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TECHNICAL MEMORANDUM

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Subject
NCDOT STIP Projects R-2721, R-2828 & R-2829 Complete 540
Wake & Johnston County
TRM V5 and TRM V6 Sensitivity Analysis - FINAL DRAFT

Date
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Introduction

The purpose of this memo is to examine how the newly released Triangle Regional Model Version 6 (TRM V6) compares to the Triangle Regional Model Version 5 (TRM V5) that was used for the most recent Complete 540 traffic forecast, traffic capacity analysis, and numerous other traffic-related studies and reports.

Complete 540 lies within the boundaries of the Capital Area Metropolitan Planning Organization (CAMPO). It is included in the TRM. The TRM was used as the tool to analyze the impacts to the area roadways based on various socioeconomic (SE) data scenarios. TRM V5 was created on February 8, 2016 and includes SE data projections to the year 2040. TRM V6 was created on April 1, 2018 and includes SE data projections to the year 2045.

Differences between TRM V5 and TRM V6

TRM V5 was developed using socioeconomic data (population and employment projections) from Imagine 2040. Imagine 2040 was an initiative started in 2010 by the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO) and the CAMPO to promote community-based regionalism, aimed at guiding growth and coordinating decision-making processes for a more sustainable transportation system. Imagine 2040 was developed using CommunityViz software. As an extension of ESRI's ArcGIS desktop software, CommunityViz facilitates the visualization and comparison of development scenarios. The base year for Imagine 2040 is 2010, and the forecasts are for a 30-year period from 2010 to 2040.

In February 2018, the CAMPO Policy Board approved the updated 2045 Metropolitan Transportation Plan (MTP), and with it, the socioeconomic forecasts from the Connect our Future 2045 Initiative (Connect 2045). Connect 2045 was also developed using CommunityViz, but with a new version of the software and based on updated input data. The Connect 2045 planning effort also used new control-total forecasts for population and employment. These new forecasts are associated with the update of the regional travel demand model, TRM 6. The base year for Connect 2045 is 2013, and the forecasts are for a 32-year period from 2013-2045.

Complete 540 was included as part of the future roadway network in Imagine 2040. Similarly, the Connect 2045 forecasts include Complete 540 and its anticipated effects on land use as of the 2045 initiative timeline. Therefore, given that new regional forecasts have been adopted, the Complete 540 study team evaluated the specific differences between Imagine 2040 and Connect 2045.

Compared with socioeconomic data from Imagine 2040, Connect 2045 has different traffic analysis zones (TAZs), and overall, the 2045 projections have fewer residences and more employment in the traffic study area than are assumed in Imagine 2040.

The CAMPO (CAMPO, 2018) notes differences between Imagine 2040 and Connect 2045 socioeconomic forecasts. Key changes include the following:

- Projected population growth for Wake and Johnston counties slowed from the 2040 forecasts to the 2045 forecasts. This may be a result of the timing of the forecasts' preparation, which was shortly after the recession.
- The employment totals were based on the same methodology as the CAMPO 2040 forecasts, using current data from the North Carolina Employment Security Commission (ESC) as the basis for the estimates. Based on previous study findings that the ESC county-level employment estimates capture 92% of the actual total (see CAMPO, 2018 for references), the base year totals for Connect 2045 were adjusted to reflect this observed undercount, and then projected using growth rates from Woods and Poole Economics. Based on the updated (2013) data and forecasts, the Wake County employment growth rate is higher than that of the 2040 forecasts.

To ensure a complete review, a sensitivity analysis was conducted to determine if additional analysis of the alternatives based on Connect 2045 and TRM v6 was warranted.

The sensitivity analysis below provides a comparison of multiple Measures of Effectiveness (MOEs) within the traffic study area. Both the TRM V5 and the TRM V6 were run and compared for this study. The officially adopted FY SE data was used in the model runs for both TRM V5 (data from Imagine 2040) and TRM V6 (data from Connect 2045). The following MOEs were considered:

- **Average Daily VHT and VMT** – The VMT and VHT for each modeled alternative scenario were extracted from the loaded TRM highway networks. VMT and VHT were calculated for region-wide model traffic assignment, roadways that fall within the traffic study area, and roadways within the project FLUSA.
- **Average Daily Congested VHT and VMT** – The congested VMT and VHT data were extracted from the loaded TRM highway networks. Roadways with daily volume over capacity (V/C) ratios of greater than 0.80 were considered to be "congested" and were included in the data set developed for each alternative scenario. A V/C ratio of 0.80 or greater was chosen as the threshold because it typically equals a Highway Capacity Manual Level of Service (LOS) of D or worse.
- **Average PM Peak Period Congested VHT and VMT** - While daily congested VMT and VHT statistics provide a useful MOE for comparison between alternative scenarios, the PM period conditions were also examined to further evaluate impacts on reducing congestion. The PM period in the TRM assigns traffic on network roadways from 3:00 PM to 7:00 PM. The 2040 PM highway assignments from the TRM for each alternative were used to calculate totals for both region-wide and within the traffic study area and the FLUSA.

- **Average Daily and PM Period Speed Analysis** – Average network speed is a useful MOE in evaluating and comparing the ability of alternative scenarios to meet the project purpose of improving mobility. The TRM was used to calculate the average future year speeds for each alternative scenario. The average daily and average PM period speeds were calculated by dividing the VMT totals by the VHT totals.
- **Daily and PM Peak Period Congested Roadway Mileage** – Congested roadway mileage is a useful MOE in evaluating and comparing the ability of scenarios to meet the project purpose of improving mobility. The TRM was used to calculate the average future year congested roadway mileage totals for each scenario.

TRM V6 MOE Comparisons

Both a Future Year (FY) 2045 No-Build scenario (Complete 540 not assumed to be in place) and a FY 2045 Build scenario (Complete 540 preferred alternative in place) were run in TRM V6. A comparison of the MOE results for both scenarios are displayed in **Table 1**. The completion of Complete 540 results in an increase in average daily VMT within in the traffic study area. However, having the Complete 540 facility in place results in the reduction of average daily VHT, average congested VHT and VMT (both daily and PM period), and daily and PM peak congested roadway mileage. Average trip speeds will increase in both the PM period and over the daily period. In summary, construction of Complete 540 will provide substantial improvements to the transportation network when compared to the No-Build condition.

Table 1: TRM V6 FY 2045 MOE Comparisons

Future Year MOEs	% Change – No-Build to Build
Average Daily VMT	1.44%
Average Daily VHT	-5.34%
Average Daily Congested VMT	-17.22%
Average Daily Congested VHT	-21.41%
Average PM Peak Period Congested VMT	-7.57%
Average PM Peak Period Congested VHT	-16.02%
Average Daily Speed	7.17%
Average PM Period Speed	11.57%
Daily Congested Roadway Mileage	-14.71%
PM Peak Period Congested Roadway Mileage	-9.22%

Figure 1 – Complete 540 Traffic Study Area and FLUSA Boundaries

TRM V5 to V6 Comparison

Similarly to TRM V6, the construction of Complete 540 in TRM V5 provides an increase in average daily VMT and average daily and PM period speeds and decreases in average daily VHT, average congested VHT and VMT (both daily and PM period), and daily and PM Peak Period congested roadway mileage. **Table 2** provides a FY 2040 scenario MOE comparison summary for TRM V5. As summarized in the Complete 540 FEIS, construction of Complete 540 results in substantial benefits to the transportation network when compared to the No-Build condition.

Table 2: TRM V5 FY 2040 MOE Comparisons

Future Year MOEs	% Change – No-Build to Build
Average Daily VMT	3.13%
Average Daily VHT	-3.60%
Average Daily Congested VMT	-17.45%
Average Daily Congested VHT	-19.96%
Average PM Peak Period Congested VMT	-6.34%
Average PM Peak Period Congested VHT	-16.33%
Average Daily Speed	6.98%
Average PM Period Speed	10.02%
Daily Congested Roadway Mileage	-17.06%
PM Peak Period Congested Roadway Mileage	-9.99%

Another way to compare the two models is to examine the MOE changes of the same alternative in both models. **Table 3** displays the percentage differences within the traffic study area from TRM V5 to TRM V6 No-Build Models runs and the TRM V5 to TRM V6 Build Model runs.

Table 3: TRM V5 to TRM V6 MOE Comparisons for the Same Alternative

Future Year MOEs	TRM V5 FY No-Build vs. TRM V6 FY No-Build	TRM V5 FY Build vs. TRM V6 FY Build
Average Daily VMT	7%	5%
Average Daily VHT	24%	22%
Average Daily Congested VMT	220%	221%
Average Daily Congested VHT	355%	347%
Average PM Peak Period Congested VMT	38%	36%
Average PM Peak Period Congested VHT	5%	3%
Average Daily Speed	-14%	-14%
Average PM Period Speed	-16%	-15%
Daily Congested Roadway Mileage	328%	340%
PM Peak Period Congested Roadway Mileage	17%	14%

As shown in Table 3, when compared with the TRM V5, performance for the Build condition for VRM 6 shows an increased need for the project in 2045. Moreover, the change in MOEs from v5 to v6 for both the build and no-build alternatives is very similar for each alternative. Consequently, as the need for the project is clearly shown in the Build condition and the results are consistent, it is not necessary to evaluate other alternatives that were previously show not to perform as well as the "New Location Highway" alternative.

Conclusion

All MOEs worsen in TRM V6 for both the No-Build and Build alternatives compared to TRM V5, but the relative performance of build versus no-build is consistent. The percentage changes for each MOE are also relatively close for both alternatives in TRM V6.

A comparison of Complete 540 FY No-Build and Build scenarios in both TRM V5 and TRM V6 display similar percentage changes in MOEs because of Complete 540 being built. In several instances, TRM V6 displays a greater MOE percentage change benefit to the traffic study area road networks with Complete 540 being constructed, compared to TRM V5. HNTB recommends that traffic forecast projections based on TRM V5 continues to provide valid and meaningful data and that TRM V5 remains an appropriate tool for all transportation planning and traffic analysis purposes. This will provide conservative traffic MOE benefit projections for Complete 540.