# I-40 Add Lanes from I-440 to Lake Wheeler Rd (I-5701)

WBS No. 50120.1.1

# Capacity Operations Analysis Technical Memorandum

**December 2019**

**Prepared for:**

North Carolina
Department of Transportation

**Prepared by:**

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Member of the SNC-Lavalin Group

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Date

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Atkins

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## Tables



## Figures

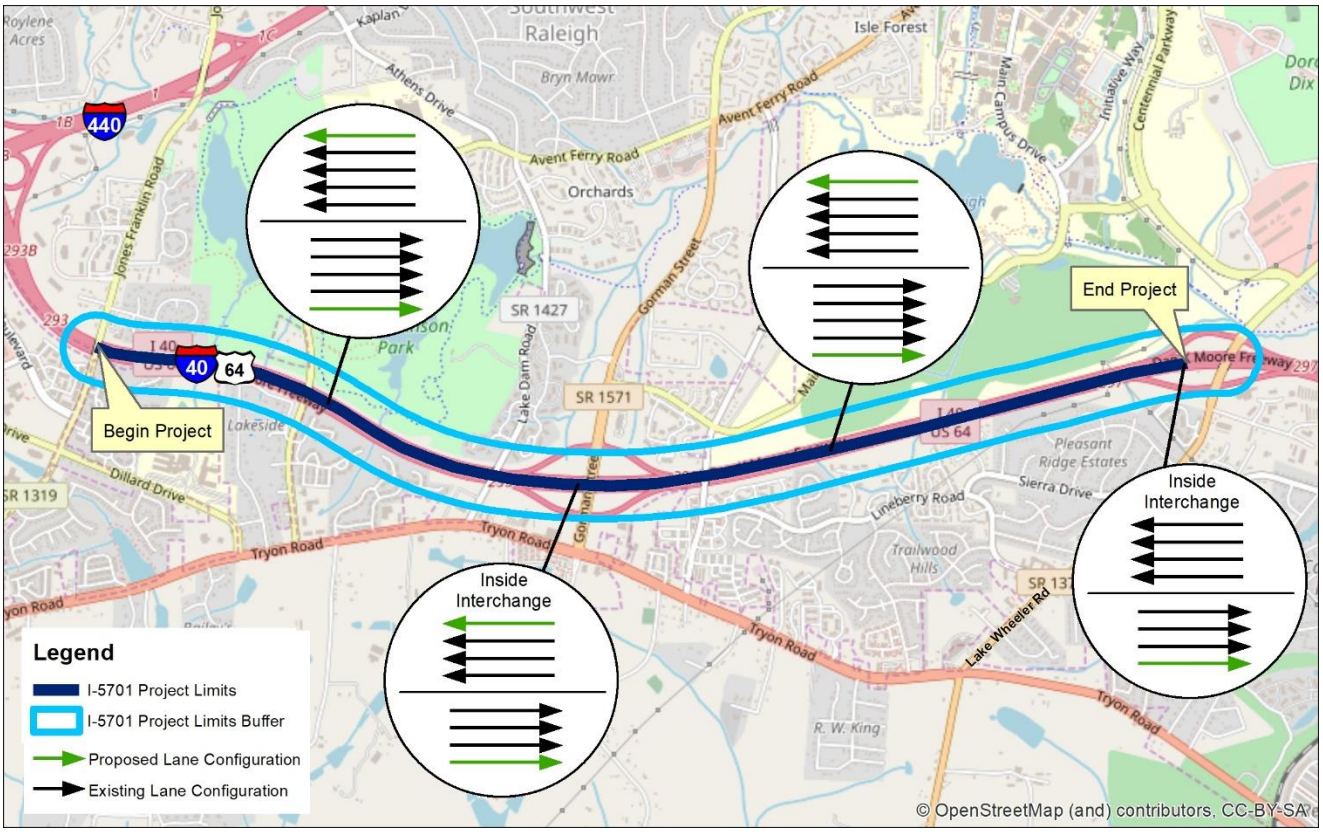
# 1. Introduction

For State Transportation Improvement Program (STIP) Project I-5701, North Carolina Department of Transportation (NCDOT) is proposing to make the following improvements along I-40 between the Lake Wheeler Road interchange and the Jones Franklin Road interchange:

- Construct an additional through-lane within the Gorman Street and Lake Wheeler Road interchanges. With the addition of this through-lane, the current auxiliary lanes at these interchange locations in both directions will be converted into a general-purpose lane.
- Add an auxiliary lane in both directions between the I-40/I-440 system interchange and the Gorman Street interchange and between the Gorman Street interchange and the Lake Wheeler Road interchange.

The project is within the City of Raleigh, Wake County. Project limits and proposed improvements are presented in **Figure 1**. No new right of way is anticipated to be required for the project.

**Figure 1. I-5701 Project Limits and Proposed Improvements**




A traffic forecast for the study area was developed by AECOM and published on September 2018 (Appendix A). Based on the forecast, year 2018 Annual Average Daily Traffic (AADT) on I-40 west of Gorman Street is 133,000 vehicles per day (vpd). AADT on I-40 between the Gorman Street and the Lake Wheeler Road interchanges is 130,300 vpd. AADT on I-40 is expected to increase substantially by 2045. It is anticipated that under the 2045 Build Condition, AADT west of Gorman Street will be 226,00 vpd while AADT between Gorman Street and Lake Wheeler Road will be 239,300 vpd.

Atkins performed capacity analyses of the corridor for Existing (2018) conditions and Design Year (2045) No Build and Build Conditions. This technical memorandum describes the analysis methodology and summarizes the analysis results.

# 2. Analysis Methodology

Highway Capacity Software version 7 (HCS 7) was used for the analysis. Hourly traffic volume projections along this study area corridor were developed by Atkins for year 2045 No-Build and Build conditions as part of STIP Project I-5703. There is an overlap in the study areas between these two projects. Therefore, to be consistent, the hourly volume projections developed for I-5703 are used in this analysis. Volume projections for 7 AM are used for AM peak hour analysis, and volume projections for 5 PM are used for PM peak hour analysis.

The merge, diverge, and basic segments were identified along eastbound and westbound I-40 within the study limits, and each segment was individually coded in HCS. Lane configuration for pertinent analysis scenario as presented in **Figure 1** was used in the analysis. Volumes for each segment used in analysis are presented in later sections. The following values are also used in the analysis:

- Lane width: 12 ft
- Total trucks: 3.1% (based on actual traffic count)
- Terrain: Level
- PHF: .9
- Other parameters: NCDOT recommended defaults

# 3. Existing Conditions

An existing conditions analysis was completed to develop an understanding of the traveling experience of the current network users. The following sections describe the current transportation system within the study area, existing traffic volumes and patterns, and existing traffic operations.

## 3.1. Existing (2018) Roadway Characteristics

This section describes the existing geometry of I-40, its interchanges, and portions of the connecting local street system that were evaluated in the traffic analysis for this study. Within the project limits, I-40 is classified as a full-access-controlled-freeway that generally travels on an east-west alignment through level terrain in an urbanized area. **Figure 1** shows the current lane alignments along I-40 within the study area.

### 3.1.1. Interchange Forms

There are two major roadways that intersect with I-40 at grade-separated interchanges within the traffic analysis area. Each interchange provides full access to I-40 in the form of ramps that have acceleration/deceleration lanes of varying lengths. **Table 1** provides a summary of the interchange types located within the traffic analysis area.

**Table 1. Existing Conditions—Interchange Forms**

| Intersecting Roadway | Interchange Form |
|---|---|
| Exit 295 (Gorman Street) | Full Movement Diamond |
| Exit 297 (Lake Wheeler Road) | Full Movement Diamond |

### 3.1.2. Exit 295 – Gorman Street

**Figure 2** depicts the full-movement diamond interchange of I-40 at Exit 295. Gorman Street passes under I-40 with a signalized intersection at the westbound I-40 ramp junction and a signalized intersection at the eastbound I-40 ramp junction. Gorman Street (SR 1571) is classified as a state-maintained secondary route, which provides access to Raleigh to the north and Tryon Road to the south.

**Figure 2. Exit 295 (Gorman Street) Interchange**


## 3.1.3. Exit 297 – Lake Wheeler Road

**Figure 3** depicts the full-movement, diamond interchange of I-40 at Exit 297. Lake Wheeler Road passes over I-40 with a signalized intersection at the westbound I-40 ramp junction and a signalized intersection at the eastbound I-40 ramp junction. Lake Wheeler Road (SR 1009) is classified as a state-maintained secondary route, which provides access to Raleigh to the north and Raleigh and Cary to the south.

**Figure 3. Exit 297 (Lake Wheeler Road) Interchange**

## 3.2. Existing (2018) Traffic Volumes

### 3.2.1. Existing Mainline Traffic Volumes

The following turning movement counts represent the AM and PM peak hour traffic volumes along I-40 eastbound and I-40 westbound from Exit 295 to Exit 297. **Figures 4 through 7** display the AM and PM peak hour traffic volumes along I-40 from Exit 295 to Exit 297 for the eastbound and westbound directions, respectively.

**Figure 4. Existing (2018) AM Peak Hour Traffic Volumes along I-40 EB**

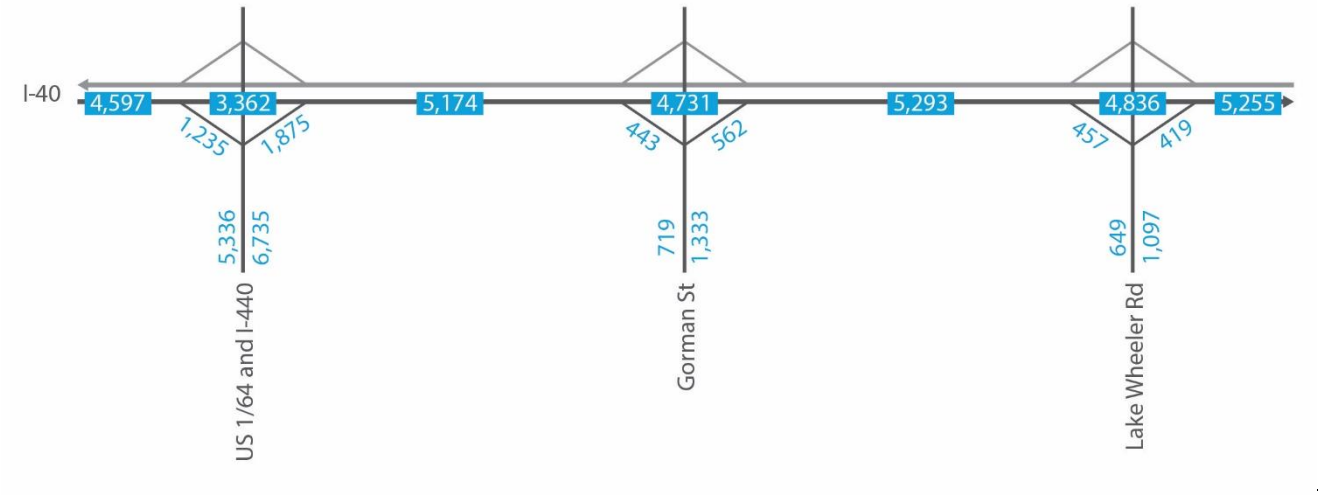



**Figure 5. Existing (2018) PM Peak Hour Traffic Volumes along I-40 EB**

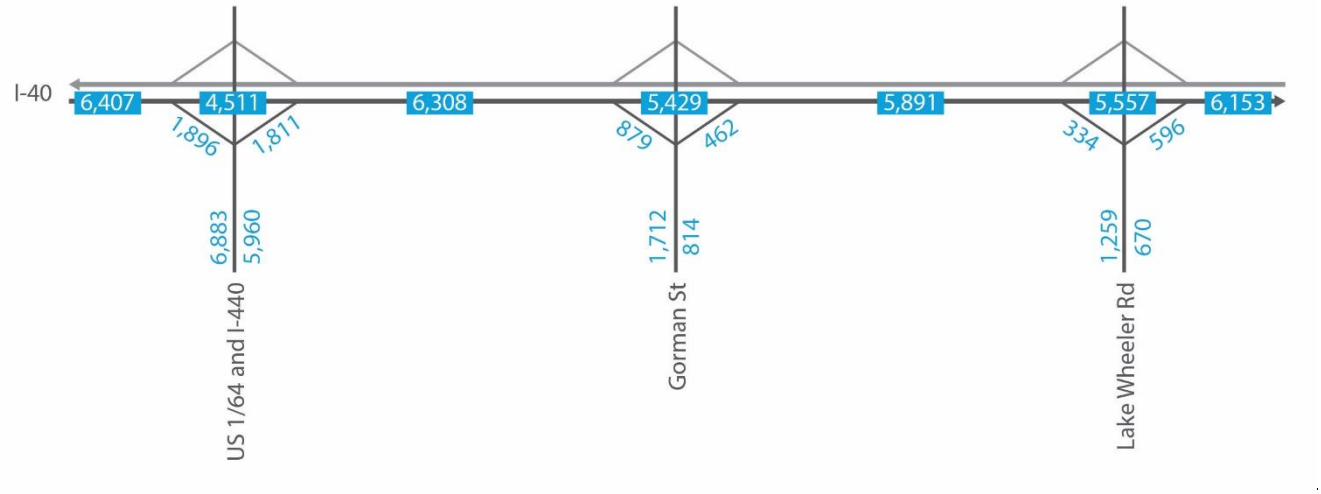


**Figure 6. Existing (2018) AM Peak Hour Traffic Volumes along I-40 WB**

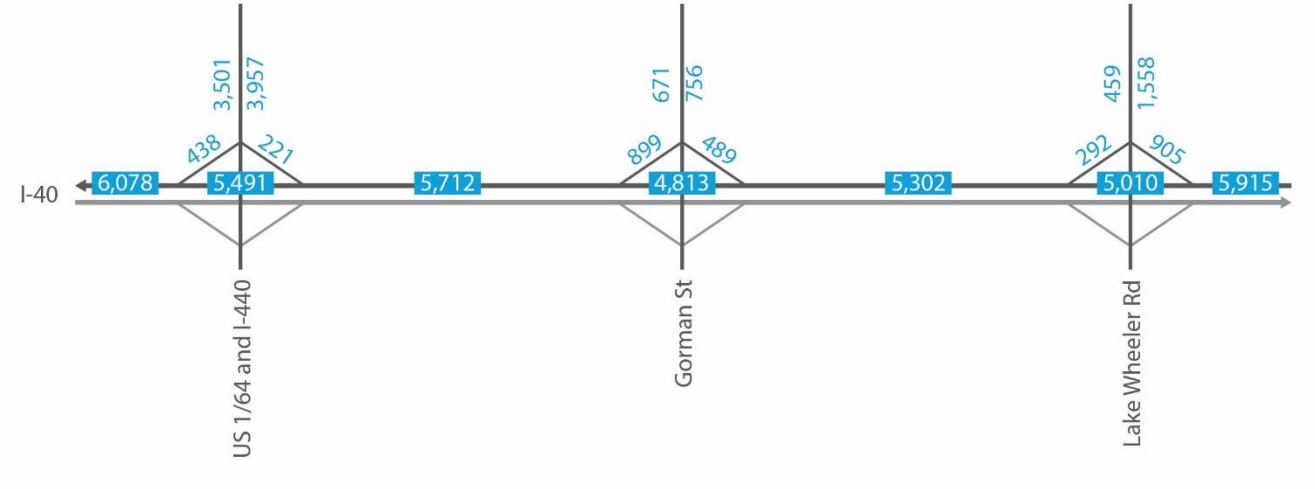
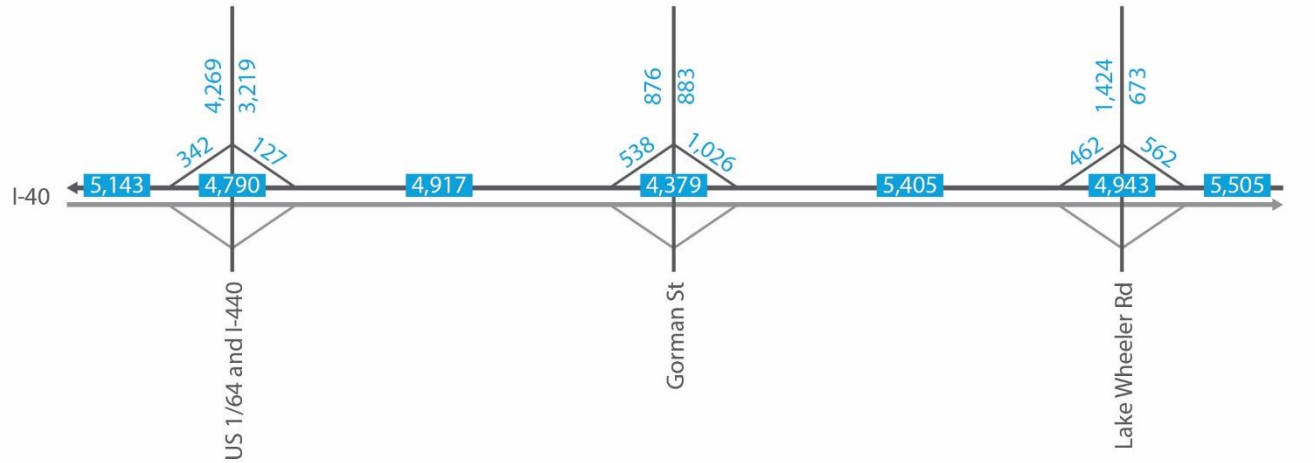



**Figure 7. Existing (2018) PM Peak Hour Traffic Volumes along I-40 WB**




# 3.3. Existing Operational Conditions

## 3.3.1. Existing Mainline Conditions Results

**Table 2 and Table 3** show the Highway Capacity Software 7 (HCS7) Analysis results for the existing traffic conditions on eastbound I-40 and westbound I-40, respectively. The freeway was divided into analysis segments per the definitions in the freeway facility analysis methodology from the *Highway Capacity Manual* (HCM), 6th edition, and analyzed for the AM and PM peak hours as separate segments.

Level of Service (LOS) is measured from LOS A, representing free-flow traffic conditions, to LOS F, representing heavily congested traffic. LOS A through LOS D generally are considered acceptable.

For eastbound I-40, the segments operate primarily at LOS D or better, except for the segment from east of the Lake Wheeler Rd off-ramp to the 4-lane transition operating at LOS E in the PM peak hour. For westbound I-40, the segments operate at LOS D or better in both the AM and PM peak hours.

**Table 2. Existing (2018) AM and PM Peak Hour HCS Operational Results along I-40 EB**

| | EB I-40 Segment HCS Summary | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | |
| | Btwn Jones Franklin Rd and Gorman St Off-Ramp (freeway) | | Gorman St Off-Ramp (diverge) | | Btwn Gorman St Off-Ramp and On-Ramp (freeway) | | Gorman St On-Ramp (merge) | | Gorman St On-Ramp to Lake Wheeler Off-Ramp (freeway) | |
| Scenario | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) |
| **Existing (2018) AM** | C | 21.9 | B | 22.1 | D | 28.0 | B | 23.5 | C | 22.6 |
| **Existing (2018) PM** | D | 27.5 | C | 27.3 | D | 33.9 | B | 26.1 | C | 25.3 |

| | EB I-40 Segment HCS Summary | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 6 | | 7 | | 8 | | 9 | | 10 | |
| | Lake Wheeler Rd Off-Ramp (diverge) | | East of Lake Wheeler Rd Off-Ramp to 4 lane transition (freeway) | | East of 4-lane transition (freeway) | | Lake Wheeler Rd On-Ramp (merge) | | East of Lake Wheeler Rd On-Ramp (freeway) | |
| Scenario | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) |
| **Existing (2018) AM** | B | 22.7 | D | 28.9 | C | 20.5 | B | 14.2 | B | 17.8 |
| **Existing (2018) PM** | B | 24.9 | E | 35.3 | C | 23.6 | B | 16.7 | C | 20.6 |

**Table 3. Existing (2018) AM and PM Peak Hour HCS Operational Results along I-40 WB**

| | WB I-40 Segment HCS Summary | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | |
| | East of Lake Wheeler Rd (freeway) | | Lake Wheeler Rd Off-Ramp (diverge) | | Btwn Lake Wheeler Rd Ramps (freeway) | | Lake Wheeler Rd On-Ramp (merge) | | btwn Lake Wheeler Rd and Gorman St (freeway) | |
| Scenario | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) |
| **Existing (2018) AM** | C | 19.9 | B | 17.1 | C | 21.3 | B | 23.6 | C | 22.6 |
| **Existing (2018) PM** | C | 18.3 | B | 15.5 | C | 20.7 | B | 23.8 | C | 22.8 |

| | WB I-40 Segment HCS Summary | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 6 | | 7 | | 8 | | 9 | |
| | Gorman St Off-Ramp (diverge) | | Btwn Gorman St Ramps (freeway) | | Gorman St On-Ramp (merge) | | West of Gorman St (freeway) | |
| Scenario | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) |
| **Existing (2018) AM** | B | 22.7 | D | 28.8 | C | 25.6 | C | 24.6 |
| **Existing (2018) PM** | B | 23.5 | C | 25.0 | B | 21.5 | C | 20.5 |

# 4. Future 2045 Conditions

## 4.1. Future 2045 Traffic Volumes and Patterns

### 4.1.1. Future 2045 No-Build Mainline Traffic Volumes

AM and PM Peak hour traffic volumes along the study area roadway network obtained under adjacent project I-5703 were used in this analysis. **Figures 8 through 11** display the No-Build 2045 projected AM and PM peak hour traffic volumes along I-40 from Exit 295 to Exit 297 in the eastbound and westbound directions.

**Figure 8. Future (2045) No-Build AM Peak Hour Traffic Volumes along I-40 EB**

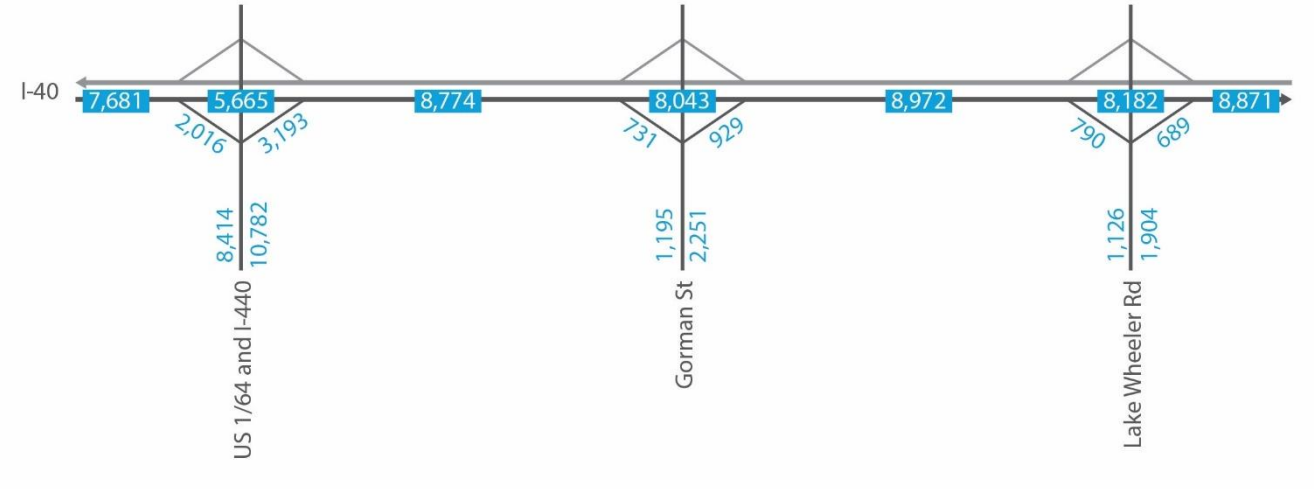



**Figure 9. Future (2045) No-Build PM Peak Hour Traffic Volumes along I-40 EB**

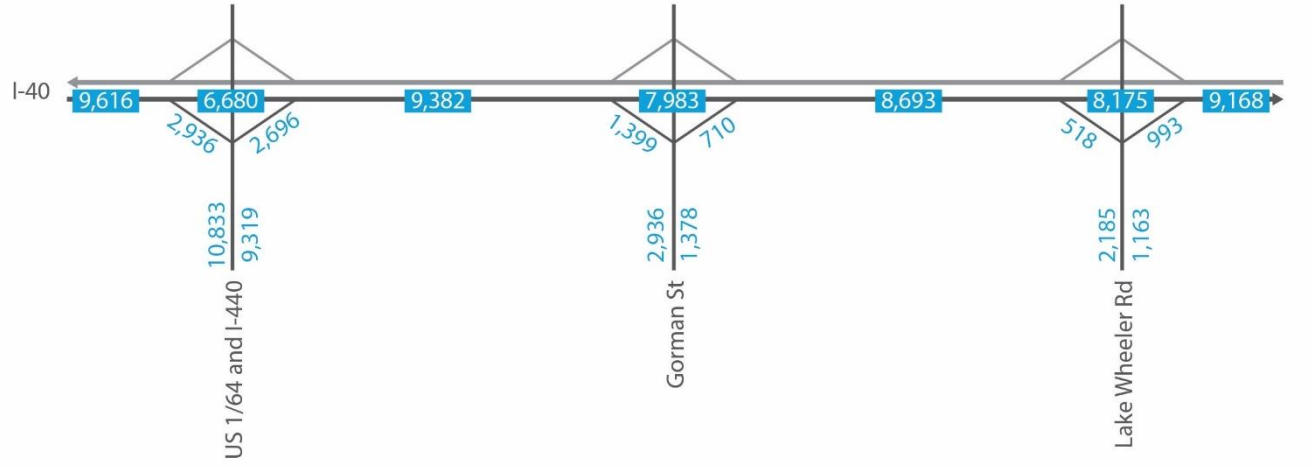


**Figure 10. Future (2045) No-Build AM Peak Hour Traffic Volumes along I-40 WB**

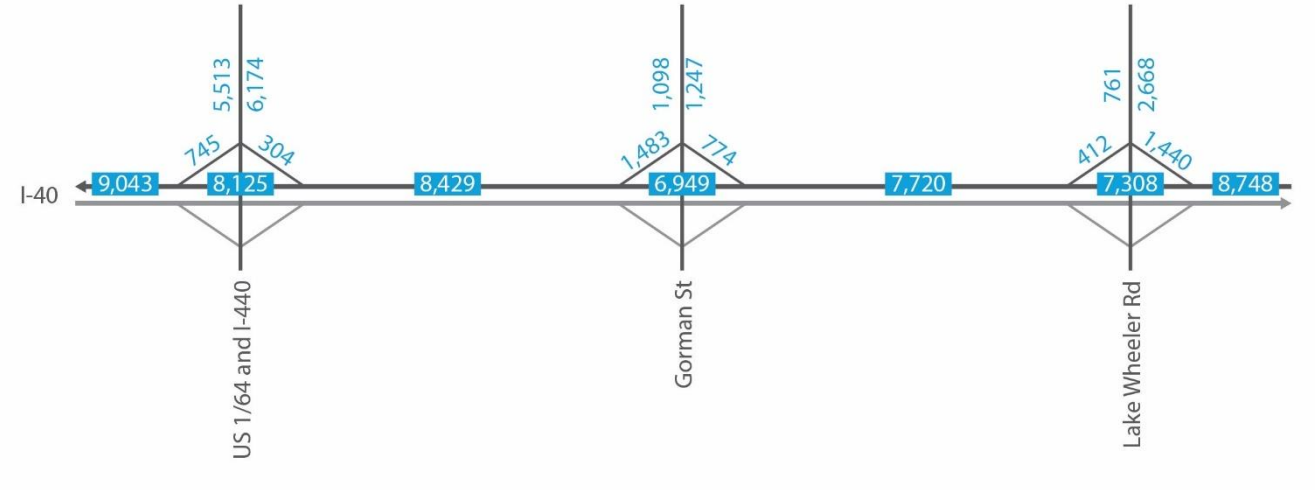
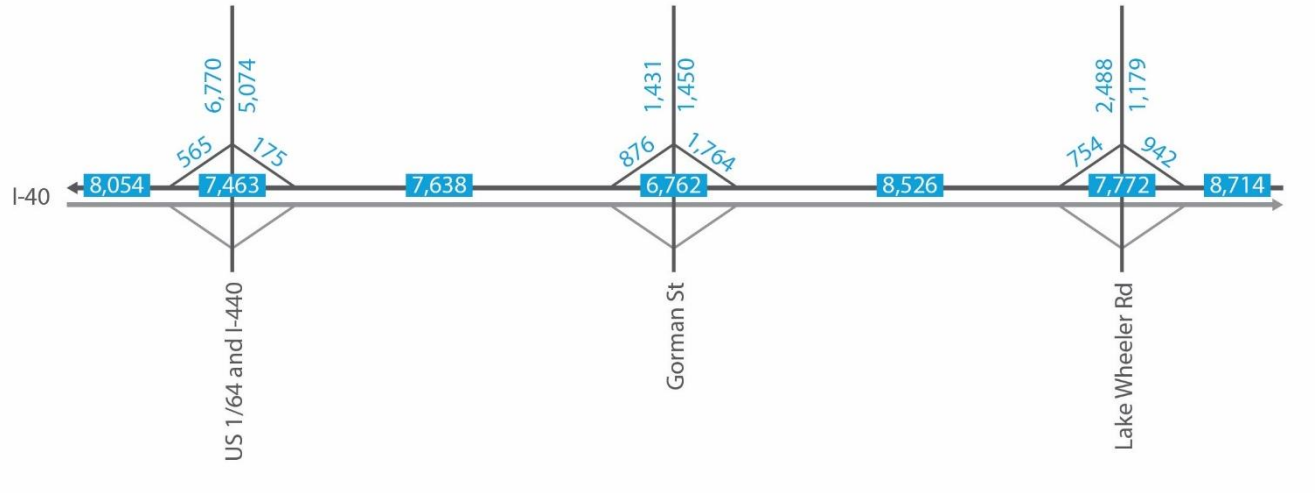



**Figure 11. Future (2045) No-Build PM Peak Hour Traffic Volumes along I-40 WB**




## 4.1.2. Future 2045 Build Mainline Traffic Volumes

**Figures 12 through 15** display the Build 2045 projected AM and PM peak hour traffic volumes along I-40 from Exit 295 to Exit 297 in the eastbound and westbound directions.

**Figure 12. Future (2045) Build AM Peak Hour Traffic Volumes along I-40 EB**

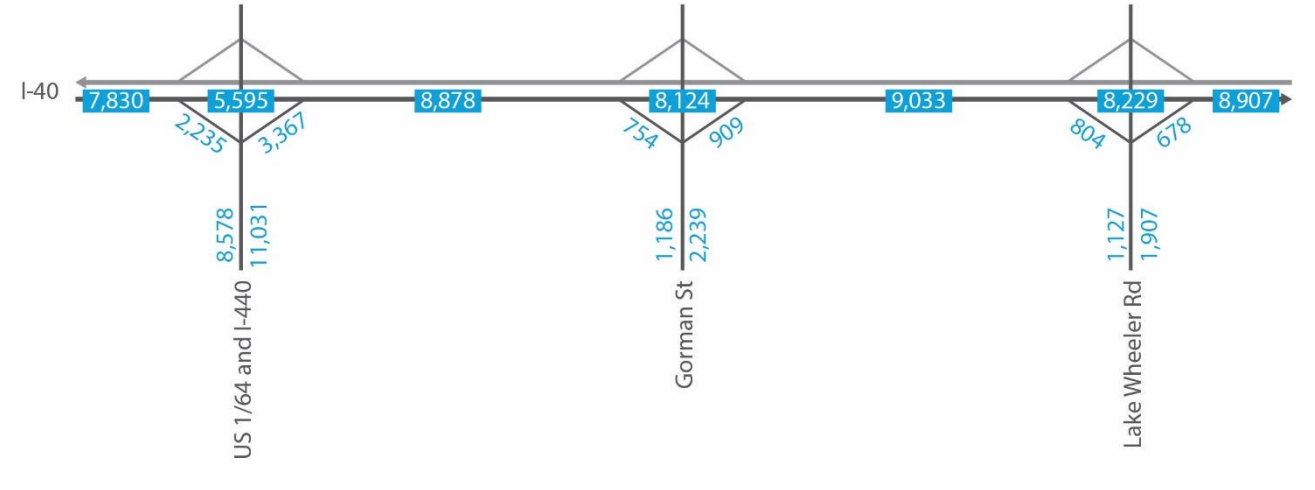



**Figure 13. Future (2045) Build PM Peak Hour Traffic Volumes along I-40 EB**

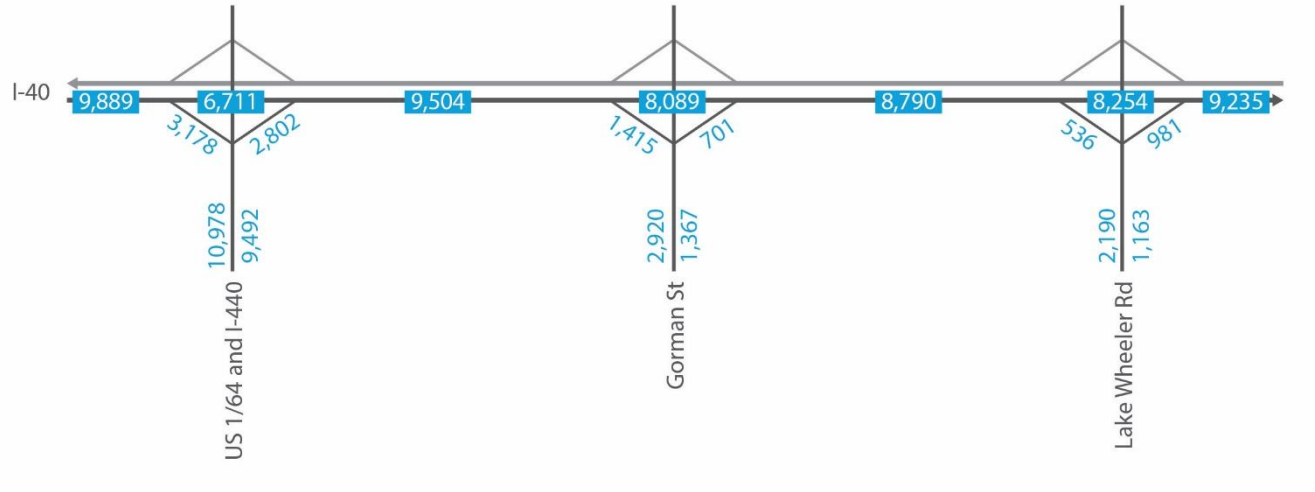


**Figure 14. Future (2045) Build AM Peak Hour Traffic Volumes along I-40 WB**

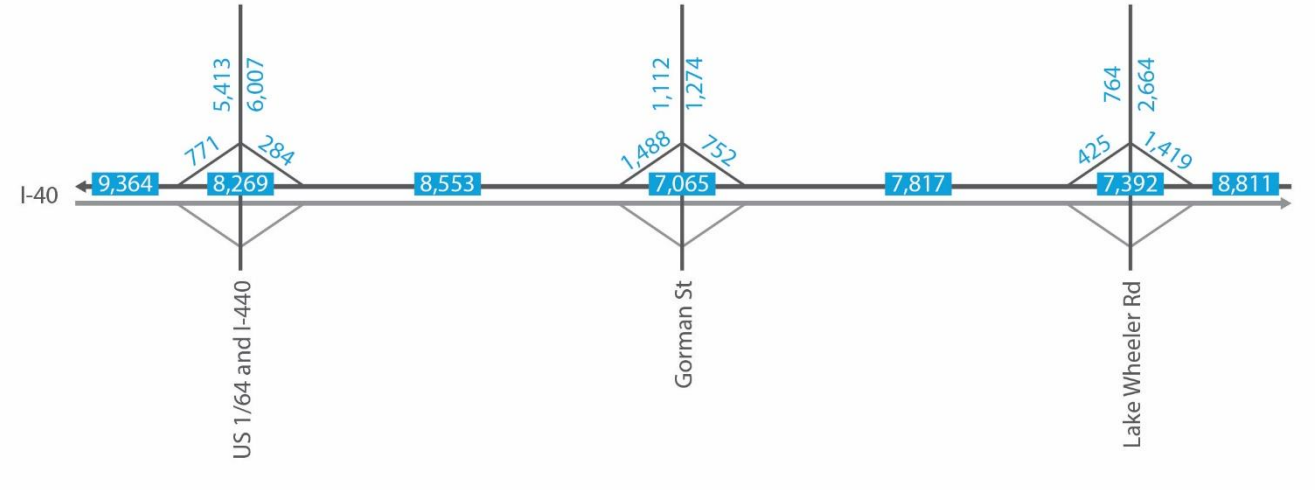
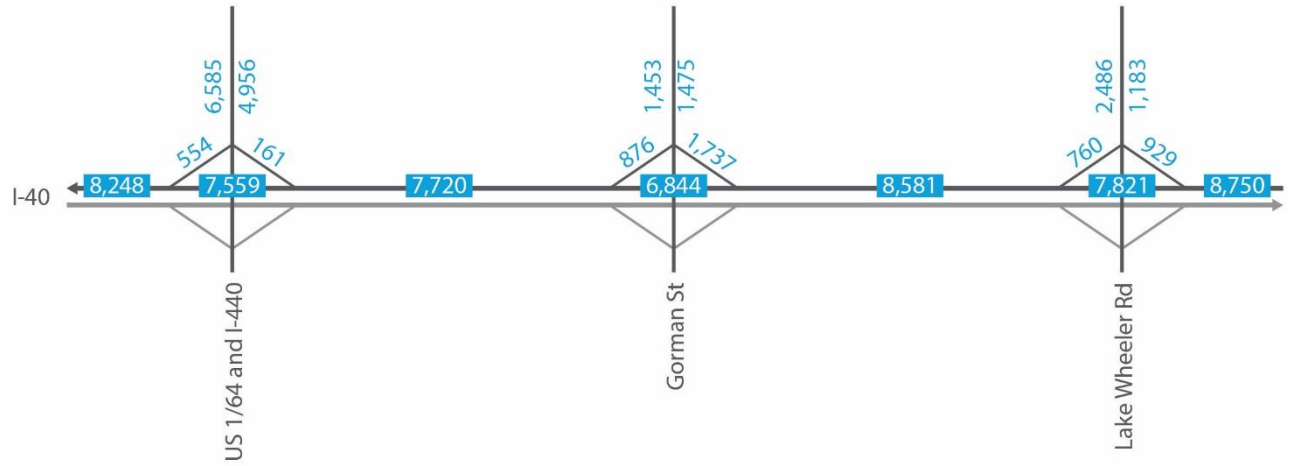



**Figure 15. Future (2045) Build PM Peak Hour Traffic Volumes along I-40 WB**




## 4.2. Future 2045 Operational Conditions

### 4.2.1. Future 2045 No-Build Mainline Conditions Results

The 2045 No Build models were developed from the 2018 Existing Conditions models by forecasting traffic demand to 2045 and incorporating any planned changes in the corridor that are independent of the project. Currently, there are no planned changes to the geometry along the I-40 corridor within the project limits; thus, the 2045 No Build model has the same geometry as the Existing Conditions.

**Table 4 and Table 5** show the results of the 2045 No Build analysis for eastbound and westbound I-40 in the AM and PM peak hours, respectively. As traffic volumes increase, the freeway will begin to experience more segments that operate at LOS F. For eastbound I-40, the segments primarily operate at LOS F. For westbound I-40, the segments primarily operate at LOS C-E, except for Segment 7 between the Gorman Street Ramps operating at LOS F in both the AM and PM conditions.

**Table 4. Future (2045) No-Build AM and PM Peak Hour HCS Operational Results along I-40 EB**

| Scenario | EB I-40 Segment HCS Summary | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | |
| | Btwn Jones Franklin Rd and Gorman St Off-Ramp (freeway) | | Gorman St Off-Ramp (diverge) | | Btwn Gorman St Off-Ramp and On-Ramp (freeway) | | Gorman St On-Ramp (merge) | | Gorman St On-Ramp to Lake Wheeler Off-Ramp (freeway) | |
| | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) |
| **No Build (2045) AM** | F | > 45 | D | 36.9 | F | > 45 | F | > 45 | F | > 45 |
| **No Build (2045) PM** | F | > 45 | F | > 45 | F | > 45 | D | 40.1 | F | > 45 |

| Scenario | EB I-40 Segment HCS Summary | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 6 | | 7 | | 8 | | 9 | | 10 | |
| | Lake Wheeler Rd Off-Ramp (diverge) | | East of Lake Wheeler Rd Off-Ramp to 4 lane transition (freeway) | | East of 4-lane transition (freeway) | | Lake Wheeler Rd On-Ramp (merge) | | East of Lake Wheeler Rd On-Ramp (freeway) | |
| | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) |
| **No Build (2045) AM** | F | > 45 | F | > 45 | E | 39.4 | C | 22.7 | D | 31.0 |
| **No Build (2045) PM** | D | 36.4 | F | > 45 | E | 39.5 | C | 24.0 | D | 32.8 |

**Table 5. Future (2045) No-Build AM and PM Peak Hour HCS Operational Results along I-40 WB**

| Scenario | WB I-40 Segment HCS Summary | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | |
| | East of Lake Wheeler Rd (freeway) | | Lake Wheeler Rd Off-Ramp (diverge) | | Btwn Lake Wheeler Rd Ramps (freeway) | | Lake Wheeler Rd On-Ramp (merge) | | Btwn Lake Wheeler Rd and Gorman St (freeway) | |
| | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) |
| **No Build (2045) AM** | D | 30.3 | C | 23.3 | D | 32.3 | C | 34.1 | E | 35.4 |
| **No Build (2045) PM** | D | 30.6 | C | 23.1 | E | 36.5 | D | 39.7 | E | 44.0 |

| Scenario | WB I-40 Segment HCS Summary | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 6 | | 7 | | 8 | | 9 | |
| | Gorman St Off-Ramp (diverge) | | Btwn Gorman St Ramps (freeway) | | Gorman St On-Ramp (merge) | | West of Gorman St (freeway) | |
| | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) |
| **No Build (2045) AM** | C | 32.2 | F | > 45 | D | 40.0 | E | 42.0 |
| **No Build (2045) PM** | E | 37.5 | F | > 45 | C | 34.3 | E | 35.4 |

## 4.2.2. Future 2045 Build Mainline Conditions Results

As discussed in Chapter 1, the proposed project would connect existing auxiliary lanes to create new through lanes on I-40 between Gorman Street (Exit 295) and Lake Wheeler Road (Exit 297) and would add new auxiliary lanes in both directions in the same area.

**Table 6 and Table 7** show the results of the 2045 Build analysis for eastbound and westbound I-40 in the AM and PM peak hours, respectively. The addition of the eastbound auxiliary lane from Exit 295 to Exit 297 will alleviate much of the congestion on I-40 in this area. LOS E or better is expected to occur for both eastbound and westbound I-40.

**Table 6. Future (2045) Build AM and PM Peak Hour HCS Operational Results along I-40 EB**

| Scenario | EB I-40 Segment Build Condition HCS Summary | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | |
| | Btwn Jones Franklin Rd and Gorman St Off-Ramp (freeway) | | Gorman St Off-Ramp (diverge) | | Btwn Gorman St Off-Ramp and On-Ramp (freeway) | | Gorman St On-Ramp (merge) | | Gorman St On-Ramp to Lake Wheeler Off-Ramp (freeway) | |
| | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) |
| **Build (2045) AM** | D | 33.3 | C | 24.4 | E | 42.9 | C | 25.1 | D | 34.4 |
| **Build (2045) PM** | E | 36.7 | D | 26.4 | E | 41.6 | C | 23.7 | D | 32.4 |

| Scenario | EB I-40 Segment Build Condition HCS Summary | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 6 | | 7 | | 8 | | 9 | |
| | Lake Wheeler Rd Off-Ramp (diverge) | | East of Lake Wheeler Rd Off-Ramp to 4 lane transition (freeway) | | East of 4-lane transition (freeway) | | Lake Wheeler Rd On-Ramp (merge) | |
| | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) |
| **Build (2045) AM** | C | 24.9 | E | 44.1 | C | 24.5 | D | 33.7 |
| **Build (2045) PM** | C | 23.7 | E | 43.4 | C | 25.6 | E | 35.1 |

**Table 7. Future (2045) Build AM and PM Peak Hour HCS Operational Results along I-40 WB**

| Scenario | WB I-40 Segment HCS Summary | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | |
| | East of Lake Wheeler Rd (freeway) | | Lake Wheeler Rd Off-Ramp (diverge) | | Btwn Lake Wheeler Rd Ramps (freeway) | | Lake Wheeler Rd On-Ramp (merge) | | Btwn Lake Wheeler Rd and Gorman St (freeway) | |
| | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) |
| **Build (2045) AM** | D | 32.9 | D | 24.7 | E | 35.8 | B | 20.5 | D | 27.7 |
| **Build (2045) PM** | D | 32.0 | C | 23.8 | E | 38.8 | C | 22.8 | D | 31.2 |

| Scenario | WB I-40 Segment HCS Summary | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 6 | | 7 | | 8 | | 9 | |
| | Gorman St Off-Ramp (diverge) | | Btwn Gorman St Ramps (freeway) | | Gorman St On-Ramp (merge) | | West of Gorman St (freeway) | |
| | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) | LOS | Freeway Density (pc/mi/ln) |
| **Build (2045) AM** | C | 21.3 | D | 33.2 | C | 24.1 | D | 31.4 |
| **Build (2045) PM** | D | 24.0 | D | 31.1 | C | 20.4 | D | 26.7 |

# Conclusions

It is anticipated that without any improvement, I-40 within the study area will not have enough capacity to serve the expected traffic demand. The proposed improvements will improve traffic operation substantially along the study corridor in both directions of travel.

In the eastbound direction, eight of the ten segments analyzed are expected to operate at LOS E or worse during one or both the peak hours under 2045 No Build condition. With the proposed improvements in place, 50 percent of the previously failing segments will see operational improvements as they would operate at LOS D or better during both the peak hours.

In the westbound direction, five of the nine analyzed segments would operate at LOS E or worse during one or both the peak hours under 2045 No Build condition. With the proposed improvements in place, 80 percent (4 out of 5) of the previously failing segments would operate at LOS D or better during both peak hours.

# Appendices

# Appendix A. AECOM Traffic Forecast

# Traffic Forecast

# STIP No. I-5701

## Wake County, North Carolina

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

**Prepared By:**
**AECOM Technical Services of North Carolina, Inc.**

September 2018

# M E M O R A N D U M

September 2018

TO: Greg Blakeney
Project Development – Eastern Region

FROM: Ivo Dernev, PE
AECOM, Technical Services of North Carolina, Inc.

SUBJECT: TIP Project No. I-5701 (I-40/US 64 from I-440 /US 1/64 to SR 1370 (Lake Wheeler Rd) in Raleigh – add lanes)

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Please find attached the 2018/2045 Traffic Forecast for the above mentioned project. The traffic forecast was originally requested by Greg Blakeney with NCDOT's Project Development Group – Eastern Region Unit on July 6, 2017 in support of the project design and development. The final forecast was reviewed and approved by NCDOT Transportation Planning Division on September 26, 2018.

Project I-5701 proposes to construct additional through-lanes at the Gorman Street and Lake Wheeler interchanges to convert the auxiliary lanes along I-40 to general purpose lanes. I-40/US 64 project limits extend from I-440/US 1/64 to SR 1370 (Lake Wheeler Rd) in Wake County. The project is approximately 5.0 miles in length. The project subject to the forecast analysis is located within the Capital Area Metropolitan Planning Organization (CAMPO) and is part of the Triangle Regional Model (TRM) roadway network. The 2018-2027 NCDOT STIP document (adopted in in August 2017) shows project I-5701 scheduled for construction in year 2022.

Through project scoping with NCDOT, it has been agreed that for the purpose of this forecast two 2018 Base Year and two 2045 Future Year scenarios would be developed. The 2018 Base Year traffic forecast includes one No-Build and one Build Scenario. The 2045 Future Year traffic forecast includes one No-Build and one Build Scenario. The evaluated scenarios are:

**Base Year 2018 No-Build** - Existing Conditions I-40:

- west of US1/64 interchange – 6 lanes
- between US 1/64 and SR 1571 (Gorman St) interchanges – 6 lanes
- between SR 1571 (Gorman St) and SR 1375 (Lake Wheeler Rd) interchanges – 6 lanes
- between SR 1375 (Lake Wheeler Rd) and US 401 (S Saunders St) interchanges – 6 lanes
- east of US 401 (S Saunders St) – 6 lanes

**Base Year 2018 Build** - Future Conditions I-40:

- west of US1/64 interchange – 6 lanes
- between US 1/64 and SR 1571 (Gorman St) interchanges – 8 lanes
- between SR 1571 (Gorman St) and SR 1375 (Lake Wheeler Rd) interchanges – 8 lanes
- between SR 1375 (Lake Wheeler Rd) and US 401 (S Saunders St) interchanges – 6 lanes
- east of US 401 (S Saunders St) – 6 lanes

**Future Year 2040 No-Build** - Existing Conditions I-40:

- west of US1/64 interchange – 8 lanes
- between US 1/64 and SR 1571 (Gorman St) interchanges – 6 lanes
- between SR 1571 (Gorman St) and SR 1375 (Lake Wheeler Rd) interchanges – 6 lanes
- between SR 1375 (Lake Wheeler Rd) and US 401 (S Saunders St) interchanges – 8 lanes
- east of US 401 (S Saunders St) – 8 lanes

**Future Year 2040 Build** - Future Conditions I-40:

- west of US1/64 interchange – 8 lanes
- between US 1/64 and SR 1571 (Gorman St) interchanges – 8 lanes
- between SR 1571 (Gorman St) and SR 1375 (Lake Wheeler Rd) interchanges – 8 lanes
- between SR 1375 (Lake Wheeler Rd) and US 401 (S Saunders St) interchanges – 8 lanes
- east of US 401 (S Saunders St) – 8 lanes

**Certain assumptions were made in the development of the forecast:**

Fiscal Constraint: The subject project is located within the boundaries of a MPO; therefore, the travel demand model and traffic forecast are fiscally-constrained to match the assumptions of the Capital Area Metropolitan Planning Organization (CAMPO) 2045 Metropolitan Transportation Plans (MTP).

The following TIP projects included in the 2045 MTP were considered as projects anticipated to have possible impact on traffic volumes and patterns in the traffic forecast vicinity:

- I-5702 – I-40 Widening between Durham County Line and Wade Ave
- I-5704 – I-40 Widening between Wade Avenue and east of I-440/US 1/US 64
- I-5703 – I-40/US 1/US 64 Interchange Improvement
- U-2719 – I-440 Widening from US 1/US 64 to Wade Ave
- U-5301C – US 64 (superstreet) between US 1 and Lake Pine Dr

**Travel Demand Model:** The Triangle Regional Travel Demand Model, Version 6 (TRM_v6), adopted in March 2018 was used as a tool in the development of this forecast.

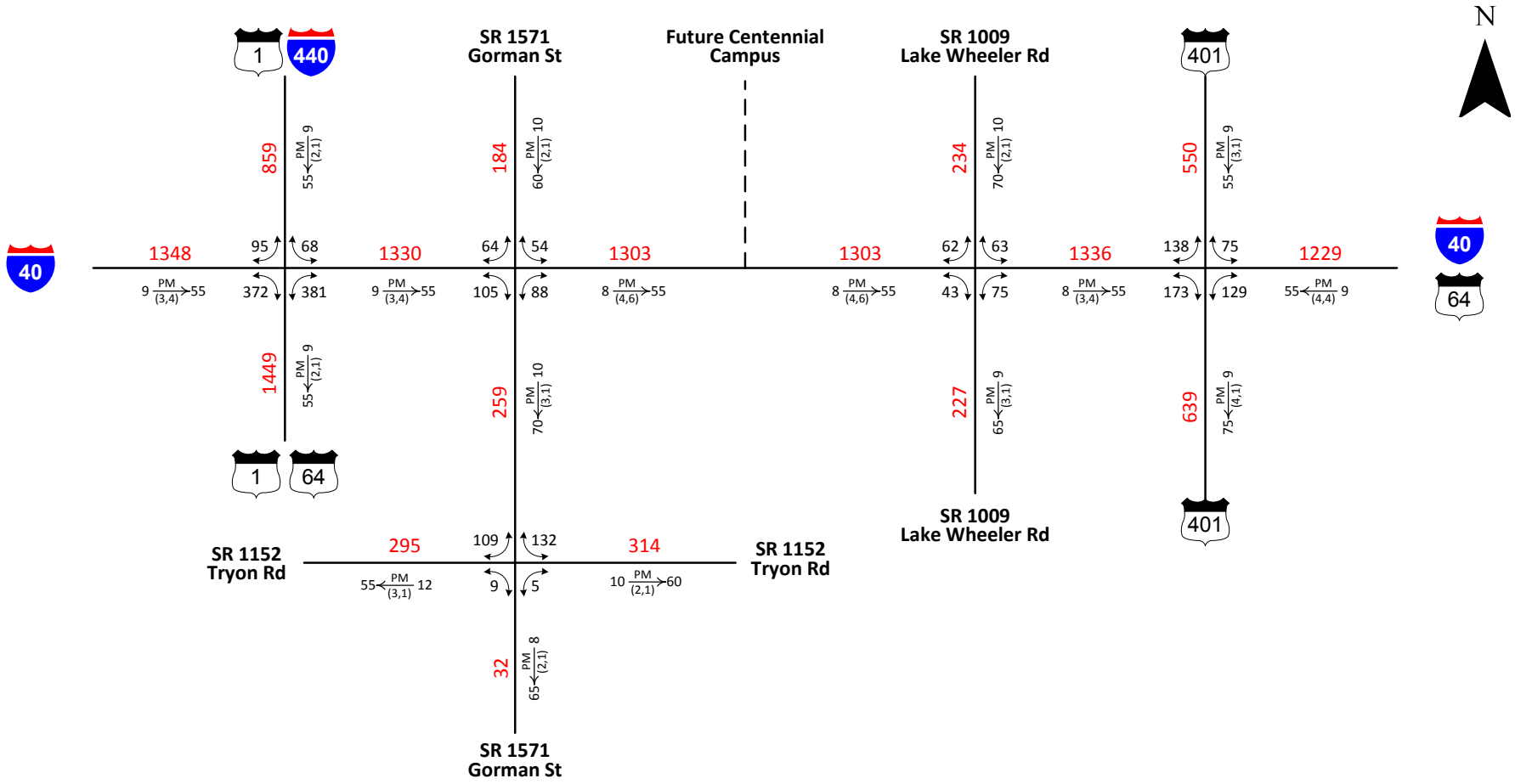
**Forecast Methodology:** The 2018 traffic volumes and design factors were developed based upon current counts, historic AADT trend projections and previous forecasts.

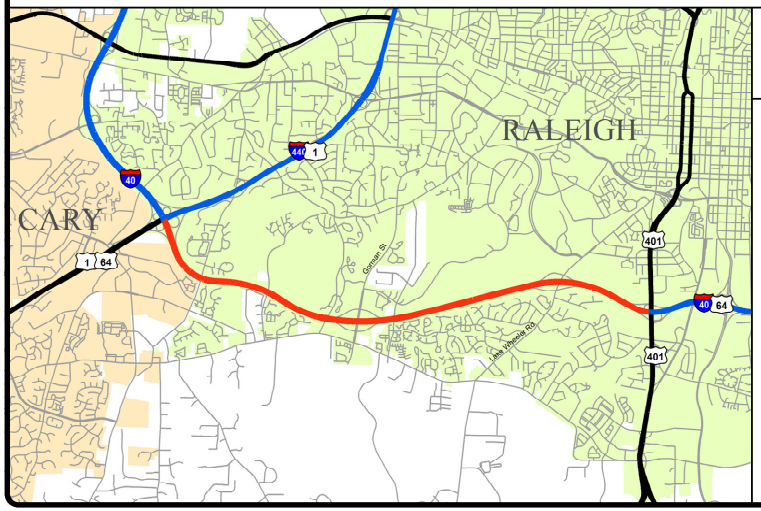
The TRM_v6 was relied upon in the calculation of the 2040 Future Year traffic volumes. Historic growth trends were analyzed and compared to modeled growth rates. Engineering judgment adjustments were applied as needed in finalizing the volumes in order to develop a balanced forecast.

If you have any questions or if I can be of further assistance, please do not hesitate to call me at (919) 239-7203, or e-mail me at ivo.dernev@aecom.com.

cc: FILE (Wake County TIP Project I-5701)

cc: (*via e-mail as PDF attachments)*
Keith G. Dixon, State Traffic Forecast Engineer
Jim Dunlop, Congestion Management Section
Brenda Moore, PE, CPM, PE, Roadway Design Unit
Clark Morrison, PE, Pavement Management Unit
David Keilson, PE, Highway Division 5 Planning Engineer
Chris Lukasina, Capital Area MPO Director
Scott Walston, PE, TPB Triangle Group Supervisor




# 2018 AVERAGE ANNUAL DAILY TRAFFIC

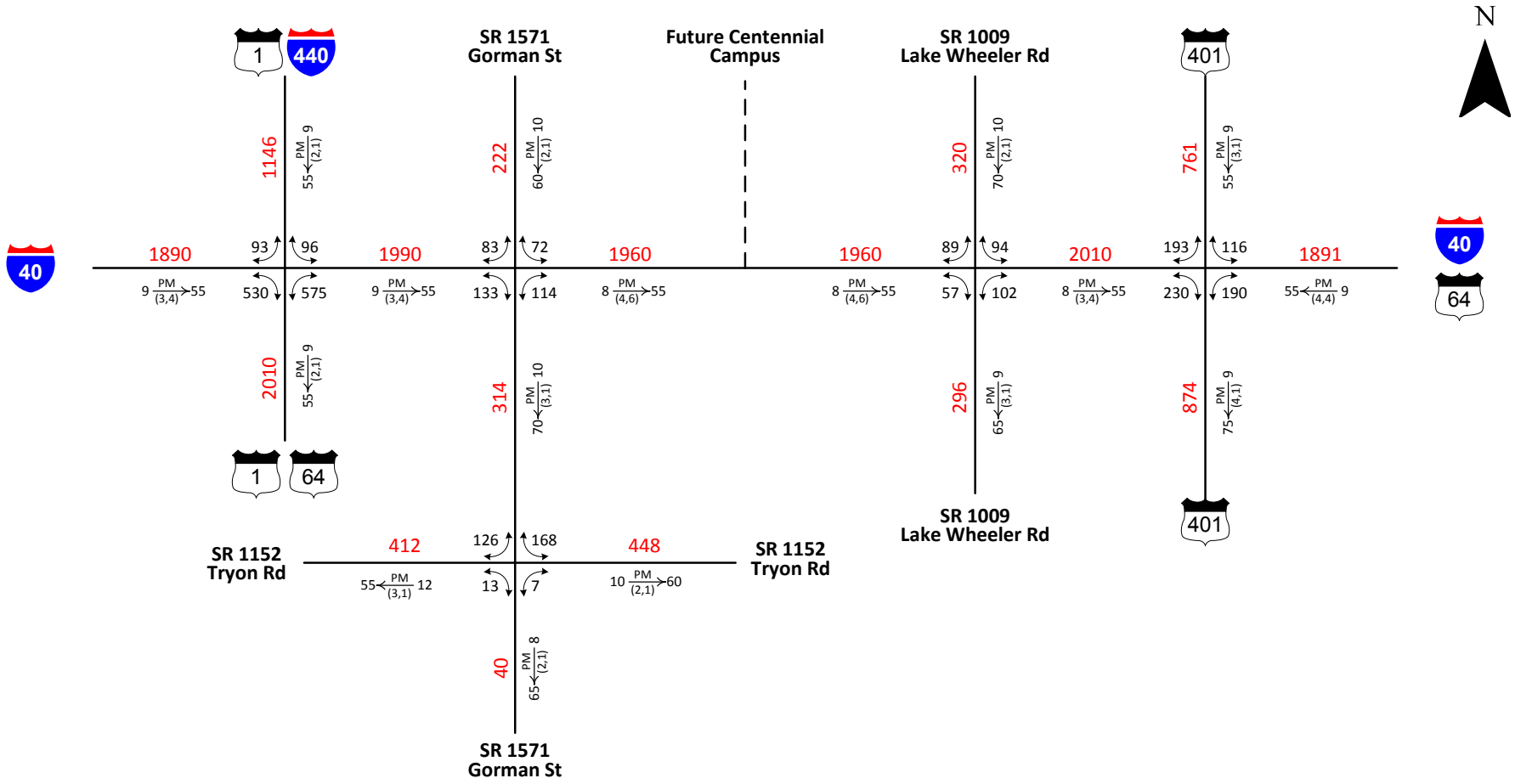
## BASE YEAR NO-BUILD

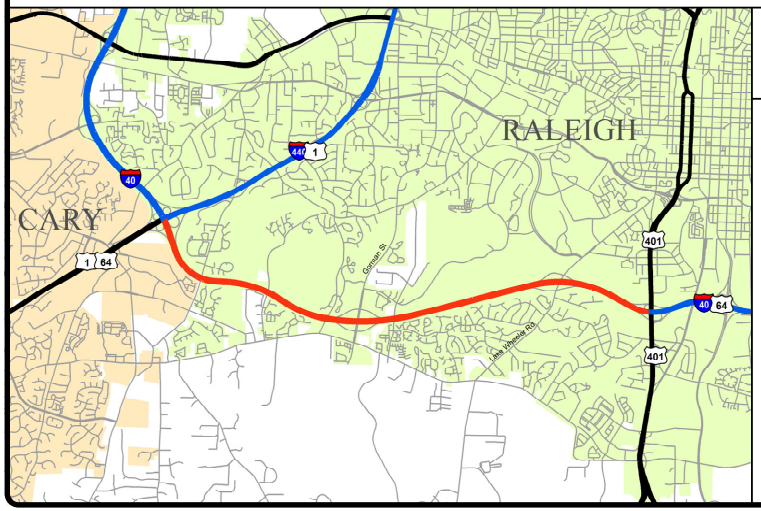
**SHEET 1 OF 4**

## LEGEND

| | |
|---|---|
| ### | No. of Vehicles Per Day in 100s |
| 1- | Less than 50 vpd |
| X | Movement Prohibited |
| K PM (d, t) D | |
| K | Design Hour Factor (%) |
| PM | PM Peak Period |
| D | Peak Hour Directional Split (%) |
| → | Indicates Direction of D |
| ( d, t ) | Duals, TT-STs (%) |

| | |
|---|---|
| **TIP:** I-5701 | **WBS:** 50119.1.1 |
| **COUNTY:** Wake | **DIVISION:** 5 |
| **DATE:** September 2018 | |
| **PREPARED BY:** AECOM | |
| **LOCATION:** I-40 from I-440 / US 1 / US 64 to US 401 | |
| **PROJECT:** Widen I-40 | |



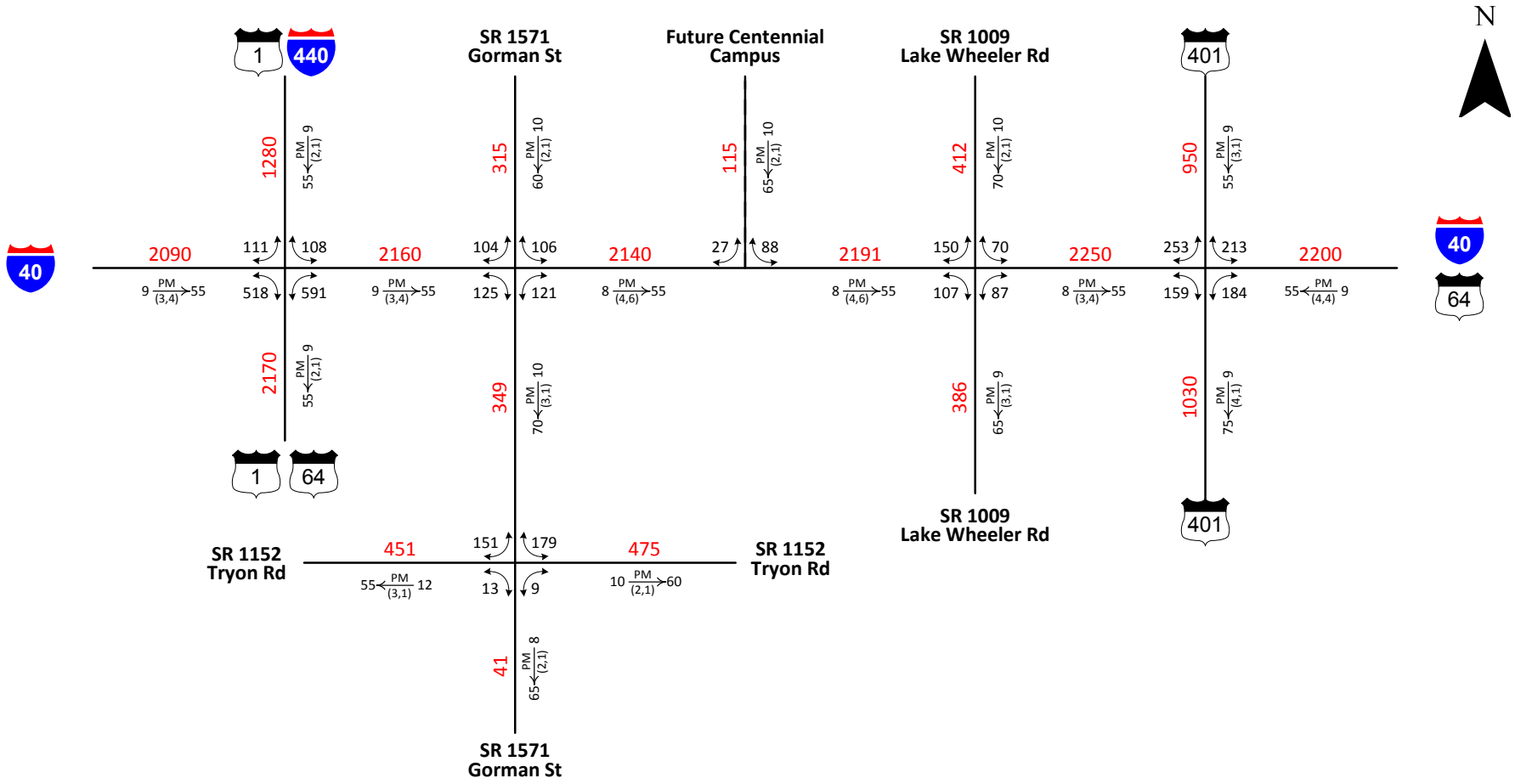

# 2018 AVERAGE ANNUAL DAILY TRAFFIC

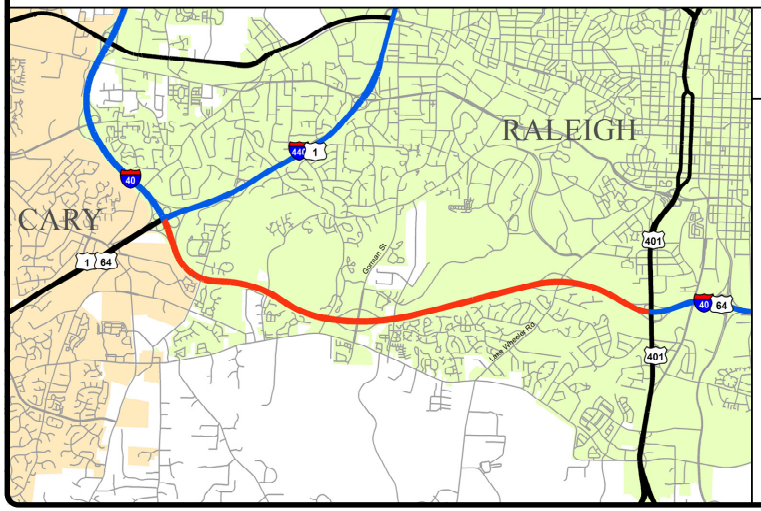
## BASE YEAR BUILD
**SHEET 2 OF 4**

## L E G E N D

| | |
|---|---|
| ### | No. of Vehicles Per Day in 100s |
| 1- | Less than 50 vpd |
| X | Movement Prohibited |
| K PM (d, t) D | |
| K | Design Hour Factor (%) |
| PM | PM Peak Period |
| D | Peak Hour Directional Split (%) |
| → | Indicates Direction of D |
| ( d, t ) | Duals, TT-STs (%) |

| | |
|---|---|
| **TIP:** I-5701 | **WBS:** 50119.1.1 |
| **COUNTY:** Wake | **DIVISION:** 5 |
| **DATE:** September 2018 | |
| **PREPARED BY:** AECOM | |
| **LOCATION:** I-40 from I-440 / US 1 / US 64 to US 401 | |
| **PROJECT:** Widen I-40 | |



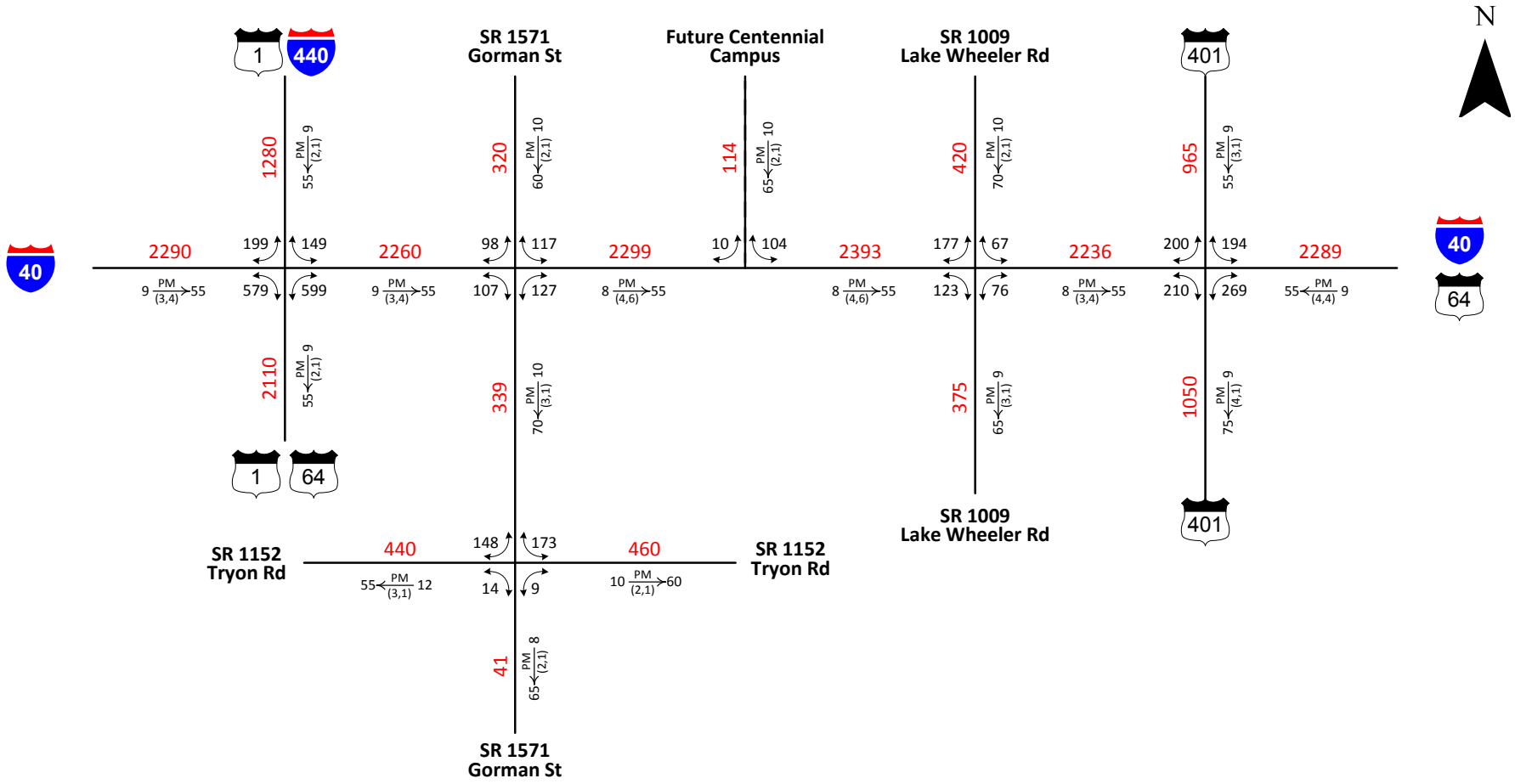

# 2045 AVERAGE ANNUAL DAILY TRAFFIC

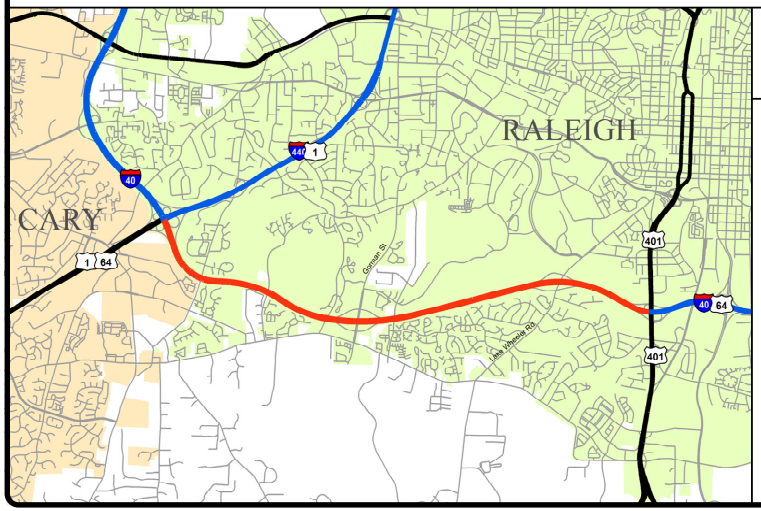
## FUTURE YEAR NO-BUILD
**SHEET 3 OF 4**

### L E G E N D

| | |
|---|---|
| ### | No. of Vehicles Per Day in 100s |
| 1- | Less than 50 vpd |
| X | Movement Prohibited |
| $K \xrightarrow{PM}_{(d,t)} D$ | |
| K | Design Hour Factor (%) |
| PM | PM Peak Period |
| D | Peak Hour Directional Split (%) |
| → | Indicates Direction of D |
| ( d, t ) | Duals, TT-STs (%) |

| | |
|---|---|
| **TIP:** I-5701 | **WBS:** 50119.1.1 |
| **COUNTY:** Wake | **DIVISION:** 5 |
| **DATE:** September 2018 | |
| **PREPARED BY:** AECOM | |
| **LOCATION:** I-40 from I-440 / US 1 / US 64 to US 401 | |
| **PROJECT:** Widen I-40 | |




# 2045 AVERAGE ANNUAL DAILY TRAFFIC

## FUTURE YEAR BUILD
**SHEET 4 OF 4**

## L E G E N D

| | |
|---|---|
| ### | No. of Vehicles Per Day in 100s |
| 1- | Less than 50 vpd |
| X | Movement Prohibited |
| K PM (d, t) D | |
| K | Design Hour Factor (%) |
| PM | PM Peak Period |
| D | Peak Hour Directional Split (%) |
| → | Indicates Direction of D |
| ( d, t ) | Duals, TT-STs (%) |

| | |
|---|---|
| **TIP:** I-5701 | **WBS:** 50119.1.1 |
| **COUNTY:** Wake | **DIVISION:** 5 |
| **DATE:** September 2018 | |
| **PREPARED BY:** AECOM | |
| **LOCATION:** I-40 from I-440 / US 1 / US 64 to US 401 | |
| **PROJECT:** Widen I-40 | |

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- Table C5: Model Validation
- Table C6: Growth Rates and 2045 Future Year Traffic Volumes

# 1.0 PROJECT BACKGROUND

AECOM Technical Services of North Carolina, Inc (AECOM) has been contracted by the North Carolina Department of Transportation (NCDOT) to develop base and future year traffic forecast for NCDOT State Transportation Improvement Program (STIP) Project:

- I-5701 – Widen I-40/US 64 from I-440/US 1/US 64 to SR 1370 (Lake Wheeler Rd) in Raleigh

## 1.1 PROJECT REQUEST INFORMATION

The traffic forecast for the projects was requested by the NCDOT's Project Development and Environmental Analysis (PDEA) Branch in support of the projects design and development. The scope of work for the traffic forecast, prepared by AECOM, was finalized in April, 2018.

The proposed project is located in Raleigh, North Carolina, within Wake County and is within the planning boundary of Capital Area Metropolitan Planning Organization (CAMPO). The projects purpose is to increase capacity and improve traffic flow and mobility on I-40 by adding lanes in each direction between I-440 /US 1 /US 64 and SR 1009 (Lake Wheeler Road) interchanges. The project length is approximately 5 miles.

Through project scoping with NCDOT it has been agreed that for the purpose of this forecast two 2018 Base Year and two 2045 Future Year scenarios would be developed. The 2018 Base Year traffic forecast includes one No-Build and one Build Scenario. The 2045 Future Year traffic forecast includes one No-Build and one Build Scenario. The evaluated scenarios are:

**Base Year 2018 No-Build** - Existing Conditions I-40:

- west of US1/64 interchange – 6 lanes
- between US 1/64 and SR 1571 (Gorman St) interchanges – 6 lanes
- between SR 1571 (Gorman St) and SR 1375 (Lake Wheeler Rd) interchanges – 6 lanes
- between SR 1375 (Lake Wheeler Rd) and US 401 (S Saunders St) interchanges – 6 lanes
- east of US 401 (S Saunders St) – 6 lanes

**Base Year 2018 Build** - Future Conditions I-40:

- west of US1/64 interchange – 6 lanes
- between US 1/64 and SR 1571 (Gorman St) interchanges – 8 lanes
- between SR 1571 (Gorman St) and SR 1375 (Lake Wheeler Rd) interchanges – 8 lanes
- between SR 1375 (Lake Wheeler Rd) and US 401 (S Saunders St) interchanges – 6 lanes
- east of US 401 (S Saunders St) – 6 lanes

**Future Year 2045 No-Build** - Existing Conditions I-40:

- west of US1/64 interchange – 8 lanes
- between US 1/64 and SR 1571 (Gorman St) interchanges – 6 lanes
- between SR 1571 (Gorman St) and SR 1375 (Lake Wheeler Rd) interchanges – 6 lanes
- between SR 1375 (Lake Wheeler Rd) and US 401 (S Saunders St) interchanges – 8 lanes
- east of US 401 (S Saunders St) – 8 lanes

**Future Year 2045 Build** - Future Conditions I-40:

- west of US1/64 interchange – 8 lanes
- between US 1/64 and SR 1571 (Gorman St) interchanges – 8 lanes
- between SR 1571 (Gorman St) and SR 1375 (Lake Wheeler Rd) interchanges – 8 lanes
- between SR 1375 (Lake Wheeler Rd) and US 401 (S Saunders St) interchanges – 8 lanes
- east of US 401 (S Saunders St) – 8 lanes

## 1.2 FORECASTS HISTORY

Three previously developed traffic forecasts overlap completely or partially with the current I-5701 project traffic forecast. The subject forecasts are:

- I-5701 - developed by NCDOT in 2013 and updated by AECOM in 2017.
  The project includes Improvements to I-440 – between just south of Walnut Street in Cary and north of Wade Avenue in Raleigh – needed to improve traffic flow, access and efficiency along the roadway (referred to locally as the Raleigh Beltline). Changes include widening I-440 from four to six lanes, replacing pavement and bridges and upgrading interchanges.
  Common areas between this and the current forecasts are the I-40 interchanges with I-440/US1/US64 and Gorman St.

- FS-1205A – project forecast was developed by KImley-Horn and Associates in 2014.
  The primary need for this project is to improve traffic flow and reduce traffic congestion along the I-40 corridor. The purpose of this study is to describe the transportation issue including proposed project cost, to develop and evaluate alternatives at a screening level, recommend an alternative, and identify potential impacts to the human and natural environment that may require consideration in future planning and design phases.
  The feasibility study includes the entire length of I-5701 forecast study area.

- FS-1005AB – traffic forecast was developed by NCDOT in 2014.
  The project includes Improvements to I-440 – between just south of Walnut Street in Cary and north of Jones Franklin Rd in Raleigh. Changes include removing ramps at Crossroads Blvd and adding interchange at Jones Franklin Rd.
  Common areas between this and the current forecasts are the I-40 interchanges with I-440/US1/US64 and Gorman St.

## 1.3 AREA INFORMATION

The traffic forecast study area along the subject project is an expansive, diverse, and fast-growing area of the city that is home to shopping areas (Crossroads Plaza) established neighborhoods to the north and south of I-40, along with many newly built subdivisions along Tryon Rd. The area includes Lake Johnson recreational area, NC State's Lonnie Poole Golf Course and State Farmers Market all located north of I-40. South of the mainline residential neighborhood connect to downtown Raleigh via Gorman St and Lake Wheeler Rd.

There are no know developments in near future within the project area vicinity.

## 1.4 ROUTE INFORMATION

### 1.4.1 PRIMARY INTERSTATES, US ROUTES AND NC ROUTES

**I-40**

Interstate 40 (I-40), is a part of the Interstate Highway System that runs from California to North Carolina. Locally, I-40 enters the state along the Pigeon River Gorge, from Tennessee. Crossing the entire state, it connects the cities of Asheville, Winston-Salem, Greensboro, Durham and Raleigh before ending in Wilmington. The landscapes traversed by I-40 include the Blue Ridge Mountains, foothills of western North Carolina, suburban communities, the urban core of several Piedmont cities, along with eastern North Carolina farmland. At a total of 423.55 miles (681.64 km), it is the longest interstate highway in North Carolina.

The approximately 5 mile long portion of I-40 within the project extents is a six-lane, divided interstate that forms part of the southern portion of the Raleigh beltline. This section of I-40 connects I-440/US 1/US 64 and the Crossroads Plaza, a popular shopping center in Cary, to the south side of Raleigh. The posted speed limit along the route is 65 mph. Within the project study area, AADT's along the route range from 115,000 to 117,000. The road is classified as "Interstate" road in the Federal Highway Classification System.

**I-440**

Interstate 440 (I-440), also known as the Raleigh Beltline, the Cliff Benson Beltline, or locally as just The Beltline, is a 16.4-mile-long partial beltway that nearly encircles central Raleigh I-440 begins at the interchange of I-40, US 1, and US 64 in southwest Raleigh. It then proceeds northwest shortly before turning north, running concurrently with US 1 for 11 miles until northeast of downtown Raleigh, where US 1 diverges and continues northeastward. I-440 terminates at an interchange with I-40 in southeast Raleigh. South of I-40, US 1 / US 64 link residential communities in southwestern Wake County to I-40 and I-440. I-440 is a divided interstate with number of lanes varying from four to eight lanes in both directions. The road is classified as "Interstate" road in the Federal Highway Classification System.

**US 1/US 64**

US Route 1 is a major north-south US Highway that travels through the East Coast region of the United States, running from the Canada-US border in Maine to Key West, Florida. Its 2,369 mile route makes it the longest north-south road in the United States. In North Carolina, US 1 runs for 174.1 miles (280.2 km) from the South Carolina state line, near Rockingham, to the Virginia state line, near Wise. It serves as a strategic highway, connecting the North Carolina Sandhills and Research Triangle regions. The roadway enters the forecast area from the southwest, running concurrent with US 64 until the interchange with Interstate 40. At that point, US 64 departs to the east to join Interstate 40, while US 1 continues to the northeast running concurrent with I-440. South of I-40, US 1 / US 64 links residential communities in southwestern Wake County to I-40 and I-440. Within the project area, US 1/US 64 is a four-lane, divided highway with a posted speed limit of 55 mph. The road is classified as "Other Freeway" road in the Federal Highway Classification System.

**US 401**

US Route 401 is an auxiliary route of US 1. US 401 connects the northeast suburbs to the heart of Raleigh all the way south to Fayetteville and on to Laurinburg. US 401 also connects Raleigh to Fort Bragg. In the heart of Raleigh, US 401 merges with US 1 (Capital Blvd). US 401 links Fayetteville, Fort Bragg, Harnett County, and southern Wake County, I-40, downtown Raleigh, and north Raleigh. In the project area, US 401 is a six-lane, divided roadway with a posted speed limit of 45 miles-per-hour. The road is classified as an "Other Principal Arterial" in the Federal Highway Classification System.

### 1.4.2 SECONDARY AND LOCAL ROADS

**SR 1571 (Gorman St)**

SR 1571 (Gorman St) is a north-south road in southwest Raleigh that connects I-40 to the NC State Main Campus and NC State Centennial Campus. Gorman St also serves as the primary road for Main Campus housing for NC State. Gorman St connects traffic from I-40 to Tryon Rd. In the project area, Gorman St is a four-lane, undivided road with a posted speed limit of 35 miles-per-hour. The road is classified as a "Minor Arterial" road in the Federal Highway Classification System.

**SR 1009 (Lake Wheeler Rd)**

SR 1009 (Lake Wheeler Rd) is a north-south route in south Raleigh. Lake Wheeler Rd connects south Raleigh to Wake Technical Community College heading south towards Fuquay Varina. Lake Wheeler Road parallels US 401 from South Raleigh to the outskirts of Fuquay Varina and is approximately 12 miles long. North of I-40, SR 1009 (Lake Wheeler Rd) travels north-northeast towards downtown Raleigh, providing access to NC State Centennial Campus and the State Farmers Market before terminating just southwest of downtown Raleigh at its intersection with S Saunders St. SR 1009 (Lake Wheeler Rd) is classified as a "Minor Arterial" road in the Federal Highway Classification System.

**SR 1152 (Tryon Rd)**

SR 1152 (Tryon Rd) is an east-west route south of Raleigh between the cities of Cary and Garner. Tyron Rd links US 1 / US 64, Gorman St, Lake Wheeler Rd, and US 401, providing an important connection to those routes for the many residential areas surrounding it. In the project area, Tryon Rd is surrounded by residential developments. Further west, the land use around Tryon Rd is predominantly commercial, including the Crossroads shopping center. In the project vicinity, Tryon Rd is a four-lane, divided roadway with a posted speed limit of 45 mph. Tyron Rd is classified as a "Minor Arterial" road in the Federal Highway Classification System.

### 1.5 FUTURE AREA ROADWAY IMPROVEMENTS – FISCAL CONSTRAINT

The 2045 CAMPO MTP was adopted in December 2017. Future fiscally constrained projects in the project vicinity included in the plan and anticipated to have possible impact on traffic volumes and patterns in the traffic forecast vicinity were taken into consideration during travel demand modeling and projecting future traffic volumes. These projects are listed in **Table 1**. All projects consistent with the MTP were included in the travel demand model runs.

**Table 1: MTP Projects in the Vicinity of the I-5701 Traffic Forecast**

| MTP No. | TIP Number | Description | MTP Horizon Year |
|---|---|---|---|
| F40 | I-5702 | I-40 Widening between Durham County Line and Wade Ave | 2035 |
| F81a | I-5704 | I-40 Widening between Wade Avenue and US 1-64 | 2035 |
| F41 | - | I-40 Managed Lanes (Toll) between Wade Avenue and Johnston County | 2030 |
| A197b | - | Main Campus Drive Connector | 2045 |
| F43b | I-5703 | I-40 / US 1 / US 64 Interchange Improvement | 2020 |
| A562 | - | Wade Ave Widening between I-40 and I-440 | 2045 |
| F10 | I-5701 | I-440 Widening from US 1/64 to Wade Ave | 2025 |
| F15a3 | U-5301C | US 64 (superstreet) between US 1 and Lake Pine Dr | 2025 |
| F15a | | US 64 West Conversion to Expressway between Laura Duncan Road and I-540 | 2035 |
| F16 | I-4744 | I-40 Widening between US 1-64 and Wade Avenue | 2020 |
| F110 | - | US 1 Widening between US 64 and NC 540 | 2045 |
| A37 | - | Walnut St widening between Maynard Rd and Macedonia Rd | 2035 |
| A560b | - | Jones Franklin Widening between I-440 and Dillard Dr | 2035 |
| A439 | - | Buck Jones Rd Widening between Farmgate Rd and Xebec Way | 2020 |
| A234 | - | Western Blvd Widening between Gorman St and Pullen Rd | 2045 |

Sources: 2045 CAMPO MTP

## 2.0 SOURCES OF INFORMATION AND DATA

The following sections describe the various information and data sources used in the development of the traffic forecast.

### 2.1 RELATED TRAFFIC FORECASTS

Three traffic forecasts described in Section 2.1 developed previously near or overlapping the current project vicinity were reviewed and past and future traffic volumes and design factors from those forecasts have been compared and considered during the development of the current forecast in order to ensure consistency and reasonableness. Recent forecasts that were found to be relevant and considered in the development and evaluation of this forecast are:

- I-5701 - developed by NCDOT in 2013 and updated by AECOM in 2017.
  The project includes Improvements to I-440 – between just south of Walnut Street in Cary and north of Wade Avenue in Raleigh – needed to improve traffic flow, access and efficiency along the roadway (referred to locally as the Raleigh Beltline). Changes include widening I-440 from four to six lanes, replacing pavement and bridges and upgrading interchanges.
  Common areas between this and the current forecasts are the I-40 interchanges with I-440/US1/US64 and Gorman St.

- FS-1205A – project forecast was developed by KImley-Horn and Associates in 2014.
  The primary need for this project is to improve traffic flow and reduce traffic congestion along the I-40 corridor. The purpose of this study is to describe the transportation issue including proposed project cost, to develop and evaluate alternatives at a screening level, recommend an alternative, and identify potential impacts to the human and natural environment that may require consideration in future planning and design phases.
  The feasibility study includes the entire length of I-5701 forecast study area.

- FS-1005AB – traffic forecast was developed by NCDOT in 2014.
  The project includes Improvements to I-440 – between just south of Walnut Street in Cary and north of Jones Franklin Rd in Raleigh. Changes include removing ramps at Crossroads Blvd and adding interchange at Jones Franklin Rd.
  Common areas between this and the current forecasts are the I-40 interchanges with I-440/US1/US64 and Gorman St.

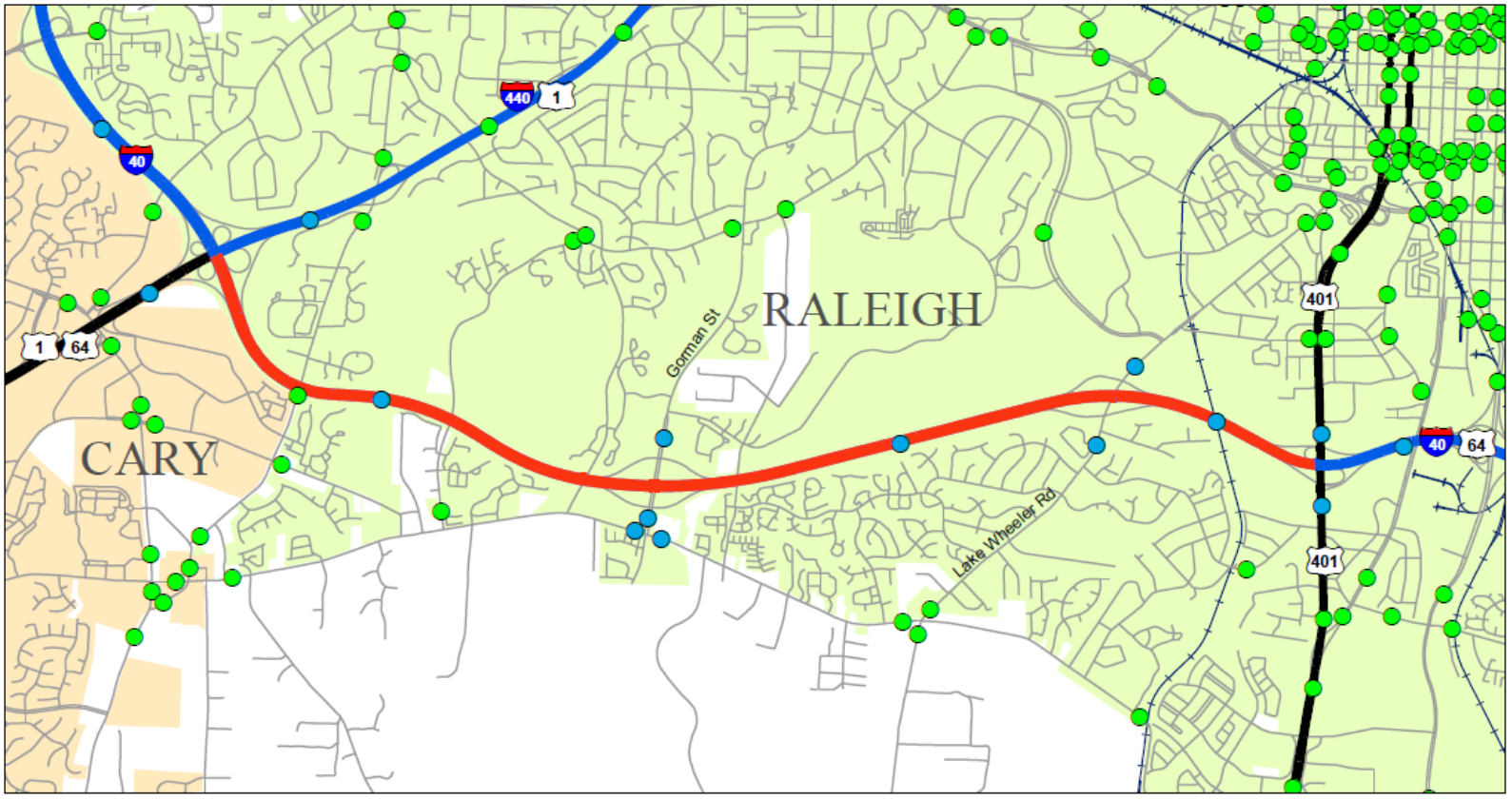
## 2.2 HISTORIC AADT

- Existing traffic count data for study area roadways was obtained from the NCDOT Traffic Survey Group (TSG) website. Data sources included:

  - NCDOT TSG Average Annual Daily Traffic (AADT) history from 1996 to 2016

The locations of the historic traffic data counts are shown in **Figure 1**. The complete 20-year AADT history for each location is found in Appendix A.

**Figure 1: NCDOT Historic AADT Locations**




**Legend**

- NCDOT AADT Stations selection
- NCDOT AADT Stations
- Project Study Area
- Interstates
- Primary Routes
- SR Routes
- Railroad
- Cary
- Raleigh

**NCDOT Historic AADT Locations**

Widen I-40 from I-440 / US 1 / US 64 to Lake Wheeler Rd
Wake County

**TIP: I-5701**
August 2018

FIGURE 1

Nothing Compares. NORTH CAROLINA

Data Source:
NCDOT, ESRI
AECOM - North Carolina

## 2.3 FIELD DATA COLLECTION

Mainline and ramp 48-Hour classification counts and intersection 16-Hour turning movement counts (TMC) throughout the study area were collected by the consultant. Five (5) classification counts were taken along with eight (8) ramp counts and seven (7) TMCs for this traffic forecast. Additional traffic counts taken by another engineering firm (Atkins) in the development of STIP project I-5703 traffic forecast were provided to AECOM.

All TMC locations fall under the TSG Automated Traffic Recorder (ATR) classification of Group 1 (The most dominant group in the State. Mostly rural in nature and is predominantly used for count locations on nonurban primary routes and all rural and most urban secondary roads) and Group 11 (Applies to urban interstate and some rural locations strongly influenced by nearby large urban areas).

The Class Count locations along I-40 and I-440/US 1/US 64 fall under the TSG Automated Traffic Recorder (ATR) classification of Group 11 (applies to urban interstate and some rural locations strongly influenced by nearby large urban areas). These locations are listed in **Table C1** of Appendix C and are displayed in **Figure 2.** The traffic count data can be found in Appendix D (Not Included in Final Forecast).

The TMCs were converted to 24-Hour volumes by applying the "Partial Weekday Count Expansion Factors" provided by NCDOT's Traffic Survey Group. The classification counts were converted to 24-Hour volumes by taking the average volume between the two 24 hour counts and applying the appropriate seasonal factors.

## 2.4 FIELD INVESTIGATION

Few field investigation trips were taken between April and August of 2018 by AECOM staff. The staff observed traffic patterns and site developments to verify the reasonableness of the Base Year traffic forecast after completion of the I-40/I-440 Fortify Project. The staff also verified the geometric roadway attributes coded into the travel demand model.

## 2.5 INFORMATION FROM LOCAL PLANNERS

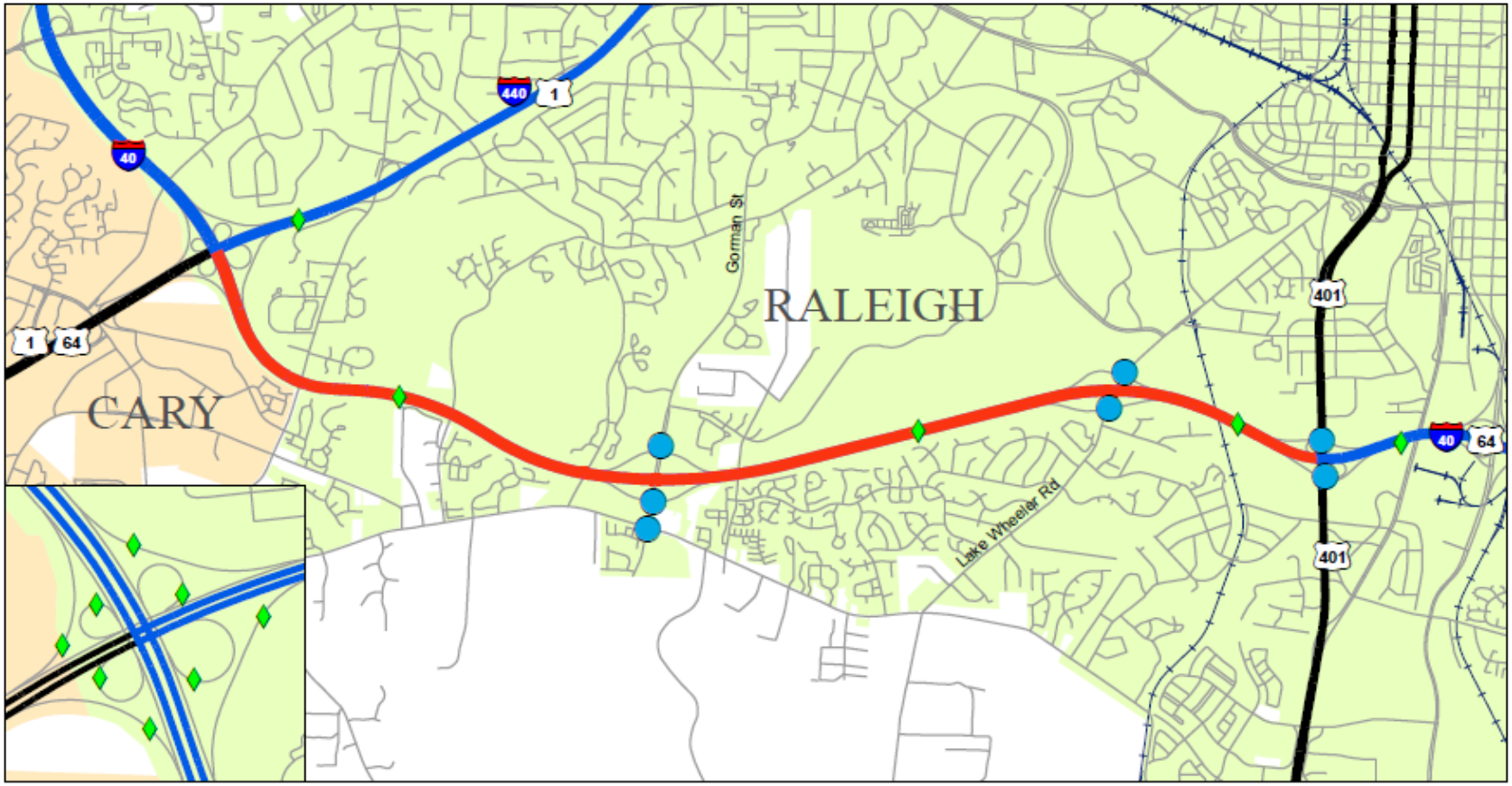
Local planners and engineers were contacted to discuss the project and Traffic Forecast Study Area. Table B1, included in Appendix B shows the contacted stakeholders and their respective responses.

## 2.6 OTHER SOURCES

Data sources used that are not listed in Sections 2.1 through 0 include:

- Joint CAMPO and DCHC MPO 2045 MTP
- North Carolina Department of Transportation. North Carolina Strategic Transportation Corridors. Accessed April 2017.
- Federal Highway Administration "Functional Classification Highway Maps": https://connect. ncdot. gov/projects/planning/Pages/Functional-Classification-of-Highways. aspx. Accessed April, 2017.

**Figure 2: Collected Traffic Count Locations**




**Legend**

- Turning Movement Counts
- Vehicle Classification Counts
- Project Study Area
- Interstates
- Primary Routes
- SR Routes
- Railroad
- Cary
- Raleigh

**Traffic Count Locations**

Widen I-40 from I-440 / US 1 / US 64 to Lake Wheeler Rd

Wake County

**TIP: I-5701**

August 2018

FIGURE 2

Nothing Compares NORTH CAROLINA

Data Source:
NCDOT, ESRI
AECOM - North Carolina

# 3.0 2012 BASE YEAR NO-BUILD TRAFFIC FORECAST (EXISTING CONDITIONS)

A Base Year of 2018 was chosen for the I-5701 Traffic Forecast. One Base Year No-Build Alternative was analyzed in the development of this forecast:

- **Base Year 2018 No-Build** - Existing Conditions

## 3.1 METHODOLOGY

A review of previous traffic forecasts, field-collected traffic counts, area AADT history, comparison to the Triangle Regional Travel Demand Model - Version 6 (TRTDM V6) volumes and engineering judgment serve as the basis for the 2018 Base Year No-Build Traffic Forecast.

After careful review for reasonableness checks, the 48-Hour mainline classification counts and 16-Hour TMCs were first converted to AADT volumes by using the appropriate NCDOT TSG expansion and seasonal adjustment factors based on the month and day of the week the counts were collected. 2018 Interim Year No-Build model volumes were interpolated between the 2013 Base Year and 2045 Future Year No-Build runs, completed without project I-5701 in place.

A variation of the NCDOT Traffic Forecast Utility (TFU) spreadsheet was also a major tool used in the determination of the traffic forecast volumes. The NCDOT TFU spreadsheet includes the calculation of a validation score that considers the approach volumes and design factors for each intersection. The score is utilized as a tool in selecting the appropriate volumes and factors with a score that is less than 1.0 being considered to be valid. However, if a score is greater than 1.0 it will receive additional evaluation to determine if the selected volumes and factors are acceptable, especially for those that are based on count data and well established travel patterns or trends. Ultimately, the approach volumes and factors will be selected based on engineering judgment such that the AADTs and turn movements can be converted to peak hour volumes.

The data from the field-collected traffic counts was incorporated into the spreadsheet in order to replicate volumes as closely as possible for each intersection in the traffic forecast. The traffic forecast volumes for the 2018 Base-Year traffic forecast mimic the observed patterns found in the collected traffic counts. Once the traffic forecast volumes were determined, they were compared to historic AADT trends for reasonableness.

**Table C2** in Appendix C provides a comparison of historic AADT trends, field collected data, model volumes, previous traffic forecast and the selected traffic forecast volumes for all locations within the study area. The chosen forecast values typically match or vary minimally from the field collected data.

## 3.2 DESIGN FACTORS

Design factors are a very important aspect of traffic forecasting. The truck percentages, peak hour factor (or K-Factor), and directional distribution are all used along with forecasted traffic volumes when designing a roadway. The methodology and chosen values for each of the aforementioned factors are described below.

**Truck Percentages**

Truck Percentages were determined using the 48-Hour mainline classification count data, the 13-Hour TMC data, NCDOT HPMS data and relevant traffic forecasts. Overall truck percentages were separated into the two NCDOT standard classifications: Duals (single-unit trucks with at least one dual-tired axle) and TTSTs (multi-unit trucks with single or twin trailers). Attempts were made to maintain consistent truck percentages along a roadway facility unless circumstances warranted a change. Data used in determining the truck percentages and the chosen values are found in **Table C3** in Appendix C.

**Directional Distribution**

The directional distribution (D) provides information on the direction of traffic flow in the peak period. Generally D is in the 50% to 65% range. D values ranged from 55% to 80%. **Table C4** in Appendix C provides the D value information used for this traffic forecast.

**Peak Hour Factor**

The peak hour factor (K) is the percentage of AADT that occurs during the peak time period of the day. The K-factor is meant to approximate what percentage of daily traffic would be present during the 30$^{th}$ highest peak hour of a given year, which is commonly referred to as $K_{30}$. To determine the K-value for the classification counts the highest hourly volume was divided by the daily average of the 48-Hour counts. Typically, the roadways with higher classification and volumes tend to have lower K-factors. The K-factor information used for this forecast is found in **Table C5** in Appendix C.

### 3.3 TRAFFIC FORECAST VOLUMES

Based on the methodology described in Section 3.1, traffic forecasts for the 2018 Base Year No-Build Scenario were calculated. These traffic volumes were also compared to overlapping previously completed traffic forecasts. A comparison of the Base Year No-Build volumes at key locations is found in **Table C2** in Appendix C. The difference in traffic volumes could be contributed to the different base years used in the previous and current forecast, as well as additional development that has occurred prior the completion of the previous traffic forecasts.

## 4.0 MODEL DATA

The TRTDM V6 was used as a tool to determine the growth rate for the roadway segments analyzed in the forecast. Highway networks, transit networks, socio-economic data, and external trip tables for the base and future years are included in the official TRM files. It utilizes the software program TransCAD (version 7) to perform the model runs. The 2013 Base Year model was reviewed for the project area and the surrounding areas. No issues were found with the networks. **Table C6** in Appendix C displays 2013 Base Year model performance and interpolated 2018 model volumes compared to the 2018 NCDOT AADTs. After comparison of the model and AADT volumes for the same locations, volumes that differed by more than 10 (ten) percent were given additional consideration and engineering judgement was used in selecting the 2018 forecast volumes at these locations.

# 5.0 2018 BASE YEAR BUILD TRAFFIC FORECAST

## 5.1 ASSUMPTIONS

Base Year 2018 Build Scenario was developed for this forecast. The following differences with the NB Scenario were implemented:

- I-40 between I-440/US 1/US 64 and US 401 (S Saunders St) interchanges – 6 lanes were changed to 8

While Socio-economic data for BY was utilized in this scenario model run, interim year 2035 roadway network with implementation of managed lanes along I-40 was used in order for comparability and the possibility for interpolation between Base Year Build and Future Year Build Scenarios.

## 5.2 METHODOLOGY

The TRTDM V6 was an essential tool in the determination of diversion rates and the estimation of 2018 Base Year Build traffic volumes. Diversion factors between the BY NB and BY B model runs were established. While travel demand model predictions played a critical part in determining diversion factors within the study area, judgement calls were made to use rates different from the modeled ones at certain locations.

Diversion rate is the ratio between volumes from build and no-build scenarios in the same forecasted year. They can be used as a reasonableness check in volume development when growth rates are being utilized, but in the absence of growth rates, diversion rates are employed to establish a correlation between traffic volumes of different scenarios in the same year.

$$Diversion\ Rate\ (\%) = \left(\frac{Build\ scenario\ total\ flow\ -\ No\ Build\ scenario\ total\ flow}{No-Build\ scenario\ total\ flow}\right) \times 100$$

## 5.3 DESIGN FACTORS

The 2018 Year Build model network was reviewed to see if the study area experienced changes in the percent of traffic occurring in the peak hour, direction of peak travel, or directional split. Based on a review of the model data and knowledge of the forecast study area and anticipated growth in the area, it was determined that no design factors for the Base Year Build Alternative would change within the forecast study area.

# 6.0 FUTURE YEAR 2045 NO-BUILD TRAFFIC FORECAST

## 6.1 ASSUMPTIONS

A Future Year of 2045 was chosen for the I-5701 traffic forecast. The 2045 fiscally-constrained projects (see Section 1.5) found in the 2045 CAMPO MTP, with the exception of I-5701 were included in the 2045 No-Build Alternative model run.

## 6.2 METHODOLOGY

The 2013 TRM was an essential tool in the determination of future growth rates and the estimation of 2045 Future Year No-Build traffic volumes. The model has a base year of 2013 and future year of 2045. No issues were found with the networks. A combination of growth rates from the 2013 TRM and historic AADT was relied on in the calculation of the forecast growth rates and the 2045 Future Year No-Build traffic volumes and while travel demand model predictions played critical part in determining growth rates along the projects corridor, considering AADT growth rates, judgement call was made to use rates different from the modeled ones at certain locations.

2013 Base Year and a 2045 Future Year model runs were completed. The Compound Annual Growth Rate (CAGR) for each traffic volume location was calculated using the following equation:

$$((2045\ Model\ Value/2013\ Model\ Value)^{1/32}) - 1$$

The CAGR rates were adjusted during this phase using engineering judgment where needed. The selected CAGR rates were then applied to the 2018 No-Build traffic volumes to determine the 2045 No-Build traffic volumes. Table C6 in Appendix C shows the comparisons of historic growth rates, model output, CAGRs, and selected volumes. Some of the volumes were modified slightly to allow for the development of a balanced network.

According to socioeconomic data obtained from the North Carolina Office of State Budget and Management, population growth rates in Wake County are lower compared to growth rates from the previous decade, following similar trend for the State of North Carolina. Between 2000 and 2010, the population of Wake County has grown from 627,865 to an estimated 906,964, or approximately 44.5%. The growth is estimated to continue as Census projections indicate and in 2020 Wake County is expected to have grown by another 23.4% to a population of 1,119,118. The county growth data can be found in **Table 2 and Table 3.**

**Table 2: Area and State Population Growth 2000 - 2036**

| Population | 2000 | 2010 | 2020 | 2030 | 2037 |
|---|---|---|---|---|---|
| Wake Co | 633,333 | 906,951 | 1,116,912 | 1,348,745 | 1,511,392 |
| North Carolina | 8,081,986 | 9,574,344 | 10,619,432 | 11,759,744 | 12,553,271 |

Source: http://www. osbm. nc. gov/demog/county-projections

**Table 3: Area and State Population Growth Percentages 2000 - 2035**

| Population Growth | 2000-2010 | 2010-2020 | 2020-2030 | 2030-2036 |
|---|---|---|---|---|
| Wake Co | 4.3% | 2.3% | 2.1% | 1.7% |
| North Carolina | 1.8% | 1.1% | 1.1% | 1.0% |

Source: http://www. osbm. nc. gov/demog/county-projections

## 6.3 DESIGN FACTORS

The 2045 Year No-Build model network was reviewed to see if the I-40 corridor experienced changes in the percent of traffic occurring in the peak hour, direction of peak travel, or directional split. Based on a review of the model data and knowledge of the forecast study area and anticipated growth in the area, it was determined that no design factors for the Future Year No-Build Alternative would change within the forecast study area.

# 7.0 FUTURE YEAR 2045 BUILD TRAFFIC FORECAST ALTERNATIVES

## 7.1 ASSUMPTIONS

One Build Alternative was developed for Future Year 2045. The build alternative was described in Section 1. 1 of this report. The FY 2045 Build Alternative traffic forecast contains the same assumptions found in the 2045 No-Build traffic volume network discussed in Chapter 6 with the exception that Project I-5701 is in place. The following differences with the NB Scenario were implemented:

- I-40 between I-440/US 1/US 64 and US 401 (S Saunders St) interchanges – 6 lanes were changed to 8

## 7.2 METHODOLOGY

The TRM V6 was relied upon in the calculation of the forecast growth rate and the 2045 Future Year Build traffic volumes.

Model runs for BY 2013 NB and FY 2045 with the corresponding Build Scenario were completed and growth rates extracted. Growth rates were then compared and checked for reasonableness and utilized in the determination of future traffic volumes. **Table C7** in Appendix C shows the comparisons of model growth rates and volumes and selected forecast growth rates and volumes. Engineering judgment adjustments were applied as needed in finalizing the volumes in order to develop a balanced forecast.

Model runs for the FY 2045 Build Alternatives were completed and diversion factors between the FY 2045 Build Alternatives and the FY 2045 No-Build Scenario were developed. Additionally growth rates between BY 2012 NB volumes and FY 2045 Build Alternatives volumes were developed and used for comparison and as a reasonableness check when selecting the diversion factors utilized in determination of future traffic volumes. Table C6 in Appendix C shows the comparisons of model growth rates, model diversion factors and selected forecast diversion factors and volumes. Engineering judgment adjustments were applied as needed in finalizing the volumes in order to develop a balanced forecast.

## 7.3 DESIGN FACTORS

The 2045 Year Build model network was reviewed to see if the I-40 corridor experienced changes in the percent of traffic occurring in the peak hour, direction of peak travel, or directional split. Based on a review of the model data and knowledge of the forecast study area and anticipated growth in the area, it was determined that no design factors for the Future Year Build Alternative would change within the forecast study area.

# Appendix A

## NCDOT Historic AADT Data

## Appendix A - NCDOT Historic AADT Data

| Location | Station ID | 2016 | 2015 | 2014 | 2013 | 2012 | 2011 | 2010 | 2009 | 2008 | 2007 | 2006 | 2005 | 2004 | 2003 | 2002 | 2001 | 2000 | 1999 | 1998 | 1997 | 1996 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I-40 FROM EXIT 291 TO EXIT 293 (west of I-440/US1/US64) | 9100638 | 119,000 | 118,000 | 114,000 | 111,000 | 110,000 | 105,000 | 99,000 | 98,000 | 96,000 | 102,000 | 102,000 | 106,000 | 105,000 | 96,000 | 96,000 | 98,000 | 85,000 | 77,000 | 74,000 | - | 70,000 |
| I-40 FROM EXIT 293 TO EXIT 295 (between I-440/US1/US64 and SR 1571 (Gorman St)) | 9100637 | 116,000 | 119,000 | 118,000 | 114,000 | 112,000 | 109,000 | 106,000 | 108,000 | 101,000 | 113,000 | 109,000 | 111,000 | 109,000 | 103,000 | 101,000 | 103,000 | 94,000 | 87,000 | 84,000 | - | 76,000 |
| I-40 FROM EXIT 295 TO EXIT 297 (between SR 1571 (Gorman St) and SR 1009 (Lake Wheeler Rd)) | 9100635 | 110,000 | 115,000 | 114,000 | 111,000 | 111,000 | 108,000 | 107,000 | 108,000 | 102,000 | 112,000 | 112,000 | 111,000 | 106,000 | 101,000 | 99,000 | 101,000 | 94,000 | 88,000 | 86,000 | - | 78,000 |
| I-40 FROM EXIT 297 TO EXIT 298 (between SR 1009 (Lake Wheeler Rd) and US401 (S Saunders St)) | 9100634 | 113,000 | 119,000 | 119,000 | 117,000 | 115,000 | 113,000 | 113,000 | 113,000 | 106,000 | 115,000 | 115,000 | 113,000 | 108,000 | 104,000 | 101,000 | 104,000 | 97,000 | 91,000 | 89,000 | - | 78,000 |
| I-40 FROM EXIT 298 TO EXIT 299 ( East of US401 (S Saunders St)) | 9100633 | 105,000 | 111,000 | 111,000 | 114,000 | 110,000 | 107,000 | 106,000 | 107,000 | 102,000 | 109,000 | 108,000 | 107,000 | 99,000 | 97,000 | 94,000 | 94,000 | 90,000 | 86,000 | 83,000 | - | 75,000 |
| I-440 N of I-40 | 9100064 | 83,000 | 78,000 | 77,000 | 75,000 | 75,000 | 76,000 | 76,000 | 72,000 | 64,000 | 76,000 | 72,000 | 78,000 | 81,000 | 79,000 | 73,000 | 74,000 | 71,000 | - | 64,000 | - | - |
| US 1-64 S of I-40 | 9100895 | - | 138,000 | - | 137,000 | - | 131,000 | - | 126,000 | - | - | - | - | - | 71,000 | - | 58,000 | - | - | 68,000 | - | 52,000 |
| SR 1571 (GORMAN ST) N OF I-40 | 9100636 | - | 18,000 | - | - | - | 16,000 | - | 18,000 | - | 18,000 | - | 17,000 | - | 19,000 | - | 16,000 | - | - | 17,000 | - | - |
| SR 1571 (GORMAN ST) Between I-40 and SR 1009 TRYON RD | 9103450 | - | 26,000 | - | - | - | 19,000 | - | 20,000 | - | 18,000 | - | - | - | - | - | - | - | - | - | - | - |
| SR 1009 (LAKE WHEELER RD) N OF I-40 | 9100087 | - | 22,000 | - | 19,000 | - | 18,000 | - | 19,000 | - | 20,000 | - | 19,000 | - | 18,000 | - | 16,000 | - | - | 15,000 | - | - |
| SR 1009 (LAKE WHEELER RD) S Between I-40 and KIRKLAND RD | 9109657 | - | 21,000 | - | 16,000 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| US401 (S Saunders St) N of I-40 | 9100486 | - | 50,000 | - | 41,000 | - | 43,000 | - | 42,000 | - | 41,000 | - | 42,000 | - | 42,000 | - | 42,000 | - | - | 42,000 | - | 38,000 |
| US401 (S Saunders St) S of I-40 | 9109658 | - | 63,000 | - | 51,000 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| SR 1009 (TRYON RD) W OF SR 1571 (GORMAN ST) | 9100930 | - | 29,000 | - | 24,000 | - | 23,000 | - | 22,000 | - | 21,000 | - | 21,000 | - | 19,000 | - | 16,000 | - | - | 15,000 | - | - |
| SR 1009 (TRYON RD) E OF SR 1571 (GORMAN ST) | 9103449 | - | 29000 | - | 26000 | - | 23000 | - | 23000 | - | 21000 | - | - | - | - | - | - | - | - | - | - | - |

# Appendix B

## Local Contacts Table

**Table B1: Local Contacts Table**

| Name of Contact | Organization | Date of Contact | Contact Info | Information |
|---|---|---|---|---|
| Mark Eatman, PE | NCDOT TPB - Capital Area Metropolitan Planning Organization (CAMPO) Coordinator | 06/27/2018 | Phone: (919) 707-0923<br>Email: mreatman@ncdot.gov | No response was provided |
| Joey Hopkins, PE | NCDOT Div. 5<br>Division Engineer | 06/27/2018 | Phone: 919-220-4600<br>Email: jhopkins@ncdot.gov | No response was provided |
| David Keilson, PE | NCDOT Div. 5<br>Planning Engineer | 06/27/2018 | Phone: 919-220-4600<br>Email: dpkeilson@ncdot.gov | No response was provided |
| Chris Lukasina | Capital Area MPO - Executive Director | 06/27/2018 | Phone: (919) 996-4402<br>Email: chris.lukasina@campo-nc.us | No response was provided |
| Shelby Powell | Capital Area MPO (Raleigh)<br>Deputy Director | 06/27/2018 | Phone: 919-996-4393<br>Email: Shelby.Powell@campo-nc.us | No response was provided |
| Keith Lankford | Planner III<br>Wake County Planning Department | 06/27/2018 | Phone: 919-856-7569<br>Email: keith.lankford@wakegov.com | Response Attached |
| Tim Gardiner | Planner III - Transportation<br>Wake County Planning Department | 06/27/2018 | Phone: 919-856-5477<br>Email: Tim.Gardiner@wakegov.com | No response was provided |
| Michael Moore | City of Raleigh<br>Transportation Director | 06/27/2018 | Phone: 919-996-3030<br>Email: Michael.Moore@raleighnc.gov | No response was provided |
| Eric Lamb, PE | City of Raleigh<br>Manager, Office of Transportation Planning | 06/27/2018 | Phone: 919-996-2161<br>Email: eric.lamb@raleighnc.gov | No response was provided |
| Gerald Daniel | Capital Area MPO<br>Transportation Modeling Engineer | 06/27/2018 | Phone: 919-996-4395<br>Email: Gerald.Daniel@raleighnc.gov | Response Attached |
| Kenneth Withrow | Capital Area MPO<br>Senior Transportation Planner | 06/27/2018 | Phone: 919-996-4394<br>Email: Kenneth.Withrow@campo-nc.us | Response Attached |

Gerald Daniel

# TIP Project I-5701 (I-40 Widening) Traffic Forecast Questionnaire

The goal of this traffic forecast is to analyze existing and determine future traffic volumes within the project study area (see included figure). The following is a list of the studied interchanges and intersections:

1. I-40 at I-440
2. I-40 at Gorman Street
3. I-40 at Future Centennial Campus Connection
4. I-40 at Lake Wheeler Road
5. I-40 at US 401 (S Sanders St)

Please provide answers to the following questions to the best of your ability and knowledge of the study area:

1. Are you aware of any traffic trends that have affected traffic in the past 4-5 years? Rehabilitation of I-40/I-440 from the I-40/I-440/U.S. 64 interchange, at Exit 301, to just north of I-495/U.S. 264/Knightdale Bypass, at Exit 14 (Project Fortify)

2. Do you know of any recent or planned developments that may have a substantial effect on traffic volumes or patterns in the study area? Maybe the Renaissance Park development in SE Raleigh once it is built out.

3. Are there any local projects that may affect traffic volumes or patterns along the study area?

    a. Walnut Street widening (from Macedonia to US 1, 4-6 lanes by 2020)
    b. Cary Pkwy Southern Extension, 0-2 lanes by 2020
    c. Tryon Road widening (from Lake Wheeler Road to NSRR lines, 2- 4 lanes by 2020)

4. Do you know of any areas in the project vicinity where the future growth may be different than the assumptions in the socioeconomic data included in the Wilmington Model? CAMPO uses the TRM V6 model and its associated SE Data generated via CommunityViz for this area, please see the attached TAZ shapefile containing SE Data for this region for comparison.

5. Do traffic volumes on the roadways within the traffic forecast study area experience any major seasonal fluctuations? Not to my knowledge.

6. Can you identify any locations within the traffic forecast study area that experience substantial recurring congestion? US 1/64/440 interchange

7. What do you think is the peak period length every day? 1.5-2 hrs each peak period. Is there any evidence that the peak period is getting longer or more severe? I am not aware of any such evidence in terms of duration, only severity in terms of VHT and VoC.

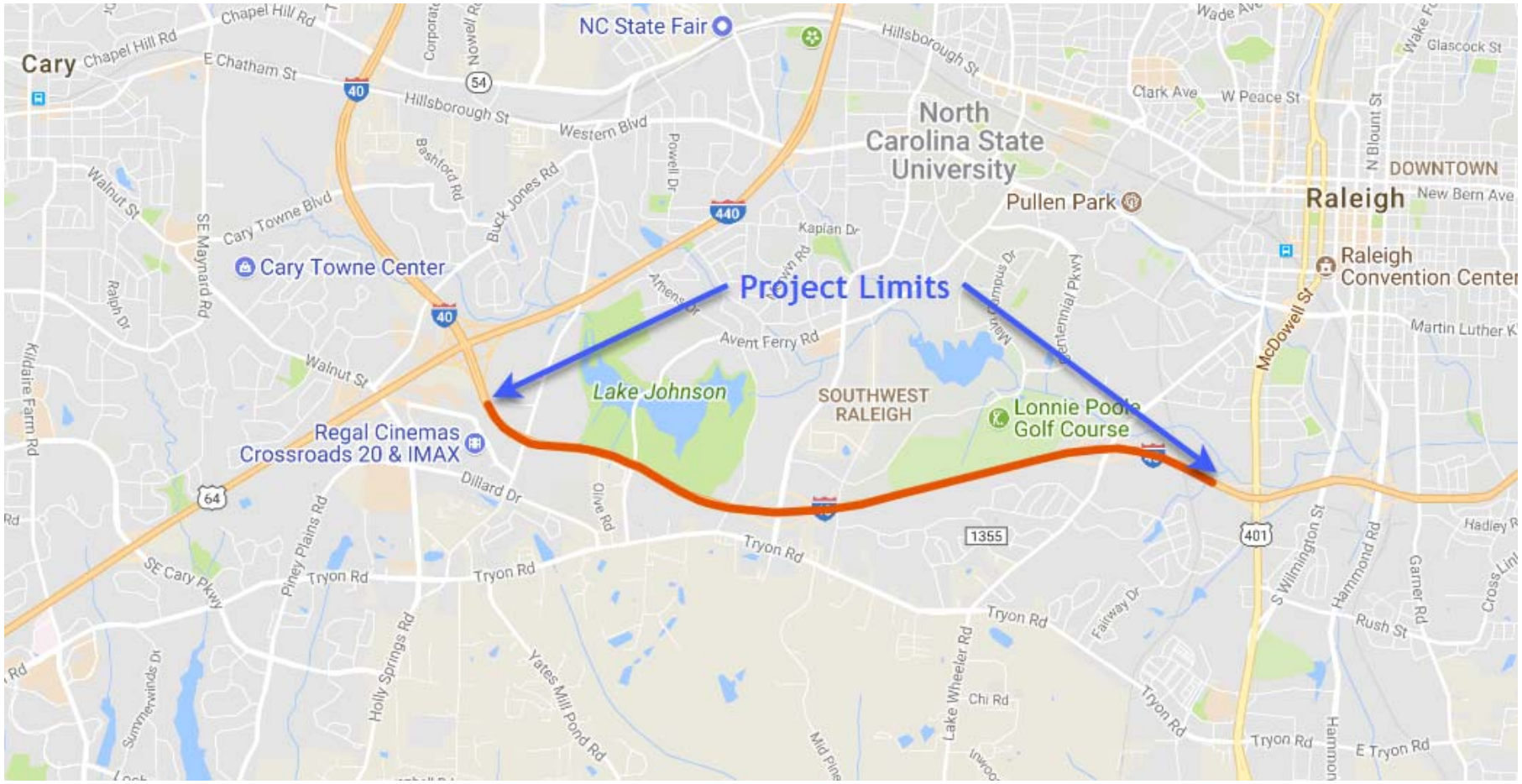
8. Do you know of any major employers or facilities that may be increasing or decreasing their size, shifting their work hours or changing the amount of truck traffic that may affect traffic volumes or patterns in the area? Not aware.

Gerald Daniel

9. Do you have any local data or information (traffic counts, recent plans or studies, traffic impact analyses or development plans) that would be helpful in developing the traffic forecasts? N/A

   Please feel free to provide any additional information that you feel will be helpful in the development this traffic forecast!

Gerald Daniel



Keith A. Lankford

# TIP Project I-5701 (I-40 Widening) Traffic Forecast Questionnaire

The goal of this traffic forecast is to analyze existing and determine future traffic volumes within the project study area (see included figure). The following is a list of the studied interchanges and intersections:

1. I-40 at I-440
2. I-40 at Gorman Street
3. I-40 at Future Centennial Campus Connection
4. I-40 at Lake Wheeler Road
5. I-40 at US 401 (S Sanders St)

Please provide answers to the following questions to the best of your ability and knowledge of the study area:

Please note that the subject roadway is located completely within the City of Raleigh's and the Town of Cary's zoning jurisdictions, although Wake County has some contributory zoning jurisdiction nearby (along Yates Mill Pond Road and along Lake Wheeler Road south of Inwood Road—see related responses below). I have focused my responses on that Lake Wheeler Road area.

1. Are you aware of any traffic trends that have affected traffic in the past 4-5 years?
   Nothing in specific, just a steady increase in traffic from regional growth.

2. Do you know of any recent or planned developments that may have a substantial effect on traffic volumes or patterns in the study area?
   We recently approved a subdivision, Olde Mill Trace, of 155 lots on the eastern side of Lake Wheeler Road just south of where Penny Road intersects.

3. Are there any local projects that may affect traffic volumes or patterns along the study area?
   These would come through Raleigh and/or Cary.

4. Do you know of any areas in the project vicinity where the future growth may be different than the assumptions in the socioeconomic data included in the Wilmington Model?
   None known, not familiar with that model—I'd be curious to see a summary of the model

5. Do traffic volumes on the roadways within the traffic forecast study area experience any major seasonal fluctuations?
   Not familiar with any specific data, but there may be some seasonal increase in traffic in warmer months related to visitors to the State Farmer's Market and Yates Mill County Park (including school field trips as this is an educational park). Along those lines, NCSU is proposing to build a dairy museum across from Yates Mill County Park.

6. Can you identify any locations within the traffic forecast study area that experience substantial recurring congestion?
   See the response to question # 9 below.

7. What do you think is the peak period length every day? Is there any evidence that the peak period is getting longer or more severe?
   Probably the typical commuter peak of 7AM to 9AM and 4PM to 6PM

Keith A. Lankford

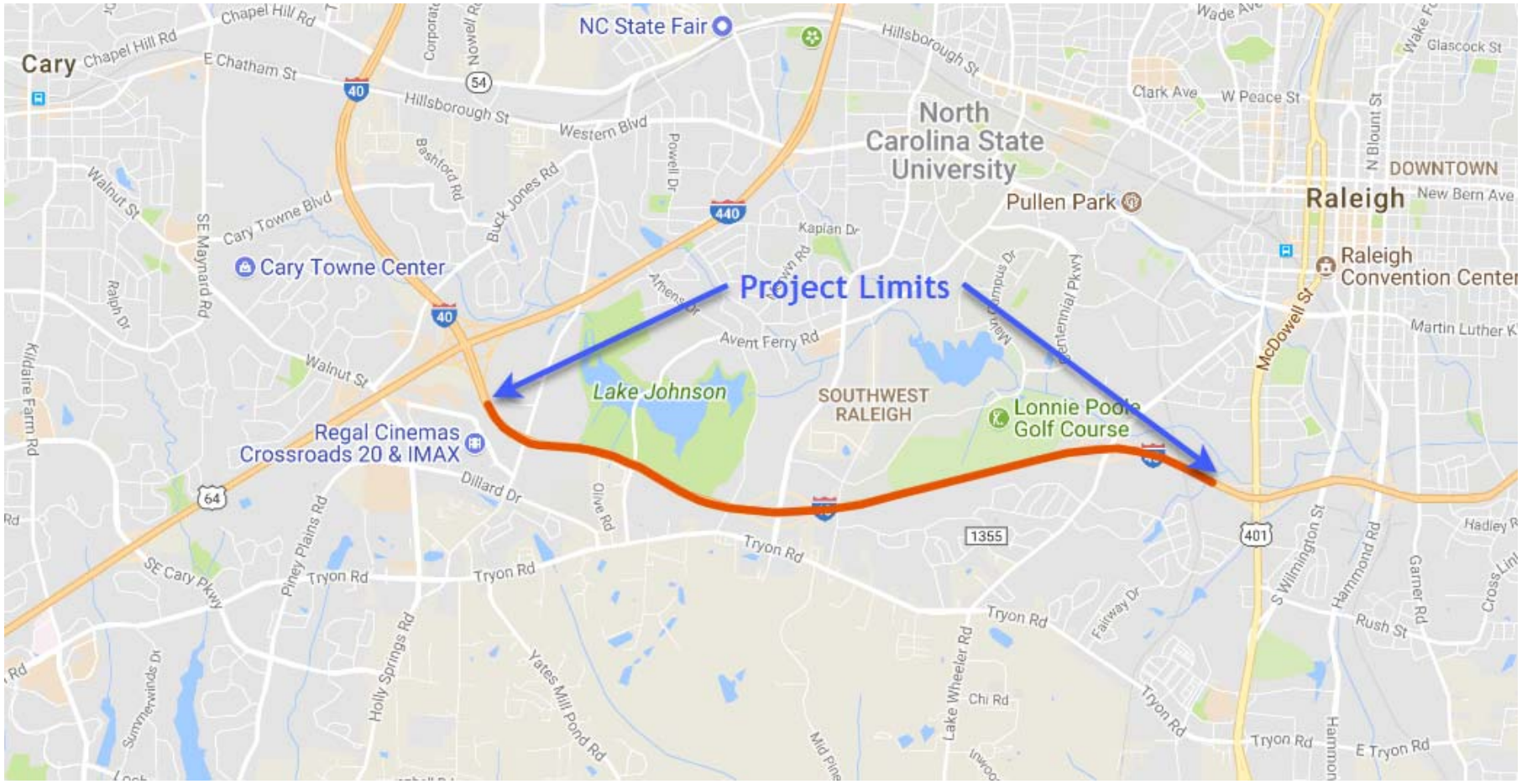
8. Do you know of any major employers or facilities that may be increasing or decreasing their size, shifting their work hours or changing the amount of truck traffic that may affect traffic volumes or patterns in the area?
   None known, but will defer to Raleigh and Cary.

9. Do you have any local data or information (traffic counts, recent plans or studies, traffic impact analyses or development plans) that would be helpful in developing the traffic forecasts?

   The developer for the Olde Mill Trace subdivision noted above produced a TIA that showed a significant Level or Service issue at the intersection of Lake Wheeler Road and Tryon Road, with the problem being unresolvable without significant improvements at that intersection. Ultimately, that intersection was beyond the distance requirements and below the contributory traffic increase threshold where the county could require them to make those improvements. Frankly that intersection should **not** have been included in the original study, but it initially appeared to be logical to include it in the TIA scope, so it was studied in detail, before we had to back away from requiring any improvements at that location. That TIA, in case you want a copy, was prepared by Will Letchworth of Volkert, Inc (919 854-0344), Will.Letchworth@Volkert.com .

   Please feel free to provide any additional information that you feel will be helpful in the development this traffic forecast!

Keith A. Lankford



Kenneth Withrow

# TIP Project I-5701 (I-40 Widening) Traffic Forecast Questionnaire

The goal of this traffic forecast is to analyze existing and determine future traffic volumes within the project study area (see included figure). The following is a list of the studied interchanges and intersections:

1. I-40 at I-440
2. I-40 at Gorman Street
3. I-40 at Future Centennial Campus Connection
4. I-40 at Lake Wheeler Road
5. I-40 at US 401 (S Sanders St)

<u>Please provide answers to the following questions to the best of your ability and knowledge of the study area:</u>

1. Are you aware of any traffic trends that have affected traffic in the past 4-5 years?

   Yes, within the abovementioned segments, the "Fortify Project" has affected traffic and traffic movement within the 4 to 5-year timeframe. Initial Public Service Announcements encouraged the motoring public to avoid congestion during the construction timeframe by riding the bus and choosing alternative commuting patterns. In fact, new bus routes were implemented between Johnston County/Clayton and downtown Raleigh with the deployment of buses to serve commuters between Johnston County and downtown Raleigh. Furthermore, additional bus routes (and vehicles) were added between and Town of Cary and downtown Raleigh as well. Please see the attached pdf file that addresses bicycle, pedestrian, and transit improvements that would be applied to the Fortify Project. Regarding the bicycle/pedestrian improvements, there have been significant greenway connections/accommodations made around the interchanges prior to and during the Fortify Project. Please perform due diligence for the existing (and planned bicycle/pedestrian accommodations in area as this TIP project progresses.

2. Do you know of any recent or planned developments that may have a substantial effect on traffic volumes or patterns in the study area?

   I do not know of any recent of planned development that may have (or may have had) a substantial effect on traffic volumes or patterns in the study area.

3. Are there any local projects that may affect traffic volumes or patterns along the study area?

   The only "local" project that may (and has affected) affect traffic volumes or patterns along the study area has been the Fortify Project; which modified traffic patterns at the I-40 at US 401 (South Saunders Street) interchange. There have been no municipality initiated projects in the study area that would have affected traffic volumes or traffic patterns.

4. Do you know of any areas in the project vicinity where the future growth may be different than the assumptions in the socioeconomic data included in the Triangle Regional Model?

   All growth assumptions are based on socioeconomic data included within the Triangle Regional Model; which is also incorporated into the adopted FY 2045 Metropolitan Transportation Plan. There are no areas in the project vicinity where future growth is differentiated.

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5. Do traffic volumes on the roadways within the traffic forecast study area experience any major seasonal fluctuations?
   Traffic volumes on the roadways within the traffic forecast study area do not experience major seasonal fluctuations.

6. Can you identify any locations within the traffic forecast study area that experience substantial recurring congestion?
   Please review the file "I-40 between US-70US-401NC-50Exit 298 and I-440US-64US-1Exit 293 Congestion Scan Speed - July 2014 through July 2018" as created in the Congestion Scan module of the Vehicle Probe Project Suite software package. The file is attached. Recurring intense congestion in the morning is seen westbound along the I-40 segment between US 401 and Gorman Street. The eastbound segment between the US 1/US 64 interchange and Lake Wheeler experiences recurring congestion in the morning, however, not at the intensity as the westbound section. Recurring congestion in the afternoon is strictly experienced along eastbound I-40 between the US 1/US 64 interchange and US 401; with the most significant intensity within the vicinity of the US 1/US 64 interchange with I-40.

7. What do you think is the peak period length every day? The peak period during the regular work week is from 6:00 – 10:00 am and 3:30 – 7:30 pm. Is there any evidence that the peak period is getting longer or more severe? I do not have any proof (based on Congestion-Scam results using Vehicle Probe Project Suite) that indicates that the peak period is getting longer or more severe.

8. Do you know of any major employers or facilities that may be increasing or decreasing their size, shifting their work hours or changing the amount of truck traffic that may affect traffic volumes or patterns in the area?
   I do not you know of any major employers or facilities that may be increasing or decreasing their size, shifting their work hours or changing the amount of truck traffic that may affect traffic volumes or patterns in the area?

9. Do you have any local data or information (traffic counts, recent plans or studies, traffic impact analyses or development plans) that would be helpful in developing the traffic forecasts?

   The Capital Area MPO does not manage any local data or information (i.e. information (traffic counts, recent plans or studies, traffic impact analyses or development plans) for the area that would be helpful in developing the traffic forecasts. Please contact both the City of Raleigh and the Town of Cary to obtain all local data.

   Again, please review the bike/pedestrian accommodations around those interchanges to ensure they are considered when interchanges are being studied. The Capital Area MPO does have up-to-date mapping for existing and future bicycle/pedestrian accommodations for the project area.

Please feel free to provide any additional information that you feel will be helpful in the development this traffic forecast!

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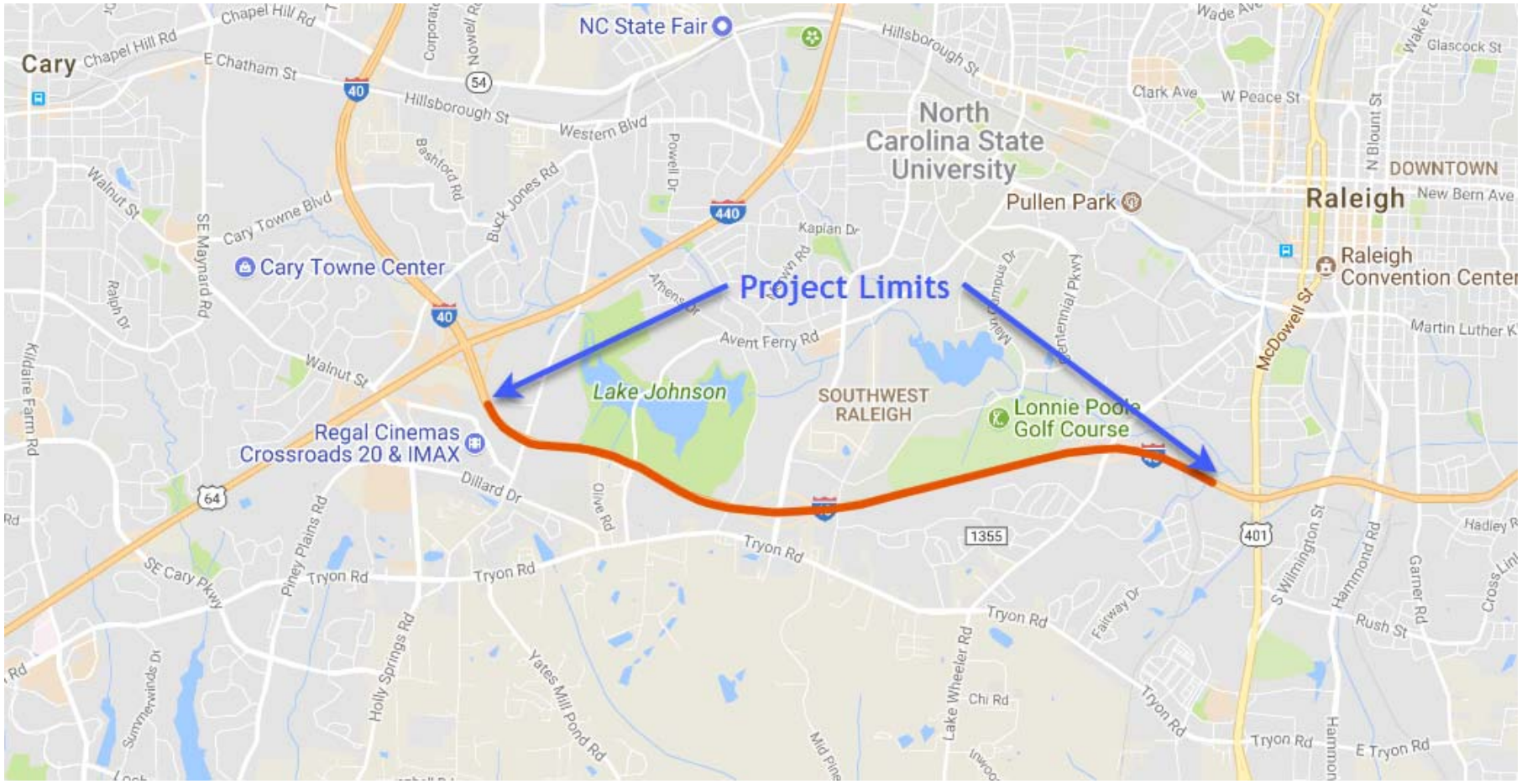

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# Transit and Bike/Pedestrian Improvements for I-40/440 Project

N

RDU
Triangle Transit Hub
7
BOSS Corridor
Wade Avenue to NC 147
1 & 7
Morrisville
Harrison Ave.
PNC Arena
Cary
Chatham St.
Buck Jones
5
Hillsborough St.
Western
NCSU
Crabtree
Raleigh
Downtown
Highwoods
New Bern Avenue
Wake Med
Project Limit
Knightdale
Zebulon
Wendell
8
Project Limit
6
Crossroads
Tryon Road
Regency Park
Apex
12
11
Rock Quarry
Quarry
Jones Sausage Road
Rock Quarry Road
4
2
Timber Drive
Garner
Garner Station
3
2 & 4
Greenfield
9
10
13
Holly Springs
Wake Tech
Fuquay-Varina
BOSS Corridor
I-440 to NC 42
Exit 301 to 312
Wake County
Johnston County
Clayton
NC 42/
US 70 Bus.
Cleveland Crossing
Wilson's Mills

**Legend**

- Silver Bike/Ped Option
- Bronze Bike/Ped Option
- Bronze Transit Options
- Silver Transit Options
- Interstates
- NCRR/NS Rail
- TTA Routes
- CAT Routes
- Municipal Boundary

Transit Routes
Numbers 1 through 13

# Appendix C

## Traffic Forecast Tables

## Table C1: Collected Traffic Counts

| Count Location | Count Type | Date(s) Collected | County | ATR Group | Seasonal Adjustment Factor [1] |
|---|---|---|---|---|---|
| I-40 WB Ramps terminal and SR 1571 (Gorman St) | TMC | 4/17/2018 | Wake | 1<br>11 | 0.99<br>0.97 |
| I-40 EB Ramps terminal and SR 1571 (Gorman St) | TMC | 4/17/2018 | Wake | 1<br>11 | 0.99<br>0.97 |
| I-40 WB Ramps terminal and SR 1375 (Lake Wheeler Rd) | TMC | 4/17/2018 | Wake | 1<br>11 | 0.99<br>0.97 |
| I-40 EB Ramps terminal and SR 1375 (Lake Wheeler Rd) | TMC | 4/17/2018 | Wake | 1<br>11 | 0.99<br>0.97 |
| I-40 WB Ramps terminal and US 401 (S Sounders St) | TMC | 4/17/2018 | Wake | 1<br>11 | 0.99<br>0.97 |
| I-40 EB Ramps terminal and US 401 (S Sounders St) | TMC | 4/17/2018 | Wake | 1<br>11 | 0.99<br>0.97 |
| SR 1571 (Gorman St) and SR 1152 (Tryon Rd) | TMC | 4/17/2018 | Wake | 1 | 0.99 |
| I-440/US 1 north of I-40 Interchange | Classification | 4/17/2018<br>4/18/2018 | Wake | 11 | 0.97<br>0.94 |
| I-40 between I-440/US 1/US 64 and SR 1571 (Gorman St) | Classification | 4/17/2018<br>4/18/2018 | Wake | 11 | 0.97<br>0.94 |
| I-40 between SR 1571 (Gorman St) and SR 1375 (Lake Wheeler Rd) | Classification | 4/17/2018<br>4/18/2018 | Wake | 11 | 0.97<br>0.94 |
| I-40 between SR 1375 (Lake Wheeler Rd) and US 401 (S Sounders St) | Classification | 4/17/2018<br>4/18/2018 | Wake | 11 | 0.97<br>0.94 |
| I-40 east of US 401 (S Sounders St) | Classification | 4/17/2018<br>4/18/2018 | Wake | 11 | 0.97<br>0.94 |
| I-40 WB Off-Ramp to I-440/US 1 NB | Classification | 6/13/2018<br>6/14/2018 | Wake | 11 | 0.96<br>0.92 |
| I-40 WB On-Ramp from US 1/US 64 NB | Classification | 6/13/2018<br>6/14/2018 | Wake | 11 | 0.96<br>0.92 |
| I-40 EB On-Ramp from US 1/US 64 NB | Classification | 6/13/2018<br>6/14/2018 | Wake | 11 | 0.96<br>0.92 |
| I-40 EB Off-Ramp to I-440/US 1 NB | Classification | 6/13/2018<br>6/14/2018 | Wake | 11 | 0.96<br>0.92 |

| Count Location | Count Type | Date(s) Collected | County | ATR Group | Seasonal Adjustment Factor [1] |
|---|---|---|---|---|---|
| I-40 EB Off-Ramp to US 1/US 64 SB | Classification | 6/13/2018<br>6/14/2018 | Wake | 11 | 0.96<br>0.92 |
| I-40 EB On-Ramp from I-440/US 1 SB | Classification | 6/13/2018<br>6/14/2018 | Wake | 11 | 0.96<br>0.92 |
| I-40 WB On-Ramp from I-440/US 1 SB | Classification | 6/13/2018<br>6/14/2018 | Wake | 11 | 0.96<br>0.92 |
| I-40 WB Off-Ramp to US 1/US 64 SB | Classification | 6/13/2018<br>6/14/2018 | Wake | 11 | 0.96<br>0.92 |

Notes:

(1) Seasonal Adjustment Factor assigned to the corresponding ATR group based on intersection approach

# Table C2: Historic AADT and 2018 Base Year No-Build Traffic Volumes

| Forecast Location | NCDOT Historic Count [1] | | | | | | | AADT Extrapolated to 2018 [2] | Project Specific Count Data [3] | | Adjacent Forecasts Volume | BY 2018 NB Forecast Volume |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | | TMC | Mainline | | |
| I-40 west of I-440/US 1/US 64 | 99,000 | 105,000 | 110,000 | 111,000 | 114,000 | 118,000 | 119,000 | 122,000 | - | - | 109,800 [4]<br>112,000 [5]<br>111,500 [6] | 134,800 |
| I-40 between I-440/US 1/US 64 and SR 1571 (Gorman St) | 106,000 | 109,000 | 112,000 | 114,000 | 118,000 | 119,000 | 116,000 | 119,500 | - | 131,400 | 116,000 [4]<br>116,000 [5]<br>113,200 [6] | 133,000 |
| I-40 between SR 1571 (Gorman St) and Centennial Campus Interchange | 107,000 | 108,000 | 111,000 | 111,000 | 114,000 | 115,000 | 110,000 | 113,100 | - | 130,900 | 117,000 [4]<br>117,000 [5]<br>112,300 [6] | 130,300 |
| I-40 Between Centennial Campus Interchange and SR 1009 (Lake Wheeler Rd) | 107,000 | 108,000 | 111,000 | 111,000 | 114,000 | 115,000 | 110,000 | 113,100 | - | 130,900 | 117,000 [4]<br>117,000 [5]<br>112,300 [6] | 130,300 |
| I-40 between SR 1009 (Lake Wheeler Rd) and US 401 (S Saunders St) | 113,000 | 113,000 | 115,000 | 117,000 | 119,000 | 119,000 | 113,000 | 117,900 | - | 131,500 | 116,500 [6] | 133,600 |
| I-40 east of US 401 (S Saunders St) | 106,000 | 107,000 | 110,000 | 114,000 | 111,000 | 111,000 | 105,000 | 110,600 | - | 125,300 | 111,700 [6] | 122,900 |
| I-440/US 1/US 64 north of I-40 | 76,000 | 76,000 | 75,000 | 75,000 | 77,000 | 78,000 | 83,000 | 81,700 | - | 85,900 | 79,200 [4]<br>80,000 [5]<br>77,700 [6] | 85,900 |
| I-440/US 1/US 64 south of I-40 | - | 131,000 | - | 137,000 | - | 138,000 | - | 145,600 | - | - | 134,200 [4]<br>136,200 [5]<br>136,200 [6] | 144,900 |
| SR 1571 (Gorman St) north of I-40 | - | 16,000 | - | - | - | 18,000 | - | 17,300 | 18,400 | - | 16,000 [4]<br>16,000 [5]<br>15,000 [6] | 18,400 |
| SR 1571 (Gorman St) between I-40 and SR 1152 (Tryon Rd) | - | 19,000 | - | - | - | 26,000 | - | 27,900 | 26,000 | - | 19,000 [4]<br>19,000 [5]<br>17,700 [6] | 25,900 |
| SR 1571 (Gorman St) south of SR 1152 (Tryon Rd) | - | - | - | - | - | - | - | - | 2,700 | | - | 3,200 |
| SR 1152 (Tryon Rd) west of SR 1571 (Gorman St) | - | 23,000 | - | 24,000 | - | 29,000 | - | 30,100 | 29,500 | | - | 29,500 |
| SR 1152 (Tryon Rd) east of SR 1571 (Gorman St) | - | 23,000 | - | 26,000 | - | 29,000 | - | 31,100 | 31,400 | | - | 31,400 |
| Future Centennial Campus Access | - | - | - | - | - | - | - | - | - | - | - | - |
| SR 1009 (Lake Wheeler Rd) north of I-40 | - | 18,000 | - | 19,000 | - | 22,000 | - | 21,000 | 23,400 | - | 18,000 [6] | 23,400 |
| SR 1009 (Lake Wheeler Rd) south of I-40 | - | - | - | 16,000 | - | 21,000 | - | 28,500 | 22,700 | - | 17,600 [6] | 22,700 |
| US 401 (S Saunders St) north of I-40 | - | 43,000 | - | 41,000 | - | 50,000 | - | 49,400 | 51,100 | - | 44,000 [6] | 55,000 |
| US 401 (S Saunders St) south of I-40 | - | - | - | 51,000 | - | 63,000 | - | 81,000 | 63,600 | - | 57,200 [6] | 63,900 |

Notes:

(1) Historic AADT counts prior and 2010 can be found in Appendix A

(2) Historic AADT was extrapolated to 2018 utilizing Average Annual Rate projections from NCDOT Traffic Forecast Utility (from 2006 to 2016)

(3) Project specific counts were factored to AADT values

(4) Volume obtained from traffic forecast for TIP Project U-2719 (Base Year 2012)

(5) Volume obtained from traffic forecast for TIP Project FS-1005AB (Base Year 2013)

(6) Volume obtained from traffic forecast for TIP Project FS-1205A (Base Year 2013)

## Table C3: 2018 Base Year No-Build Design Data - Truck Percentages

| Forecast Location | Adjacent Forecasts | | Project Specific Count Data [1] | | NCDOT HPMS | Selected Value |
|---|---|---|---|---|---|---|
| | Truck Percentage | TIP Project | TMC | Mainline | | |
| I-40 west of I-440/US 1/US 64 | 4,6<br>4,6<br>4,6 | U-2719 [2]<br>FS-1005AB [3]<br>FS-1205A [4] | - | 3,3 | 2,2 | 3,3 |
| I-40 between I-440/US 1/US 64 and SR 1571 (Gorman St) | 4,6<br>4,6<br>4,6 | U-2719 [2]<br>FS-1005AB [3]<br>FS-1205A [4] | - | 3,4 | 3,3 | 3,4 |
| I-40 between SR 1571 (Gorman St) and Centennial Campus Interchange | 4,6<br>4,6 | U-2719 [2]<br>FS-1205A [4] | - | 4,6 | 3,3 | 4,6 |
| I-40 Between Centennial Campus Interchange and SR 1009 (Lake Wheeler Rd) | 4,6 | U-2719 [2]<br>FS-1205A [4] | - | 4,6 | 3,3 | 4,6 |
| I-40 between SR 1009 (Lake Wheeler Rd) and US 401 (S Saunders St) | 4,6 | FS-1205A [4] | - | 3,4 | 3,3 | 3,4 |
| I-40 east of US 401 (S Saunders St) | 4,6 | FS-1205A [4] | - | 4,4 | 3,3 | 4,4 |
| I-440/US 1/US 64 north of I-40 | 3,3<br>3,3<br>3,3 | U-2719 [2]<br>FS-1005AB [3]<br>FS-1205A [4] | - | 2,1 | 2,0 | 2,1 |
| I-440/US 1/US 64 south of I-40 | 4,5<br>3,3<br>4,5<br>3,3 | U-2719 [2]<br>FS-1205A [4] | - | 3,2 | 3,2 | 3,2 |
| SR 1571 (Gorman St) north of I-40 | 4,5<br>3,1 | U-2719 [2]<br>FS-1205A [4] | 2,0 | - | - | 2,1 |
| SR 1571 (Gorman St) between I-40 and SR 1152 (Tryon Rd) | 4,5<br>3,1 | U-2719 [2]<br>FS-1205A [4] | 3,0 | - | - | 3,1 |
| SR 1571 (Gorman St) south of SR 1152 (Tryon Rd) | - | - | 2,0 | - | - | 2,1 |
| SR 1152 (Tryon Rd) west of SR 1571 (Gorman St) | - | - | 2,0 | - | - | 3,1 |
| SR 1152 (Tryon Rd) east of SR 1571 (Gorman St) | - | - | 2,0 | - | - | 2,1 |
| Future Centennial Campus Access | - | - | - | - | - | 2,1 |
| SR 1009 (Lake Wheeler Rd) north of I-40 | 3,1 | FS-1205A [4] | 0,0 | - | - | 2,1 |
| SR 1009 (Lake Wheeler Rd) south of I-40 | 3,1 | FS-1205A [4] | 3,1 | - | - | 3,1 |
| US 401 (S Saunders St) north of I-40 | 3,1 | FS-1205A [4] | 3,0 | - | 3,1 | 3,1 |
| US 401 (S Saunders St) south of I-40 | 3,1 | FS-1205A [4] | 4,1 | - | 3,1 | 4,1 |

Notes:

(1) Count taken April and June, 2018

(2) TIP Project forecasts developed with BY 2012

(3) TIP Project forecasts developed with BY 2013

(4) TIP Project forecasts developed with BY 2013

## Table C4: 2018 Base Year No-Build Design Data - Directional Distribution

| Forecast Location | Adjacent Forecasts | | Project Specific Count Data [1] | | NCDOT HPMS | Selected Value |
|---|---|---|---|---|---|---|
| | Directional Distribution | TIP Project | TMC | Mainline | | |
| I-40 west of I-440/US 1/US 64 | 55 EB<br>55 EB<br>55 EB | U-2719 [2]<br>FS-1005AB [3]<br>FS-1205A [4] | - | 55 EB | - | 55 EB |
| I-40 between I-440/US 1/US 64 and SR 1571 (Gorman St) | 55 EB<br>55 EB<br>55 EB | U-2719 [2]<br>FS-1005AB [3]<br>FS-1205A [4] | - | 55 EB | - | 55 EB |
| I-40 between SR 1571 (Gorman St) and Centennial Campus Interchange | 55 EB<br>55 EB | U-2719 [2]<br>FS-1205A [4] | - | 55 EB | 55 | 55 EB |
| I-40 Between Centennial Campus Interchange and SR 1009 (Lake Wheeler Rd) | 55 EB<br>55 EB | U-2719 [2]<br>FS-1205A [4] | - | 55 EB | 55 | 55 EB |
| I-40 between SR 1009 (Lake Wheeler Rd) and US 401 (S Saunders St) | 55 EB | FS-1205A [4] | - | 55 EB | - | 55 EB |
| I-40 east of US 401 (S Saunders St) | 55 EB | FS-1205A [4] | - | 55 WB | - | 55 WB |
| I-440/US 1/US 64 north of I-40 | 55 SB<br>55 SB<br>55 SB | U-2719 [2]<br>FS-1005AB [3]<br>FS-1205A [4] | - | 55 SB | - | 55 SB |
| I-440/US 1/US 64 south of I-40 | 55 SB<br>55 SB | U-2719 [2]<br>FS-1205A [4] | - | 55 SB | - | 55 SB |
| SR 1571 (Gorman St) north of I-40 | 55 SB<br>55 SB | U-2719 [2]<br>FS-1205A [4] | 50 | - | - | 60 SB |
| SR 1571 (Gorman St) between I-40 and SR 1152 (Tryon Rd) | 55 SB<br>70 SB | U-2719 [2]<br>FS-1205A [4] | 70 SB | - | - | 70 SB |
| SR 1571 (Gorman St) south of SR 1152 (Tryon Rd) | - | - | 65 SB | - | - | 65 SB |
| SR 1152 (Tryon Rd) west of SR 1571 (Gorman St) | - | - | 55 WB | - | - | 55 WB |
| SR 1152 (Tryon Rd) east of SR 1571 (Gorman St) | - | - | 60 EB | - | - | 60 EB |
| Future Centennial Campus Access | - | - | - | - | - | 65 SB |
| SR 1009 (Lake Wheeler Rd) north of I-40 | 70 SB | FS-1205A [4] | 70 SB | - | - | 70 SB |
| SR 1009 (Lake Wheeler Rd) south of I-40 | 60 SB | FS-1205A [4] | 65 SB | - | - | 65 SB |
| US 401 (S Saunders St) north of I-40 | 65 SB | FS-1205A [4] | 65 SB | - | 63 | 55 SB |
| US 401 (S Saunders St) south of I-40 | 60 SB | FS-1205A [4] | 75 SB | - | 76 | 75 SB |

Notes:

(1) Count taken April and June, 2018

(2) TIP Project forecasts developed with BY 2012

(3) TIP Project forecasts developed with BY 2013

(4) TIP Project forecasts developed with BY 2013

## Table C5: 2018 Base Year No-Build Design Data - Peak Hour Factors

| Forecast Location | Adjacent Forecasts | | Project Specific Count Data [1] | | NCDOT HPMS | Selected Value |
|---|---|---|---|---|---|---|
| | Peak Hour Factor | TIP Project | TMC | Mainline | | |
| I-40 west of I-440/US 1/US 64 | 10<br>10<br>10 | U-2719 [2]<br>FS-1005AB [3]<br>FS-1205A [4] | - | 9 | - | 9 |
| I-40 between I-440/US 1/US 64 and SR 1571 (Gorman St) | 10<br>10<br>10 | U-2719 [2]<br>FS-1005AB [3]<br>FS-1205A [4] | - | 8 | - | 9 |
| I-40 between SR 1571 (Gorman St) and Centennial Campus Interchange | 10<br>10 | U-2719 [2]<br>FS-1205A [4] | - | 9 | 9 | 8 |
| I-40 Between Centennial Campus Interchange and SR 1009 (Lake Wheeler Rd) | 10<br>10 | U-2719 [2]<br>FS-1205A [4] | - | 9 | 9 | 8 |
| I-40 between SR 1009 (Lake Wheeler Rd) and US 401 (S Saunders St) | 10 | FS-1205A [4] | - | 8 | - | 8 |
| I-40 east of US 401 (S Saunders St) | 10 | FS-1205A [4] | - | 9 | - | 9 |
| I-440/US 1/US 64 north of I-40 | 10<br>10<br>10 | U-2719 [2]<br>FS-1005AB [3]<br>FS-1205A [4] | - | 9 | - | 9 |
| I-440/US 1/US 64 south of I-40 | 10<br>10 | U-2719 [2]<br>FS-1205A [4] | - | 9 | - | 9 |
| SR 1571 (Gorman St) north of I-40 | 10<br>9 | U-2719 [2]<br>FS-1205A [4] | 10 | - | - | 10 |
| SR 1571 (Gorman St) between I-40 and SR 1152 (Tryon Rd) | 10<br>10 | U-2719 [2]<br>FS-1205A [4] | 11 | - | - | 10 |
| SR 1571 (Gorman St) south of SR 1152 (Tryon Rd) | - | - | 8 | - | - | 8 |
| SR 1152 (Tryon Rd) west of SR 1571 (Gorman St) | - | - | 12 | - | - | 12 |
| SR 1152 (Tryon Rd) east of SR 1571 (Gorman St) | - | - | 10 | - | - | 10 |
| Future Centennial Campus Access | - | - | - | - | - | 10 |
| SR 1009 (Lake Wheeler Rd) north of I-40 | 9 | FS-1205A [4] | 10 | - | - | 10 |
| SR 1009 (Lake Wheeler Rd) south of I-40 | 10 | FS-1205A [4] | 9 | - | - | 9 |
| US 401 (S Saunders St) north of I-40 | 8 | FS-1205A [4] | 9 | - | 8 | 9 |
| US 401 (S Saunders St) south of I-40 | 8 | FS-1205A [4] | 9 | - | 10 | 9 |

Notes:

(1) Count taken April and June, 2018

(2) TIP Project forecasts developed with BY 2012

(3) TIP Project forecasts developed with BY 2013

(4) TIP Project forecasts developed with BY 2013

# Table C6: Model Validation

| Forecast Location | Model Calibration BY 2018 NB | | | | BY 2018 Build | | | Extrapolated from AADT to 2045 | | FY 2045 NB | | FY 2045 B | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2018 AADT [1] | Model 2013 | Interpolated Model 2018 | Forecast 2018 | Model 2013 [2] | Interpolated Model 2018 | Forecast 2018 | 1996-2016 | 2006-2016 | Model | Forecast | Model | Forecast |
| I-40 west of I-440/US 1/US 64 | 122,000 | 116,400 | 130,900 | 134,800 | 184,965 | 189,838 | 189,000 | 177,819 | 180,909 | 209,381 | 209,000 | 216,152 | 229,000 |
| I-40 between I-440/US 1/US 64 and SR 1571 (Gorman St) | 119,500 | 121,800 | 136,900 | 133,000 | 198,572 | 203,646 | 199,000 | 169,326 | 150,927 | 218,417 | 216,000 | 231,045 | 226,000 |
| I-40 between SR 1571 (Gorman St) and Centennial Campus Interchange | 113,100 | 114,800 | 130,600 | 130,300 | 191,258 | 197,402 | 196,000 | 159,402 | 124,836 | 215,613 | 214,000 | 230,577 | 229,900 |
| I-40 Between Centennial Campus Interchange and SR 1009 (Lake Wheeler Rd) | 113,100 | 114,800 | 131,800 | 130,300 | 191,258 | 198,853 | 196,000 | 159,402 | 124,836 | 223,846 | 219,100 | 239,869 | 239,300 |
| I-40 between SR 1009 (Lake Wheeler Rd) and US 401 (S Saunders St) | 117,900 | 134,500 | 150,600 | 133,600 | 213,983 | 220,055 | 201,000 | 169,321 | 131,364 | 237,344 | 225,000 | 252,842 | 223,600 |
| I-40 east of US 401 (S Saunders St) | 110,600 | 122,900 | 141,200 | 122,900 | 202,645 | 209,698 | 189,100 | 161,717 | 119,927 | 240,139 | 220,000 | 247,783 | 228,900 |
| I-440/US 1/US 64 north of I-40 | 81,700 | 82,500 | 90,600 | 85,900 | 118,300 | 120,863 | 114,600 | 90,264 | 107,982 | 134,600 | 128,000 | 134,700 | 128,000 |
| I-440/US 1/US 64 south of I-40 | 145,600 | 146,557 | 159,900 | 144,900 | 206,683 | 210,719 | 201,000 | 299,820 | 202,300 | 231,894 | 217,000 | 232,515 | 211,000 |
| SR 1571 (Gorman St) north of I-40 | 17,300 | 18,400 | 21,200 | 18,400 | 23,400 | 25,556 | 22,200 | 18,574 | 16,514 | 36,300 | 31,500 | 37,200 | 32,000 |
| SR 1571 (Gorman St) between I-40 and SR 1152 (Tryon Rd) | 27,900 | 38,800 | 41,500 | 25,900 | 51,100 | 51,600 | 31,400 | 53,771 | 53,771 | 55,800 | 34,900 | 54,300 | 33,900 |
| SR 1571 (Gorman St) south of SR 1152 (Tryon Rd) | - | - | - | 3,200 | - | - | 4,000 | - | - | - | 4,100 | - | 4,100 |
| SR 1152 (Tryon Rd) west of SR 1571 (Gorman St) | 30,100 | 26,000 | 28,900 | 29,500 | 39,900 | 40,416 | 41,200 | 48,425 | 54,400 | 44,500 | 45,100 | 43,200 | 44,000 |
| SR 1152 (Tryon Rd) east of SR 1571 (Gorman St) | 31,100 | 31,600 | 34,700 | 31,400 | 52,500 | 51,891 | 44,800 | 56,700 | 56,700 | 51,200 | 47,500 | 48,600 | 46,000 |
| Future Centennial Campus Access | - | - | - | - | - | - | - | - | - | 10,800 | 11,500 | 11,400 | 11,400 |
| SR 1009 (Lake Wheeler Rd) north of I-40 | 21,000 | 29,600 | 34,500 | 23,400 | 44,900 | 47,244 | 32,000 | 29,934 | 26,400 | 60,800 | 41,200 | 59,900 | 42,000 |
| SR 1009 (Lake Wheeler Rd) south of I-40 | 28,500 | 19,900 | 22,900 | 22,700 | 28,000 | 29,672 | 29,600 | 96,000 | 96,000 | 38,800 | 38,500 | 38,700 | 37,500 |
| US 401 (S Saunders St) north of I-40 | 49,400 | 38,000 | 45,200 | 55,000 | 58,300 | 62,534 | 76,100 | 54,116 | 72,300 | 84,100 | 95,000 | 85,400 | 96,500 |
| US 401 (S Saunders St) south of I-40 | 81,000 | 59,600 | 64,500 | 63,900 | 74,400 | 77,041 | 87,400 | 243,000 | 243,000 | 91,100 | 103,000 | 91,300 | 105,000 |

Notes:

(1) Linear regression applied using counts for last 10 years (2006-2016)

(2) 2013 SE data with 2035 network

# Table C7: Growth / Diversion Rates and 2045 Future Year Traffic Volumes

| Forecast Location | Historic Growth Rate [1] | | BY 2018 NB Forecast Volumes | | | BY 2018 B | | | | | FY 2045 NB | | | | FY 2045 B | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Model Diversion Rate | Chosen Diversion Rate | Volumes | | | Model Growth Rate | Chosen Growth Rate | Volumes | | Model Growth Rate | Chosen Growth Rate | Model Diversation Rate | Chosen Diversion Rate | Volumes | |
| | 1996 2016 | 2006 2016 | Model 2013 | Interpolated Model 2018 | Forecast | 2018NB 2018B | 2018NB 2018B | Model 2013 | Interpolated Model 2018 | Forecast | 2018 2045 | 2018 2045 | Model | Forecast | 2018 2045 | 2018 2045 | 2045NB 2045B | 2045NB 2045B | Model | Forecast |
| I-40 west of I-440/US 1/US 64 | 2.1% | 2.1% | 116,400 | 130,900 | 134,800 | 45.0% | 40.2% | 184,965 | 189,838 | 189,000 | 1.8% | 1.6% | 209,381 | 209,000 | 0.6% | 0.7% | 3.2% | 9.6% | 216,152 | 229,000 |
| I-40 between I-440/US 1/US 64 and SR 1571 (Gorman St) | 1.6% | 1.1% | 121,800 | 136,900 | 133,000 | 48.8% | 49.6% | 198,572 | 203,646 | 199,000 | 1.7% | 1.8% | 218,417 | 216,000 | 0.6% | 0.5% | 5.8% | 4.6% | 231,045 | 226,000 |
| I-40 between SR 1571 (Gorman St) and Centennial Campus Interchange | 1.4% | 0.4% | 114,800 | 130,600 | 130,300 | 51.2% | 50.4% | 191,258 | 197,402 | 196,000 | 1.9% | 1.9% | 215,613 | 214,000 | 0.7% | 0.6% | 6.9% | 7.4% | 230,577 | 229,900 |
| I-40 Between Centennial Campus Interchange and SR 1009 (Lake Wheeler Rd) | 1.4% | 0.4% | 114,800 | 131,800 | 130,300 | 50.9% | 50.4% | 191,258 | 198,853 | 196,000 | 2.0% | 1.9% | 223,846 | 219,100 | 0.8% | 0.7% | 7.2% | 9.2% | 239,869 | 239,300 |
| I-40 between SR 1009 (Lake Wheeler Rd) and US 401 (S Saunders St) | 1.5% | 0.4% | 134,500 | 150,600 | 133,600 | 46.1% | 50.4% | 213,983 | 220,055 | 201,000 | 1.7% | 1.9% | 237,344 | 225,000 | 0.6% | 0.4% | 6.5% | -0.6% | 252,842 | 223,600 |
| I-40 east of US 401 (S Saunders St) | 1.6% | 0.3% | 122,900 | 141,200 | 122,900 | 48.5% | 53.9% | 202,645 | 209,698 | 189,100 | 2.0% | 2.2% | 240,139 | 220,000 | 0.7% | 0.7% | 3.2% | 4.0% | 247,783 | 228,900 |
| I-440/US 1/US 64 north of I-40 | 0.6% | 1.3% | 82,500 | 90,600 | 85,900 | 33.4% | 33.4% | 118,300 | 120,863 | 114,600 | 1.5% | 1.5% | 134,600 | 128,000 | 0.5% | 0.4% | 0.1% | 0.0% | 134,700 | 128,000 |
| I-440/US 1/US 64 south of I-40 | 6.1% | 1.6% | 146,557 | 159,900 | 144,900 | 31.8% | 38.7% | 206,683 | 210,719 | 201,000 | 1.4% | 1.5% | 231,894 | 217,000 | 0.4% | 0.2% | 0.3% | -2.8% | 232,515 | 211,000 |
| SR 1571 (Gorman St) north of I-40 | 0.2% | -0.2% | 18,400 | 21,200 | 18,400 | 20.5% | 20.7% | 23,400 | 25,556 | 22,200 | 2.0% | 2.0% | 36,300 | 31,500 | 1.7% | 1.4% | 2.5% | 1.6% | 37,200 | 32,000 |
| SR 1571 (Gorman St) between I-40 and SR 1152 (Tryon Rd) | 4.7% | 4.7% | 38,800 | 41,500 | 25,900 | 24.3% | 21.2% | 51,100 | 51,600 | 31,400 | 1.1% | 1.1% | 55,800 | 34,900 | 0.2% | 0.3% | -2.7% | -2.9% | 54,300 | 33,900 |
| SR 1571 (Gorman St) south of SR 1152 (Tryon Rd) | - | - | - | - | 3,200 | - | - | - | - | 4,000 | - | 0.9% | - | 4,100 | - | 0.1% | - | 0.0% | - | 4,100 |
| SR 1152 (Tryon Rd) west of SR 1571 (Gorman St) | 3.6% | 3.9% | 26,000 | 28,900 | 29,500 | 39.8% | 39.7% | 39,900 | 40,416 | 41,200 | 1.6% | 1.6% | 44,500 | 45,100 | 0.3% | 0.2% | -2.9% | -2.4% | 43,200 | 44,000 |
| SR 1152 (Tryon Rd) east of SR 1571 (Gorman St) | 4.0% | 4.0% | 31,600 | 34,700 | 31,400 | 49.5% | 42.7% | 52,500 | 51,891 | 44,800 | 1.5% | 1.5% | 51,200 | 47,500 | -0.3% | 0.1% | -5.1% | -3.2% | 48,600 | 46,000 |
| Future Centennial Campus Access | - | - | - | - | - | - | - | - | - | - | - | - | 10,800 | 11,500 | - | - | 5.6% | -0.9% | 11,400 | 11,400 |
| SR 1009 (Lake Wheeler Rd) north of I-40 | 1.7% | 1.0% | 29,600 | 34,500 | 23,400 | 36.9% | 36.8% | 44,900 | 47,244 | 32,000 | 2.1% | 2.1% | 60,800 | 41,200 | 1.1% | 1.0% | -1.5% | 1.9% | 59,900 | 42,000 |
| SR 1009 (Lake Wheeler Rd) south of I-40 | 14.6% | 14.6% | 19,900 | 22,900 | 22,700 | 29.6% | 30.4% | 28,000 | 29,672 | 29,600 | 2.0% | 2.0% | 38,800 | 38,500 | 1.2% | 0.9% | -0.3% | -2.6% | 38,700 | 37,500 |
| US 401 (S Saunders St) north of I-40 | 0.7% | 2.0% | 38,000 | 45,200 | 55,000 | 38.3% | 38.4% | 58,300 | 62,534 | 76,100 | 2.3% | 2.0% | 84,100 | 95,000 | 1.4% | 0.9% | 1.5% | 1.6% | 85,400 | 96,500 |
| US 401 (S Saunders St) south of I-40 | 11.1% | 11.1% | 59,600 | 64,500 | 63,900 | 19.4% | 36.8% | 74,400 | 77,041 | 87,400 | 1.3% | 1.8% | 91,100 | 103,000 | 0.8% | 0.7% | 0.2% | 1.9% | 91,300 | 105,000 |

Notes:

(1) Linear Growth Rate from NCDOT Traffic Forecast Utility (TFU)

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# Appendix B. HCS Analysis Results

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 1 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.50 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 68.2 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 5174 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1482 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2382 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2382 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.62 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 67.7 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 21.9 |
| Total Ramp Density Adjustment | 1.8 | Level of Service (LOS) | C |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 68.2 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 2 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 5174 | 443 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 5927 | 507 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.62 | 0.24 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 15.4 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.344 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1529 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 60.4 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 74.7 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2870 | Ramp Junction Speed (S), mi/h | 67.0 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 22.1 |
| Level of Service (LOS) | B | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 3 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 3 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 4731 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1806 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.76 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 64.4 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 28.0 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 4 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 4731 | 562 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 5419 | 644 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.63 | 0.31 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 17.8 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.251 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1626 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 63.0 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.137 | Outer Lanes Freeway Speed ($S_O$), mi/h | 65.9 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2168 | Ramp Junction Speed (S), mi/h | 64.5 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 2812 | Average Density (D), pc/mi/ln | 23.5 |
| Level of Service (LOS) | B | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 5 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 5293 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1516 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.64 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 67.1 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 22.6 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | C |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 6 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 5293 | 457 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 6063 | 523 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.63 | 0.25 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 16.0 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.345 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1563 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 60.3 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 74.6 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2938 | Ramp Junction Speed (S), mi/h | 66.9 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 22.7 |
| Level of Service (LOS) | B | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 7 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 3 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 4836 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1847 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.78 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 63.8 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 28.9 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 8 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 4836 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1385 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.58 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 67.6 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 20.5 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | C |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 9 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 4836 | 419 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 5540 | 480 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.50 | 0.23 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 12.8 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.220 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1285 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 63.8 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.158 | Outer Lanes Freeway Speed ($S_O$), mi/h | 67.2 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 1684 | Ramp Junction Speed (S), mi/h | 65.9 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 2164 | Average Density (D), pc/mi/ln | 14.2 |
| Level of Service (LOS) | B | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 10 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 5255 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1204 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.51 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 67.7 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 17.8 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | B |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 1 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.50 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 68.2 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 5915 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1355 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2382 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2382 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.57 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 68.1 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 19.9 |
| Total Ramp Density Adjustment | 1.8 | Level of Service (LOS) | C |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 68.2 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 2 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 5915 | 905 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 6775 | 1037 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.56 | 0.49 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 17.4 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.391 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1226 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 59.1 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 75.9 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 3096 | Ramp Junction Speed (S), mi/h | 67.2 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 17.1 |
| Level of Service (LOS) | B | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 3 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 5010 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1435 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.60 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 67.4 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 21.3 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | C |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 4 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1300 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 5010 | 292 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 5739 | 334 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.63 | 0.16 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 17.8 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.258 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1722 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 62.8 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.176 | Outer Lanes Freeway Speed ($S_O$), mi/h | 65.6 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2296 | Ramp Junction Speed (S), mi/h | 64.4 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 2630 | Average Density (D), pc/mi/ln | 23.6 |
| Level of Service (LOS) | B | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 5 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 5302 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1518 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.64 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 67.1 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 22.6 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | C |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 6 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 5302 | 489 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 6073 | 560 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.63 | 0.27 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 16.2 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.348 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1555 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 60.3 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 74.6 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2964 | Ramp Junction Speed (S), mi/h | 66.9 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 22.7 |
| Level of Service (LOS) | B | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 7 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 3 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 4813 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1838 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.77 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 63.9 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 28.8 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 8 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 4813 | 899 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 5513 | 1030 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.68 | 0.49 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 20.9 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.285 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1654 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 62.0 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.089 | Outer Lanes Freeway Speed ($S_O$), mi/h | 65.8 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2205 | Ramp Junction Speed (S), mi/h | 63.9 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 3235 | Average Density (D), pc/mi/ln | 25.6 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 9 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.50 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 68.2 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 5712 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1636 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2382 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2382 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.69 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 66.6 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 24.6 |
| Total Ramp Density Adjustment | 1.8 | Level of Service (LOS) | C |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 68.2 | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 1 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.50 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 68.2 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 6308 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1786 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2382 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2382 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.75 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 64.9 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 27.5 |
| Total Ramp Density Adjustment | 1.8 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 68.2 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 2 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 6308 | 879 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 7145 | 996 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.74 | 0.47 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 22.4 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.388 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1734 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 59.1 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 73.9 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 3677 | Ramp Junction Speed (S), mi/h | 65.5 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 27.3 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 3 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 3 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 5429 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2050 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.86 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 60.4 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 33.9 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 4 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 5429 | 462 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 6149 | 523 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.70 | 0.25 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 19.2 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.263 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1845 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 62.6 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.152 | Outer Lanes Freeway Speed ($S_O$), mi/h | 65.2 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2460 | Ramp Junction Speed (S), mi/h | 64.0 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 2983 | Average Density (D), pc/mi/ln | 26.1 |
| Level of Service (LOS) | B | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 5 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 5891 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1668 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.70 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 65.9 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 25.3 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | C |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 6 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 5891 | 334 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 6672 | 378 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.70 | 0.18 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 17.6 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.332 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1775 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 60.7 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 73.8 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 3122 | Ramp Junction Speed (S), mi/h | 67.0 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 24.9 |
| Level of Service (LOS) | B | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 7 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 3 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 5557 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2098 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.88 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 59.5 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 35.3 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | E |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 8 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 5557 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1574 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.66 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 66.7 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 23.6 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | C |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 9 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 5557 | 596 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 6294 | 675 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.58 | 0.32 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 16.0 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.238 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1460 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 63.3 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.133 | Outer Lanes Freeway Speed ($S_O$), mi/h | 66.5 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 1913 | Ramp Junction Speed (S), mi/h | 65.3 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 2588 | Average Density (D), pc/mi/ln | 16.7 |
| Level of Service (LOS) | B | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 10 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 6153 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1394 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.59 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 67.6 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 20.6 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | C |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 1 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.50 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 68.2 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 5505 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1247 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2382 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2382 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.52 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 68.2 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 18.3 |
| Total Ramp Density Adjustment | 1.8 | Level of Service (LOS) | C |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 68.2 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 2 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 5505 | 562 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 6235 | 637 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.52 | 0.30 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 13.7 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.355 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1188 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 60.1 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 76.1 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2670 | Ramp Junction Speed (S), mi/h | 68.3 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 15.5 |
| Level of Service (LOS) | B | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 3 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 4943 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1400 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.59 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 67.6 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 20.7 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | C |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 4 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1300 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 4943 | 462 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 5599 | 523 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.64 | 0.25 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 18.7 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.266 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1680 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 62.6 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.152 | Outer Lanes Freeway Speed ($S_O$), mi/h | 65.8 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2240 | Ramp Junction Speed (S), mi/h | 64.3 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 2763 | Average Density (D), pc/mi/ln | 23.8 |
| Level of Service (LOS) | B | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 5 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 5405 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1530 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.64 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 67.0 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 22.8 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | C |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 6 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 5405 | 1026 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 6122 | 1162 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.64 | 0.55 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 19.3 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.403 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1399 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 58.7 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 75.2 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 3325 | Ramp Junction Speed (S), mi/h | 65.2 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 23.5 |
| Level of Service (LOS) | B | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 7 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 3 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 4379 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1653 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.70 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 66.1 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 25.0 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | C |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 8 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 4379 | 538 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 4960 | 609 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.58 | 0.29 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 16.1 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.238 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1488 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 63.3 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.142 | Outer Lanes Freeway Speed ($S_O$), mi/h | 66.4 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 1984 | Ramp Junction Speed (S), mi/h | 64.9 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 2593 | Average Density (D), pc/mi/ln | 21.5 |
| Level of Service (LOS) | B | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Existing (2018) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 9 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.50 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 68.2 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 4917 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1392 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2382 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2382 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.58 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 68.0 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 20.5 |
| Total Ramp Density Adjustment | 1.8 | Level of Service (LOS) | C |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 68.2 | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 1 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.50 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 68.2 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8373 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2398 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2382 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2382 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 1.01 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | - |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | - |
| Total Ramp Density Adjustment | 1.8 | Level of Service (LOS) | F |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 68.2 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 2 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 8373 | 725 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 9591 | 830 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 1.00 | 0.40 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 30.7 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.373 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2471 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 59.6 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 71.1 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 4650 | Ramp Junction Speed (S), mi/h | 65.0 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 36.9 |
| Level of Service (LOS) | D | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 3 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 3 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 7648 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2920 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 1.23 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | - |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | - |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | F |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 4 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 7648 | 903 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 8761 | 1034 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 1.02 | 0.49 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | - |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | - |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2629 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | - |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.089 | Outer Lanes Freeway Speed ($S_O$), mi/h | 61.5 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 3504 | Ramp Junction Speed (S), mi/h | - |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 4538 | Average Density (D), pc/mi/ln | - |
| Level of Service (LOS) | F | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 5 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8551 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2449 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 1.03 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | - |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | - |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | F |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 6 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 8551 | 769 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 9795 | 881 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 1.02 | 0.42 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | - |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | - |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2514 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | - |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 70.9 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 4768 | Ramp Junction Speed (S), mi/h | - |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | - |
| Level of Service (LOS) | F | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 7 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 3 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 7782 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2971 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 1.25 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | - |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | - |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | F |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 8 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 7782 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2228 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.94 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 56.6 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 39.4 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | E |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 9 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 7782 | 672 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 8914 | 770 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.81 | 0.37 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 21.8 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.296 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2116 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 61.7 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.122 | Outer Lanes Freeway Speed ($S_O$), mi/h | 64.2 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2566 | Ramp Junction Speed (S), mi/h | 63.3 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 3336 | Average Density (D), pc/mi/ln | 22.7 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 10 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8454 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1937 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.81 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 62.4 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 31.0 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 1 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.50 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 68.2 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8355 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1914 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2382 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2382 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.80 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 63.1 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 30.3 |
| Total Ramp Density Adjustment | 1.8 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 68.2 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 2 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 8355 | 1410 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 9570 | 1615 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.80 | 0.77 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 27.3 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.443 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1774 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 57.6 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 73.8 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 4249 | Ramp Junction Speed (S), mi/h | 65.6 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 23.3 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 3 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 6945 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1989 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.84 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 61.6 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 32.3 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 4 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1300 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 6945 | 400 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 7955 | 458 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.88 | 0.22 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 25.6 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.353 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2387 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 60.1 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.161 | Outer Lanes Freeway Speed ($S_O$), mi/h | 63.0 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 3182 | Ramp Junction Speed (S), mi/h | 61.7 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 3640 | Average Density (D), pc/mi/ln | 34.1 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 5 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 7345 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2104 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.88 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 59.4 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 35.4 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | E |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 6 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 7345 | 744 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 8414 | 852 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.88 | 0.41 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 26.4 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.375 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2133 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 59.5 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 72.4 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 4149 | Ramp Junction Speed (S), mi/h | 65.4 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 32.2 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 7 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 3 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 6601 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2520 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 1.06 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | - |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | - |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | F |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 8 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 6601 | 1456 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 7561 | 1668 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.96 | 0.79 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 32.0 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.611 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2269 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 52.9 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.009 | Outer Lanes Freeway Speed ($S_O$), mi/h | 63.6 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 3024 | Ramp Junction Speed (S), mi/h | 57.7 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 4692 | Average Density (D), pc/mi/ln | 40.0 |
| Level of Service (LOS) | D | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 9 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.50 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 68.2 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8057 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2307 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2382 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2382 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.97 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 54.9 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 42.0 |
| Total Ramp Density Adjustment | 1.8 | Level of Service (LOS) | E |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 68.2 | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 1 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.50 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 68.2 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 9093 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2575 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2382 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2382 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 1.08 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | - |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | - |
| Total Ramp Density Adjustment | 1.8 | Level of Service (LOS) | F |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 68.2 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 2 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 9093 | 1391 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 10299 | 1575 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 1.07 | 0.75 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | - |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | - |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2460 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | - |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 71.1 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 5379 | Ramp Junction Speed (S), mi/h | - |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | - |
| Level of Service (LOS) | F | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 3 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 3 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 7702 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2908 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 1.22 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | - |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | - |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | F |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 4 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 7702 | 703 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 8724 | 796 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.99 | 0.38 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 29.2 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.469 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2617 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 56.9 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.118 | Outer Lanes Freeway Speed ($S_O$), mi/h | 61.6 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 3490 | Ramp Junction Speed (S), mi/h | 59.4 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 4286 | Average Density (D), pc/mi/ln | 40.1 |
| Level of Service (LOS) | D | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 5 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8405 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2380 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 1.00 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | - |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | - |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | F |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 6 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 8405 | 515 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 9520 | 583 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.99 | 0.28 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 29.3 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.350 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2520 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 60.2 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 70.9 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 4480 | Ramp Junction Speed (S), mi/h | 65.4 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 36.4 |
| Level of Service (LOS) | D | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 7 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 3 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 7890 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2979 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 1.25 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | - |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | - |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | F |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 8 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 7890 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2234 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.94 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 56.5 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 39.5 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | E |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 9 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 7890 | 980 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 8936 | 1110 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.84 | 0.53 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 24.4 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.341 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2121 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 60.5 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.079 | Outer Lanes Freeway Speed ($S_O$), mi/h | 64.2 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2574 | Ramp Junction Speed (S), mi/h | 62.8 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 3684 | Average Density (D), pc/mi/ln | 24.0 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 10 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8870 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2009 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.85 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 61.2 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 32.8 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 1 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.50 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 68.2 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8492 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1924 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2382 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2382 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.81 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 62.9 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 30.6 |
| Total Ramp Density Adjustment | 1.8 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 68.2 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 2 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 8492 | 936 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 9618 | 1060 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.80 | 0.50 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 24.7 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.393 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1888 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 59.0 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 73.3 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 3953 | Ramp Junction Speed (S), mi/h | 66.7 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 23.1 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 3 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 7556 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2140 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.90 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 58.6 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 36.5 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | E |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 4 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1300 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 7556 | 753 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 8558 | 853 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.98 | 0.41 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 30.4 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.485 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2568 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 56.4 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.111 | Outer Lanes Freeway Speed ($S_O$), mi/h | 61.9 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 3423 | Ramp Junction Speed (S), mi/h | 59.3 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 4276 | Average Density (D), pc/mi/ln | 39.7 |
| Level of Service (LOS) | D | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 5 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8309 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2353 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.99 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 53.5 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 44.0 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | E |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 6 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 8309 | 1735 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 9411 | 1965 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.98 | 0.94 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 35.6 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.475 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2100 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 56.7 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 72.5 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 5211 | Ramp Junction Speed (S), mi/h | 62.8 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 37.5 |
| Level of Service (LOS) | E | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 7 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 3 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 6574 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2482 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 1.04 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | - |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | - |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | F |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 8 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 4 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 6574 | 868 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 7446 | 983 |
| Capacity (c), pc/h | 9600 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.88 | 0.47 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 26.6 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.391 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2234 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 59.1 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.095 | Outer Lanes Freeway Speed ($S_O$), mi/h | 63.8 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2978 | Ramp Junction Speed (S), mi/h | 61.5 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 3961 | Average Density (D), pc/mi/ln | 34.3 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | No-Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 9 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.50 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 68.2 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 7442 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2107 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2382 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2382 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.88 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 59.6 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 35.4 |
| Total Ramp Density Adjustment | 1.8 | Level of Service (LOS) | E |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 68.2 | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 1 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.50 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 68.2 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8878 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2034 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2382 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2382 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.85 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 61.0 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 33.3 |
| Total Ramp Density Adjustment | 1.8 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 68.2 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 2 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 8878 | 754 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 10170 | 864 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.85 | 0.41 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 25.5 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.376 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2045 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 59.5 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 72.7 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 4035 | Ramp Junction Speed (S), mi/h | 66.8 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 24.4 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 3 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8124 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2326 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.98 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 54.2 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 42.9 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | E |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 4 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 8124 | 909 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 9306 | 1041 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.86 | 0.50 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 25.0 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.354 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2195 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 60.1 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.088 | Outer Lanes Freeway Speed ($S_O$), mi/h | 63.9 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2722 | Ramp Junction Speed (S), mi/h | 62.5 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 3763 | Average Density (D), pc/mi/ln | 25.1 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 5 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 9033 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2069 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.87 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 60.1 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 34.4 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 6 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 9033 | 804 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 10347 | 921 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.86 | 0.44 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 26.3 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.381 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2073 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 59.3 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 72.6 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 4128 | Ramp Junction Speed (S), mi/h | 66.6 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 24.9 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 7 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8229 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2356 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.99 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 53.4 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 44.1 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | E |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 8 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 8229 | 678 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 9426 | 777 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.85 | 0.37 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 23.5 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.321 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2219 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 61.0 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.121 | Outer Lanes Freeway Speed ($S_O$), mi/h | 63.8 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2770 | Ramp Junction Speed (S), mi/h | 62.8 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 3547 | Average Density (D), pc/mi/ln | 24.5 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 9 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8907 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2041 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.86 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 60.6 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 33.7 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 1 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.50 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 68.2 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8811 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2019 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2382 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2382 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.85 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 61.3 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 32.9 |
| Total Ramp Density Adjustment | 1.8 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 68.2 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 2 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 8811 | 1419 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 10093 | 1625 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.84 | 0.77 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 28.9 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.444 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1885 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 57.6 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 73.3 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 4437 | Ramp Junction Speed (S), mi/h | 65.5 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 24.7 |
| Level of Service (LOS) | D | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 3 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 7392 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2117 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.89 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 59.1 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 35.8 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | E |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 4 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 7392 | 425 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 8467 | 487 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.75 | 0.23 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 18.6 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.258 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2015 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 62.8 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.157 | Outer Lanes Freeway Speed ($S_O$), mi/h | 64.5 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2422 | Ramp Junction Speed (S), mi/h | 63.9 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 2909 | Average Density (D), pc/mi/ln | 20.5 |
| Level of Service (LOS) | B | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 5 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 7817 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1791 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.75 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 64.6 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 27.7 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 6 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 7817 | 752 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 8954 | 861 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.75 | 0.41 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 21.8 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.375 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1782 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 59.5 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 73.7 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 3609 | Ramp Junction Speed (S), mi/h | 67.2 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 21.3 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 7 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 7065 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2023 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.85 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 60.9 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 33.2 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 8 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 7065 | 1488 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 3.10 | 3.10 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 | 0.970 |
| Flow Rate ($v_i$), pc/h | 8093 | 1704 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.82 | 0.81 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 26.7 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.403 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1926 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 58.7 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.005 | Outer Lanes Freeway Speed ($S_O$), mi/h | 64.9 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2315 | Ramp Junction Speed (S), mi/h | 62.2 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 4019 | Average Density (D), pc/mi/ln | 24.1 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 7:00-8:00 |
| Project Description | Segment 9 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.50 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 68.2 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8553 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.970 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1959 |
| Total Trucks, % | 3.10 | Capacity (c), pc/h/ln | 2382 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2382 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.82 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 62.4 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 31.4 |
| Total Ramp Density Adjustment | 1.8 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 68.2 | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 1 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.50 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 68.2 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 9504 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2153 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2382 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2382 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.90 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 58.6 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 36.7 |
| Total Ramp Density Adjustment | 1.8 | Level of Service (LOS) | E |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 68.2 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 2 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 9504 | 1415 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 10765 | 1603 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.90 | 0.76 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 30.8 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.442 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2035 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 57.6 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 72.8 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 4659 | Ramp Junction Speed (S), mi/h | 65.3 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 26.4 |
| Level of Service (LOS) | D | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NDCOT | Analysis Year | Build (2045) |
| Jurisdiction | NDCOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 3 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8089 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2290 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.96 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 55.1 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 41.6 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | E |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 4 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 8089 | 701 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 9162 | 794 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.83 | 0.38 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 22.8 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.310 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2166 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 61.3 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.119 | Outer Lanes Freeway Speed ($S_O$), mi/h | 64.0 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2665 | Ramp Junction Speed (S), mi/h | 63.0 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 3459 | Average Density (D), pc/mi/ln | 23.7 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NDCOT | Analysis Year | Build (2045) |
| Jurisdiction | NDCOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 5 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8790 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1991 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.84 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 61.5 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 32.4 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 6 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 8790 | 536 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 9956 | 607 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.83 | 0.29 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 23.6 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.353 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2047 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 60.1 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 72.7 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 3815 | Ramp Junction Speed (S), mi/h | 67.3 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 23.7 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NDCOT | Analysis Year | Build (2045) |
| Jurisdiction | NDCOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 7 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8254 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2337 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.98 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 53.9 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 43.4 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | E |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 8 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 8254 | 981 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 9349 | 1111 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.87 | 0.53 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 25.7 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.369 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2203 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 59.7 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.079 | Outer Lanes Freeway Speed ($S_O$), mi/h | 63.9 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2740 | Ramp Junction Speed (S), mi/h | 62.3 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 3851 | Average Density (D), pc/mi/ln | 25.6 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/25/2019 |
| Agency | NDCOT | Analysis Year | Build (2045) |
| Jurisdiction | NDCOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 9 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 9235 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2092 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.88 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 59.6 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 35.1 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | E |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 1 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.50 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 68.2 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8750 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1982 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2382 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2382 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.83 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 62.0 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 32.0 |
| Total Ramp Density Adjustment | 1.8 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 68.2 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 2 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 8750 | 929 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 9911 | 1052 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.83 | 0.50 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 25.6 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.393 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1954 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 59.0 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 73.1 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 4050 | Ramp Junction Speed (S), mi/h | 66.6 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 23.8 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 3 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 7821 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 2214 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.93 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 57.0 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 38.8 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | E |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 4 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 7821 | 760 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 8858 | 861 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.81 | 0.41 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 22.3 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.303 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 2105 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 61.5 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.110 | Outer Lanes Freeway Speed ($S_O$), mi/h | 64.2 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2543 | Ramp Junction Speed (S), mi/h | 63.2 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 3404 | Average Density (D), pc/mi/ln | 22.8 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 5 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 8581 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1944 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.82 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 62.3 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 31.2 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Diverge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 6 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Deceleration Length ($L_D$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 8581 | 1737 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 9719 | 1967 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.81 | 0.94 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 29.4 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($D_S$) | 0.475 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1740 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | Off-Ramp Influence Area Speed ($S_R$), mi/h | 56.7 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FD}$) | 0.436 | Outer Lanes Freeway Speed ($S_O$), mi/h | 73.9 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 4499 | Ramp Junction Speed (S), mi/h | 64.8 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | - | Average Density (D), pc/mi/ln | 24.0 |
| Level of Service (LOS) | D | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 7 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 4 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.67 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 67.7 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 6844 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1938 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2377 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2377 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.82 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 62.4 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 31.1 |
| Total Ramp Density Adjustment | 2.3 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 67.7 | | |

# HCS7 Freeway Merge Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 8 | | |

## Geometric Data

| | Freeway | Ramp |
|---|---|---|
| Number of Lanes (N) | 5 | 1 |
| Free-Flow Speed (FFS), mi/h | 70.0 | 45.0 |
| Segment Length (L) / Acceleration Length ($L_A$), ft | 1500 | 1500 |
| Terrain Type | Level | Level |
| Percent Grade, % | - | - |
| Segment Type / Ramp Side | Freeway | Right |

## Adjustment Factors

| | | |
|---|---|---|
| Driver Population | All Familiar | All Familiar |
| Weather Type | Non-Severe Weather | Non-Severe Weather |
| Incident Type | No Incident | - |
| Final Speed Adjustment Factor (SAF) | 1.000 | 1.000 |
| Final Capacity Adjustment Factor (CAF) | 1.000 | 1.000 |
| Demand Adjustment Factor (DAF) | 1.000 | 1.000 |

## Demand and Capacity

| | | |
|---|---|---|
| Demand Volume ($V_i$), veh/h | 6844 | 876 |
| Peak Hour Factor (PHF) | 0.90 | 0.90 |
| Total Trucks, % | 1.90 | 1.90 |
| Single-Unit Trucks (SUT), % | - | - |
| Tractor-Trailers (TT), % | - | - |
| Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 | 0.981 |
| Flow Rate ($v_i$), pc/h | 7752 | 992 |
| Capacity (c), pc/h | 12000 | 2100 |
| Volume-to-Capacity Ratio (v/c) | 0.73 | 0.47 |

## Speed and Density

| | | | |
|---|---|---|---|
| Upstream Equilibrium Distance ($L_{EQ}$), ft | - | Density in Ramp Influence Area ($D_R$), pc/mi/ln | 20.7 |
| Distance to Upstream Ramp ($L_{UP}$), ft | - | Speed Index ($M_S$) | 0.283 |
| Downstream Equilibrium Distance ($L_{EQ}$), ft | - | Flow Outer Lanes ($v_{OA}$), pc/h/ln | 1845 |
| Distance to Downstream Ramp ($L_{DOWN}$), ft | - | On-Ramp Influence Area Speed ($S_R$), mi/h | 62.1 |
| Prop. Freeway Vehicles in Lane 1 and 2 ($P_{FM}$) | 0.094 | Outer Lanes Freeway Speed ($S_O$), mi/h | 65.2 |
| Flow in Lanes 1 and 2 ($v_{12}$), pc/h | 2217 | Ramp Junction Speed (S), mi/h | 64.0 |
| Flow Entering Ramp-Infl. Area ($v_{R12}$), pc/h | 3209 | Average Density (D), pc/mi/ln | 20.4 |
| Level of Service (LOS) | C | | |

# HCS7 Basic Freeway Report

## Project Information

| | | | |
|---|---|---|---|
| Analyst | Atkins | Date | 7/26/2019 |
| Agency | NCDOT | Analysis Year | Build (2045) |
| Jurisdiction | NCDOT | Time Period Analyzed | 17:00-18:00 |
| Project Description | Segment 9 | | |

## Geometric Data

| | | | |
|---|---|---|---|
| Number of Lanes (N), ln | 5 | Terrain Type | Level |
| Segment Length (L), ft | - | Percent Grade, % | - |
| Measured or Base Free-Flow Speed | Base | Grade Length, mi | - |
| Base Free-Flow Speed (BFFS), mi/h | 70.0 | Total Ramp Density (TRD), ramps/mi | 0.50 |
| Lane Width, ft | 12 | Free-Flow Speed (FFS), mi/h | 68.2 |
| Right-Side Lateral Clearance, ft | 10 | | |

## Adjustment Factors

| | | | |
|---|---|---|---|
| Driver Population | All Familiar | Final Speed Adjustment Factor (SAF) | 1.000 |
| Weather Type | Non-Severe Weather | Final Capacity Adjustment Factor (CAF) | 1.000 |
| Incident Type | No Incident | Demand Adjustment Factor (DAF) | 1.000 |

## Demand and Capacity

| | | | |
|---|---|---|---|
| Demand Volume (V), veh/h | 7720 | Heavy Vehicle Adjustment Factor ($f_{HV}$) | 0.981 |
| Peak Hour Factor (PHF) | 0.90 | Flow Rate ($v_p$), pc/h/ln | 1749 |
| Total Trucks, % | 1.90 | Capacity (c), pc/h/ln | 2382 |
| Single-Unit Trucks (SUT), % | - | Adjusted Capacity ($c_{adj}$), pc/h/ln | 2382 |
| Tractor-Trailers (TT), % | - | Volume-to-Capacity Ratio (v/c) | 0.73 |
| Passenger Car Equivalent ($E_T$) | 2.000 | | |

## Speed and Density

| | | | |
|---|---|---|---|
| Lane Width Adjustment ($f_{LW}$) | 0.0 | Average Speed (S), mi/h | 65.4 |
| Right-Side Lateral Clearance Adj. ($f_{RLC}$) | 0.0 | Density (D), pc/mi/ln | 26.7 |
| Total Ramp Density Adjustment | 1.8 | Level of Service (LOS) | D |
| Adjusted Free-Flow Speed ($FFS_{adj}$), mi/h | 68.2 | | |

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