added to the New Frontage Road traffic.
- Crooked Creek Road was realigned to connect to the New Frontage Road intersection with Columbia Avenue. In the build scenario, it will not have direct access to the I-26 EB on ramp. Crooked Creek Road traffic was redistributed and added to the Frontage Road traffic.

**Table 22** shows the intersection delay and level of service for the AM and PM peak hours under 2020 Build scenario. The build scenario would be a Diverging Diamond Interchange (DDI) at I-26 and Columbia Avenue interchange.

**Table 22: 2020 Build (DDI) AM / PM Peak Hour Delay and LOS (VISSIM)**

Intersection	2020 Build Condition					
	Exit #	Intersection Traffic Controller	AM		PM	
			Avg. Delay (Sec. / Veh.)	LOS*	Avg. Delay (Sec. / Veh.)	LOS*
S-48 and I-26 WB Ramps	91	Signalized	15.5	B	16.3	B
S-48 and I-26 EB Ramps		Signalized	12.0	B	12.6	B
*Delay and LOS for the stop controlled intersection is the worst case approach delay and LOS observed. It is not the overall delay and LOS for the stop controlled intersection.						

4.3.6 2040 No-Build AM and PM Peak Hour MOEs

Table 23 shows the intersection delay and level of service for the 2040 No-Build AM and PM peak hour scenario.

**Table 23: 2040 No-Build AM / PM Peak Hour Delay and LOS (VISSIM)**

Intersection	2040 No-Build Condition					
	Exit #	Intersection Traffic Controller	AM		PM	
			Avg. Delay (Sec. / Veh.)	LOS*	Avg. Delay (Sec. / Veh.)	LOS*
S-48 and I-26 WB Ramps	91	Signalized	74.2	E	90.9	F
S-48 and I-26 EB Ramps		Stop	>300.0	F	>300.0	F
*Delay and LOS for the stop controlled intersection is the worst case approach delay and LOS observed. It is not the overall delay and LOS for the stop controlled intersection.						

4.3.7 2040 Build (DDI) AM and PM Peak Hour MOEs

In 2040 Build scenario, in addition to the DDI project, the following changes were included in the 2040 Build scenario:

- A New Frontage was included to carry the traffic of the proposed future developments. It was connected to the Columbia Avenue around Shell Gas Station, south of the I-26 EB Ramps intersection. It coded and analyzed as a signalized intersection.
- Ellet Road was removed in the built scenario. In the build scenario, Ellet Road traffic redistributed and added to the New Frontage Road traffic.
- Crooked Creek Road was realigned to connect to the New Frontage Road intersection with Columbia Avenue. In the build scenario, it will not have direct access to the I-26 EB on ramp. Crooked Creek Road traffic was redistributed and added to the Frontage Road traffic.

**Table 24** shows the intersection delay and level of service for the 2040 Build AM and PM peak hour scenario.

**Table 24: 2040 Build (DDI) AM / PM Peak Hour Delay and LOS (VISSIM)**

Intersection	2040 Build Condition					
	Exit #	Intersection Traffic Controller	AM		PM	
			Avg. Delay (Sec. / Veh.)	LOS*	Avg. Delay (Sec. / Veh.)	LOS*
S-48 and I-26 WB Ramps	91	Signalized	17.8	B	15.7	B
S-48 and I-26 EB Ramps		Signalized	24.5	C	27.5	C
*Delay and LOS for the stop controlled intersection is the worst case approach delay and LOS observed. It is not the overall delay and LOS for the stop controlled intersection.						

## 5.0 SUMMARY OF FINDINGS

The following is a summary of the results for the analysis of the project to provide interchange improvements at Exit 91 – S-48 (Columbia Avenue). As shown in this analysis, under the No-Build conditions, by 2020 the level of service begins to fail (LOS E/F) at the I-26 ramps. In the 2040 No-Build scenario, all intersections of concern at Exit 91 are at failing level of service conditions.

1. I-26 Eastbound Ramps at S-48
2. I-26 Westbound Ramps at S-48

The scenario in which the diverging diamond interchange alternative is constructed, the 2020 and 2040 Build conditions show an acceptable level of service (C or higher) at all intersections.

The HCS analysis of the freeway, merge, and diverge segments reach similar conclusions regarding acceptable levels of service. The freeway segments directly adjacent to Exit 91 in the Existing, No-Build, and Build scenarios operate at level of service D or better. Merge and diverge analysis at Exit 91 also indicates a level of service of D or better in the existing and 2020/2040 No-Build and Build years.

It should be noted that at Exit 97, to the East of Exit 91, intersections reach a failing level of service by 2020. Freeway segments reach failing conditions in 2040.

### 5.1 FINDINGS

#### *2014 Existing Condition*

The 2014 analysis results show that most of the intersections in the study area operate at LOS C or better.

#### *2020 No-Build Condition*

In the 2020 No-Build AM and PM scenarios, only a few stop controlled approaches operate at LOS D or better. The signalized intersections and stop controlled approaches listed below operate at a LOS E or worse.

- I-26 EB Ramps & S-48 Intersection ; Stop Controlled Approach
- I-26 WB Ramps & S-48 Intersection; Signalized Intersection

#### *2020 Build (DDI) Condition*

In the 2020 Build (DDI) AM and PM scenarios, both the intersections on S-48 (Columbia Avenue) operate well at LOS B. The signalized intersections listed below operate at a LOS E or worse:

- I-26 WB Off-Ramp & US-176; Signalized Intersection

#### *2040 No-Build Condition*

Under the 2040 No-Build condition the signalized intersections and stop controlled approaches listed below operate at a LOS E or worse:

- I-26 EB Ramps & S-48 Intersection ; Stop Controlled Approach
- I-26 WB Ramps & S-48 Intersection; Signalized Intersection

*2040 Build (DDI) Condition*

All the signalized intersections on S-48 (Columbia Avenue) operate at LOS C or better.

## **5.2 CONCLUSION AND RECOMMENDATION**

The traffic analysis presented in this report suggests that the proposed diverging diamond alternative at S-48 (Columbia Avenue) interchange will operate acceptably in both the 2020 and 2040 build scenarios and does not adversely impact the adjacent interchanges.

## 6.0 FEDERAL HIGHWAY ADMINISTRATION (FHWA) POLICY

It is in the national interest to maintain the Interstate System to provide the highest level of service on terms of safety and mobility. Adequate control of access is critical to providing such service. Therefore FHWA has developed policy points that must be addressed prior to granting a new or modified access point to the interstate system. The policy points were originally detailed in the Federal Register on October 22, 1990 955 FR 42670), and updated in the Federal Register: February 11, 1998 (Volume 63, Number 28). On August 27, 2009 FHWA published a new policy in the Federal Register (Volume 74, Number 165. The following section details how the proposed action meets the requirements for the new or revised access points to the existing Interstate System.

**Policy Point #1:** *The need being addressed by the request cannot be adequately satisfied by existing interchanges to the Interstate, and/or local roads and streets in the corridor can neither provide the desired access, nor can they be reasonably improved (such as access control along surface streets, improving traffic control, modifying ramp terminals and intersections, adding turn bays or lengthening storage) to satisfactorily accommodate the design-year traffic demands (23 CFR 625.2(a)).*

Interstate 26 is an east / west main route of the interstate highway system in the southeastern United States. It spans from US 17 in Charleston, South Carolina to US 23 in Kingsport, Tennessee. I-26 is a 4-lane divided highway with a posted speed limit of 70 mile per hour. S-48 (Columbia Avenue) is a two lane minor arterial that connects downtown Chapin with I-26 at Exit 91. The existing Exit 91 interchange is a diamond interchange approximately 20 miles from Columbia, South Carolina. The eastbound off ramp is under stop control while westbound off ramp is signalized. No turn lanes are present to / from I-26. Access management concerns include Ellett Road which is less than 100 feet south of the I-26 eastbound off ramp and Crooked Creek Road which intersects with I-26 eastbound on ramp.

Access management along S-48 is also expected to improve with the proposed DDI. There are plans to consolidate closely spaced driveways adjacent to the interchange termini ramps to one frontage road intersecting S-48 over 1000 feet south of the interchange under signal control.

The purpose of the interchange modification is to improve the operational efficiency and safety of the existing interchange configuration and to accommodate projected traffic volumes. Based on 2020 and 2040 projection traffic volumes, both interstate off-ramps are expected to operate at LOS F with the current interchange configuration. Safety concerns include I-26 westbound off ramp queuing onto I-26 and unsignalized traffic control for the I-26 eastbound off ramp.

**Policy Point #2:** *The need being addressed by the request cannot be adequately satisfied by reasonable transportation system management (such as ramp metering, mass transit, and HOV facilities), geometric design, and alternative improvements to the Interstate without the proposed change(s) in access (23 CFR 625.2(a)).*

The diverging diamond interchange and partial cloverleaf alternatives were analyzed as part of this report. Results from the analysis indicates both alternatives are expected to provide a LOS C or better for the 2040 projected design volumes. The preferred alternative was the diverging

diamond interchange due its right-of-way costs and location of the planned development north of the interchange. Ramp metering, mass transit, and HOV facilities are not warranted based on existing or design year volumes and are not expected to improve operations for this suburban interchange.

**Policy Point #3:** *An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis shall, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (23 CFR 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, shall be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)).*

*Requests for a proposed change in access must include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request must also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).*

An operational analysis was performed for Existing 2014, Opening 2020, and Design 2040 years along I-26 between Exit 85 (SC 202) and Exit 97 (US 176). All mainline segments, merge and diverge ramp junctions as well as surface street intersection were studied. Synchro 9.1 was used for the intersections, HCS 2010 for the mainline segments and merge / diverge areas, and VISSIM 7.0 to model everything together.

The Existing 2014 traffic analysis indicates as shown in Figure 10 that majority of the study is operating at LOS C or better with following exceptions:

- US 176 at I-26 westbound off ramp (Exit 97)
- I-26 freeway segment east of Exit 97

The No-Build 2020 and 2040 traffic analysis indicates, as shown in Figure 11 and 12, that basically everything east of Exit 91 (S-48) is not operating at an acceptable LOS C. Please note the intersections on Exit 91 (S-48) are expected to operate at LOS F while the I-26 westbound segment prior to Exit 91 and off-ramp are projected to operate at LOS D.

The Build 2020 and 2040 traffic analysis indicates, as shown in Figure 13 and 15, that overall operations at the interchange of I-26 at S-48 (Columbia Avenue) would be improved when comparing to the No-Build scenario. East of Exit 91 (S-48) would continue to operate at LOS D until Exit 97 where the LOS worsens to F due to capacity on the mainline. Operation at the intersections on the surface streets at Exit 97 would not be impacted with the proposed interchange modification due to the 6-mile distance to the study interchange and would continue to operate the same as in the No-Build scenario.

**Policy Point #4:** *The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access for managed lanes (e.g., transit, HOVs, HOT lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)).*

The proposed interchange modification for this project would provide all relevant traffic movements at the I-26 and S-48 interchange. The proposed interchange design concept will meet or exceed all applicable SCDOT, AASHTO, and FHWA design standards.

It should be noted that the proposed design plans to remove the existing Crooked Creek Road access with the I-26 eastbound on ramp and realign it with S-48 (Columbia Avenue) to the south. In addition, the closely spaced Ellett Road just south of the I-26 eastbound off ramp is expected to be realigned with this new Crooked Creek Road.

**Policy Point #5:** *The proposal considers and is consistent with local and regional land use and transportation plans. Prior to receiving final approval, all requests for new or revised access must be included in an adopted Metropolitan Transportation Plan, in the adopted Statewide or Metropolitan Transportation Improvement Program (STIP or TIP), and the Congestion Management Process within transportation management areas, as appropriate, and as specified in 23 CFR part 450, and the transportation conformity requirements of 40 CFR parts 51 and 93.*

The proposed project is consistent with the COATS 2035 Long Range Transportation Plan, and lists the S-48 (Columbia Avenue) project as a Prioritized Road Widening Project. The project is also included as a system upgrade in SCDOT's Statewide Transportation Improvement Program (STIP) for Lexington County. The STIP covers all federally funded transportation improvements for which funding has been approved and that are expected to be undertaken in the six-year period the STIP covers. The fiscally-constrained STIP includes approximately \$13,000,000 for preliminary design services, right-of-way acquisition, and project construction through 2019. Full funding is reasonably anticipated to be available for its completion.

**Policy Point #6:** *In corridors where the potential exists for future multiple interchange additions, a comprehensive corridor or network study must accompany all requests for new or revised access with recommendations that address all of the proposed and desired access changes within the context of a longer-range system or network plan (23 U.S.C. 109(d), 23 CFR 625.2(a), 655.603(d), and 771.111).*

There are currently no planned or programmed additional interchanges within the study area for the project or the expanded study area for analysis of the adjacent interchanges in the SCDOT STIP or the Central Midland Council of Governments (CMCOG) Long Range Plan.

In the event that a project to construct an interchange is initiated in the future it will also be subject to the FHWA policy for additional access to the Interstate System, and an Interchange Justification Report will be required.

**Policy Point #7:** *When a new or revised access point is due to a new, expanded, or substantial change in current or planned future development or land use, requests must demonstrate appropriate coordination has occurred between the development and any proposed transportation system improvements (23 CFR 625.2(a) and 655.603(d)). The request must describe the commitments agreed upon to assure adequate collection and dispersion of the traffic resulting from the development with the adjoining local street network and Interstate access point (23 CFR 625.2(a) and 655.603(d)).*

The current report incorporates planned traffic volumes from two major developments in the area. The Chapin Technology Park (approved) and Chapin Commerce Village (planned). Chapin Technology Park is located south of the interchange along S-48 (Columbia Avenue) and Chapin Commerce Village (planned), located north of the interchange. Both development are planned generate a significant number of vehicles and were accounted for with the proposed design of diverging diamond interchange alternative. There have been a series of public meetings that have taken place.

**Policy Point #8:** *The proposal can be expected to be included as an alternative in the required environmental evaluation, review and processing. The proposal should include supporting information and current status of the environmental processing (23 CFR 771.111).*

The proposed alternative is expected to have minimal impact on natural environment such was water quality, floodplains, farmland, and cultural resources as a result retrofitting the existing diamond to a diverging diamond interchange.

A draft Environmental Assessment (EA) is currently being prepared for SCDOT and submitted to FHWA. Effects on human and natural environment was assessed.

Approval of this IMR can only be given by FHWA with the completion of a successful NEPA document.

# **APPENDIX D**

## **Exit 97 IMR**

**Interchange Modification Report**  
**Interstate 26 Exit 97 – US 176/Broad River Road**  
**Richland County, SC**

**Prepared For:**  
**South Carolina Department of Transportation**



Prepared By:

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September 2017

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## EXECUTIVE SUMMARY

The South Carolina Department of Transportation (SCDOT) proposes multiple improvements to the I-26 corridor from mile marker 85 – SC 202 to mile marker 101 – Broad River Road (US 176) designed to increase capacity, upgrade interchanges to meet design requirements, and expand vertical clearance at overpass bridges. Specifically, SCDOT proposes widening I-26 from four to six lanes from Exit 85 – SC 202 to Exit 97 - Broad River Road (US 176) and from four to eight lanes from Exit 97 - Broad River Road (US 176) to Exit 101 - Broad River Road (US 176). Along the project area, interchanges at Exit 85 – SC 202, Exit 91 – Columbia Avenue (S-48), and Exit 97 - Broad River Road (US 176) will be improved to bring them to compliance with design requirements.

Throughout nearly all of the study area, I-26 currently provides two lanes in each direction. From Exit 82 southeastward, the two lane section is maintained, until it is widened from two to three lanes approaching Exit 101.

The proposed project has two primary purposes: increase roadway capacity to address the projected traffic volumes and improve geometric deficiencies along the mainline and at several interchanges and overpasses in this section of I-26 by bringing them to compliance with current state and federal design standards. The secondary purpose is to improve safety which will be enhanced by improving the geometric design of the facility.

This interchange modification report (IMR) presents information for the proposed interchange modifications at Exit 97 – Broad River Road (US 176), located in Richland County, SC. Today, this interchange is a partial cloverleaf with loop on-ramps and slip ramp off-ramps. Julius Richardson Road intersects the westbound loop ramp and Rauch-Metz Road intersects the eastbound loop ramp.

Information discussed in the report is derived from the following projects reports: *Interstate 26 Widening Traffic Analysis Report: I-26 Widening Project MM 85-MM 101*, *Accident Analysis Report: I-26 Widening Project MM 85-MM 101*, and *Interstate 26 Widening and Improvements Mile Marker 85-101 Environmental Assessment*.

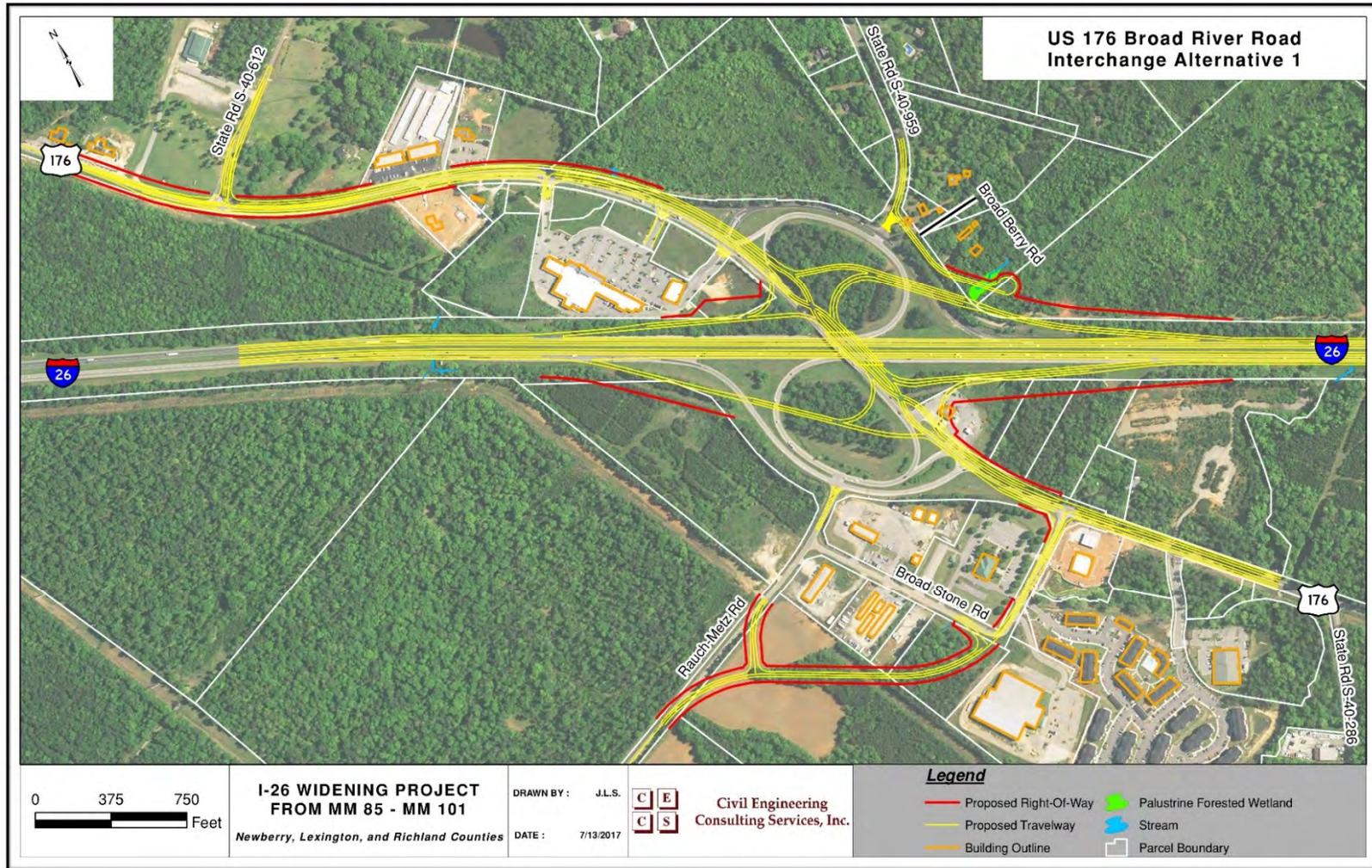
Three alternatives were developed for Exit 97. The three Build alternatives at Exit 97 consist of:

- Alternative 1: Diverging Diamond Interchange (DDI) – the concept would replace the existing interchange with a DDI.
- Alternative 2: Partial Cloverleaf (ParClo) Interchange – this concept would add a westbound on-ramp and eastbound on-ramp to the existing interchange configuration.
- Alternative 3: Single Point Urban Interchange (SPUI) – this concept would replace the existing interchange configuration with a SPUI.

In each of the Exit 97 alternatives, traffic from the existing ramp intersections of Julius Richardson Road and Rauch Metz Road would be redirected to West Shady Grove Road and Broad Stone Road, respectively. The existing ramp intersections with Broad River Road would be eliminated, and Broad River Road would be widened through the interchange area between Broad Stone Road and the main Shopping Center Driveway. The eastbound off-ramp intersection would operate under traffic signal control. The existing traffic signal at the shopping center driveway would be removed and a new signal would be installed at the southern access to the shopping center, and traffic signals would be installed at the Broad River Road intersections with Broad Stone Road and West Shady Grove Road.

Alternative 1, the DDI, was selected as the Preferred Alternative for Exit 97. Alternative 1 would impact the least amount of streams and wetlands, when compared to the other Build alternatives, making this the least environmentally damaging practicable alternative. It also requires the least amount of new right-of-way and has the lowest overall estimated construction cost. The DDI would also reduce congestion and provide a safer interchange, satisfying the project purpose and need. The intersections of Broad River Road and the I-26 ramps would be improved from LOS E or F to LOS C or better. Because of these reasons, Alternative 1 was selected as the Preferred Alternative. Alternative 1 is shown in Figure E-1.

Based on the analysis, other improvements to the original concept were made including turn lane lengths, number of approach lanes, number of lanes on Broad River Road, and traffic signal phasing to obtain an acceptable Level of Service (LOS) results.



Source: Figure 84, *Interstate 26 Widening Traffic Analysis Report*  
**Figure E-1. Preferred Alternative 1**

## I. Introduction

I-26 is an east-west interstate highway that begins at the junction of U.S. Route 11W and U.S. Route 23 in Kingsport, Tennessee. From this origin, I-26 runs generally southeastward through Tennessee, North Carolina, and South Carolina, where it ends at U.S. Route 17 in Charleston, South Carolina.

Along its nearly 306 mile length, I-26 provides access to Johnson City, Tennessee; Asheville, North Carolina; and Spartanburg, Columbia and Charleston, South Carolina.

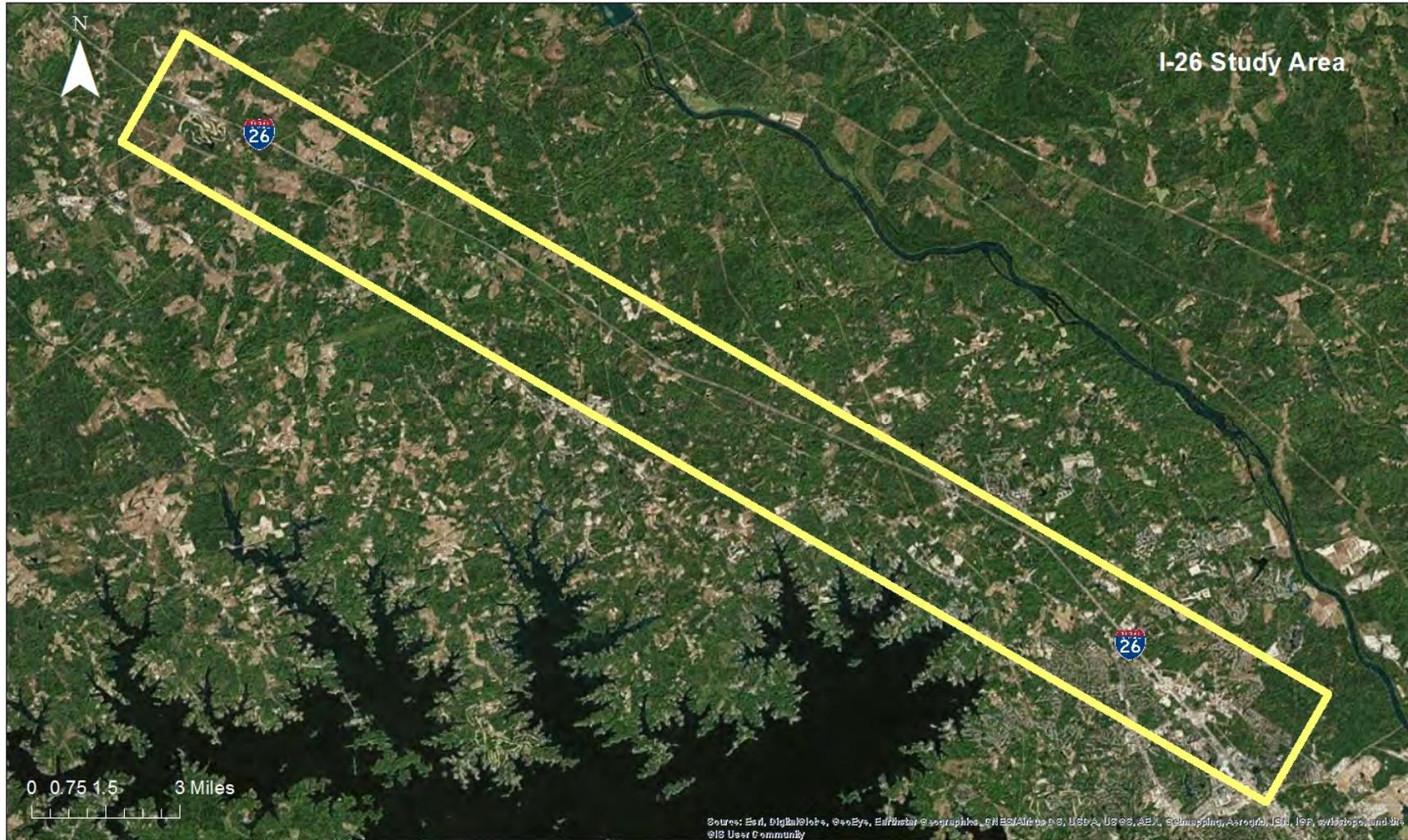
In South Carolina, I-26 covers about 221 miles, and provides connections to I-95 south of Providence, to I-77 south of Cayce, to I-20 west of Columbia, and to I-85 north-west of Spartanburg. The portion of I-26 under study in the *Interstate 26 Widening Traffic Analysis Report: I-26 Widening Project MM 85-MM 101* is located west of Columbia, generally between Exit 82 and Exit 102. Exit 85 is located on the west end of the study area.

In the vicinity of Exit 97, I-26 currently provides two lanes in each direction. The posted speed limit on I-26 in the vicinity of Exit 97 is 70 miles per hour.

In general, interstate routes can be characterized as having either level, rolling, or mountainous terrain. Consistent with the Mainline Study, the portion of I-26 adjacent to Exit 97 is characterized as having a rolling terrain.

Information discussed in the report is derived from the following projects reports: *Interstate 26 Widening Traffic Analysis Report: I-26 Widening Project MM 85 to MM 101 (Mainline Study)*, *Accident Analysis Report: I-26 Widening Project MM 85 to MM 101 (Accident Analysis)*, and *Interstate 26 Widening and Improvements Mile Marker 85-101 Environmental Assessment*.

The I-26 Mainline Study evaluated multiple improvements to the I-26 corridor designed to increase capacity, upgrade interchanges to meet design requirements, and expand vertical clearance at overpass bridges and/or replace them. The study considered widening I-26 from two to three lanes from approximately 1.6 miles west of Exit 85 to about 2,200 feet west of Exit 101 and examined modifications to interchanges at Exit 85 (SC 202), Exit 91 (S-32-48/Columbia Avenue) and Exit 97 (US 176/Broad River Road). To provide sufficient coverage to prepare interchange modification reports, the I-26 Mainline Study included the existing interchanges at Exits 82, 101 and 102. **Figure 1** depicts the study area for the overall I-26 Widening project.



Source: Figure 12, *Interstate 26 Widening Traffic Analysis Report*  
**Figure 1 . Interstate 26 Widening Study Area**

## II. Exit 97 - US 176/Broad River Road

Exit 97 is a partial cloverleaf interchange with loop on-ramps in the northeast and southwest quadrants. The existing configuration of the Exit 97 interchange is shown in **Figure 2**.

### Existing Conditions

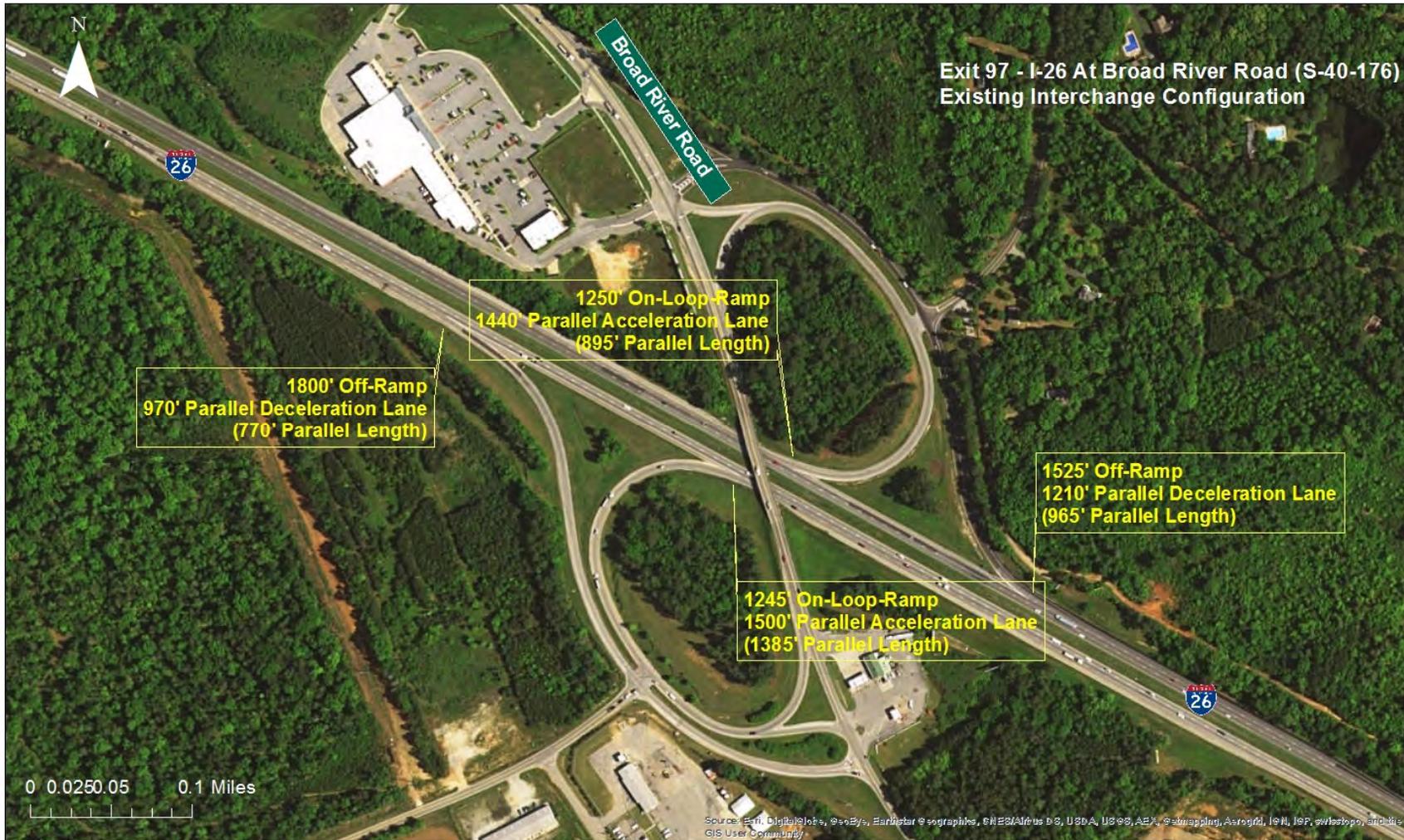
The existing configuration of Exit 97 Exit 97 was constructed in the early 1970s. The section of I-26 in the vicinity of Exit 97 currently consists of a four-lane interstate with a grassed median for all of its length.

The westbound off-ramp is approximately 1,525 feet long with a 1,210 feet long parallel deceleration lane (with a parallel length of approximately 965 feet). The off-ramp has a 35 mph posted advisory speed limit.

The westbound loop on-ramp is a single lane ramp that begins at the signalized off-ramp intersection. The loop on-ramp is approximately 1,250 feet long and merges into I-26 with a 1,440 feet long parallel acceleration lane (with a parallel length of approximately 895 feet). The ramp accepts the southbound left turn from a separate left turn lane on Broad River Road, and northbound right turn traffic from Broad River. The lanes for these two movements are separated by a grass island, with the southbound left turn traffic from Broad River Road controlled by a yield sign at the merge with the northbound right turn traffic from Broad River Road. The intersection with Julius Richardson Road is located approximately 775 feet from the signalized ramp intersection on Broad River Road.

The westbound loop off-ramp and on-ramp are separated by approximately 710 feet on westbound I-26.

The eastbound off-ramp is approximately 1,800 feet long with a 970 feet long parallel deceleration lane (with a parallel length of approximately 770 feet). The off-ramp has a 35 mph posted advisory speed limit. In the middle of the ramp, traffic can make a right turn to Rauch-Metz Road (S-40-385) or it can proceed straight until the end of the ramp. At the end of the off-ramp, traffic can make a left turn to "Peak" and "Pomaria" or make a right turn to "Irmo" and "Ballentine". Near the end, the off-ramp widens from a single lane to provide a separate left turn lane and a separate right turn lane with approximately 200 feet of storage that are separated from each other by a concrete island. Both movements are controlled by the STOP signs. The stop lines are set back 25-35 feet from the edge of Broad River Road.



Source: Figure 12, *Interstate 26 Widening Traffic Analysis Report*

**Figure 2. Existing Interchange**

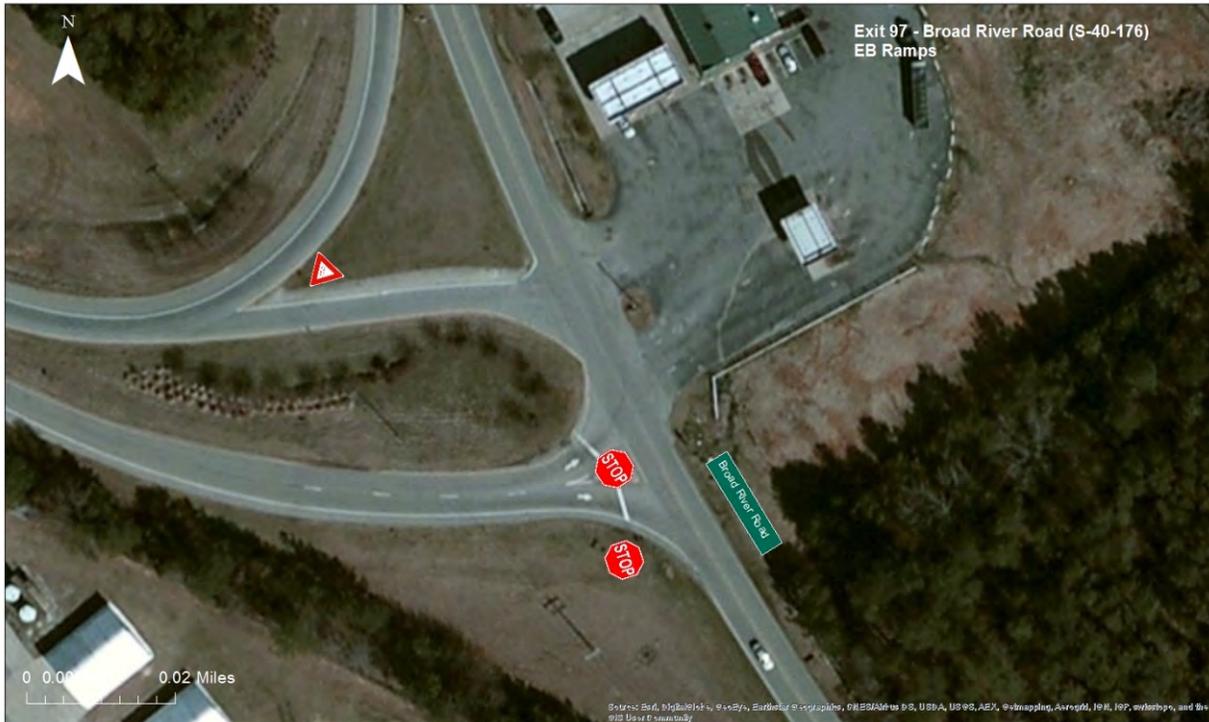
The eastbound on-ramp is a single lane loop ramp approximately 1,245 feet long that merges into I-26 with a 1,500 feet long parallel acceleration lane (with a parallel length of approximately 1,385 feet). The ramp accepts the southbound right turn and the northbound left turn traffic from Broad River Road along with eastbound left turn traffic from Rauch-Metz Road. The northbound left turn traffic from Broad River Road has a yield sign at the merge with the southbound right turn traffic from Broad River Road. The Rauch-Metz Road approach is controlled by a STOP sign.

The eastbound off-ramp and loop on-ramp are separated by approximately 905 feet.

The exit is signed “176” using the route shield, along with the text “Peak” in the westbound direction. In the eastbound direction, the route shield “176” is shown along with the text “Ballentine” and “White Rock”.

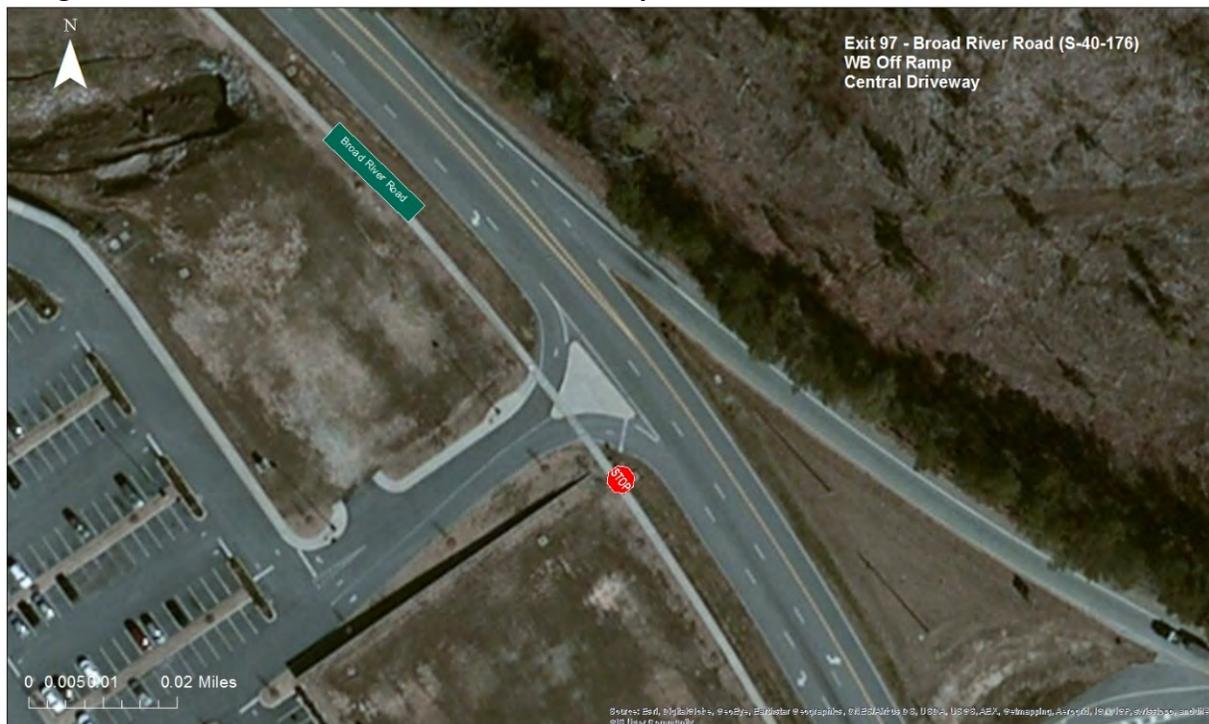
Broad River Road to the north of the interchange is a two lane roadway with a posted 45 mph speed limit. As Broad River Road approaches the interchange, separate right turn lanes are provided to the north and center driveway to the shopping center. At the signalized intersection with the westbound off-ramp, Broad River Road provides separate southbound left turn, through and right turn lanes. The southbound left turn lane provides 270 feet of storage and the southbound right turn lane provides 175 feet of storage. In the northbound direction at this signal, Broad River Road provides separate left turn with 140 feet of storage, and a separate through lane; the right turn movement to the westbound loop on-ramp diverges from northbound Broad River Road approximately 240 feet to the south of the stop line with a 130 feet long diverging taper. The Broad River Road bridge crossing I-26 is two lanes wide. At the eastbound ramp intersection, southbound of Broad River Road provides a single through lane; the right turn lane to the eastbound loop on-ramp diverges approximately 250 north of where northbound traffic turns left onto the ramp. No separate turn lanes are provided to separate traffic turning left onto the eastbound loop on-ramp from the northbound through traffic on Broad River Road.

The eastbound ramp intersection is shown in **Figure 3**. The westbound ramp intersections are shown in **Figure 4** and in **Figure 5**.



Source: Figure 21, Interstate 26 Widening Traffic Analysis Report

**Figure 3. Exit 97: Broad River Road at EB Ramps**



Source: Figure 22, Interstate 26 Widening Traffic Analysis Report

**Figure 4. Exit 97: Broad River Road at Westbound Ramps and Central Driveway**



Source: Figure 23, Interstate 26 Widening Traffic Analysis Report

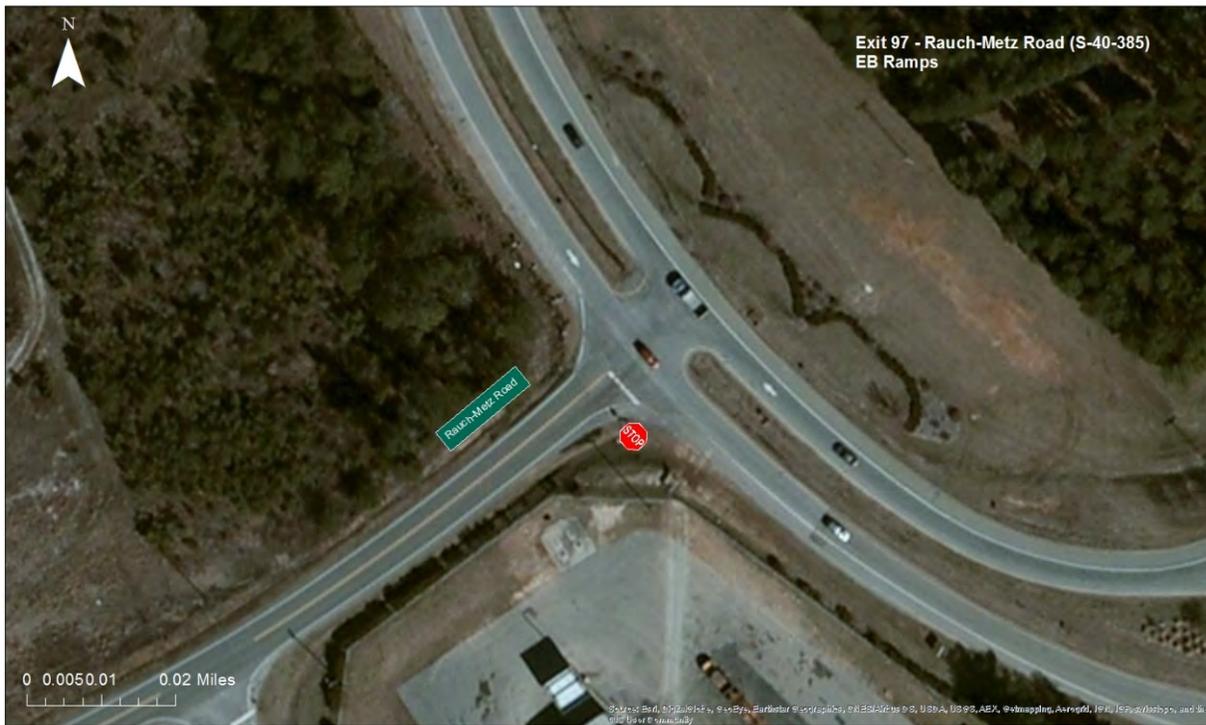
**Figure 5. Exit 97: Broad River Road at Westbound Ramps and South Driveway**

Adjacent intersections

Seven intersections are located in the vicinity of the interchange. These are:

- Eastbound Ramps and Rauch-Metz Road (S-40-385)
- Broad Stone Road (S-40-2805) and Rauch-Metz Road
- Broad Stone Road with Broad River Road
- Westbound Ramps with Julius Richardson Road (S-40-959)
- Broad River Road and South Shopping Center Driveway/Westbound ramps
- Broad River Road and Center Shopping Center Driveway
- Broad River Road and North Shopping Center Driveway
- Broad River Road and West Shady Grove Road

The intersection of eastbound ramps with Rauch-Metz Road (S-40-385) is located in the southwestern quadrant of the interchange approximately 1,165 feet southeast from gore point of eastbound off-ramp. The intersection of eastbound ramps with Rauch-Metz Road (S-40-385) is an unsignalized intersection with the approach of Rauch-Metz Road controlled by a STOP sign. Rauch-Metz Road is an undivided two lane road with 45 mph posted speed limit. The existing configuration of the eastbound ramps with Rauch-Metz Road is shown in **Figure 6**.

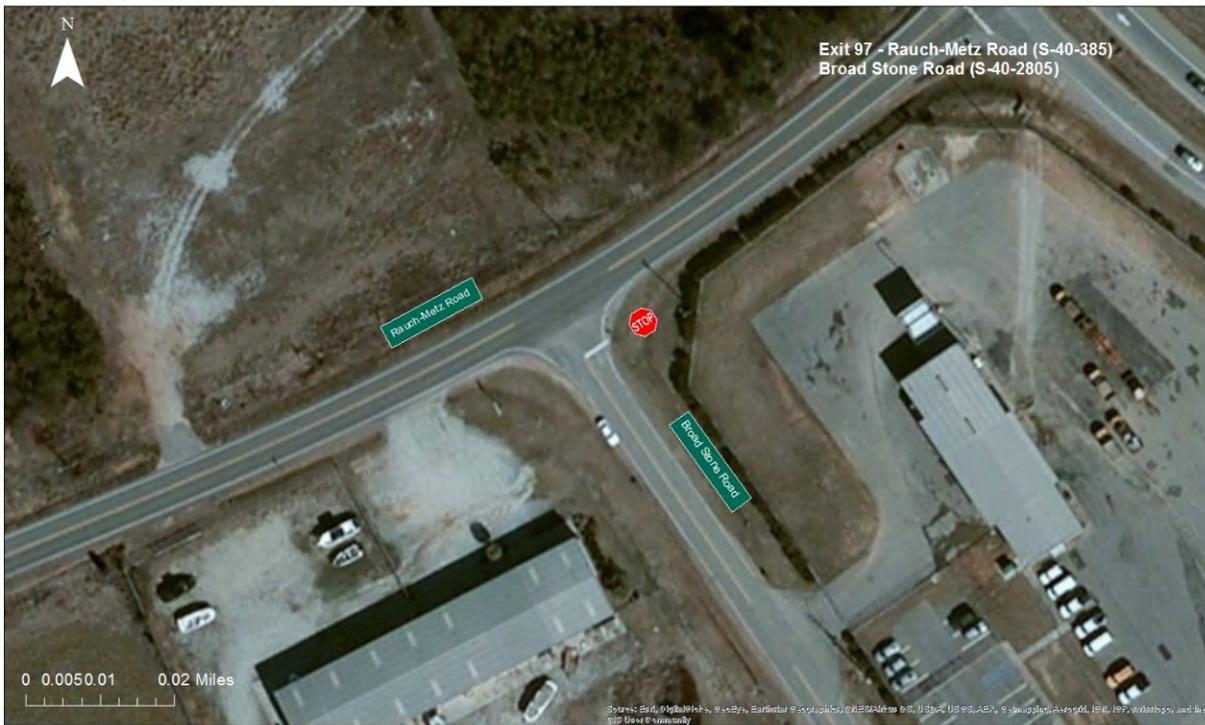


Source: Figure 24, Interstate 26 Widening Traffic Analysis Report

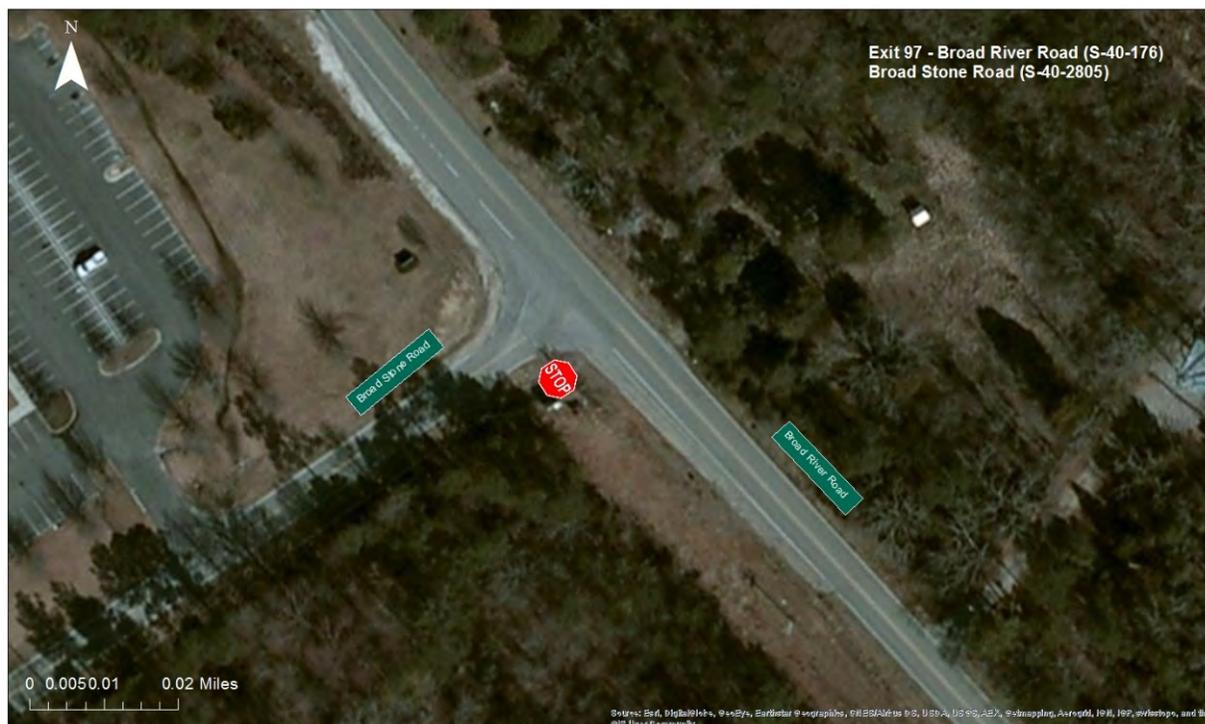
**Figure 6. Exit 97: Eastbound Ramps at Rauch-Metz Road**

The intersection of Broad Stone Road (S-40-2805) with Rauch-Metz Road is located in the southwestern quadrant of the interchange approximately 310 feet from the intersection of eastbound ramps with Rauch-Metz Road. The intersection of Broad Stone Road (S-40-2805) with Rauch-Metz Road is an unsignalized intersection with the approach of Broad Stone Road controlled by the STOP sign. Broad Stone Road is an undivided two lane road without posted speed limit, however, it has a 15 mph advisory speed at the curves. The existing configuration of Broad Stone Road with Rauch-Metz Road intersection is shown in **Figure 7**.

The intersection of Broad Stone Road with Broad River Road is located in the southern end of the interchange area approximately 1,395 feet from the middle of I-26 and Broad River Road intersection. The intersection of Broad Stone Road with Broad River Road is an unsignalized intersection with the approach of Broad Stone Road controlled by the STOP sign. Broad Stone Road is an undivided two lane road without posted speed limit, however, it has a 15 mph advisory speed at the curves. At the intersection with Broad River Road, Broad Stone Road with has right turn lane with 260 feet of storage and a 185 feet long taper. The existing configuration of Broad Stone Road with Broad River Road intersection is shown in **Figure 8**.

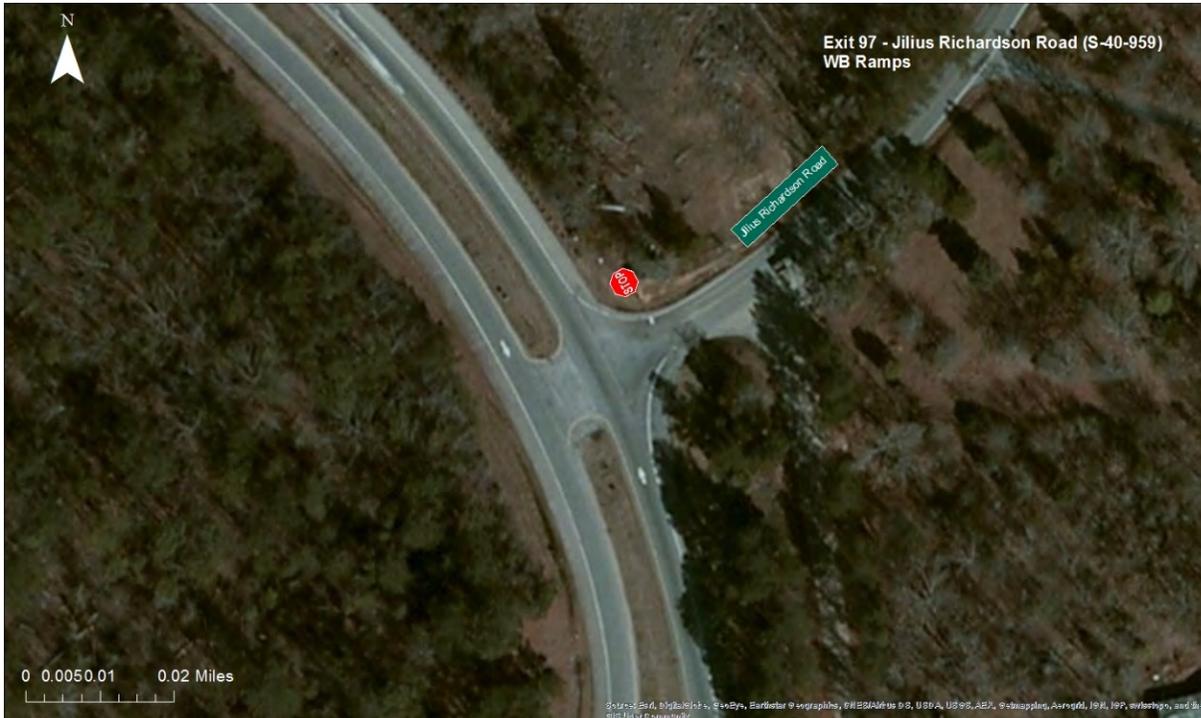


Source: Figure 25, Interstate 26 Widening Traffic Analysis Report  
**Figure 7. Exit 97: Broad Stone Road at Rauch-Metz Road**



Source: Figure 26, Interstate 26 Widening Traffic Analysis Report  
**Figure 8. Exit 97: Broad Stone Road at Broad River Road**

The intersection of the westbound ramps with Julius Richardson Road (S-40-959) is located in the northeastern quadrant of the interchange approximately 835 feet northwest from gore point of westbound off-ramp. The intersection of westbound ramps with Julius Richardson Road (S-40-959) is an unsignalized intersection with the approach of Julius Richardson Road controlled by the STOP sign. Julius Richardson Road is an undivided two lane road with 45 mph posted speed limit. The existing configuration of westbound ramps with Julius Richardson Road intersection is shown in **Figure 9**.



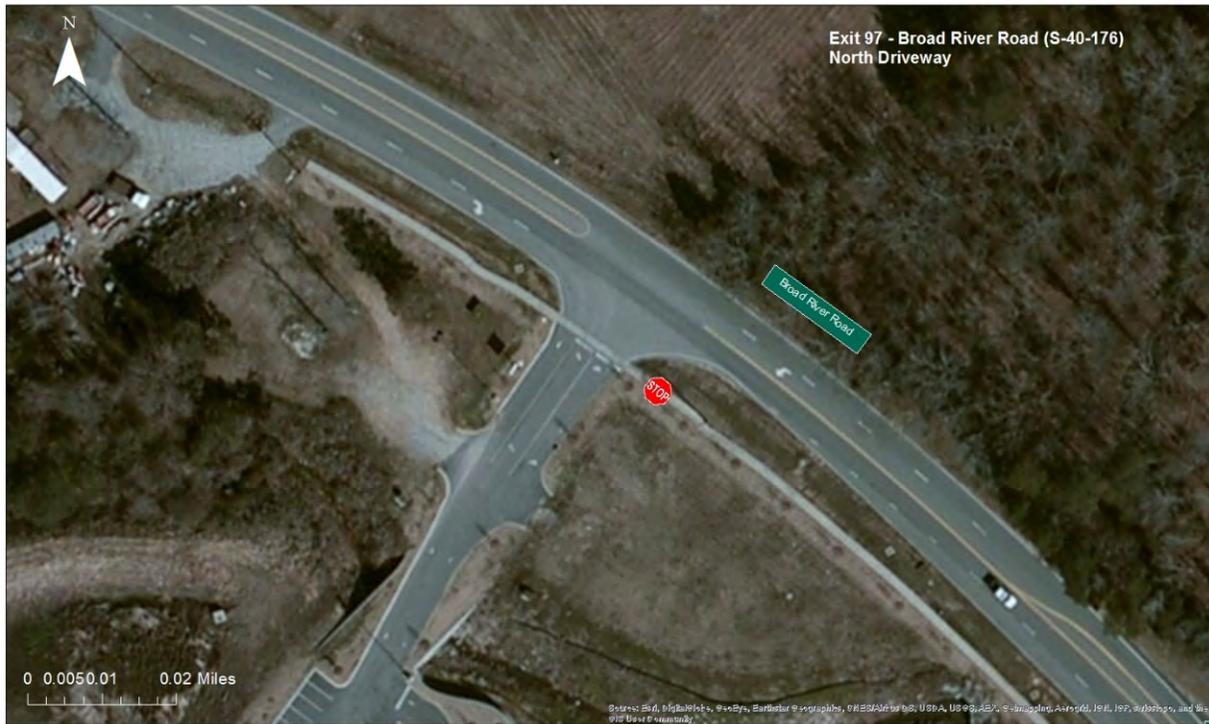
Source: Figure 27, Interstate 26 Widening Traffic Analysis Report  
**Figure 9. Exit 97: Westbound Ramps at Julius Richardson Road**

The intersection of Broad River Road with westbound ramps and with south driveway to the Broad River Village shopping center is located in the northern end of the interchange approximately 790 feet from the middle of the I-26 and Broad River Road interchange. The intersection of Broad River Road with the westbound ramps and the south driveway to the shopping center is a signalized intersection. The south shopping center driveway has two inbound lanes and two outbound lanes consisting of a separate left turn lane and a shared through-right turn lane. These lanes are separated by a concrete median. The westbound off-ramp approach has a left turn lane with 185 feet of storage and a through lane with 185 feet long storage with a painted median between them. The existing configuration of Broad River Road at the westbound ramps and with south driveway to the mall with Food Lion intersection is shown in **Figure 5**.

The intersection of Broad River Road with the center driveway to the Broad River Village shopping center is located in the northern end of the interchange approximately 1,150 feet from the middle of I-26 and Broad River Road interchange, and approximately 360 feet from the signalized intersection of Broad River Road with the westbound ramps and the southern shopping center driveway. The right turn movement from the westbound off-ramp merges into northbound Broad River Road approximately 60 feet north of the central driveway intersection. The central shopping center driveway is an unsignalized right turn in/right turn out intersection with a concrete channelizing island. The southbound right turn movement into driveway is made from a separate right turn lane with approximately 310 feet of storage, and a taper that ends just south of the northern shopping center driveway. The STOP sign controlled right turn movement from the driveway is made into the southbound right turn lane at the signalized intersection with the westbound ramps and the southern shopping center driveway. Traffic wishing to travel through on southbound Broad River Road or turn left onto the westbound on-ramp has to weave into those lanes within the approximately 245 feet available between the outbound driveway stop line and the stop line at the signalized intersection. The existing configuration of Broad River Road with westbound ramps and with central driveway to the mall with Food Lion intersection is shown in **Figure 4**.

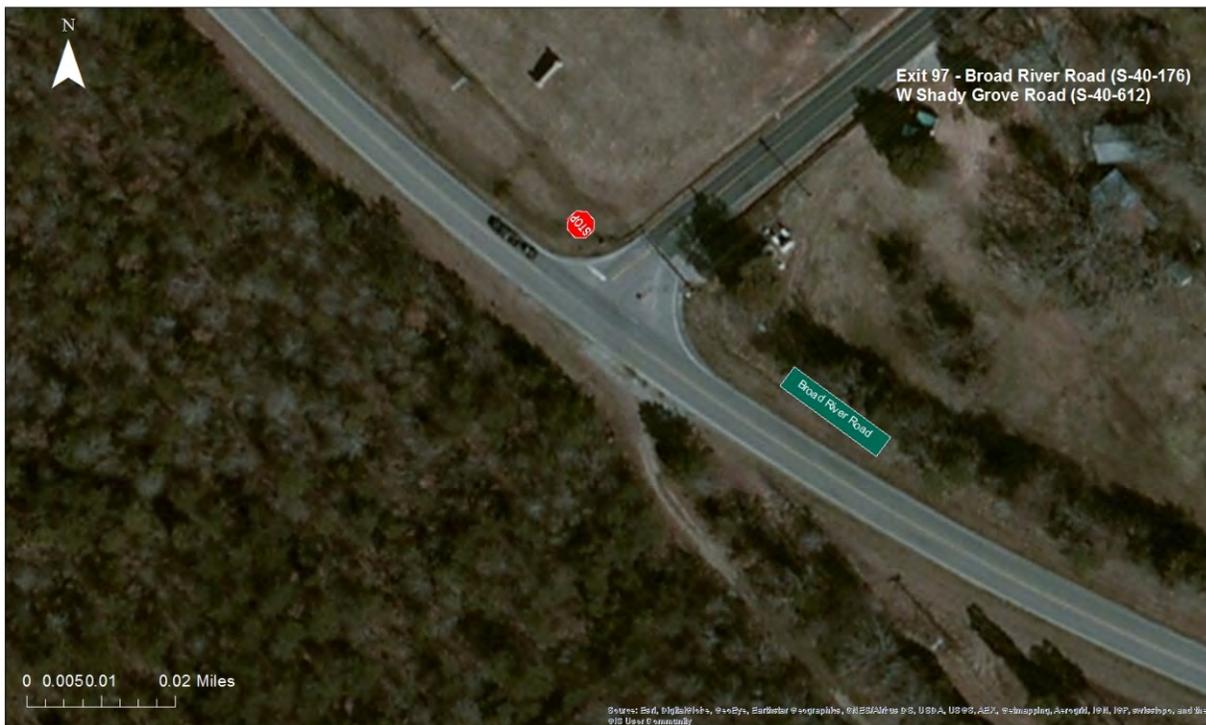
The intersection of Broad River Road with the north driveway to the Broad River Village shopping center is located approximately 1,740 feet north of the middle of the I-26 and Broad River Road interchange and approximately 600 feet north of the center shopping center driveway. The intersection of Broad River Road with the north shopping center driveway is an unsignalized intersection with the approach of north driveway controlled by a STOP sign. The approach of north driveway has a single entrance lanes and separate left and right turn exit lanes. On southbound Broad River Road, there is a separate right turn lane for traffic entering the shopping center. This right turn lane has approximately 270 feet of vehicle storage. Northbound Broad River Road has a separate left turn lane for traffic turning left into this driveway. This left turn lane has approximately 215 feet of vehicle storage. The existing configuration of Broad River Road with westbound ramps and with north driveway to the mall with Food Lion intersection is shown in **Figure 10**.

The intersection of Broad River Road with West Shady Grove Road is located approximately 3,400 feet north of the middle of the I-26 and Broad River Road interchange and approximately 1,680 feet north of the north shopping center driveway. West Shady Grove Road intersects Julius Richardson Road approximately 4,170 east of its intersection with Broad River Road. The intersection of Broad River Road with West Shady Grove Road is an unsignalized intersection with the westbound approach of West Shady Grove controlled by a STOP sign. There are no separate turn lanes provided on any of the approaches to the intersection. The configuration of the intersection of Broad River Road and West Shady Grove Road is shown in **Figure 11**.



Source: Figure 28, Interstate 26 Widening Traffic Analysis Report

**Figure 10. Exit 97: Broad River Road at Westbound Ramps and North Driveway**



Source: Figure 29, Interstate 26 Widening Traffic Analysis Report

**Figure 11. Exit 97: Broad River Road at West Shady Grove Road**

## Purpose and Need

The proposed project has two primary purposes: increase roadway capacity to address the projected increased traffic volumes and improve geometric deficiencies along the mainline and at several interchanges and overpasses in this section of I-26 by bringing them into compliance with current state and federal design standards. The secondary purpose is to improve safety, which will be enhanced by improving the geometric design of the facility.

The needs for this project were identified through a comprehensive review of previous studies along with the analysis of current data compiled for this study. This includes information in the Traffic Analysis Report and the Accident Analysis Report, as well as that collected through meetings with SCDOT; federal, state and local agencies; project stakeholders, and the public.

## Conceptual Design

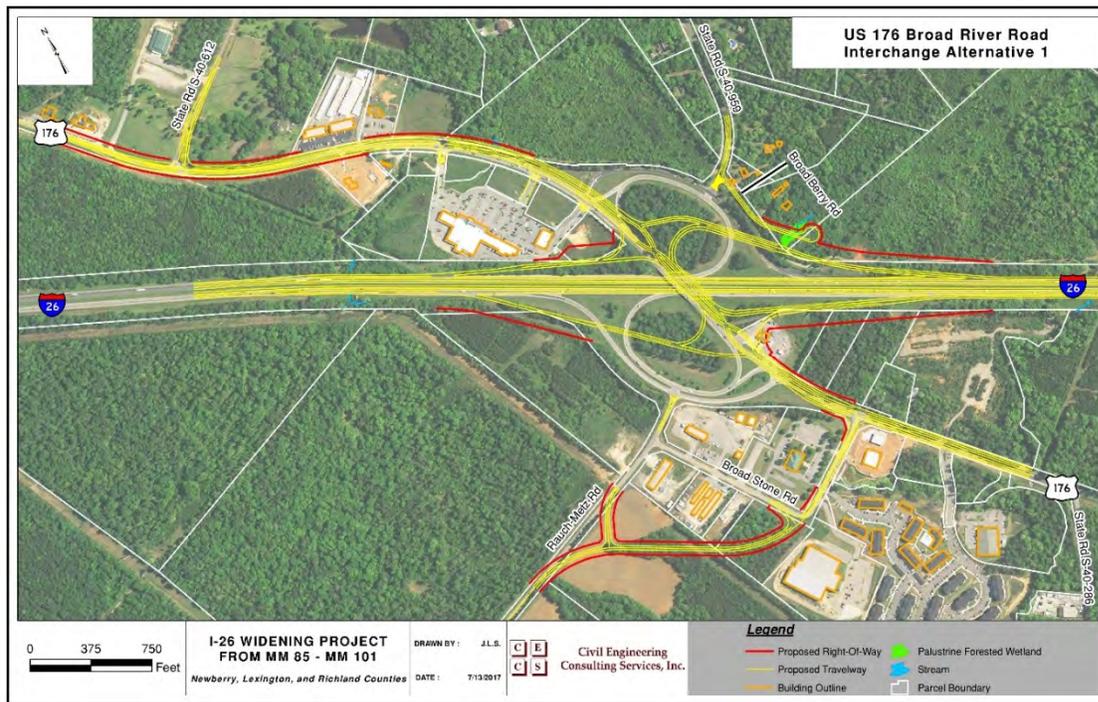
The US 176/Broad River Road interchange is expected to be modified as part of the I-26 widening project. Analyses evaluating 2040 Build conditions for the intersections within the Exit 97 interchange area were performed for three alternatives.

Three alternatives were developed for Exit 97 (**Figure 12** through **Figure 14**).

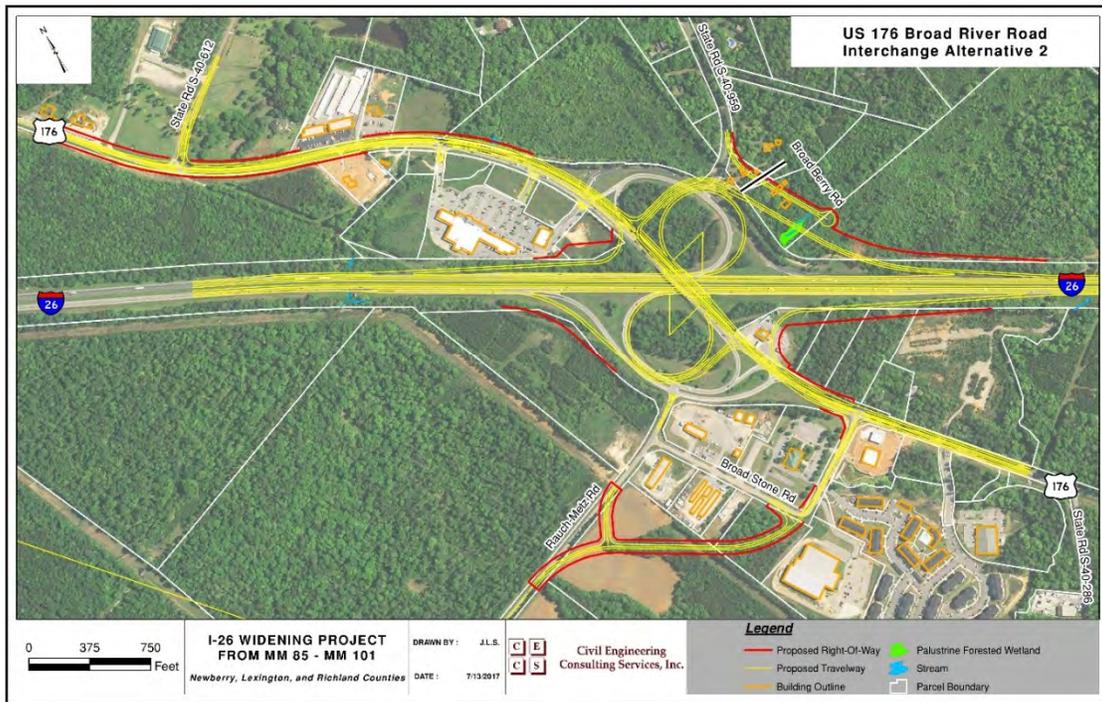
- Alternative 1 replaces the existing Exit 97 with a diverging diamond interchange (DDI). The conceptual design of Alternative 1 is shown in **Figure 12**.
- Alternative 2 replaces the existing Exit 97 with a new partial cloverleaf interchange. The conceptual design of Alternative 2 is shown in **Figure 13**.
- Alternative 3 replaces the existing Exit 97 with a single point urban interchange (SPUI). The conceptual design of Alternative 3 is shown in **Figure 14**.

In each of the Exit 97 alternatives, traffic from the existing ramp intersections of Julius Richardson Road and Rauch Metz Road would be redirected to West Shady Grove Road and Broad Stone Road respectively. The existing intersection ramp intersections with Broad River Road would be eliminated, and Broad River Road would be widened through the interchange area between Broad Stone Road and the main Shopping Center Driveway. The eastbound off-ramp intersection would operate under traffic signal control. The existing traffic signal at the shopping center driveway would be removed and a new signal would be installed at the southern access to the shopping center, and traffic signals would be installed at the Broad River Road intersections with Broad Stone Road and West Shady Grove Road.

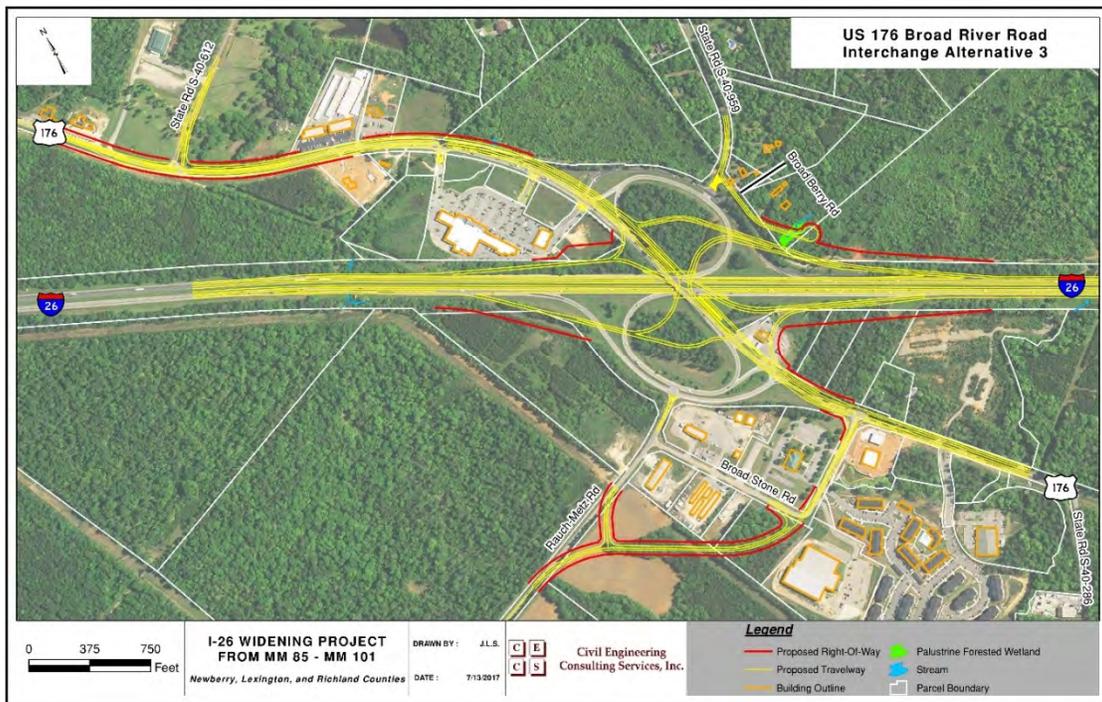
Alternative 1, the DDI, was selected as the Preferred Alternative for Exit 97. Alternative 1 would impact the least amount of streams and wetlands, when compared to the other Build alternatives, making this the least environmentally damaging practicable alternative. It also requires the least amount of new right-of-way and has the lowest overall estimated construction cost. The DDI would also reduce congestion and provide a safer interchange, satisfying the project purpose and need. The intersections of Broad River Road and the I-26 ramps would be improved from LOS E or F to LOS C or better. Because of these reasons, Alternative 1 was selected as the Preferred Alternative.



Source: Figure 84, *Interstate 26 Widening Traffic Analysis Report*  
**Figure 12. Improvement Alternative 1 Diverging Diamond Interchange**



Source: Figure 83, *Interstate 26 Widening Traffic Analysis Report*  
**Figure 13. Improvement Alternative 2 Partial Cloverleaf**



Source: Figure 85, *Interstate 26 Widening Traffic Analysis Report*  
**Figure 14. Improvement Alternative 3 SPUI**

## Intersection Modification Report Applicant

The interchange policy is administered by the Federal Highway Administration (FHWA). Therefore, FHWA is required to approve all new access or changes in access points pursuant to this policy.

As the owner and operator of the Interstate System, SCDOT is responsible for submitting a formal request to the FHWA in the form of an IMR that documents the analysis, the rationale for the proposed change in access, and the recommended action.

SCDOT is the sponsoring agency for the I-26 Widening project. The contact information for the I-26 Exit 97 IMR study is provided below:

Michael L. Hood, P.E., DBIA  
Assistant Program Manager, Design-Build Group  
SC Department of Transportation  
955 Park St., Columbia, SC 29201

### III. Study Area

In South Carolina, I-26 covers about 221 miles, and provides connections to I-95 south of Providence, to I-77 south of Cayce, to I-20 west of Columbia, and to I-85 north-west of Spartanburg. Within the study area shown on **Figure 1**, I-26 crosses portions of Newberry, Lexington and Richland Counties.

#### Demographics

According to the 2010 Census, Newberry County has approximately 37,500 residents, Lexington County has approximately 262,500 residents and Richland County has approximately 384,500. The counties have seen a steady increase in population since the 1950's. Between 2000 and 2010, Newberry county saw a 3.7% increase in population, Lexington County saw a 17.7% increase in population and Richland County saw a 16.6% increase in population.

According to the South Carolina Revenue and Fiscal Affairs Office, Newberry County is expected to continue to see gradual population growth between 2010 and 2030,<sup>1</sup> while Lexington County is expected to see more significant population growth by 2030. The same source estimates

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<sup>1</sup> S.C. Revenue and Fiscal Affairs Office, *County Population Projections 2000-2030*, [http://www.sccommunityprofiles.org/census/proj\\_c2010.html](http://www.sccommunityprofiles.org/census/proj_c2010.html)

Richland County’s population will continue to grow but possibly at a slower rate than from 2000 to 2010. Table 1, presents population growth and projections for the three counties.

**Table 1: Population Growth in the I-26 PSA**

County	2000 Population	2010 Population	2030 Population	2000 – 2010 % Growth	2010 – 2030 % Growth
Newberry	36,108	37,508	39,800	3.7%	5.6%
Lexington	216,014	262,391	333,200	17.7%	21.3%
Richland	320,677	384,504	456,000	16.6%	15.7%

Source: [http://www.sccommunityprofiles.org/census/proj\\_c2010.html](http://www.sccommunityprofiles.org/census/proj_c2010.html)

### Land Use

The I-26 Widening project corridor is located primarily within unincorporated areas of Newberry, Lexington, and Richland counties, but includes small portions of the towns of Irmo and Chapin. Existing land uses are primarily forested land and commercial businesses with areas of rural residential and light industrial operations. The closest incorporated municipalities are the City of Columbia to the southeast; the town of Irmo to the southwest; the Town of Chapin to the southwest; the Town of Little Mountain to the south and the Town of Newberry to the northwest.

Along the mainline of I-26, land uses consist mainly of forested land but become increasingly mixed with commercial and residential properties moving from west to east towards Columbia. An industrial park (Chapin Business and Technology Park) and a planned residential/ commercial neighborhood is located southwest of Exit 91. The industrial park has infrastructure and zoning in place but no buildings as of yet. The adjacent residential/ commercial area is in the planning stages.

### *Exit 97 – Broad River Road*

Land uses surrounding Exit 97 – Broad River Road consist of light industrial, commercial, low-density residential, and open/forested land. Low-density residential land, off of Julius Richardson Road, and forested land is located to the north and northeast of the interchange. To the east of the interchange is the Evergreen 123 BP gas station and forested land. An SCDOT section shed and the SC Department of Motor Vehicles office are located to the south of the interchange. Small commercial businesses occupy this area as well. To the southwest of the interchange are two utility rights-of-way and forested land. To the northwest of the interchange is a commercial shopping center with several small businesses, anchored by the Food Lion grocery store.

With anticipated population growth and the corridor's proximity to Columbia, residential, commercial and industrial development are expected to continue within the project study area, for the No-Build and the Preferred Alternative.

Along the mainline of I-26 in the project study area, the land use consists of mainly of forested land, with areas of commercial, residential, and light industrial uses. The proposed widening of the mainline is not expected to change land uses along the mainline of the interstate.

### Transportation System

The Project study area roadway transportation system is part of the I-26 Widening study depicted in **Figure 1**. This region of Lexington, Newberry and Richland counties is accessed via I-26, which is an east-west freeway connecting Columbia with its suburbs in northwest direction.

For this IMR, a focused roadway system was evaluated. It consisted of I-26 mainline with its merges and diverges areas and the Exit 97 – Broad River Road (US 176) interchange. Specifically, I-26 westbound and eastbound mainline segments at Exit 97 – Broad River Road (US 176) were evaluated for traffic conditions during different hours of the day. This study area is a subset of the broader study area that was analyzed during the Interstate 26 Widening Traffic Analysis Report.

## IV. Methodology

### Scenarios Analyzed

In March 2017, STV Incorporated prepared the I-26 Widening Traffic Analysis Report that included the following scenarios:

- Existing Conditions
- 2040 No-Build Conditions
- 2040 Build Conditions

Analyses were performed for existing conditions (existing traffic, intersection traffic control and geometry), 2040 No-Build conditions (2040 traffic, and existing intersection traffic control and geometry) and 2040 Build conditions (2040 traffic and modified intersection traffic control and geometry reflecting the reasonable interchange improvement alternative). The Exit 97 alternatives were compared against one another to determine which best met the purpose and need with the least impacts.

The 2040 No-Build Alternative for the Exit 97 interchange represents the existing interchange configuration, intersection traffic control and geometric conditions with no changes to those conditions. Many of the impacts associated with the construction of the interchanges would not occur, but the interchanges would continue to be out of conformance with current state and federal design standards. This would not satisfy the purpose and need for the project.

There were three Reasonable Alternatives developed for Exit 97. These alternatives share many common features. They all would meet the purpose and need for the project by bringing the interchange into compliance with current state and federal design requirements. The safety at the interchange will be improved by providing on and off ramps that separate the interstate traffic from local traffic, and which will be long enough to allow traffic to merge onto the interstate and to store traffic that is exiting the interstate during peak hours. Alternative 1 was recommended as the Preferred Alternative for Exit 97. Therefore, the other alternatives were not carried forward in this document and Alternative 1 was analyzed for the 2040 Build Conditions for Exit 97.

The interchanges adjacent to Exit 97 are Exit 91 and Exit 101. Exit 91 – Columbia Avenue (S-32-48) is located approximately 5.30 miles northwest of Exit 97. Exit 101 – Broad River Road (S-40-76, US 176) is the next adjacent interchange to the southeast of Exit 97 and is located approximately 4.95 miles away. The interaction of the modifications proposed at Exit 97 with the adjacent interchanges at Exits 91 and 101 were initially analyzed and are included in the I-26 Widening Traffic Analysis Report.

By replacing the substandard ramps and modifying the existing interchange to meet current design standards, the proposed modified interchange with US 176/Broad River Road is anticipated to contribute to an improvement in traffic safety and provide space for the construction of an additional travel lane in each direction along I-26. The proposed improvements should mitigate the existing factors identified in the Accident Analysis as contributing to a high occurrence of rear-end collisions in the area, including short ramps and merge/diverge areas, as well as a narrow clear zone at and adjacent to the overpass for US 176/Broad River Road.

The Preferred Alternative of the interchange design also provides space for the construction of an additional travel lane in each direction along I-26 to the west of the interchange and 2 additional lanes in each direction to the east of the interchange. Altogether, these design provisions would enhance the operational efficiency and safety of the corridor, thereby increasing capacity and improving levels of service in the long term.

### Traffic Forecasts

A proposed average annual growth rate was estimated based on a comparison of the AADT average annual growth rates (for 1996 and 2015) and the SCSWM average annual growth rates

for each of the segments. This proposed growth rates were applied to all mainline, ramp and arterial turning movement volumes within the study area to generate the design year peak hour volumes for use in the alternatives analysis. In setting the growth rate, an annual percentage that is comparable to, but higher than the observed growth rates is often desirable so a conservative analysis of future traffic conditions may be attained.

Many of the segments in the study area had estimated growth rates exceeding 1.00 percent per year based on the statewide model. Historic data of all segments exceeded 2.00 percent per year. Given the long term historic growth in the corridor, the growth rate falls in a range from 1.5 percent (based on the model assignments) and 2.5 percent per year (based on the long term growth rate from 1996 – 2015). Based on discussions with SCDOT it was determined that a growth rate of 1.5 percent would be used to the east of US 176 (Broad River Road), a growth rate of 2 percent would be used from US 176 (Broad River Road) to east of SC 202, and a growth rate of 2.5 percent would be used from SC 202 to the west.

### Traffic Analysis

A series of capacity analyses were performed based on the methodologies and guidelines contained in the Transportation Research Board’s publication ***HCM 2010 Highway Capacity Manual*** (HCM). Various analysis and simulation software packages based on the HCM were used in performing the analyses. These included:

- a. McTrans’ *HCS 2010* (Version 6.3)
  - o Freeway Segments
  - o Ramp Merge/Diverge Areas
  - o Weaving Segments
- b. Trafficware’s *Synchro* (Version 9.1.910.24)
  - o Unsignalized Intersections
  - o Signalized Intersections
- c. Caliper’s *TransModeler* (Version 4.0 Build 6020)
  - o Network Simulation
  - o Freeway Segments
  - o Ramp Merge/Diverge Areas

### Level of Service Criteria

The analysis methodologies contained in the HCM for the various facility types and users describe the operational conditions in terms of a Level of Service (LOS). The HCM defines LOS as

*“...a quality measure describing operations conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience. Six LOS are defined for each type of facility that has analysis procedures available. Letters designate each level, from A to F, with LOS A representing the best operating*

conditions and LOS F the worst. Each level of service represents a range of operating conditions and the driver’s perception of those conditions. Safety is not included in the measures that establish service levels.”

The following discussions and tables describe the HCM LOS criteria for freeway segments, ramp merge/diverge segments, weaving segments, unsignalized intersections and signalization intersections.

*Freeway Segments*

The HCM characterizes the capacity of a basic freeway segment “...by three performance measures: density in passenger cars per mile per lane (pc/mi/ln), space mean speed in miles per hour (mi/h), and the ratio of demand flow rate to capacity (v/c). Each of these measures is an indication of how well traffic is being accommodated by the basic freeway segment.” **Table 2** shows the HCM LOS criteria for basic freeway segments. LOS F occurs when either the segment density exceeds 45 pc/mi/ln or when the segment v/c ratio exceeds 1.0 (regardless of the segment density).

**Table 2. Freeway Segment LOS Criteria**

Basic Freeway Segments	
LOS	Density (pc/mi/ln)
A	< 11
B	> 11-18
C	> 18-26
D	> 26-35
E	> 35-45
F	> 45 v/c > 1.0

Source: Table 12 – Interstate 26 Widening Traffic Analysis Report

*Weaving Segments*

Weaving segments occur where two or more streams of traffic traveling in the same direction are able to cross each other without traffic control devices. This typically occurs where a merge segment is followed by a diverge segment within a relative short distance (usually less than 2,800 feet). The LOS of a weaving segment is also related to the density of the segment. Regardless of the density, the weaving segment is considered to operate at LOS F when the v/c exceeds 1.0. **Table 3** shows the HCM LOS criteria for Freeway Weaving Segments.

**Table 3. Weaving Segment LOS Criteria**

Freeway Weaving Segments	
LOS	Density (pc/mi/ln)
A	< 10
B	> 10-20
C	> 20-28
D	> 28-35
E	> 35
F	$v/c > 1.0$

Source: Table 13 – Interstate 26 Widening Traffic Analysis Report

### Ramp Merge and Diverge Areas

Ramp-freeway junctions occur when merging maneuvers occur (on-ramps) or when diverging maneuvers occur (off-ramps). The operation of these merge and diverge areas are affected by a number of factors, including the operation of the adjacent freeway segment and the proximity and flow on adjacent ramps. Typically, the influence area of the ramps is 1,500 feet upstream of a diverge point and downstream from a merge point. As with freeway segments and weaving segments, the LOS of a merge or diverge area is related to the density of the segment. Regardless of the density, the merge or diverge areas are considered to operate at LOS F when the freeway demand exceeds the capacity of the upstream freeway segment (at diverge areas) or the downstream freeway segment (at merge areas), as well as when the ramp demand exceeds the ramp capacity. **Table 4** shows the HCM LOS criteria for Ramp Merge and Diverge areas.

**Table 4. Merge/Diverge LOS Criteria**

Ramp Merge and Diverge Areas	
LOS	Density (pc/mi/ln)
A	< 10
B	> 10-20
C	> 20-28
D	> 28-35
E	> 35
F	$v/c > 1.0$

Source: Table 14 – Interstate 26 Widening Traffic Analysis Report

### Unsignalized Intersections

The LOS for unsignalized intersections is based on the average control delay per vehicle. Since major street traffic is seldom controlled by STOP signs (except at intersections with ALL-WAY STOP control or in special circumstances), major street traffic generally will experience virtually no delay. Most of the delay will be encountered by traffic on approaches controlled by STOP

signs. Under certain conditions, delay will also be encountered by left turning traffic on the major street waiting for appropriate sized gaps in the opposing traffic flow to complete their turn. Therefore, the delay experienced by STOP controlled movements and major street left turns, rather than the entire average intersection delay, are used to identify the critical LOS at these intersections. **Table 5** shows the HCM LOS criteria for unsignalized intersections.

**Table 5. Unsignalized Intersection LOS Criteria**

Unsignalized Intersections	
LOS	Control Delay (sec/vehicle)
A	< 10
B	> 10-15
C	> 15-25
D	> 25-35
E	> 35-50
F	> 50

Source: Table 15 – Interstate 26 Widening Traffic Analysis Report

### Signalized Intersections

The LOS for signalized intersections is based on the average control delay per vehicle. LOS can be identified for the entire intersection, individual intersection approaches, and each movement/lane-group. **Table 6** shows the HCM LOS criteria for signalized intersections.

**Table 6. Signalized Intersection LOS Criteria**

Signalized Intersections	
LOS	Control Delay (sec/vehicle)
A	< 10
B	> 10-20
C	> 20-35
D	> 35-55
E	> 55-80
F	> 80

Source: Table 16 – Interstate 26 Widening Traffic Analysis Report

## V. Traffic Volumes

The traffic volumes used in the analysis for Exit 97 consisted of Existing (2016) conditions, and Future (2040) No-Build and Build conditions.

### Existing 2016 Traffic Volumes

Turning movement traffic count data was obtained for a number of ramp termini and other adjacent intersections within the Exit 97 interchange area from 7:00 to 9:00 AM and from 4:00 to 6:00 PM on Tuesday, August 23 2016. The turning movement count data, which are provided in **Appendix A**, included:

- US 176 & Center Food Lion Drive (right in/out)
- US 176 & North Food Lion Drive (full access/STOP controlled)
- US 176 & S-40-612 (W Shady Grove Road)
- S-40-385 Rauch-Metz Road & S-40-2805 (Broad Stone Road)

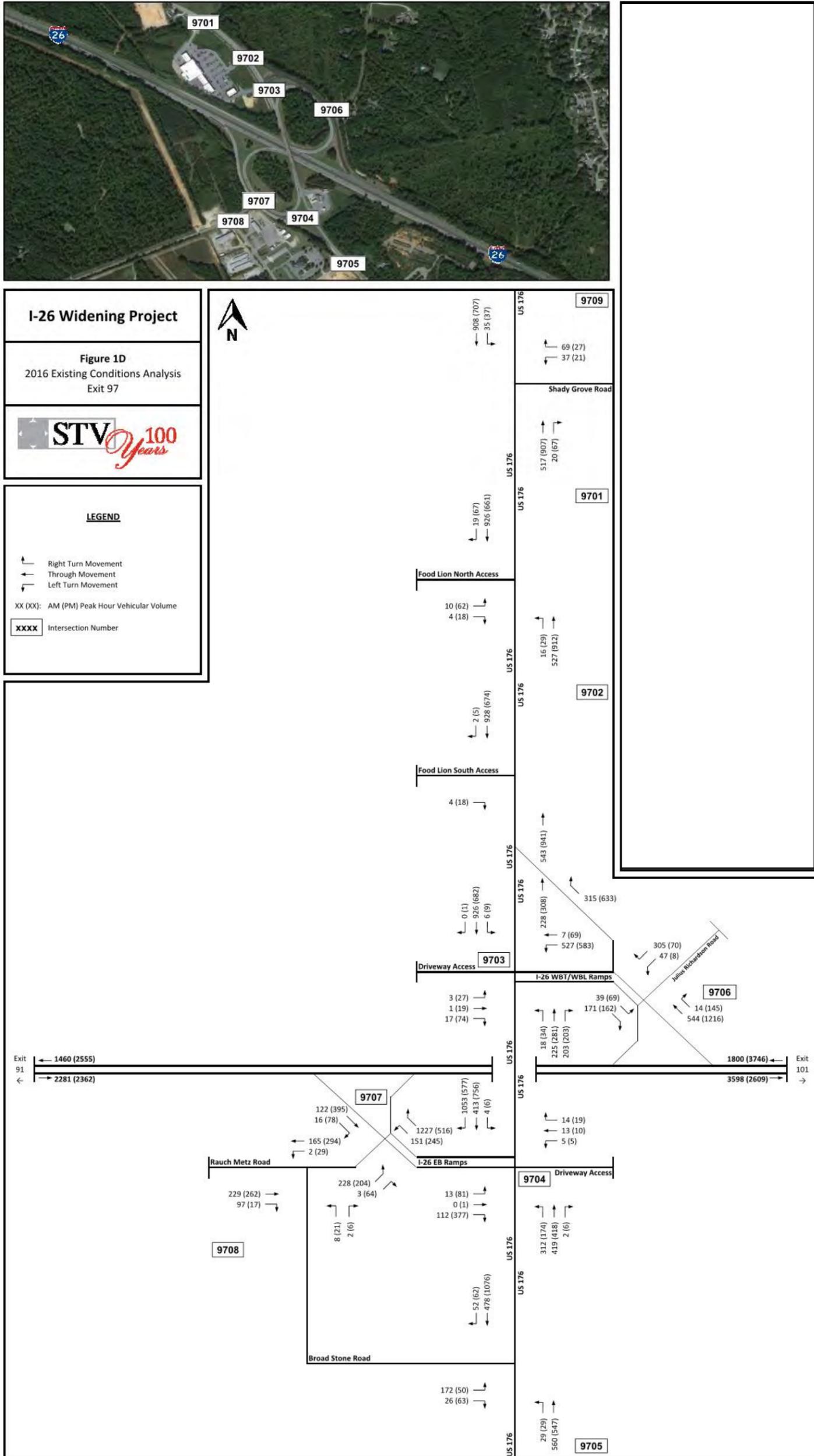
Turning movement counts were conducted for 12 hours between 7:00 AM and 7:00 PM on Tuesday, August 23 2016 at the following locations:

- US 176 & I-26 westbound ramps/Exxon Drive
- US 176 & I-26 eastbound ramps/South Food Lion Drive
- I-26 eastbound ramp & S-40-385 (Rauch-Metz Road)
- I-26 westbound ramp & S-40-2894 (Julius Richardson Road)
- US 176 & S-40-2805 (Broad Stone Road)
- S-40-385 Rauch-Metz Road & S-40-2805 (Broad Stone Road)

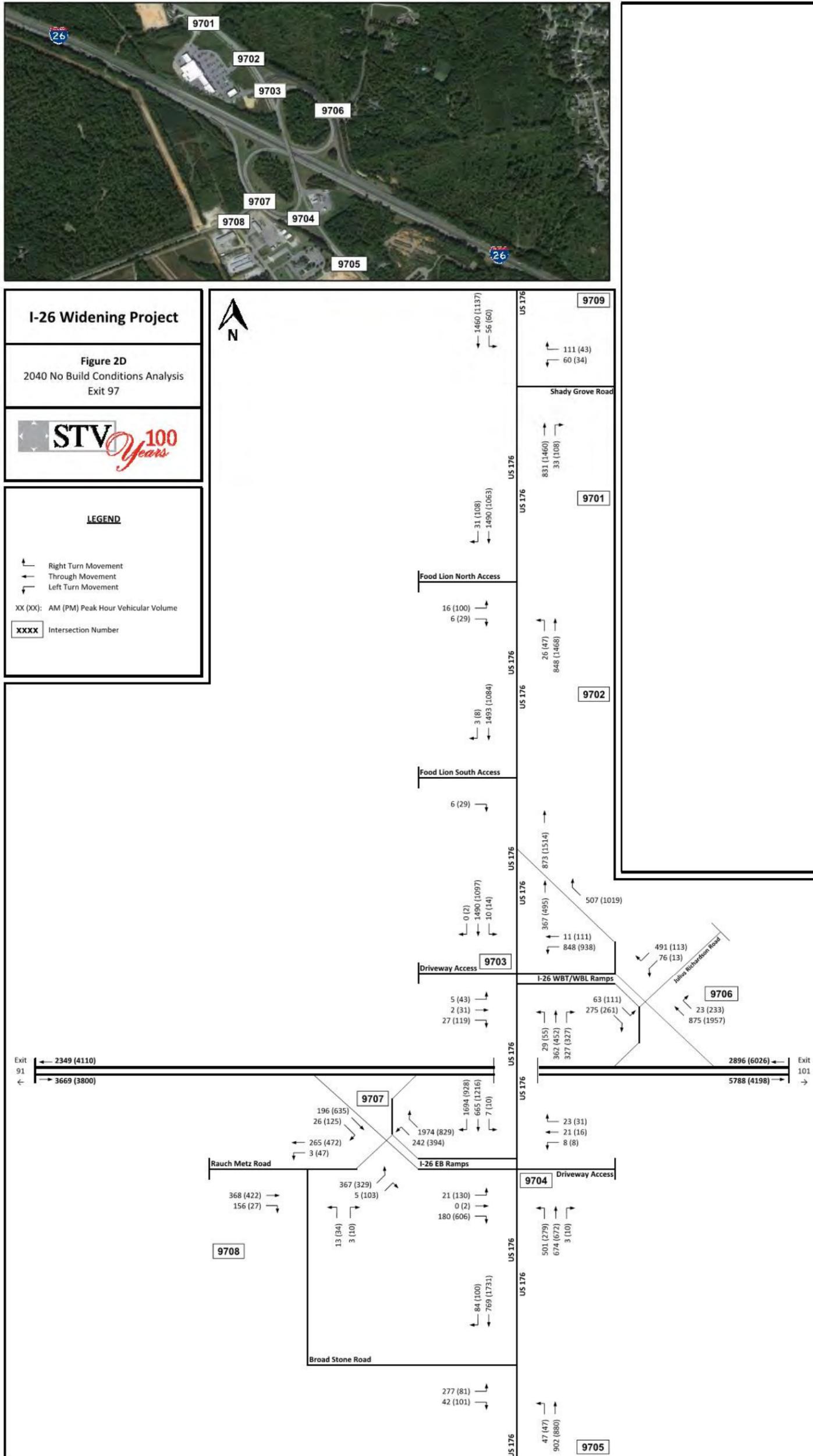
The turning movement traffic count data were evaluated and reviewed. The morning and afternoon peak hour volumes at each of the ramp termini and the adjacent intersections at each interchange were identified and were balanced between intersections. The balanced morning and afternoon peak hour volumes for the interchanges are shown in **Figure 15**.

### 2040 Traffic Volumes

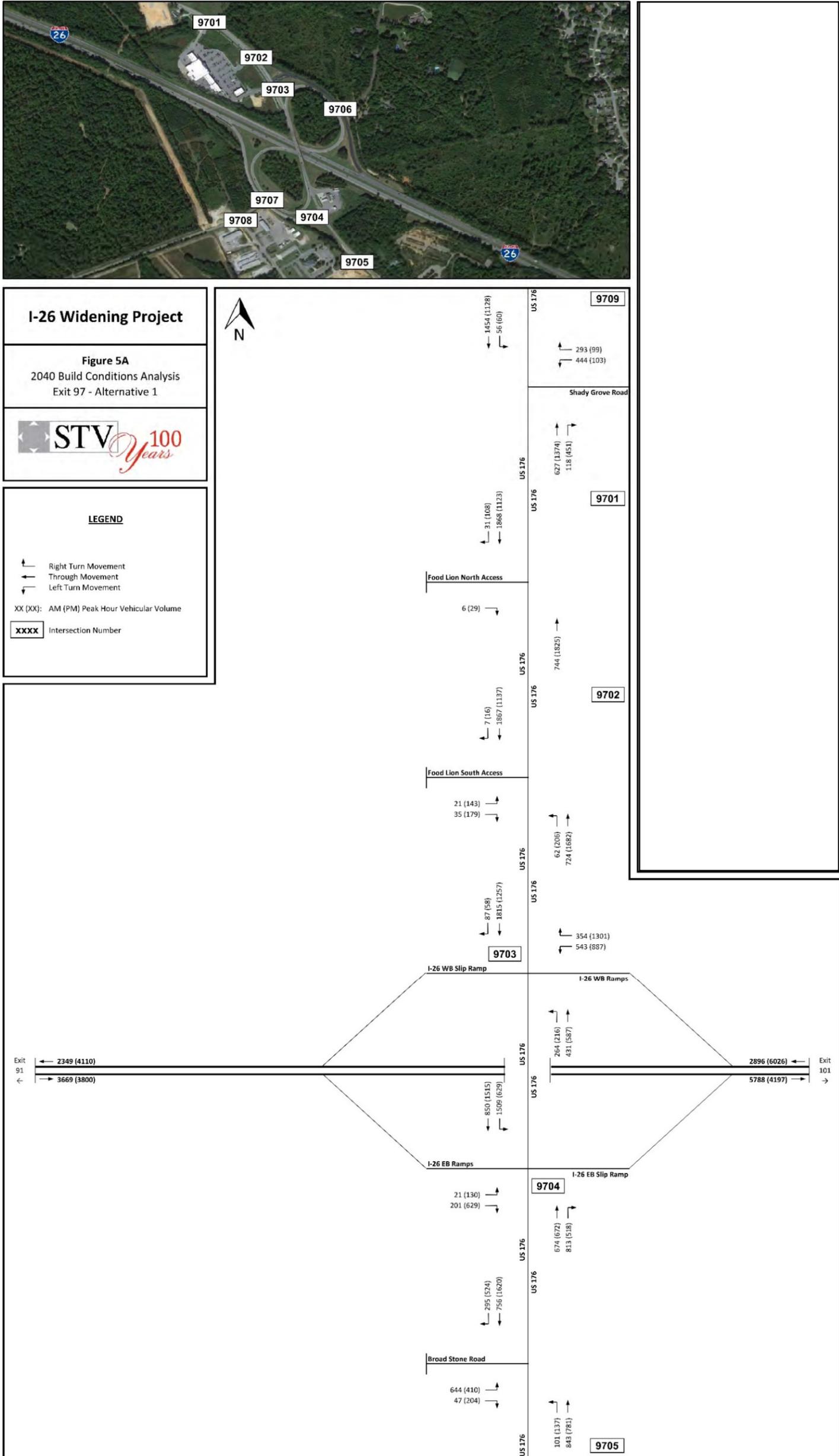
An annual growth rate of the study area of about 2.0 percent per year was applied to the freeway between Exits 91 and 101 to achieve balanced volumes through the corridor to achieve balanced volumes throughout the corridor. A similar rate was applied to the ramp traffic, and intersection turning movement volumes to develop projections of the 2040 No-Build Design Hour Traffic Volumes. The 2040 estimated peak hour turning movement volumes on the existing (No-Build) network at the Exit 97 interchange are shown in **Figure 16** and on the Preferred Alternative 1A in **Figure 17**.



Source: Figure 60, *Interstate 26 Widening Traffic Analysis Report*  
**Figure 15. Existing Peak Hour Turning Movement Volumes**



Source: Figure 66, Interstate 26 Widening Traffic Analysis Report  
Figure 16. 2040 Estimated No-Build Peak Hour Turning Movement Volumes



Source: Figure 93, Interstate 26 Widening Traffic Analysis Report  
Figure 17. 2040 Estimated Peak Hour Turning Movement Volumes Alternative 1

## VI. Traffic Operations

### Freeway and Ramp Merge/Diverge Segment Analysis

The analysis of basic freeway segments within the study area were performed for existing conditions (2016), future (2040) No-Build conditions and future (2040) Build conditions. The following criteria were identified through discussions with SCDOT and used for various inputs within the freeway segment analysis:

- The 10<sup>th</sup> highest hour volumes based on the P-0112 ATR count station data for the eastbound AM design hour, and the P-0015 ATR count station data for the eastbound PM and westbound AM and PM design hours, balanced through the system, were used for the freeway segment mainline volumes.
- To develop future (2040) traffic volumes, a growth rate of 2.0 percent was applied to existing volumes from US 176 (Broad River Road) to east of SC 202.
- A peak hour factor of 0.90 was used for freeway segments and ramp areas.
- The proportion of trucks and buses traveling on the freeway segments and ramp movements, based on SCDOT data, is 23 percent.
- Based on the grades through the study area, the terrain was selected as “Rolling”, instead of “Level” or “Mountainous”.
- Free-flow speed was set at the posted speed limit along the segment.

The existing conditions and 2040 No-Build conditions analyses were performed using the existing number of freeway lanes present on the segments within the study area. The 2040 Build conditions analyses were performed assuming I-26 would provide three lanes in each direction from Exit 85 to Exit 101 and four lanes in each direction from Exit 101 to Exit 102. In addition, analysis results indicated that four lanes were needed between exits 97 and 101 and five lanes between exits 101 and 102 due to inadequate LOS. The Basic Freeway Segment Analysis outputs are provided in **Appendix B** and are shown in **Table 7**. The results of the ramp merge and diverge analysis for Exit 97 are shown in **Table 8** and **Table 9** respectively.

**Table 7 - Freeway Segment Capacity Analysis Results**

Basic Freeway Segment Analysis Results															
Direction	Segment	Existing # of lanes	Future # of lanes	AM Peak Hour						PM Peak Hour					
				2016 Existing		2040 No-Build		2040 Build		2016 Existing		2040 No-Build		2040 Build	
				LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density
WB	Exit 101-97	2	4	C	19.3	E	36.5	B <sup>2</sup>	15.5	F	46.5	F	n/a	D <sup>2</sup>	30.9
WB	Exit 97-91	2	3	B	15.6	D	26.4	B	16.7	C	24.6	F	59.4	D	26.9
EB	Exit 91-97	2	3	C	23.6	F	54.1	C	25.8	C	22.9	F	50.9	C	25.0
EB	Exit 97-101	2	4	F	51.4	F	n/a	D <sup>2</sup>	33.0	D	26.0	F	68.7	C <sup>2</sup>	20.1

<sup>1</sup> - Weaving section treated as freeway segment

<sup>2</sup> - Widened to four lanes

**Table 8 - Ramp Merge Capacity Analysis Results**

Freeway Merge Analysis Results													
Direction	Merge Location	AM Peak Hour						PM Peak Hour					
		2016 Existing		2040 No-Build		2040 Build		2016 Existing		2040 No-Build		2040 Build	
		LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density
WB	Exit 97 Loop	B	13.1	C	23.2	B	14.3	C	22.0	F	40.3	C	24.4
EB	Exit 97 Loop	D	32.5	F	54.6	F <sup>1</sup>	40.2	C	21.7	F	37.3	C	25.3

<sup>1</sup> - Requires four lanes on mainline to achieve acceptable LOS (D, 31.9)

**Table 9 - Ramp Diverge Capacity Analysis Results**

Freeway Diverge Analysis Results													
Direction	Diverge Location	AM Peak Hour						PM Peak Hour					
		2016 Existing		2040 No-Build		2040 Build		2016 Existing		2040 No-Build		2040 Build	
		LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density	LOS	Density
WB	Exit 97	B	16.5	D	30.6	B	19.9	F	35.2	F	60.7	F <sup>3</sup>	35.8
EB	Exit 97	C	23.2	F	40.0	C	24.4	C	22.5	F	39.0	C	26.6

<sup>3</sup> - Two lane off-ramp, four lane freeway segment required to achieve acceptable LOS (B, 12.6)

The analysis results for the freeway segments in the westbound and in the eastbound direction between Exit 91 and Exit 101 for the 2016 Existing Conditions, summarized in **Table 7**, indicate the following:

- During the morning peak hour, the freeway segments operate at LOS C or better except the eastbound segment between Exit 97-101 that operates at LOS F;
- During the afternoon peak hour, the freeway segments operate at LOS D or better except the westbound Exit 101-97 that operates at LOS F.

With traffic volumes projected to increase within the vicinity of Exit 97 at an annual rate of about 2.0 percent per year, and if I-26 is not widened, the increased traffic volumes traveling on the existing interstate capacity will result in increased density and reductions of freeway segment LOS.

- During the 2040 No-Build morning peak hour the westbound freeway segment between Exit 97 and Exit 91 operates at LOS D. The remaining segments operate at LOS E or LOS F;
- During the 2040 No-Build afternoon peak hour all freeway segments will operate at LOS F.

The additional capacity provided by the construction of one more lane in each direction between Exits 91 and 97, and two more lanes in each direction between Exit 97 and Exit 101, will result in an improved LOS compared to the 2040 No-Build conditions and to the Existing Conditions. The 2040 Build analysis results indicate that:

- During the morning peak hour, the freeway segments operate at LOS D or better;
- During the afternoon peak hour, the freeway segments operate at LOS D or better.

The Ramp Merge Analyses outputs are provided in **Appendix C** and the summary analysis results for the ramp merge areas are shown in **Table 8**. The analysis results for the ramp merge areas indicate the following:

Using the design hour volumes for the morning and afternoon peak hours, the analysis results for the 2016 Existing Conditions indicate that:

- During the morning peak hour, all merge areas at Exit 97 operate at LOS D or better;
- During the afternoon peak hour, all merge areas at Exit 97 operate at LOS C.

With traffic volumes projected to increase on the merge ramps within the corridor at an annual rate of about 2.0 percent per year, and if I-26 is not widened, the increased traffic volumes

traveling on the existing merge ramps capacity will result in increased density and will reduce the LOS of merge areas.

- During the 2040 No-Build morning peak hour, the westbound loop on ramp merge at Exit 97 would operate at LOS C, while the eastbound Exit 97 loop on-ramp is expected to operate at LOS F;
- During the 2040 No-Build afternoon peak hour, both merge areas at Exit 97 operate at LOS F.

The additional capacity provided by the construction of one in each direction along I-26 from Exit between Exit 91 and Exit 97, and two lanes in each direction between Exit 97 to Exit 101 will lower densities in the ramp merge areas, and result in comparable LOS compared to the Existing Conditions, and improved LOS over the 2040 No-Build condition in the afternoon peak hour.

- During the 2040 Build morning peak hour, the Exit 97 merge areas would operate at LOS D or better if the fourth lane is constructed between Exit 97 and Exit 91.
- During the 2040 Build afternoon peak hour, all merge areas at Exit 97 or adjacent to it are expected to operate at LOS C.

The Ramp Diverge Analyses are also provided in **Appendix C** and summaries of the results are shown in **Table 9**. The analysis results indicate the following:

Using the design hour volumes for the morning and afternoon peak hours, the analysis results for 2016 Existing Conditions indicate that:

- During the morning peak hour, the Exit 97 diverge areas operate at LOS C or better;
- During the afternoon peak hour, the Exit 97 eastbound diverge area operates at LOS C and the westbound diverge area operates at LOS F.

With traffic volumes projected to increase within the corridor at an annual rate of 2.0 percent per year, and if I-26 is not widened, the increased traffic volumes traveling on the existing exit ramps will experience increased density and will reduce the diverge area LOS at the off-ramps.

- During the 2040 No-Build morning peak hour, the westbound off-ramp at Exit 97 will operate at LOS D and the eastbound off ramp at Exit 97 will operate at LOS F;
- During the 2040 No-Build afternoon peak hour the eastbound and westbound diverge areas at Exit 97 will operate at LOS F.

The additional capacity provided by the construction of a third lane in each direction along I-26 between Exit 91 and 97, and up to four lanes between Exits 97 and 101 will lower densities in the

ramp diverge areas, resulting in an improvement in LOS compared to the 2040 No-Build condition and comparable to 2016 Existing conditions. The 2040 Build analysis results indicate that:

- During the morning peak hour, the Exit 97 diverge areas are projected to operate at LOS C or better;
- During the afternoon peak hour, the Exit 97 westbound diverge area is projected to operate at LOS B if the fourth lane is constructed between Exit 97 and Exit 91. The eastbound diverge area is expected to operate at LOS C.

### Existing and 2040 No Build Intersection Analysis

Capacity analyses for the signalized and unsignalized intersections at the interchanges within the study area were performed. Analyses were performed for existing conditions (existing traffic, intersection traffic control and geometry), 2040 No-Build conditions (2040 traffic, and existing intersection traffic control and geometry), and 2040 Build conditions (2040 traffic and modified intersection traffic control and geometry).

For unsignalized intersections, the intersection operation is represented by the worst approach delay and LOS of all the STOP sign controlled approaches to the intersection. For signalized intersections, the intersection operation is represented by the intersection delay and LOS.

The results of the unsignalized and signalized intersection capacity analyses for existing conditions and the 2040 No-Build conditions are shown in **Table 10** and **Figure 18**. The HCM intersection capacity outputs for each intersection are provided in **Appendix D**.

Under the existing conditions at Exit 97, atypical intersection configurations at several locations and heavy volumes lead to several intersections operating at LOS E or F in both peak hours. These intersections include:

- Broad River Road at Food Lion North Access,
- Broad River Road at Broad Stone Road,
- I-26 WB Ramps at Julius Richardson Road, and
- I-26 EB Ramps at Rauch-Metz Road.

*For the intersections identified above, several improvements may be necessary to provide acceptable LOS under existing conditions, such as installing a new traffic signals on Broad River Road at Food Lion North Access and at Broad Stone Road*

In general, with the forecasted increases in traffic and without improvements to the intersections, delay in the 2040 No-Build analyses can be expected to be higher than delay during the Existing Conditions analyses. In some cases, the increases in delay may still result in

acceptable LOS being obtained. In other cases, the increases in delay may result in LOS E or LOS F conditions. When these results occur, it may be necessary to provide additional capacity (such as constructing separating left and/or right turn lanes) and/or changes in the traffic control (such as installing traffic signals) to reduce delay and improve the LOS.

Under the 2040 No-Build conditions with the forecasted increases in traffic, delay can be expected to increase on the intersection approaches. Additional intersections are expected to operate at LOS E or F in the morning and afternoon peak hours, in addition to those described in existing conditions, including Broad River Road at I-26 westbound right turn Slip Ramp, and Broad River Road at I-26 westbound ramp. However, due to unprocessed volume from upstream queuing, the No-Build conditions may appear better than the Existing conditions in some locations.

The operation of the intersections on Broad River Road at the I-26 WB Ramps may require capacity or traffic control improvements, such as an additional through lane on Broad River Road in both directions, to provide acceptable LOS during the 2040 No-Build operating conditions.

The analysis results for the existing and 2040 No-Build conditions at Exit 97 for the Broad River Road (US 176) interchange intersections are illustrated in **Figure 18**.

#### 2040 Build Intersection Analysis – Preferred Alternative (Alternative 1)

The Broad River Road (US 176) interchange is expected to be modified as part of the I-26 widening project. The 2040 Build analyses for the intersections within the Exit 97 interchange area were performed for three alternatives in the I-26 Mainline Study.

Alternative 1, which replaces the existing Exit 97 interchange with a diverging diamond interchange, was selected as the Preferred Alternative. Other elements of the alternative concept include:

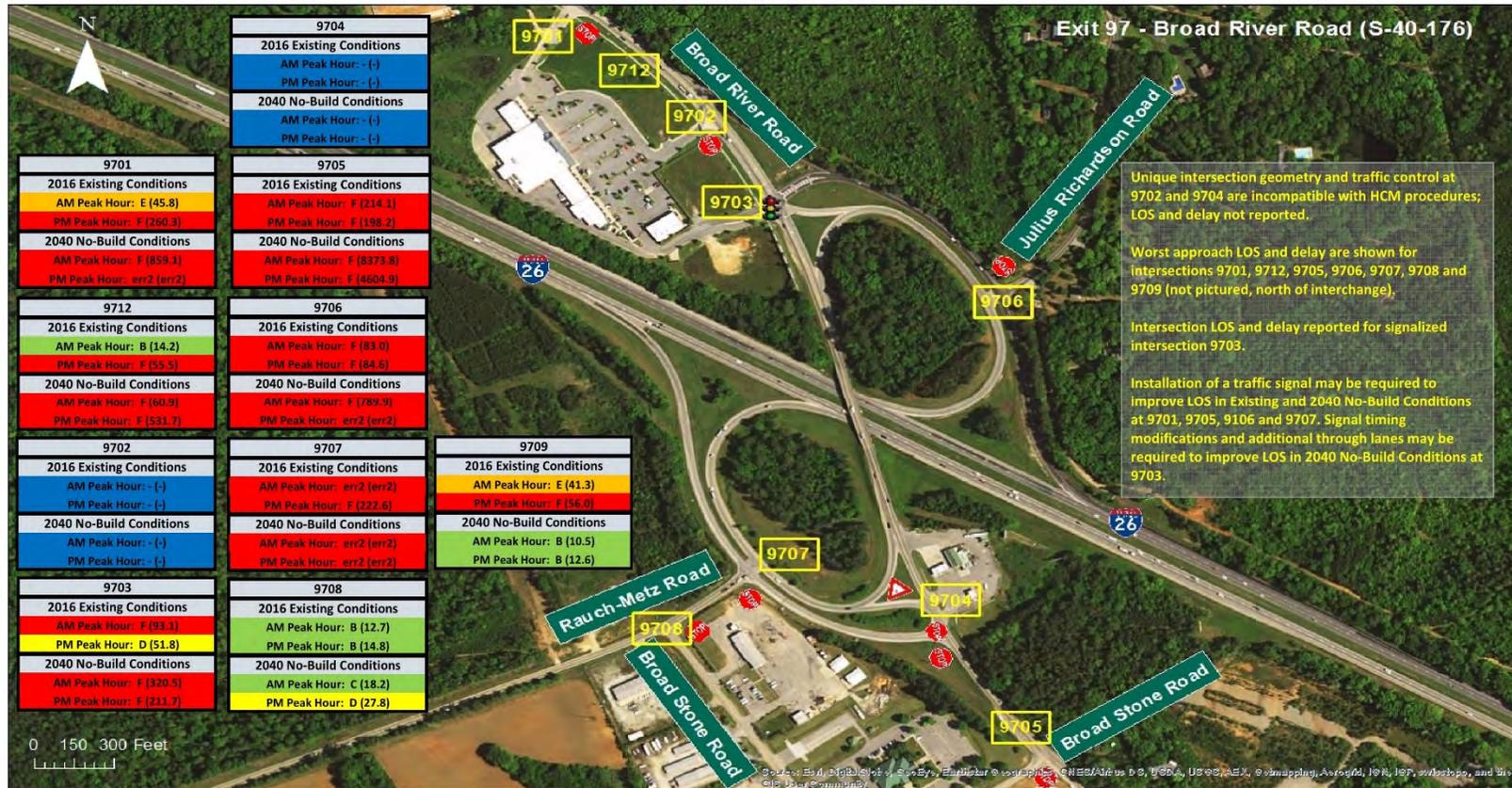
- Shifting Julius Richardson Road traffic to West Shady Grove Road
- Shifting Rauch-Metz Road traffic to Broad Stone Road
- Eliminate the existing intersection of Broad River Road and the I-26 westbound ramps/shopping center access
- Widen Broad River Road between Broad Stone Road and the Food Lion North Access

**Table 10 - Intersection Capacity Analysis Results**

Intersection #	Intersection Name	2016 Existing Conditions				2040 No Build Conditions			
		AM Peak		PM Peak		AM Peak		PM Peak	
		LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)
<b>Exit 97</b>									
9701	Broad River Road (US 176) at Food Lion North Access <sup>1</sup>	E	45.8	F	260.3	F	859.1	err <sup>2</sup>	err <sup>2</sup>
9702	Broad River Road (US 176) at Food Lion South Access	incompatible with HCM 2000 due to free movements							
9712	Broad River Road (US 176) at I-26 WBR Slip Ramp <sup>1</sup>	B	14.2	F	55.5	F	60.9	F	531.7
9703	Broad River Road (US 176) at I-26 WBT / WBL Ramps	F	93.1	D	51.8	F	320.5	F	211.7
9704	Broad River Road (US 176) at I-26 EB Ramps	incompatible with HCM 2000 due to five-legged intersection							
9705	Broad River Road (US 176) at Broad Stone Road	F	214.1	F	198.2	F	8,373.8	F	4,604.9
9706	I-26 WB Ramps at Julius Richardson Road <sup>1</sup>	F	83.0	F	84.6	F	789.9	err <sup>2</sup>	err <sup>2</sup>
9707	I-26 EB Ramps at Rauch-Metz Road <sup>1</sup>	err <sup>2</sup>	err <sup>2</sup>	F	222.6	err <sup>2</sup>	err <sup>2</sup>	err <sup>2</sup>	err <sup>2</sup>
9708	Rauch-Metz Road at Broad Stone Road <sup>1</sup>	B	12.7	B	14.8	C	18.2	D	27.8
9709	Broad River Road (US 176) at Shady Grove Road <sup>1</sup>	E	41.3	F	56.0	B	10.5	B	12.6
<sup>1</sup> Intersection unsignalized under all scenarios; worst approach LOS and delay reported. <sup>2</sup> Queue unable to be processed per HCM 2000 methodology; error reported. <sup>3</sup> Values from Interchange Modification Report: I-26 at S-48 (Columbia Avenue) Interchange Improvements.									

Source: Table 21 – Interstate 26 Widening Traffic Analysis Report

Capacity analyses for the signalized and unsignalized intersections of the Preferred Alternative were performed for the 2040 Build conditions which included the 2040 traffic volumes and modified intersection traffic control and geometry to the interchange at Exit 97. The traffic operations analysis of the Preferred Alternative identified areas where traffic control improvements were projected to be needed to provide acceptable operating LOS. The results of the unsignalized and signalized intersection capacity analyses for the 2040 Build Preferred Alternative (with and without additional improvements) are shown in **Table 11**. **Table 12** also summarizes the storage length and queuing for 2040 Build Conditions. The conceptual design of Alternative 1 for the Broad River Road (US 176) interchange intersections and the results of the capacity analyses (with additional improvements) are illustrated in **Figure 19**.



Source: Figure 76, Interstate 26 Widening Traffic Analysis Report  
Figure 18. Exit 97 – Broad River Road (US 176) Interchange Intersection LOS Summary

**Table 11- Intersection Capacity Analysis Results - 2040 Base vs 2040 Build Exit 97**

Intersection #	Intersection Name	2040 No Build Conditions				2040 Build Conditions				2040 Build Conditions with Improvements			
		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
		LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)
<b>Alternative 1: DDI</b>													
9701	Broad River Road (US 176) at Food Lion North Access <sup>1</sup>	F	859.1	err <sup>2</sup>	err <sup>2</sup>	C	21.5	B	14.9	C	21.5	B	14.9
9702	Broad River Road (US 176) at Food Lion South Access <sup>3</sup>	incompatible with HCM 2000 due to free movements				F	611.4	err <sup>5</sup>	err <sup>5</sup>	A	7.4	B	14.2
9712	Broad River Road (US 176) at I-26 WBR Slip Ramp <sup>1</sup>	F	60.9	F	531.7	intersection removed; shifted to 9713							
9703	Broad River Road (US 176) at I-26 WBT/WBL Ramps	F	320.5	F	211.7	B	16.6	C	21.1	B	10.3	B	10.8
9704	Broad River Road (US 176) at I-26 EB Ramps <sup>2</sup>	incompatible with HCM 2000 due to five-legged intersection				C	21.8	C	22.5	B	17.3	C	24.1
9705	Broad River Road (US 176) at Broad Stone Road <sup>3</sup>	F	8,373.8	F	4,604.9	F	9,323.3	err <sup>5</sup>	err <sup>5</sup>	B	15.3	B	19.3
9706	I-26 WB Ramps at Julius Richardson Road <sup>1</sup>	F	789.9	err <sup>2</sup>	err <sup>2</sup>	intersection removed; shifted to 9709							
9707	I-26 EB Ramps at Rauch-Metz Road <sup>1</sup>	err2	err2	err2	err2	intersection removed; shifted to 9705							
9708	Rauch-Metz Road at Broad Stone Road <sup>1</sup>	C	18.2	D	27.8	free-flow under Build Conditions							
9709	Broad River Road (US 176) at Shady Grove Road <sup>3</sup>	B	10.5	B	12.6	F	6,032.1	F	5,129.5	C	26.7	C	29.9
9713	Broad River Road (US 176) at I-26 WBR Slip Ramp	added under Build Conditions				B	14.7	F	541.8	A	1.8	B	10.8
9714	Broad River Road (US 176) at I-26 EBR Slip Ramp <sup>4</sup>					C	16.2	F	601.8	A	0.0	A	0.0
9723	Broad River Road (US 176) at I-26 WBL Slip Ramp					B	14.7	B	14.0	B	14.6	B	18.5
9724	Broad River Road (US 176) at I-26 EBL Slip Ramp <sup>1</sup>					B	11.2	B	12.8	B	11.2	B	12.8
<sup>1</sup> Intersection unsignalized under all scenarios; worst approach LOS and delay reported. <sup>2</sup> Intersection signalized under 2040 Build Conditions; otherwise, worst approach LOS and delay reported. <sup>3</sup> Intersection signalized under 2040 Build Conditions with Improvements; otherwise, worst approach LOS and delay reported. <sup>4</sup> Lane added and YIELD control removed under 2040 Build Conditions with Improvements; zero delay reported per HCM 2000 methodology. <sup>5</sup> Delay unable to be processed per HCM 2000 methodology; error reported.													

Source: Table 23 – Interstate 26 Widening Traffic Analysis Report

Table 12 - 2040 Build Intersection Queue Lengths Exit 97

Intersection #	Intersection Name	Movement			95th Percentile Queue Length (ft)						Available Storage Length (ft)		
		2040 No Build Conditions	2040 Build Conditions	2040 Build Conditions w/ Improvements	2040 No Build Conditions		2040 Build Conditions		2040 Build Conditions w/ Improvements		2040 No Build	2040 Build	2040 Build Conditions w/ Improvements
					AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak			
<b>Alternative 1: DDI</b>													
9701	Broad River Road (US 176) at Food Lion North Access	NBL	-	-	25	0	-	-	-	-	250	-	-
		NBT <sup>1</sup>	NBT	NBT	0	0	0	0	0	0	525	525	525
		SBT <sup>1</sup>	SBTR	SBTR	0	0	0	0	0	0	1,700	1,700	1,700
		SBR			0	0	0	0	0	250			
		EBLR	-	-	100	err <sup>1</sup>	-	-	-	-	-	-	-
EBR	-	-	-	-	0	0	0	0	-	-	-		
9702	Broad River Road (US 176) at Food Lion South Access	-	NBL	NBL	incompatible with HCM 2000 due to free movements	25	50	25 <sup>m</sup>	75 <sup>m</sup>	-	325	325	
		-	NBT	NBT		0	0	25	300 <sup>m</sup>	350	675	675	
		-	SBT <sup>1</sup>	SBTR		SBTR	0	0	775 <sup>g</sup>	250	525	525	
		-	SBR <sup>1</sup>	-		-	175	err <sup>2</sup>	25	150 <sup>g</sup>	-	-	
		-	EBLR	EBL		-	-	25	50	-	-	-	
9703	Broad River Road (US 176) at I-26 WBT/WBL Ramps	NBL	-	-	25	75	-	-	-	-	400	-	-
		NBT	NBT	NBT	300	400	75 <sup>g</sup>	100	150 <sup>g</sup>	125	400	550	550
		SBL	-	-	25	25	-	-	-	-	350	-	-
		SBTR	SAT	SBT	2,875 <sup>g</sup>	2,100 <sup>g</sup>	525	400	50	25	350	650	650
9704	Broad River Road (US 176) at I-26 EB Ramps	NBLTR	NBT	NBT	incompatible with HCM 2000 due to five-legged intersection		250	275	200	200 <sup>m</sup>	525	875	875
		SBLT	SBT	SBT	200 <sup>m</sup>	400	300 <sup>m</sup>	550 <sup>m</sup>	1,425	550	550		
9705	Broad River Road (US 176) at Broad Stone Road	NBLT	NBL	NBL	0	25	25	150	50	100 <sup>g</sup>	500	150	150
		-	NBT	NBT	0	0	0	0	225	100	500	500	
		-	SBT	SBT	0	0	0	0	100	650 <sup>g</sup>	525	725	875
		-	SBR <sup>g</sup>	SBR	0	0	0	0	0	0	100	725	725
		-	EBL	EBL	err <sup>3</sup>	err <sup>3</sup>	err <sup>3</sup>	err <sup>3</sup>	225	225 <sup>m</sup>	-	-	-
9709	Broad River Road (US 176) at Shady Grove Road	EBR	EBR	EBR	25	325	25	err <sup>3</sup>	25	100	250	250	250
		NBTR	NBT	NBT	0	0	0	0	525	1,225 <sup>g</sup>	1,700	2,225	2,225
		-	NBR	NBR	0	0	0	0	75	50		2,225	2,225
		SBLT	SBL	SBL	0	25	0	25	50	75 <sup>g</sup>	2,150	100	100
		-	SBT	SBT	0	0	0	0	550 <sup>g</sup>	125		2,150	2,150
9713	Broad River Road (US 176) at I-26 WBR Slip Ramp	WBLR	WBL	WBL	err <sup>1</sup>	err <sup>1</sup>	err <sup>3</sup>	err <sup>3</sup>	425 <sup>g</sup>	150 <sup>g</sup>	-	100	100
		-	WBR	WBR	150	125	125	75	-	-	-	-	
9714	Broad River Road (US 176) at I-26 EBR Slip Ramp	added under Build Conditions	WBR <sup>1</sup>	WBR <sup>1</sup>	added under Build Conditions	added under Build Conditions	75	2,550	50	525 <sup>g</sup>	added under Build Conditions	1,300	1,300
9723	Broad River Road (US 176) at I-26 WBL Slip Ramp	added under Build Conditions	EBR <sup>1</sup>	EBR <sup>1,2</sup>	added under Build Conditions	added under Build Conditions	50	1,350	0	0	added under Build Conditions	1,400	1,400
9724	Broad River Road (US 176) at I-26 EBL Slip Ramp	added under Build Conditions	WBL <sup>1</sup>	WBL <sup>1</sup>	added under Build Conditions	added under Build Conditions	275 <sup>g</sup>	325	275 <sup>g</sup>	375 <sup>g</sup>	added under Build Conditions	1,200	1,200
		added under Build Conditions	EBR <sup>1</sup>	EBR <sup>1</sup>	added under Build Conditions	added under Build Conditions	0	25	0	25	added under Build Conditions	1,500	1,500

<sup>1</sup> Storage length measured to I-26 diverge point.  
<sup>2</sup> Lane added and YIELD control removed under 2040 Build Conditions with Improvements; zero queue reported per HCM 2000 methodology.  
<sup>3</sup> Queue unable to be processed per HCM 2000 methodology; error reported.  
<sup>g</sup> 95th-percentile volume exceeds capacity, queue may be longer.  
<sup>m</sup> Volume for 95th-percentile queue is metered by upstream signal.

Source: Table 25, Interstate 26 Widening Traffic Analysis Report

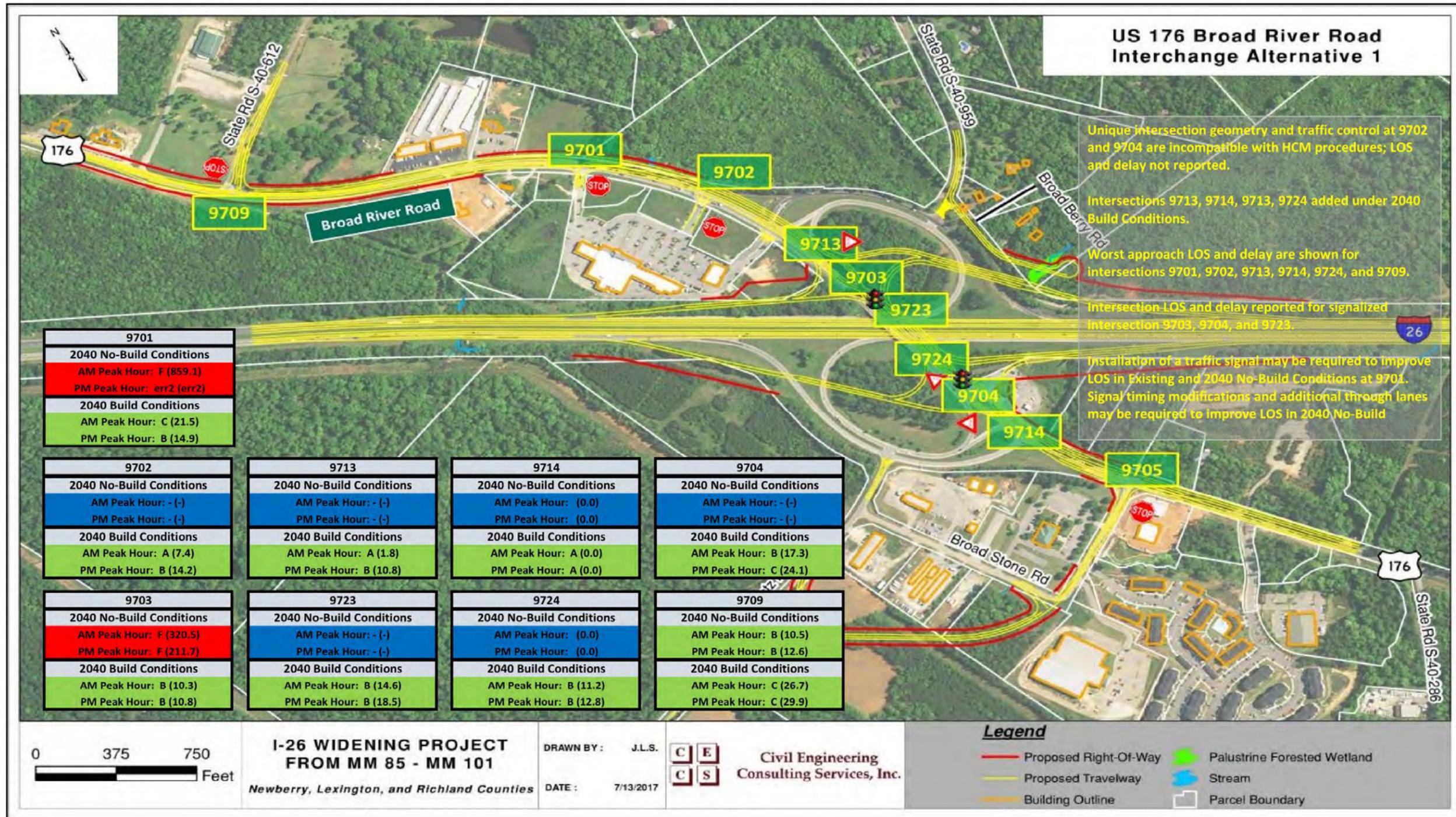


Figure 19. Exit 97 – Broad River Road (US 176) Preferred Alternative

## TransModeler Network Analysis

TransModeler, a microsimulation software, was used to analyze the Existing, No-Build, and Build alternative freeway networks. A TransModeler microsimulation model consists of a large amount of component database and executable files that are run through the TransModeler software. The model then is initiated within TransModeler through a single project file. The main components of the model are network files, traffic control and signal timing plans, vehicle detector layout and configuration, trip tables for both autos and trucks, traffic counts, and parameter files. This section illustrates how to develop these main components for creating a base year model of existing conditions. The microsimulation model was developed for the 20-mile interstate section of the project and was based on a calibrated base model for the area.

There are several limitations of using HCS, which is a macroscopic, deterministic model that uses HCM methodologies. The HCS analysis may show differing conditions than existing operations and conditions in the field because it does not consider upstream and downstream traffic impacts and is unable to model interactions between the two. The HCS model is a spot check at a certain location; therefore upstream and downstream operations are not taken into consideration and have no effect on the analyses. This is not the case for actual conditions, as upstream or downstream congestion may have direct impacts at a specific segment causing a ripple effect. TransModeler evaluates each segment and lane by taking into consideration vehicle interaction and driver behaviors, as well as the operational impacts for both the upstream and downstream traffic conditions.

The existing conditions and 2040 No-Build conditions TransModeler analysis was performed using the existing number of freeway lanes present on the segments within the study area, similar to the HCS analysis. Therefore, the same TransModeler simulation network was used for existing and No-Build conditions. The only difference between the existing and No-Build condition is the input trip table volumes and a proposed widening project along Broad River Road. The 2040 No-Build conditions volumes were developed using the growth rates determined based on discussions with SCDOT. It was determined that a growth rate of 1.5 percent would be used from the east end of the study area to east of US 176 (Broad River Road), 2.0 percent would be used from US 176 (Broad River Road) to the east of SC 202, and a growth rate of 2.5 percent would be used from SC 202 to the west. The existing truck percentages for the model were developed utilizing classification counts along the mainline along with intersection counts along the arterials. These inputs were combined to develop an Origin-Destination (OD) matrix for both medium and heavy trucks. These truck volumes were then scaled up to 2040 volumes by the same proportions as the overall volume growth.

The 2040 Build AM and PM TransModeler models for the 20-mile study area of I-26 were developed by modifying the 2040 No-Build models to incorporate the widening of I-26 in each direction as well as the Preferred Alternatives for each interchange. Synchro was used to input the recommended traffic signal timing information into the network for the arterial intersections. Each simulation was run for one hour with 30 minutes of seeding time to load the network. 10 repetitions were used for both the AM and PM peak periods.

The Basic Freeway Segment Analysis outputs for the existing conditions, 2040 No-Build conditions, and the Preferred Alternative conditions are in **Appendix E** and a summary of results are shown in **Table 13**.

The widening of I-26 through Exit 97 is necessary to accommodate the projected increase in traffic volume within the corridor. This widening will result in segment densities adjacent to Exit 97 in the 2040 Build condition being comparable to those in existing conditions.

The analysis results for the freeway segment analysis for the Existing Conditions, summarized in **Table 13**, indicate the following:

- During the morning peak hour, the eastbound segment from Exit 97 to Exit 101 operates at an LOS E, the other freeway segments operate at LOS C;
- During the afternoon peak hour, the westbound segment from Exit 101 to Exit 97 operates at LOS F and the other freeway segments operate at LOS D or better.

With traffic volumes projected to increase within the corridor at an annual rate of approximately 2.0 percent per year, and if I-26 is not widened, the increased volumes traveling on the existing interstate during the 2040 No-Build conditions will result in increased density and reductions of freeway segment LOS. However, due to unprocessed volume from upstream queuing, the No-Build conditions may appear better than the Existing conditions in some locations.

- During the 2040 No-Build morning peak hour, the westbound segment from Exit 97 to 91 is expected to operate at an LOS E. All other segments are expected to operate at LOS D or better.
- During the 2040 No-Build afternoon peak hour, the eastbound segment from Exit 91 to 97 and the westbound segment from Exit 101 to Exit 97 are expected to operate at an LOS F. All other segments are expected to operate at LOS C.

The additional capacity provided by the construction of a third in each direction along I-26 between Exit 85 and Exit 97 and a third and fourth lane in each direction along I-26 between Exit 97 and Exit 101 (the fourth lane was determined to be necessary based on the HCS analysis) will result in substantial improvement in LOS compared to the 2040 No-

Build condition, with LOS comparable to those experienced under existing conditions. The 2040 Build analysis results indicate that:

- During the morning peak hour, the eastbound segment from Exit 97 to Exit 101 is expected to operate at an LOS D. All other freeway segments operate at LOS C;
- During the afternoon peak hour, the westbound segment from Exit 101 to Exit 97 is expected to operate at LOS D and other all freeway segments operate at LOS C.

The summary of the Ramp Merge Analyses results for the Build condition, compared to the Existing and No-Build conditions are shown in **Table 14**. The outputs for the Build condition analyses are provided in **Appendix F**.

The widening of I-26 through Exit 97 to accommodate the projected increase in traffic volume within the corridor. This widening will result in the Exit 97 merge areas in the 2040 Build condition having densities comparable to those in existing conditions.

The analysis results for the ramp merge areas, summarized in **Table 14**, indicate the following:

Using the design hour volumes for the morning and afternoon peak hours, the analysis results for the Existing conditions indicate that:

- During the morning peak hour, the Exit 97 eastbound loop on-ramp merge area operates at LOS E, and westbound loop on-ramp merge area operate at LOS B;
- During the afternoon peak hour, the Exit 97 eastbound and westbound ramp merge areas operate at LOS C.

With traffic volumes projected to increase within the corridor for 2040 No-Build conditions, and if I-26 is not widened, the increased traffic volumes will result in increased density and may reduce the merge area LOS. However, due to unprocessed volume from upstream queuing, the No-Build conditions may appear better than the Existing conditions in some locations.

- During the morning peak hour, the Exit 97 eastbound loop on-ramp merge area operates at LOS D and the westbound loop on-ramp merge area operates at LOS B;
- During the afternoon peak hour, the Exit 97 eastbound and westbound loop on-ramp merge areas operate at LOS B.

The additional capacity provided by the construction of a third lane in each direction west of Exit 97 and a fourth lane in each direction east of Exit 97 will reduce density and provide an improvement in LOS compared to the 2040 No-Build condition, with LOS comparable

to that experienced under existing conditions. The 2040 Build analysis results indicate that:

- During the morning peak hour, the Exit 97 eastbound merge ramp operates at LOS C and westbound ramp merge area operate at LOS B;
- During the afternoon peak hour, the Exit 97 eastbound and westbound ramp merge areas operate at LOS B.

The summary of the Ramp Diverge Analyses results for the Build condition, compared to the Existing and No-Build conditions are shown in

**Table 15.** The outputs for the Build condition analyses are also provided in **Appendix F**.

The widening of I-26 to three lanes to the west of Exit 97 and four lanes to the east of Exit 97 will result in the Exit 97 diverge areas in the 2040 Build condition having densities comparable to those in existing conditions.

The analysis results for the ramp diverge areas, summarized in

**Table 15**, indicate the following:

Using the design hour volumes for the morning and afternoon peak hours, the analysis results for the Existing conditions indicate that:

- During the morning peak hour, the Exit 97 eastbound and westbound ramp diverge areas operate at LOS B;
- During the afternoon peak hour, the Exit 97 eastbound ramp diverge operates at LOS B and the westbound ramp diverge areas operate at LOS E.

With traffic volumes projected to increase within the corridor for 2040 No-Build conditions, and if I-26 is not widened, the increased traffic volumes will result in higher density and lower LOS at the diverge areas.

- During the morning peak hour, the Exit 97 eastbound diverge area is expected to operate at an LOS E and the westbound ramp diverge area is expected to operate at LOS C;
- During the afternoon peak hour, the Exit 97 eastbound and westbound ramp diverge areas operate at LOS F.

The additional capacity provided by the construction of a third lane in each direction west of Exit 97 and a fourth lane in each direction east of Exit 97 will result in a reduction of density and an improvement in LOS compared to the 2040 No-Build condition, with LOS comparable to those experienced under existing conditions. The 2040 Build analysis results indicate that:

- During the morning peak hour, the Exit 97 eastbound and westbound ramp diverge areas operate at LOS C or better;
- During the afternoon peak hour, the Exit 97 eastbound diverge area is expected to operate at an LOS C and the westbound ramp diverge area is expected to operate at LOS E.

**Table 13: Basic Freeway Segment Analysis TransModeler Results**

Segment	Existing Conditions				2040 No Build Conditions				2040 Build Conditions			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>
<b>I-26 Eastbound</b>												
Exit 91 to Exit 97	C	23.2	C	23.7	C	21.7	F	78.2	C	21.1	C	21.8
Exit 97 to Exit 101	E	35.9	C	25.5	D	32.2	C	20.1	D	26.2	C	18.2
<b>I-26 Westbound</b>												
Exit 101 to Exit 97	C	22.2	F	54.7	D	31.5	F	115.3	B	15.1	D	26.5
Exit 97 to Exit 91	C	19.0	D	27.8	E	36.6	C	24.5	B	16.1	C	23.5

<sup>1</sup> Per Highway Capacity Manual 2010 criteria.  
<sup>2</sup> Density expressed as passenger cars/per mile/per lane.

Source: Table 32 – *Interstate 26 Widening Traffic Analysis Report*

**Table 14: Freeway Merge Analysis TransModeler Results**

Segment	Existing Conditions				2040 No Build Conditions				2040 Build Conditions			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>
<b>I-26 Eastbound</b>												
Exit 97 Loop	E	40.6	C	20.2	D	31.9	B	16.1	C	23.5	B	15.5
<b>I-26 Westbound</b>												
Exit 97 Loop	B	13.4	C	20.3	B	17.5	B	16.2	B	12.1	B	17.9

<sup>1</sup> Per Highway Capacity Manual 2010 criteria.  
<sup>2</sup> Density expressed as passenger cars/per mile/per lane.

Source: Table 33 – *Interstate 26 Widening Traffic Analysis Report*

**Table 15: Freeway Diverge Analysis TransModeler Results**

Segment	Existing Conditions				2040 No Build Conditions				2040 Build Conditions			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>	LOS <sup>1</sup>	Density <sup>2</sup>
I-26 Eastbound												
Exit 97	B	17.2	B	16.9	E	38.3	F	133.5	B	18.0	C	18.7
I-26 Westbound												
Exit 97	B	16.1	E	40.9	C	24.7	F	86.7	C	21.8	E	39.4

<sup>1</sup> Per Highway Capacity Manual 2010 criteria.

<sup>2</sup> Density expressed as passenger cars/per mile/per lane.

Source: Table 34 – *Interstate 16 Widening Traffic Analysis Report*

## VII. Interchange Justification

A policy statement for justifying the need for additional or modified access to the existing sections of an Interstate System was first published in the Federal Register on October 22, 1990 entitled “Access to the Interstate System”. It was then modified and updated on February 11, 1998, on August 27, 2009 and on May 22, 2017. The objectives of this policy are to ensure that all new or revised access points do not adversely impact the operations and safety of the Interstate System, and all new or revised access points have been vetted through a systematic evaluation process.

In order to explain the intent and requirements of this new policy, U. S. Department of Transportation Federal Highway Administration published a Memorandum on May 22, 2017. This FHWA Guide was followed in preparing the current Interchange Modification Report (IMR) for the I-26/Exit 97 Interchange in Richland County, South Carolina.

### Policy Point 1

**An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (23 CFR 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access should include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request should also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).**

The intent of the Policy Point 1 is to require detailed operational and safety analysis of the relevant interstate segments and provide a comparison of the no-build and build conditions that are anticipated to occur through the design year of the project.

The analysis of the interstate facility and Exit 97 is an extension of the previous project-wide traffic operations and safety analysis as summarized in the *I-26 Widening Traffic Analysis Report* and the *I-26 Widening Project MM 85 – MM 101 Traffic Safety Analysis Report*.

The analysis of the interstate facility includes the portion of I-26 between Columbia Avenue (S-32-48) interchange (Exit 91) and the Broad River Road (S-40-76, US 176) interchange (Exit 101), including the proposed modification of Broad River Road (US 176) interchange (Exit 97). The analysis was performed using methodologies and procedures outlined in the Transportation Research Board's *Highway Capacity Manual* and used the HCS-2010 analysis and TransModeler simulation model software.

The analysis of the 2040 Build condition of the Preferred Alternative (Alternative 1) illustrates that the project would not have any significant negative impact on the safety and the operation of the facilities within the project area. The analysis shows Interstate 26 mainline operations and ramp merge/diverge areas are estimated to operate at LOS D or better during the 2040 morning peak hour and LOS E or better during the 2040 afternoon peak hour. Without the proposed improvement, the freeway segments and ramp merge/diverge areas would operate between LOS C to LOS E during the 2040 No-Build morning peak hour, and between LOS B to LOS F during the 2040 No-Build afternoon peak hour.

Exit 91 (Columbia Avenue), the interchange adjacent to the west of Exit 97, is expected to be modified to provide a Diverging Diamond Interchange. The DDI concept was evaluated and selected as the Preferred Alternative in the *Interchange Modification Report, I-26 at S-48 (Columbia Avenue) Interchange Improvements*. Exit 101 (Broad River Road), the interchange adjacent to the east of Exit 97, is not expected to be modified as a part of this project.

Exit 91 - Columbia Avenue (S-32-48) - is located approximately 5.30 miles northwest of the Exit 97 interchange. Exit 101 - Broad River Road (S-40-76, US 176) – is located approximately 4.95 miles southeast of the Exit 97 interchange. With interchange spacing exceeding 3 miles to the next adjacent interchange from Exit 97, there are no anticipated operational concerns related to the spacing between interchanges. Sufficient distance exists between upstream and downstream merging/diverging areas at the adjacent interchanges to eliminate the influence of traffic movements within these areas, and analysis shows the freeway segments are projected to operate at LOS D or better.

The Accident Analysis Report identifies rear end collisions and no collision with motor vehicle as the most frequent types of crashes within the study area. The report also identifies driving too

fast for conditions as the main cause of rear end crashes. The presence of median barriers and guardrail fences are noted as the first harmful event for no collision with motor vehicle crashes. The Accident Analysis Report points out that the geometric conditions resulting from merge/diverge areas of loop ramps seem to play a role in the frequency of the crashes and that merging distance at on-ramps and diverging distances at off-ramps should be improved to SCDOT standards where these standards are not already met. Study area hot spots along the interchange arterials include frequent crashes at Exit 91 along Columbia Avenue at business driveways to the west of the eastbound off-ramp intersection. It is anticipated that access controls implements as part of the proposed Exit 91 DDI improvement will address these concerns.

Modifying the Exit 97 interchange to eliminate the loop ramps may also reduce crashes on the free segments and the merge areas adjacent to the loop ramps. Replacing the current ParClo interchange at Exit 97 with the proposed DDI, is anticipated to contribute to an improvement in traffic safety.

The preferred alternative of the Exit 97 interchange design also provides space for the construction of additional travel lanes in each direction along I-26. Altogether, these design provisions would enhance the operational efficiency and safety of the corridor, thereby increasing capacity and improving levels of service in the long term.

However, pedestrian facilities are not incorporated into the design due to the rural nature of the interchange area.

#### Policy Point 2

**The proposed access connects to a public road only and will provide for all traffic movements. Less than “full interchanges” may be considered on a case-by-case basis for applications requiring special access, such as managed lanes (e.g., transit, HOVs, HOT lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.**

The intent of the Policy Point 2 is to require implementation of an interchange design for the new access that allows for all relevant movements for general purpose traffic, whenever feasible.

The existing Broad River Road (US 176) interchange is a partial cloverleaf interchange that provides for all traffic movements. All of the ramps are located on the northeast and southwest sides of the interchange. Spacing between the existing ramps are short. In addition, Julius Richardson Road intersects the westbound ramps and Rauch-Metz Road intersects the eastbound ramp, creating mid-ramp intersections that violate driver's expectations.

As illustrated in the design concept for the Preferred Alternative, the proposed modification of Exit 97 to a DDI would continue to provide full access for all traffic movements. It would shift ramp movements away from the two-way frontage roads directly to intersections with Broad River Road, and provide ramps that meet or exceed current design standards, improving access to Broad River Road and the surrounding roadway network.