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DCHC

METROPOLITAN PLANNING ORGANIZATION

Technical Committee

Meeting Agenda

Wednesday, July 28, 2021

9:00 AM

Meeting to be held by teleconference.

Watch on Facebook Live at https://www.facebook.com/MPOforDCHC/

Any member of the general public who wishes to make public comment should send an email to aaron.cain@durhamnc.gov and the comment will be read to the Board during the public comment portion of the meeting.

1. Roll Call

2. Adjustments to the Agenda

3. Public Comment

CONSENT AGENDA

4. Approval of the May 26, 2021 TC Meeting Minutes 21-164

A copy of the May 26, 2021 meeting minutes is enclosed.

TC Action: Approve the minutes of the May 26, 2021 TC meeting.

Attachments: 2021-07-28 (21-164) 5.26 TC Minutes_LPA2

ACTION ITEMS

5. 2050 MTP -- Alternative Analysis (15 minutes) 21-155

Andy Henry, LPA Staff

At their June meeting, the Board authorized the MPO staff to release the Alternatives Analysis when the modeling, documentation, and Web site were ready. Staff plan to release the DCHC MPO's Alternatives Analysis on July 29th, which will be the same release date as that of the Capital Area MPO (CAMPO), and give adequate time to include interactive maps, performance data, and other support materials on the Web site. Today, staff will update the Technical Committee (TC) on the Alternatives Analysis release. For background information on the various alternatives, see the attached June 9th Board presentation.

TC Action: Receive update on the 2050 MTP Alternatives Analysis release

Attachments: 2021-07-28 (21-155) 2050MTP-AltsAnalysis-PresentationToBoard

6. Bus on Shoulder Study (20 minutes) 21-162

Patrick McDonough, HDR

Alpesh Patel, Cambridge Systematics

The North Carolina Capital Area Metropolitan Planning Organization (CAMPO) and its partners, GoTriangle, the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO), and the North Carolina Department of Transportation (NCDOT) initiated a study to create a programmatic approach for identifying, prioritizing, and developing best practices for Bus on Shoulder System (BOSS) deployment in the Triangle and across North Carolina.

The goals of the study include:

- Identify most promising locations for BOSS expansion in Triangle
- Create a blueprint for how other North Carolina regions can establish successful BOSS programs
- Document best practices and design criteria for BOSS that can be used statewide

The Bus on Shoulder System (BOSS) Implementation Blueprint outlines the study's findings related to these goals.

TC Action: Receive informational report about the BOSS Study.

Attachments: 2021-07-28 (21-162) BOSS TC Presentation

2021-07-28 (21-162) BOSS Executive Briefing Presentation

2021-07-28 (21-162) BOSS Executive Summary

2021-07-28 (21-162) BOSS Implementation Blueprint

7. D-O LRT Corridor in CTP (20 minutes) 21-161

Aaron Cain, LPA Staff

In 2016 the DCHC MPO Board incorporated the alignment of the proposed Durham-Orange Light Rail Transit (D-O LRT) corridor into the Comprehensive Transportation Plan (CTP). In 2019, the D-O LRT project was discontinued and no further work has been done to advance the project. However, the D-O LRT corridor remains identified in the CTP.

The Durham Unified Development Ordinance (UDO) states that land for transportation corridors identified in the CTP must be reserved through a site plan or rezoning with a development plan. The Durham City-County Planning Department has stated concerns about this requirement and its application to the 2016 North Carolina Supreme Court case Kirby v. NCDOT, in which the court determined that NCDOT's use of the Map Act was an unconstitutional taking and required NCDOT to compensate landowners for property held in reserve for future transportation projects. Conversely, GoTriangle has identified the D-O LRT corridor as a possible future bus rapid transit (BRT) corridor serving Durham and Chapel Hill, particularly the off-road segments that could greatly aid future transit timeliness and efficiency.

The TC is asked to discuss and provide guidance to MPO staff as it finalizes CTP Amendment #3. A memo is attached that provides further background and information.

Staff Recommendation: Staff recommends that the D-O LRT corridor be removed from maps in the CTP, but that statements identifying the need for high capacity transit along the US HIghway 15/501 Corridor between Durham and Chapel Hill be included.

TC Action: Provide direction to MPO staff on the inclusion or removal of the D-O LRT corridor in CTP Amendment #3.

Attachments: 2021-07-28 (21-161) Memo on D-O LRT Corridor in CTP
2021-07-28 (21-161) Current D-O LRT Alignment in CTP

8. US 70 East Access and Connectivity Study Introduction (20 minutes) 21-159

Jake Ford, LPA Staff

The US 70 East Access and Connectivity Study will analyze NCDOT's U-5720 conversion of the US 70 East corridor, from the East End Connector to TW Alexander Drive, into a limited access freeway. The goal of the study is to evaluate the impacts on multi-modal safety and access, connectivity of local businesses and communities, collector street plans, and any impacts to transit networks. Previously, City and County staff have raised concerns with the existing U-5720 framework citing only one interchange being planned for the study area, insufficient attention to nonmotorized access, and no strategy for how the proposed conversion may alter transit networks for the corridor. These represent severe challenges to transportation networks for both communities and businesses.

The US 70 corridor is poised to experience continued growth in Durham County, hence ensuring transportation designs take into account local concerns regarding connectivity and access is imperative. This study will provide additional information on the possible impacts, providing policymakers and the community with greater transparency.

TC Action: MPO staff has drafted a letter to NCDOT to be signed by the Board Chair requesting incorporation of this study and its findings into the development of U-5720. Staff requests that the TC recommend that the Board authorize the Chair to sign the letter.

Attachments: 2021-07-28 (21-159) US 70 East Access Study Presentation
2021-07-28 (21-159) City of Durham Memo re U-5720 Concepts dated Novemb
2021-07-28 (21-159) US 70 Schedule Adjustment Letter

9. Transportation Improvement Program Amendment #7 (5 minutes) 21-160

Anne Phillips, LPA Staff

Transportation Improvement Program (TIP) Amendment #7 primarily consists of projects that have been amended in the State Transportation Improvement Program (STIP) by NCDOT, and therefore need to be amended in the DCHC MPO TIP.

TIP Amendment #7 also includes a request from the City of Durham to flex FY18-22 Surface Transportation Block Grant Direct Attributable (STBGDA) funds from the Federal Highway Administration to the Federal Transit Administration to purchase three electric buses and seven paratransit vehicles. Because the funding in this request exceeds $1 million, this amendment must be released for a 21-day public comment period in accordance with DCHC's Public Involvement Policy.

Finally, TIP Amendment #7 adds DCHC's Transit Safety Performance Targets that were adopted on June 9, 2021, to the TIP. This action fulfills a joint FHWA and FTA requirement that transit systems that receive urbanized area formula grants develop and implement transit safety management systems. MPOs are required to reflect safety measures and targets in the Metropolitan Transportation Plan (MTP) and TIP.

A summary sheet, full report, and resolution are attached.

TC Action: Recommend that the MPO Board release TIP Amendment #7 for a 21-day public comment period.

Board Action: Release TIP Amendment #7 for a 21-day public comment period.

Attachments: 2021-07-28 (21-160) TIP Amendment #7 Full Report
2021-07-28 (21-160) TIP Amendment #7 Resolution
2021-07-28 (21-160) TIP Amendment #7 Summary Sheet

REPORTS FROM STAFF:

10. Report from Staff 21-107

Felix Nwoko, LPA Staff

TC Action: Receive report from Staff.

Attachments: 2021-07-28 (21-107) LPA staff report

11. Report from the Chair 21-108

Ellen Beckmann, TC Chair

TC Action: Receive report from the TC Chair.

12. NCDOT Reports 21-109

Brandon Jones (David Keilson, Richard Hancock), Division 5 - NCDOT
Wright Archer (Pat Wilson, Stephen Robinson), Division 7 - NCDOT
Patrick Norman (Bryan Kluchar, Jen Britt), Division 8 - NCDOT
Julie Bogle, Transportation Planning Division - NCDOT
John Grant, Traffic Operations - NCDOT
Bryan Lopez, Integrated Mobility Division-NCDOT

TC Action: Receive reports from NCDOT.

Attachments: 2021-07-28 (21-109) NCDOT Progress Report

INFORMATIONAL ITEMS:

Adjourn

Next meeting: August 25, 9 a.m., Meeting location to be determined.

Dates of Upcoming Transportation-Related Meetings: None

DURHAM-CHAPEL HILL-CARRBORO METROPOLITAN PLANNING ORGANIZATION

TECHNICAL COMMITTEE

May 26, 2021

MINUTES OF MEETING

The Durham-Chapel Hill Carrboro Metropolitan Planning Organization Technical Committee met on May 26, 2021 at 9:00 a.m. through a teleconferencing platform. The following members were in attendance:

Ellen Beckmann (Chair) Durham County
Nishith Trivedi (Vice Chair) Orange County
Evan Tenenbaum (Member) City of Durham
Pierre Osei-Owusu (Member) City of Durham Transportation/Go Durham
Kayla Seibel (Member) City of Durham Planning
Brooke Ganser (Member) Durham County
Scott Whiteman (Member) Durham County
Tina Moon (Member) Carrboro Planning
Zach Hallock (Member) Carrboro Planning
Bergen Watterson (Member) Town of Chapel Hill
Josh Mayo (Member) Town of Chapel Hill
Kumar Neppalli (Member) Chapel Hill Engineering
Margaret Hauth (Member) Town of Hillsborough
Chance Mullis (Member) Chatham County Planning
John Hodges-Copple (Member) TJCOG
Jay Heikes (Member) GoTriangle
Hank Graham (Member) Research Triangle Foundation
Julie Bogle (Member) NCDOT TPD
John Grant (Member) NCDOT Traffic Operations
Kurt Stolka (Member) The University of North Carolina
Michael Page (Member) North Carolina Central University
Tom Altieri (Member) Orange County Planning
Theo Letman (Member) Orange Public Transportation
Jay Heikes (Member) GoTriangle
Bill Judge (Alternate) City of Durham
Brian Taylor (Alternate) City of Durham Transportation
David Keilson (Alternate) NCDOT Division 5
Richard Hancock (Alternate) NCDOT Division 5
Stephen Robinson (Alternate) NCDOT Division 7
Bryan Kluchar (Alternate) NCDOT Division 8
Cha'ssem Anderson (Alternate) The University of North Carolina
Matt Cecil (Alternate) Chapel Hill Transit/Planning
Meg Scully (Alternate) GoTriangle

Joe Geigle, Federal Highway Administration
Rachel Stair, Raleigh-Durham Airport Authority

Iona Thomas, McAdams
Erich Melville, McAdams
Tom Devlin, City of Durham
Ayden Cohen, Research Triangle Foundation

Brian Rhodes DCHC MPO
Aaron Cain DCHC MPO
Anne Phillips DCHC MPO
Andy Henry DCHC MPO
Dale McKeel City of Durham/DCHC MPO
Yanping Zhang, DCHC MPO
Kayla Mathews DCHC MPO
Mariel Klein, DCHC MPO

Quorum count: 30 of 31 voting members

Chair Ellen Beckmann called the meeting to order at 9:00 a.m.

PRELIMINARIES:

1. Roll Call

The roll call would be completed using the Zoom participant list. A new Technical Committee Member with the Town of Chapel Hill, Josh Mayo, was introduced. Hank Graham announced his resignation from the Research Triangle Foundation and said Ayden Cohen would be replacing him on the TC, though official notification is still forthcoming.

2. Adjustments to the Agenda

There were no adjustments to the agenda.

3. Public Comments

There were no public comments.

CONSENT AGENDA:

4. Approval of the April 28, 2021 TC Meeting Minutes

There was no discussion on the consent agenda. Pierre Osei-Owusu made a motion to approve the consent agenda. Chance Mullis seconded the motion. The motion passed unanimously.

ACTION ITEMS:

5. Triangle Bikeway Study Update
Dale McKeel, LPA Staff

Iona Thomas, leader of the bicycle/pedestrian practice with McAdams, gave an update on the Triangle Bikeway Study, which aims to determine the best alignment for a 17-mile bicycle/pedestrian facility throughout the Triangle Region. Iona Thomas reviewed the 2020 public input process that resulted in over 2,000 survey respondents with a good distribution along the corridor and a varied representation of intended uses/destinations. Iona Thomas shared several different breakdowns of survey data to further analyze the results.

Iona Thomas discussed the relationship of the Triangle Bikeway project to North Carolina Department of Transportation (NCDOT) project U-5774 (NC 54 Corridor Improvements) that will address many of the bicycle/pedestrian facility needs when it is constructed. Richard Hancock provided details on the schedule for three sections of U-5774 that are currently in the Transportation Improvement Program (TIP) and State Transportation Improvement Program (STIP).

Iona Thomas showed a map of possible alignment alternatives and the recommended alignment for the Triangle Bikeway. Iona Thomas said the next steps include an updated website launch, public meetings, a Triangle Working Group (TWG) meeting, and continued coordination with NCDOT.

Vice Chair Nishith Trivedi thanked Iona Thomas and the McAdams team for including Orange County and Chapel Hill in this regional project and for conducting thorough public engagement. Chair Ellen Beckmann agreed that coordination with the NC 54 project presents a good opportunity for funding, although many sections are still not yet funded. Chair Ellen Beckmann mentioned potential challenges for Durham residents to get to the Triangle Bikeway. Iona Thomas said this issue will be addressed specifically in the next round of public engagement that will allow survey respondents to pick a place on the map of where they think an access point is needed. There was a discussion of whether this project should be an

independent project or partnered with NCDOT, which maintains over 90% of the right of way for the proposed alignment. Iona Thomas pointed out that this project is an opportunity to foster regional cooperation while also fitting the project into the transportation network of each local community. Chair Ellen Beckmann said she sees potential for NCDOT to be the project manager of the Triangle Bikeway. This item will be brought to the next DCHC MPO Board meeting.

This item was for informational purposes; no further action was required by the TC.

6. 2050 MTP -- Alternative Analysis
Andy Henry, LPA Staff
John Hodges-Copple, TJCOG

Andy Henry said this item requests the TC to recommend that the DCHC MPO Board in June preemptively authorize MPO staff to release the Alternative Analysis for a public comment period once the documentation is ready in late June or early July because the DCHC MPO Board will not meet in July. Andy Henry said the Alternatives Analysis aims to kick off the discussion about different land use and transportation possibilities to help form the preferred scenario patchwork as the next milestone in the development of the 2050 Metropolitan Transportation Plan (MTP).

John Hodges-Copple provided context on the MTP development and reminded meeting participants that scenarios are simplified versions of the real world to aid in informed decision making. John Hodges-Copple reviewed the scenario framework that produces four scenarios, each based on the intersection of a particular development foundation (land use) and a particular mobility investment foundation. Each scenario has its own set of revenue assumptions and fiscal constraint. John Hodges-Copple mentioned the difference between anchors and mainstays in key hubs and emphasized equity centered places called REINVEST Neighborhoods (RE= Race/Ethnicity, IN=Income, VE=Vehicles, ST=Status). John Hodges-

Copple reviewed the different development foundations and Andy Henry reviewed the different mobility investment foundations.

Tina Moon mentioned that despite efforts to increase transit availability and implement bicycle/pedestrian projects, Triangle Regional Model (TRM) data for the scenarios will likely still show an increase in Vehicle Miles Traveled (VMT) and congestion. Tina Moon asked for members to stop and think about if anything could be changed in the scenarios to avoid this undesirable outcome. Chair Ellen Beckmann expressed interest in changing the 2045 MTP assumptions to put more funding towards maintenance of existing roadway facilities rather than roadway expansion. Andy Henry said about 30-40% of overall highway revenue is put towards maintenance of existing roads, and that amount could be increased, which would in turn leave less funding for highway expansion projects. Chair Ellen Beckmann said transit and bicycle/pedestrian projects are certainly worthwhile but reducing the highway expansion trend could also help achieve the MPO's climate goals. Andy Henry said he would work with Yanping Zhang to potentially adjust the TRM mobility foundations to include less highway projects to see the effect on VMT predictions.

Jay Heikes mentioned that in addition to the need for maintenance, funds could be shifted towards retrofitting existing roads and intersections to become complete streets and improve safety.

Andy Henry shared the Performance Measures and tools that will be used to compare scenarios during the public engagement process. Vice Chair Nishith Trivedi thanked local jurisdictions for their active involvement in this process and thanked Triangle J Council of Government (TJCOG) for thoroughly exploring key hubs. Vice Chair Nishith Trivedi commended the increased engagement in Communities of Concern and the increased emphasis on equity and the environment.

Jay Heikes made a motion to recommend that the DCHC MPO Board authorize staff to release the Alternatives Analysis when the modeling and documentation are complete. Tom Altieri seconded the motion. The motion passed unanimously.

7. Transportation Improvement Program Amendment #6
Anne Phillips, LPA Staff

Anne Phillips said no public comments were received throughout the 21-day public comment period. Anne Phillips pointed out the following three changes included in TIP Amendment #6: 1) the Regional Transit Center has been added, 2) Chapel Hill Transit requested the North-South Bus Rapid Transit project be added, and 3) NCDOT requested two additional statewide Congestion Mitigation and Air Quality Improvement (CMAQ) projects be fast tracked.

Evan Tenenbaum made a motion to recommend that the DCHC MPO Board approve TIP Amendment #6. Julie Bogle seconded the motion. The motion passed unanimously.

8. SPOT 6.0 Draft Local Input Points Methodology
Anne Phillips, LPA Staff

Anne Phillips said no public comments were received. Anne Phillips pointed out the addition of a sustainability metric to the now seven-point rubric.

Zach Hallock made a motion to recommend that the DCHC MPO Board adopt the 2021 Local Input Points Methodology. Hank Graham seconded the motion. The motion passed unanimously.

9. 2021 CRRSAA Section 5310 Project Selection
Felix Nwoko, LPA Manager

Aaron Cain said the Coronavirus Response and Relief Supplemental Appropriations Act (CRRSAA) includes a federal requirement to have a competitive call for projects. The only submitted application was from GoDurham ACCESS and the full amount of $47,435 has been apportioned to GoDurham ACCESS.

Pierre Osei-Owusu made a motion to recommend the DCHC MPO Board approve the use of CRRSAA 5310 funds for the GoDurham ACCESS application. Ellen Beckmann seconded the motion. The motion passed unanimously.

REPORTS FROM STAFF:

10. Report from Staff

Felix Nwoko, LPA Manager

Aaron Cain said a final decision from NCDOT on CMAQ funding is expected in June. Andy Henry gave an update on CTP Amendment #3 and said problem statements are still being worked on and will be shared with the TC in July.

11. Report from the Chair

Ellen Beckmann, TC Chair

Chair Ellen Beckmann cancelled the June 2021 TC meeting. There was consensus that the July 2021 TC meeting would be held virtually and the transition to in-person or hybrid meetings would be discussed at that meeting.

12. NCDOT Reports

Brandon Jones (David Keilson, Richard Hancock), Division 5 – NCDOT

David Keilson gave an update on the Alston Avenue/Hollow Street intersection project, the Old Durham-Old Chapel Hill project, and the East End Connector.

Wright Archer (Pat Wilson, Stephen Robinson), Division 7 – NCDOT

Stephen Robinson had no additional report.

Patrick Norman (Bryan Kluchar, Jen Britt), Division 8 - NCDOT

Bryan Kluchar had no additional report.

Julie Bogle, Transportation Planning Division – NCDOT

Julie Bogle had no additional report.

John Grant, Traffic Operations – NCDOT

John Grant had no additional report.

Bryan Lopez, Integrated Mobility Division-NCDOT

There was no additional report.

INFORMATIONAL ITEMS:

Adjourn

There being no further business, the meeting was adjourned by Chair Ellen Beckmann at 11:03 a.m.

Next meeting: July 28, 9 a.m., meeting location to be determined

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METROPOLITAN PLANNING ORGANIZATION

PLANNING TOMORROW'S TRANSPORTATION

2050 Metropolitan Transportation Plan – Alternatives Analysis –

Andy Henry, andrew.henry@durhamnc.gov, June 6, 2021

Presentation Outline

- Schedule
- Alternatives – Development and Mobility foundations
- Metrics and Maps
- Public Engagement
- Today's action

2050 MTP Milestones

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January 2022
Adopted 2050 MTP & Air Quality Conformity

October 2021
Preferred Option

June/July 2021
Alternatives Analysis

The DCHC MPO Board does not usually meet in July

April 2021
Deficiency Analysis & Needs Assessment ✓

Goals and Objectives ✓

Alternatives Analysis

- Purpose: staff, public and Board discuss different land use and transportation possibilities
- *Preferred Option* likely to be mixture of the assumptions and projects from Alternatives Analysis scenarios
- Alternatives not fiscally-constrained
- Today's presentation has overview -- Full complement of tables and maps on Web site

Context

- The "MTP" is the foundation for other plans and studies
  (these are transit examples, but the context applies to roads or other modes)
  - 2050 Metropolitan Transportation Plan
    - Long term, regional (multi-MPO) scale, fiscally constrained, meets federal AQ standards
  - County Transit Plan updates in Wake, Durham and Orange Counties
  - Project Studies and Designs:
    - **Bus Rapid Transit** in the four Wake Transit Plan corridors and in Chapel Hill
    - **Commuter Rail** in Wake, Johnston and Durham Counties
    - Relocation of GoTriangle's **Regional Transit Center**
- Opportunities & challenges to consider…
  - … post-COVID conditions
  - … technology change
  - … balancing transportation ***demand*** concerns with ***supply*** concerns
  - … rethinking land use, affordable housing, transit fare & parking policies

Scenario World – a reminder

The future is uncertain, so scenarios are created to represent a simplified world so we can better understand relationships and inform decisions …

… Scenarios are **NOT** the real world. Nor are they discrete "packages" of investments from which a single choice must be made.

We want to be accurate, but our main goal with scenarios is to depict reasonable, transparent, documented and adaptable elements that can be used to build a feasible plan.

Scenario Framework

- Four scenarios that match a development foundation with a mobility foundation: 2 have been completed; 2 are underway

Connect 2050 Scenario Framework

			Mobility Investment Foundation				
			Existing & Committed	Trend	Mobility Corridors	Complete Communities*	Comprehensive Transport Plan
Development Foundation		Existing or Underway	basis for all scenarios				
		Community Plans	Deficiency & Needs Scenario	Plans & Trends Scenario			
		Opportunity Places (Key Hubs; REINVEST Neighborhoods)			Shared Leadership Scenario	All Together Scenario	
		Build-Out					If unlimited $ & capacity growth

* More focused investment on Complete And Safe Streets, Active Transport, and Transit

The Development Foundation

-- a focus on important trip origins and destinations --

- *Key Hubs*

Hubs	Description	Examples
 Anchors	Places with the highest concentrations of jobs and services, plus places with moderate intensity and an anchor institution that can influence mobility-based policy decisions	• Metropolitan CBDs • Major Universities • Medical Centers • Research Triangle Park
 Mainstays	Places with regionally significant concentrations of jobs, either outright or in comparison to their surroundings	• Many mid-sized town and city centers • Some suburban centers, often along major transportation corridors

- *REINVEST Neighborhoods – equity centered places*

RE	Race/Ethnicity – the degree to which a neighborhood is home to people who are Black, Indigenous or People of Color (BIPOC).
IN	Income – the degree to which people in the neighborhood live in households with lower annual incomes.
VE	Vehicles – the degree to which households in the neighborhood report having no vehicles available
ST	Status – the degree to which a neighborhood has a specific characteristic, e.g. the # of legally-binding, affordability-restricted (LBAR) housing units

The Development Foundation

-- a focus on important travel origins and destinations --

- ***Community Plans*** *Development Foundation*

  Engagement based
  - Created through local planner input in 2020 (and subsequent revisions)
  - Represents adopted plans and/or likely plan updates
  - Where provided, incorporates "committed" development
  - "Asserts" development at Anchor Institutions like universities based on campus plans and discussions with staff

- ***Opportunity Places*** *Development Foundation*

  Mechanically derived – 4 main elements
  - Anchor institutions – increased asserted development
  - Mobility hubs – more intense, mixed use development in ~2 dozen places; largely at previously identified "activity centers" in CommunityViz
  - Frequent transit corridors – TOD development on developable parcels
  - Affordable housing opportunity sites – asserted "LIHTC-like" projects on undeveloped public land through GIS-based criteria

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The Mobility Investment Foundation

- ***Existing + Committed*** *Mobility Foundation*
  - Commuter Rail Transit, RTP to Raleigh (not to downtown Durham)
  - No BRT
  - Committed improvements to local and regional bus connections
  - Includes highway projects to be constructed by 2025, e.g., East End Connector

- ***Trend*** *Mobility Foundation*
  - Commuter Rail Transit, West Durham-Raleigh-Clayton at low service level (i.e., 8-2-8-2)
  - North-South BRT in Chapel Hill
  - Most of the 2045 MTP highway projects

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The Mobility Investment Foundation

- ***Mobility Corridors*** *Mobility Foundation*
  - Commuter Rail Transit at high service level (i.e., 12-8-12-8)
  - BRT: add US 15-501 (Chapel Hill/ Duke/Durham/NCCU-Durham Tech)
  - High frequency bus service in major corridors
  - Most of the 2045 MTP highway projects

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The Mobility Investment Foundation

- ***Complete Communities*** *Mobility Foundation*
  - Commuter Rail Transit, add low service extension to Mebane
  - BRT: add NC 147 (Durham/RTP), NC 54 (Chapel Hill/Durham/RTP), and BRT-like extensions to Pittsboro and Hillsborough
  - Add high frequency bus service
  - High level of complete streets investments (not in STI), e.g.,
    - Bus shelters, stop access, etc.
    - Bicycle lanes
  - Add connector roads to help create more grid networks (e.g., higher bike and pedestrian access)

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The Mobility Investment Foundation

- ***Complete Communities*** *Mobility Foundation*
  - Bus advantage improvements:
    - Along US 15-501 (bus-only lane) and NC 147 (add managed lane)
    - I-40 (from NC 147 to US 15-501) (add single managed lane)
  - Reduce new and widened roadways in areas that increase mobility to suburban and rural land:
    - Northern Durham Pkwy (north of I-85)
    - NC 54 (west of Carrboro)
    - NC 98 (east of Durham)
    - NC 751 (Chatham County)
  - Convert NC 147 to 4-lane boulevard (Briggs Av-Swift Av)
  - Convert central Durham one-way pairs to two-way)
  - Shift more roadway funding to maintenance

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Performance Measures

- Staff will produce Performance Measures (PMs) for each scenario – PMs are aligned with the Goals and Objectives

  (See Goals/Objectives/Performance Measures attached to today's agenda – indicates which PMs available for Alternatives Analysis.)

- Some PMs by low-income, minority, and zero-car household

- Some PMs not available for Alternatives Analysis:
  - PMs that cannot be forecast, e.g., federal safety, travel time reliability, infrastructure condition
  - PMs not affected by development and mobility foundation changes, e.g., TDM program effectiveness.

DCHC Goals	DCHC Objectives	Performance Measures
I. Protect the Human and Natural Environment and Minimize Climate Change	a) Reduce transportation sector emissions b) Achieve net zero carbon emissions	a) and b) Total and per capita transportation GHG (CO_2) featured. Also calculate ozone (NO_x), CO (carbon monoxide), and particulate matter emissions, and energy consumption (in vehicles)
	c) Reduce negative impacts on natural and cultural environment	c) Proportion of planned investment in existing highways (i.e., dollars for existing highways, as opposed to new highways)

Triangle Regional Model (TRM) Measures

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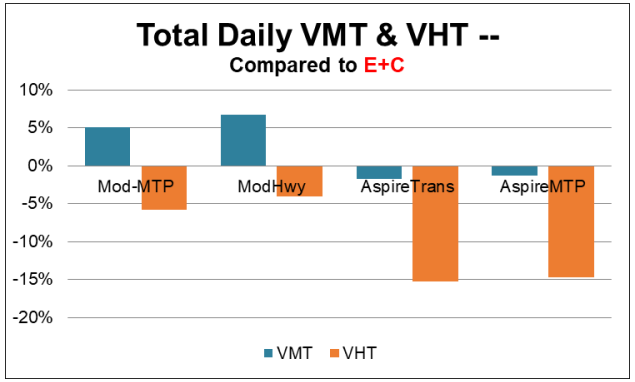
- Table will be useful for overall comparison of MTP Alternatives

(a)

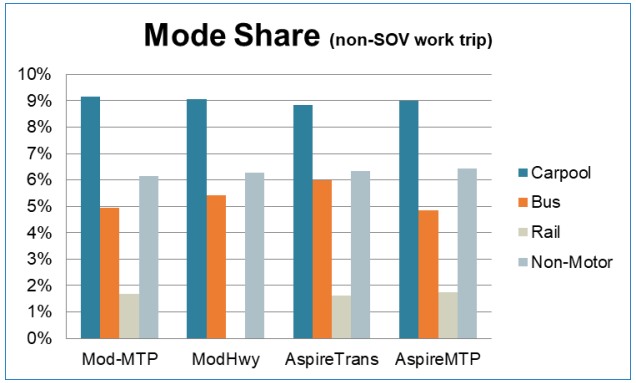
	Name =	Baseline	E+C	ModMTP	ModHwy	AspireTrans	AspireMTP
	SE Data ==>	2013	2045	2045 CP	2045 CP	2045 AIM High	2045 AIM High
	Transportation Network ==>	2013	E+C	2040 MTP	2040 MTP/ Hwy+, No FG	2040 MTP/ Transit+	2040 MTP
1	**Performance Measures**						
1.1.1	Total Vehicle Miles Traveled (VMT-daily)	12,698,821	21,108,837	22,179,755	22,533,494	20,751,593	20,822,867
1.1.1a	Total Vehicle Miles Traveled (VMT-per capita	30	31	33	34	31	31
1.2.1	Total Vehicle Hours Traveled (VHT-daily)	314,735	665,310	626,849	638,079	563,611	567,436
1.2.1a	Total Vehicle Hours Traveled (VHT-per capita	0.75	0.99	0.93	0.95	0.84	0.85

- Graphics will compare alternatives

(a)



(a)

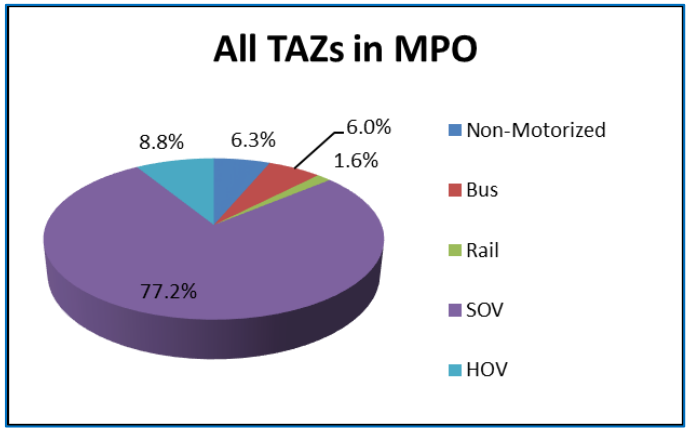


(a) Table and graphics are examples from 2045 MTP process.

Other Measures

Compare Scenarios by…

Mode split in Travel Choice Neighborhoods (i.e., high level of transit service)

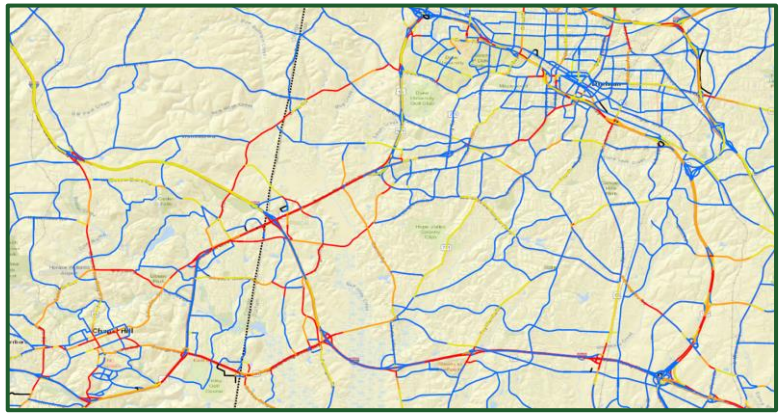


Travel time

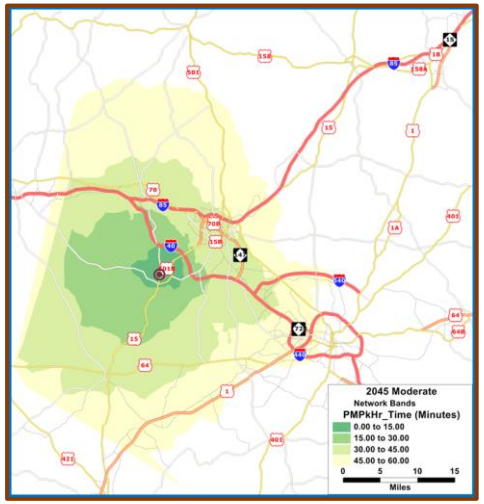
Compare 2013 andM1: PM Peak Travel time (percent increase)

From	To	Durham	RTP	Raleigh	CH/Carrboro	Hillsborough	Pittsboro
	Durham DT		29%	46%	36%	37%	43%
	RTP	31%		58%	32%	31%	43%
	Raleigh DT	36%	41%		35%	28%	41%
	CH/Carrboro	61%	43%	50%		63%	40%
	Hillsborough	21%	17%	29%	24%		5%
	Pittsboro	23%	18%	30%	12%	4%	

Congestion maps



Travel Isochrones



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PLANNING TOMORROW'S TRANSPORTATION

Public Engagement

- Open house/Pop-ups (possibly in person)
- Survey – feedback on trade-offs
- Communities of concern – special effort through survey, in-person
- Materials – summarized, more accessible
- Local boards & commissions
- Length – 42 days

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Today's Action

- Provide comments
- Recommend that the Board permit staff to release Alternatives Analysis when model completed and documents ready – late June/early July

NC Capital Area Metropolitan Planning Organization

Triangle Region Bus on Shoulder System (BOSS) Expansion Study

June 2021

Study Partnership

CAMPO
NC Capital Area Metropolitan Planning Organization

DURHAM • CHAPEL HILL • CARRBORO
DCHC
METROPOLITAN PLANNING ORGANIZATION

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

GO Triangle

HDR

CAMBRIDGE SYSTEMATICS
Design Forward

Primary Study Goals

- **Identify most promising locations for BOSS expansion in Triangle**
- **Create a blueprint for how other North Carolina regions can establish successful BOSS programs**
- **Document best practices and design criteria for BOSS that can be used statewide**

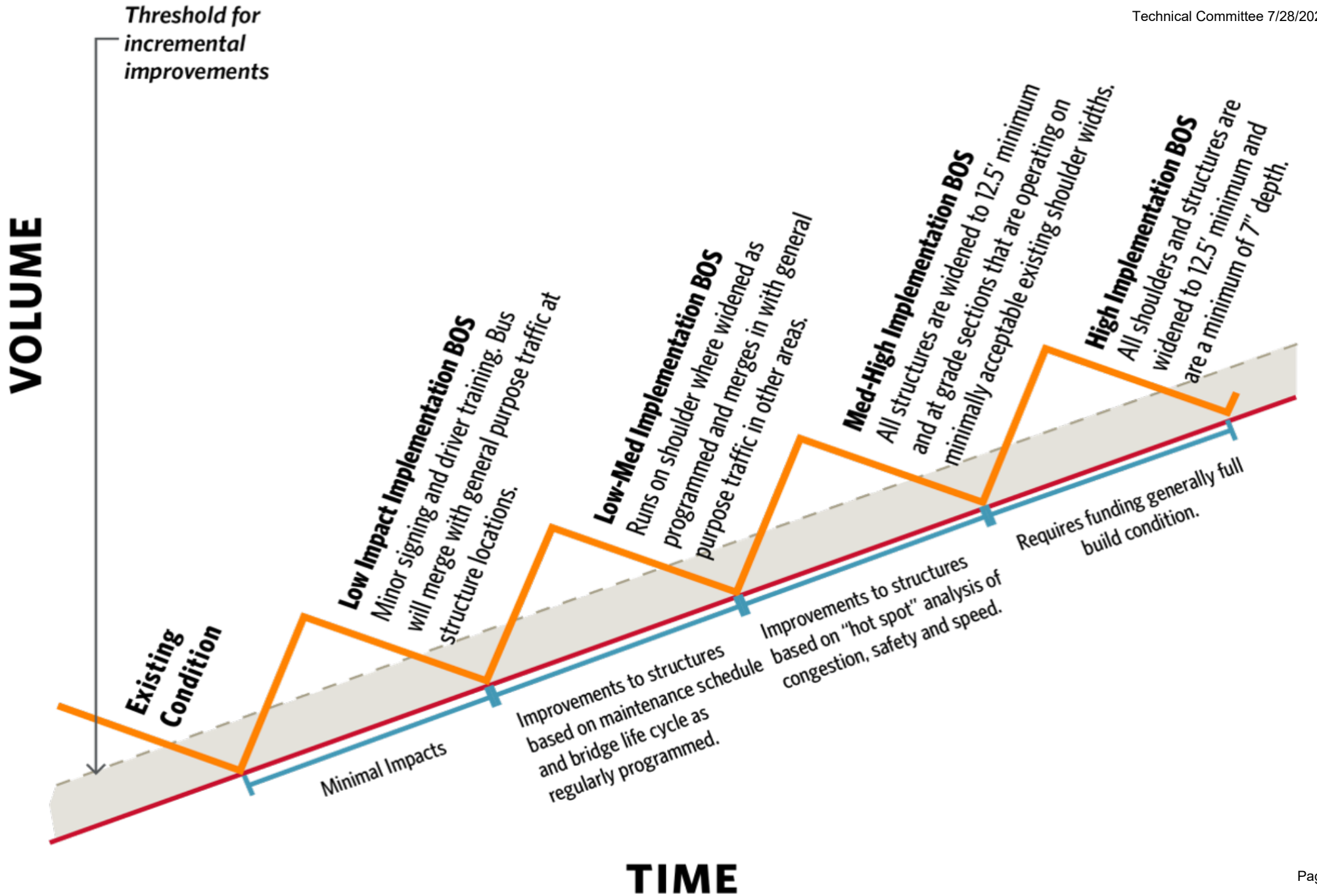
Peer Review Findings

- **The Triangle / NC are already BOSS leaders**
- **BOSS has excellent safety record everywhere; regular maintenance supports operations/safety**
- **Variety in BOSS Implementation**

Visualization of project in development - Julia Tuttle Causeway, Miami

Peer Review DESIGN Insight – Park and Ride Lots

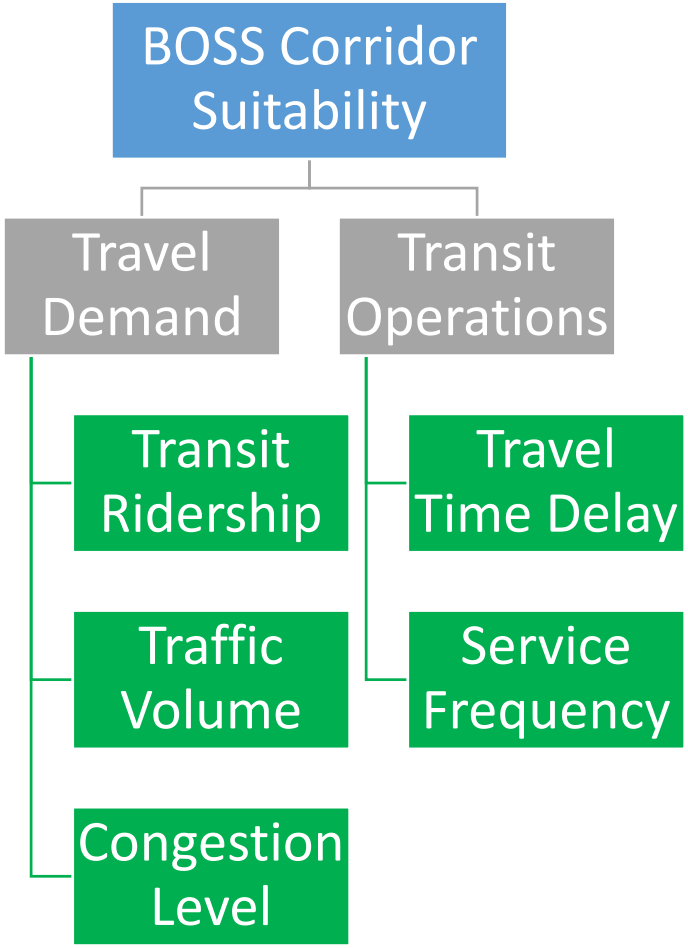
- Large PNR lot where buses enter the lot on the local street going through several signals. When they exit to head to downtown, they exit the park and ride onto the off ramp, avoiding the signals on the local street.
- Transit Signal Priority on the ramp signal allows for the buses to get back on the freeway quicker


Threshold for incremental improvements
VOLUME
Existing Condition
Low Impact Implementation BOS
Minor signing and driver training. Bus will merge with general purpose traffic at structure locations.
Low-Med Implementation BOS
Runs on shoulder where widened as programmed and merges in with general purpose traffic in other areas.
Med-High Implementation BOS
All structures are widened to 12.5' minimum and at grade sections that are operating on minimally acceptable existing shoulder widths.
High Implementation BOS
All shoulders and structures are widened to 12.5' minimum and are a minimum of 7" depth.
Minimal Impacts
Improvements to structures based on maintenance schedule and bridge life cycle as regularly programmed.
Improvements to structures based on "hot spot" analysis of congestion, safety and speed.
Requires funding generally full build condition.
TIME

Criteria Development and Potential Facilities

- **BOSS documentation is almost non-existent (except FL, and now NC)**
- **Created 24 Minimum & Recommended Criteria for Design and Operations**
- **Example: shoulder width**
  - **Minimum: 11 ft**
  - **Recommended: 12 ft**

BOSS Suitability Metrics



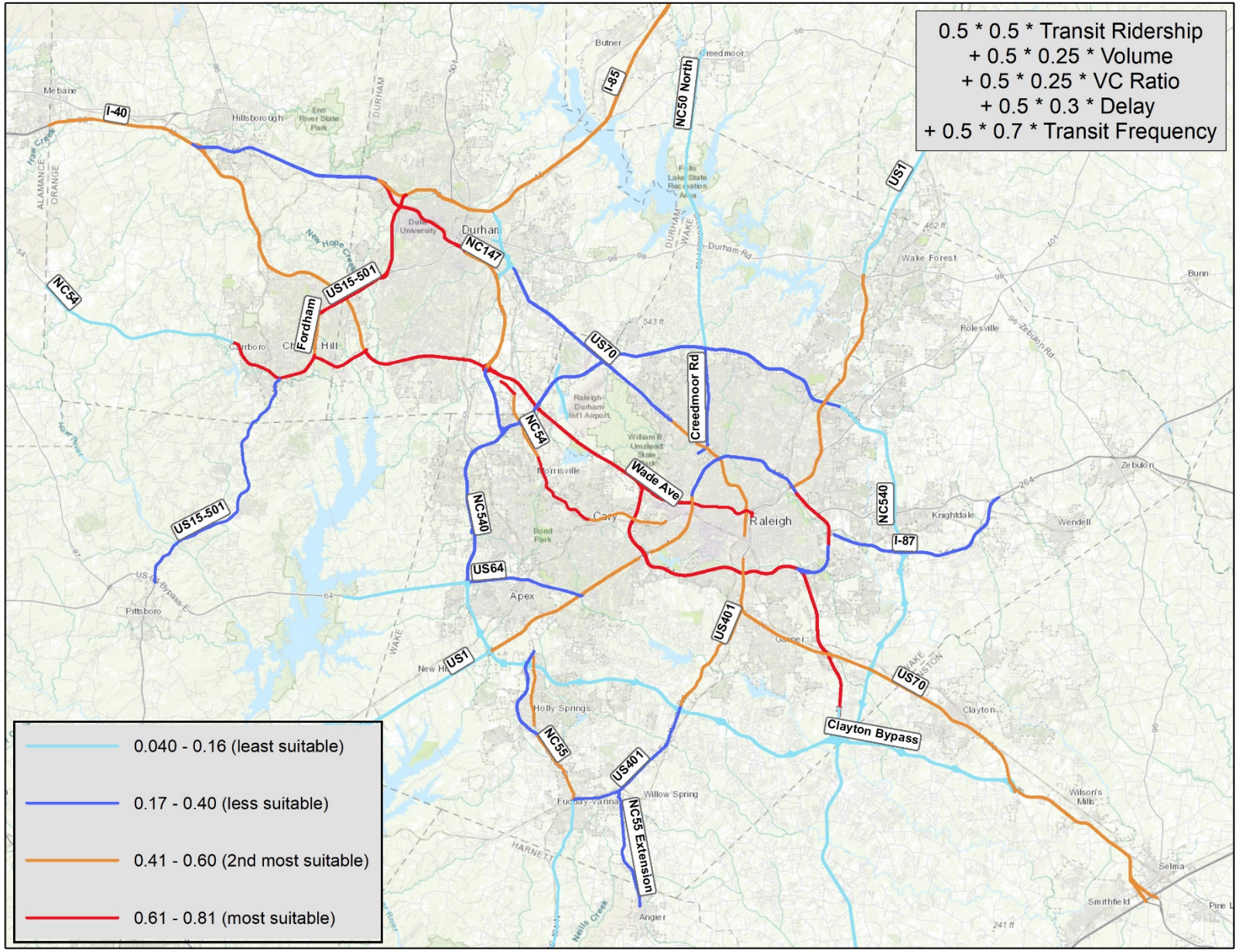
Metric and Dimensional Weights in BOSS Suitability Analysis

Dimension	Metric	Metric Weight (within dimension)	Dimension Weight (total suitability)
Travel Demand	Transit Ridership	50%	50%
	Traffic Volume	25%	
	Congestion Level (Volume-to-capacity ratio)	25%	
Transit Operations	Travel Time Delay	30%	50%
	Service Frequency	70%	

Suitability Scoring

- Scoring for each metric
- Ranking of each corridor will be based on the total weighted scores from all metrics
- Corridors with high ranking will be prioritized
  - BOSS is more suitable when traffic is more challenging
  - Most suitable – red colored segments
  - Less suitable – blue colored segments

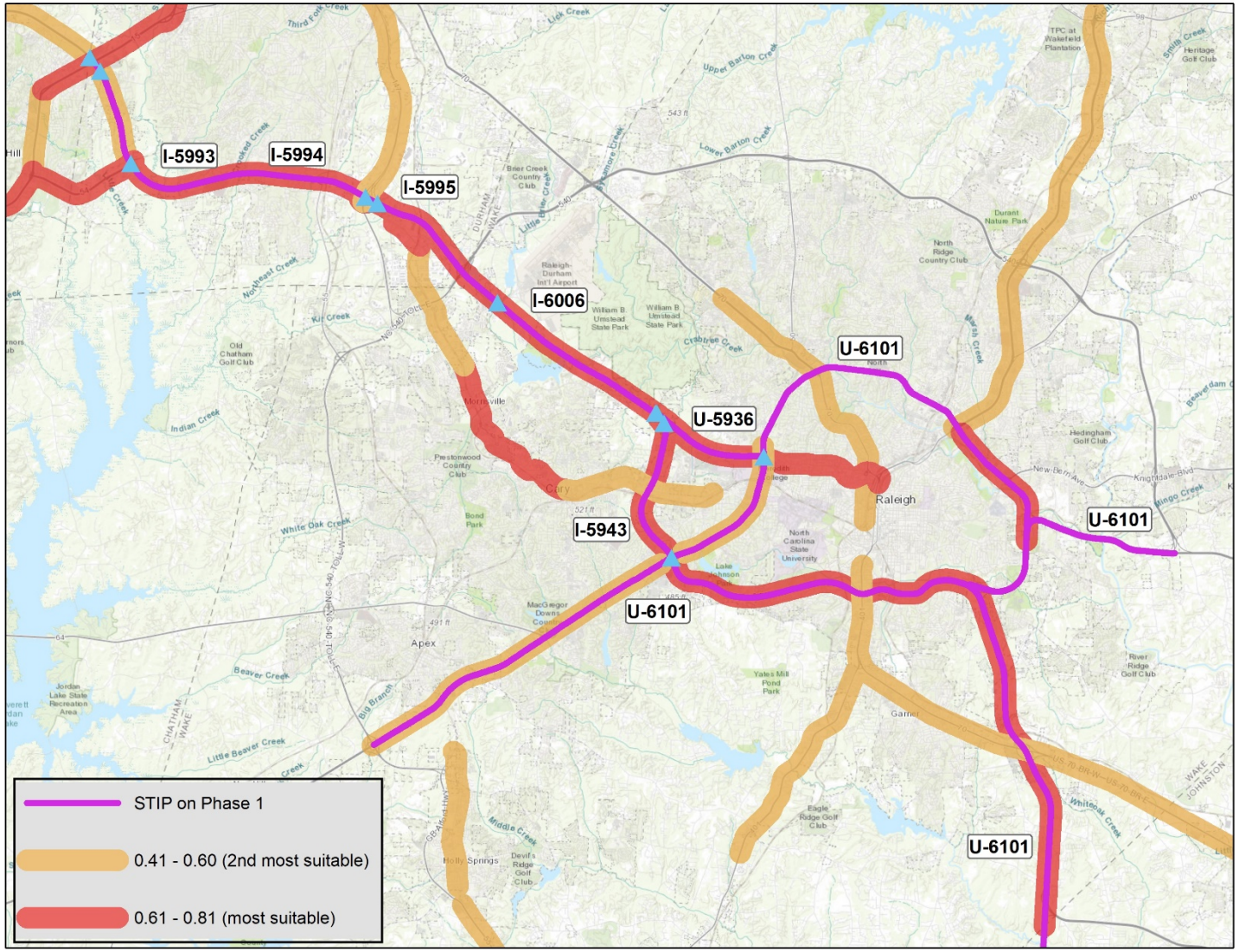
Which Facilities Would BOSS Benefit the Most?



Red – Most Suitable

Orange – Second Most Suitable

What Facilities Are Opportunities Based on Existing Plans and the STIP?



Most promising segments:

US 1 from I-540 in Apex to I-40 in Raleigh, continuing along I-440 to Wade Avenue

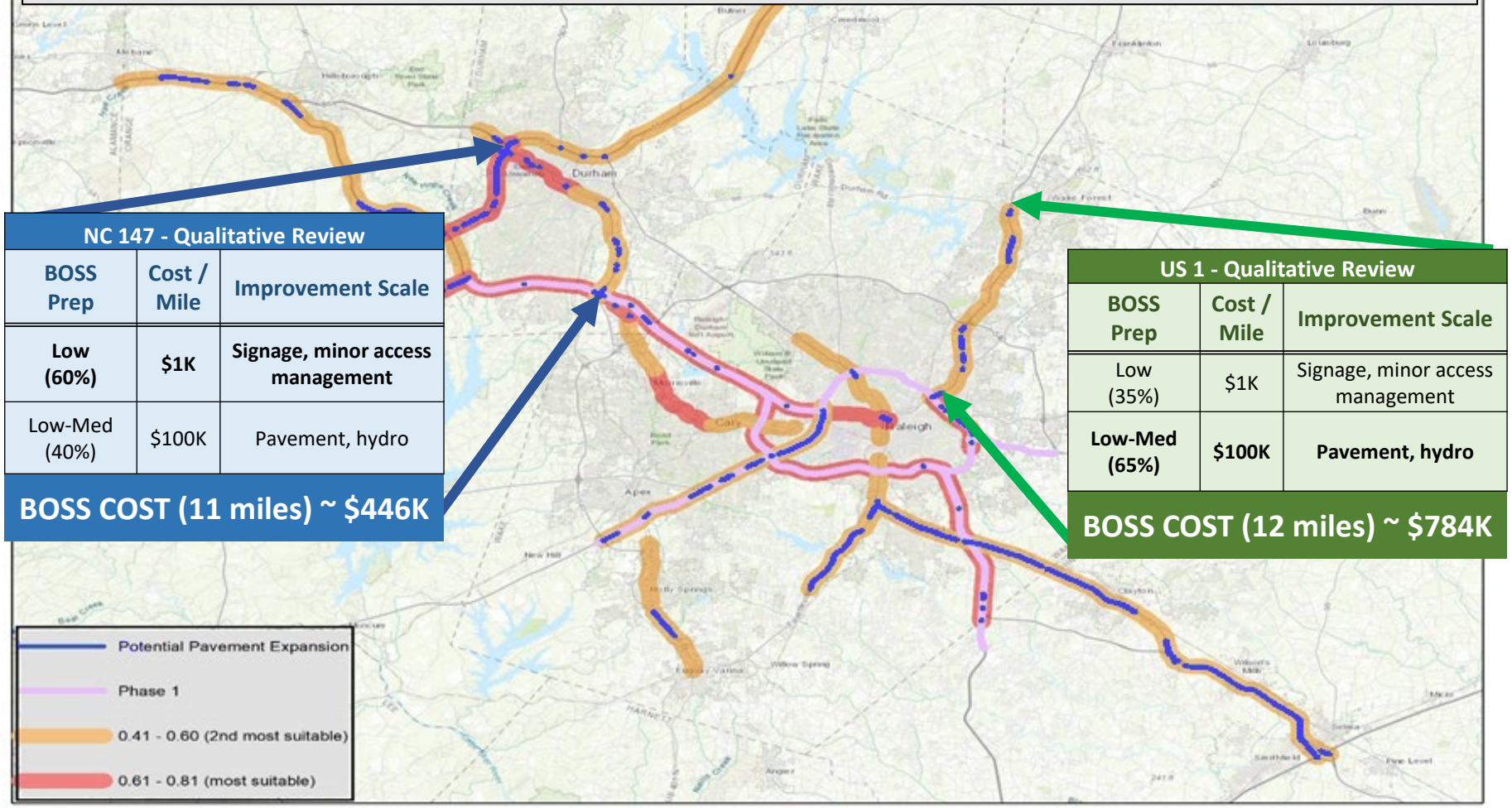
I-40 from exit 289 to the Johnson County Line

I-440 from US 1 North to I-87 in East Raleigh

Segment Perspective

Incremental Service Opportunities

BOSS Suitability + Managed Motorways (Phase 1)
Shoulder/Pavement Expansion



NC 147 - Qualitative Review

BOSS Prep	Cost / Mile	Improvement Scale
Low (60%)	**$1K**	**Signage, minor access management**
Low-Med (40%)	$100K	Pavement, hydro

BOSS COST (11 miles) ~ $446K

US 1 - Qualitative Review

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Future Steps

- **Continue active dialogue among Triangle BOSS team members**
- **MPOs, transit agencies engage NCDOT staff on which STIP projects could incorporate BOSS elements**
- **NCDOT considers amendments to BOSS Implementation and Operating Plan based on this study and additional NCDOT research**

Questions / Discussion

CONTACTS

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Shelby.Powell@campo-nc.us

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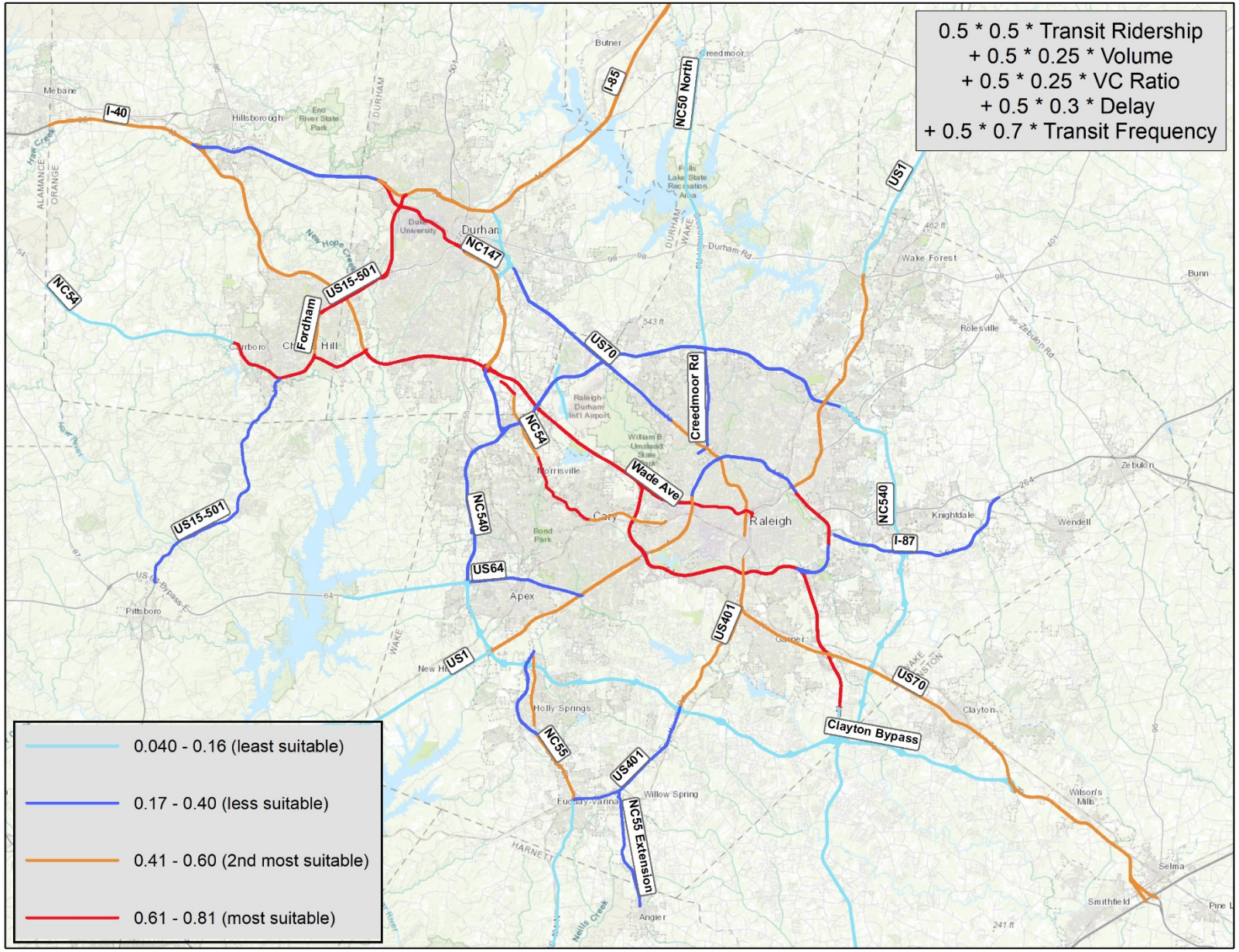

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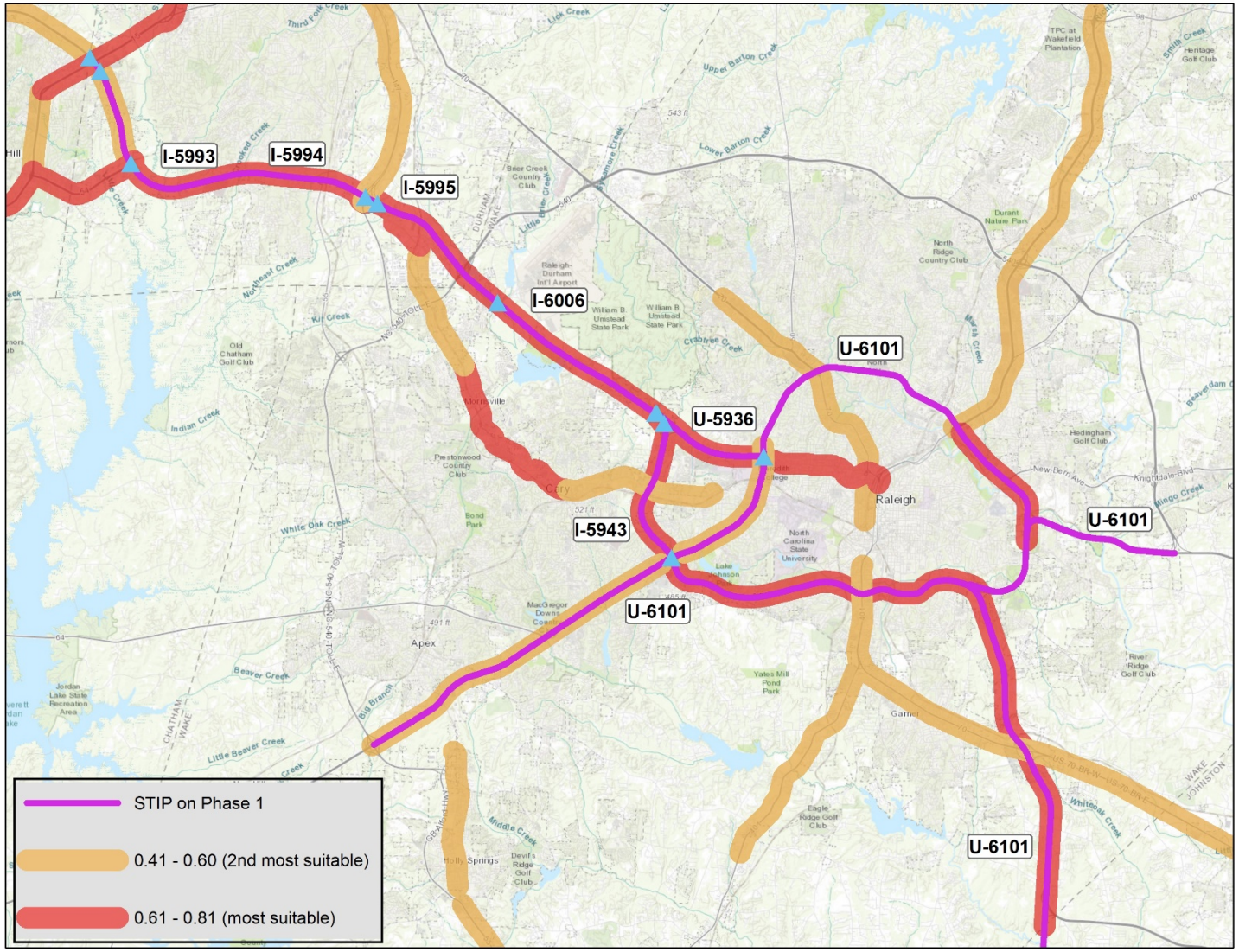

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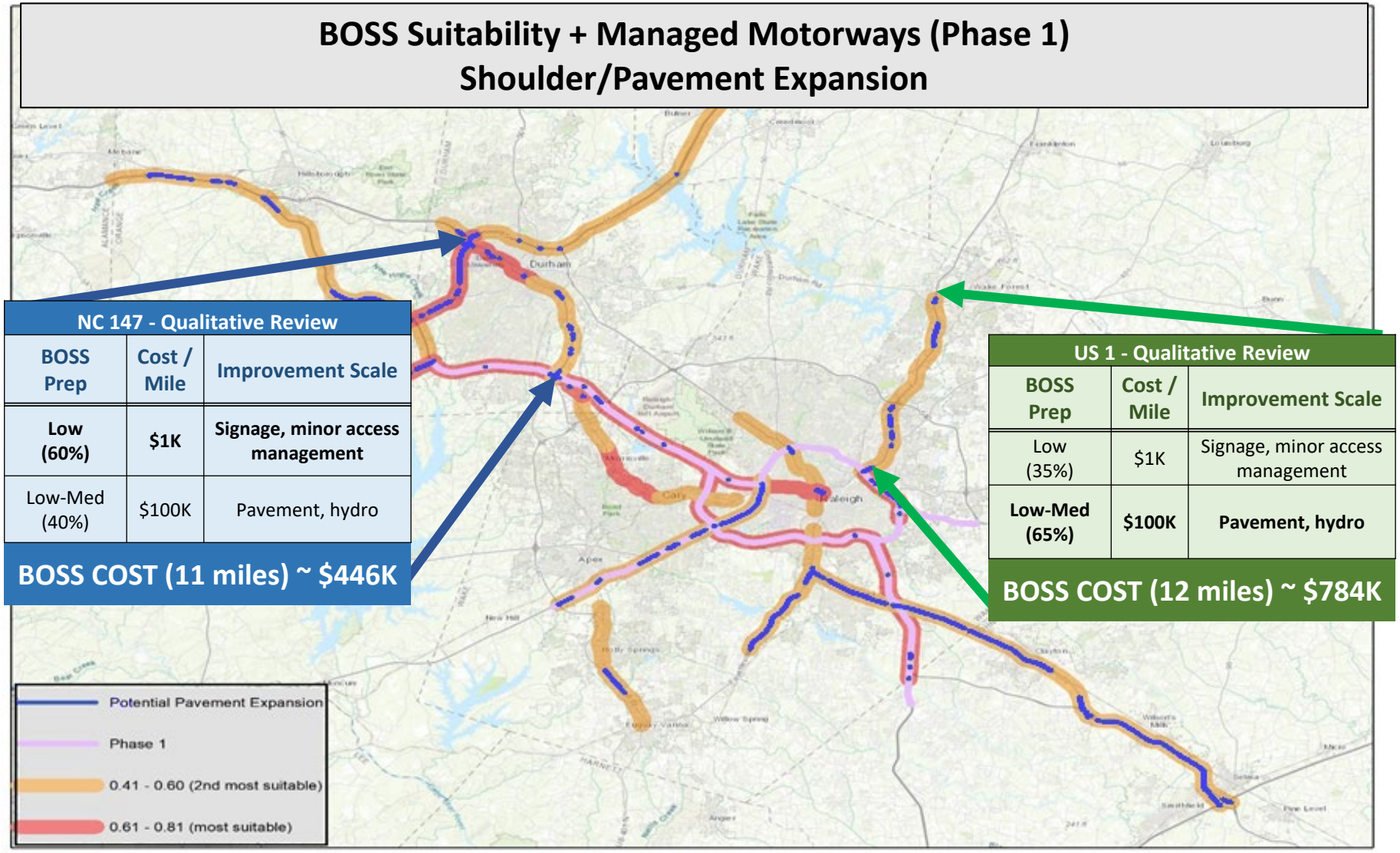

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THE BOSS IMPLEMENTATION BLUEPRINT

June 2021

Bus On Shoulder System (BOSS) Expansion in the Triangle Region

EXECUTIVE SUMMARY

CAMPO
NC Capital Area Metropolitan Planning Organization

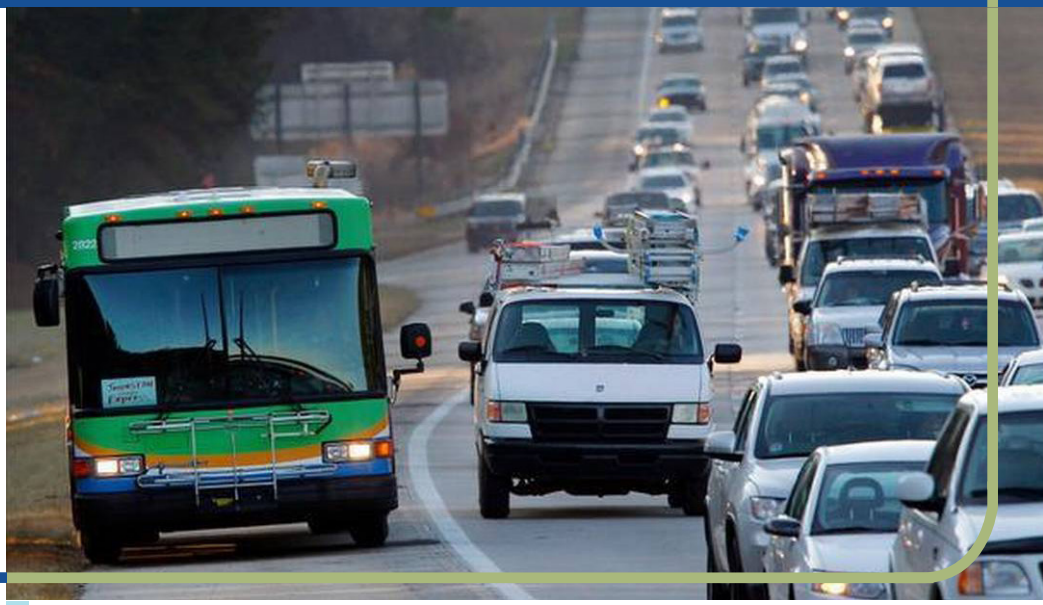
DURHAM · CHAPEL HILL · CARRBORO
DCHC
METROPOLITAN PLANNING ORGANIZATION

GO Triangle

STATE OF NORTH CAROLINA · DEPARTMENT OF TRANSPORTATION

What is a Bus On Shoulder System, or BOSS?

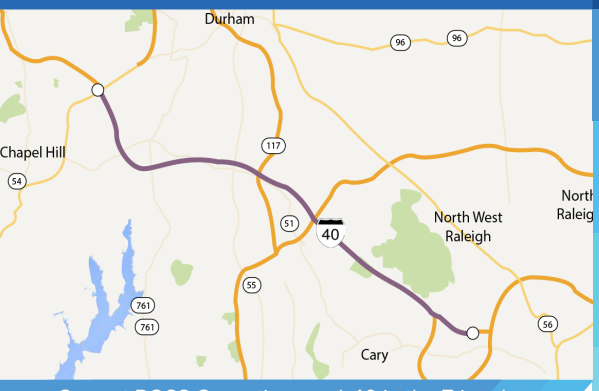
A Bus On Shoulder System, or BOSS, is a cost-effective and comparatively easy-to-implement solution to improve bus service performance on limited access facilities. With BOSS, buses are allowed to drive on the shoulder when certain conditions are met.



Key Benefits of BOSS:

- Allows buses to bypass congestion
- Helps reduce delays to transit riders during heavy traffic periods, and improve on-time performance
- Can be implemented incrementally, and at a relatively low cost per mile
- Has an excellent safety record
- Acts as an advertisement for the transit service as it keeps moving when traffic stops

Where is BOSS currently operating in the Triangle?

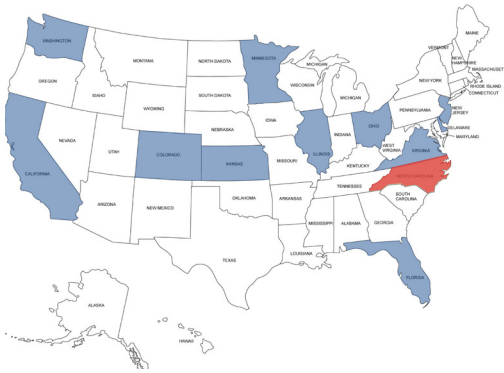


Current BOSS Operations on I-40 in the Triangle

BOSS has been successfully operated in the Triangle along I-40 from US 15-501 to east of Blue Ridge Rd along Wade Avenue since 2012.

The Triangle and NC are BOSS Leaders

- BOSS is currently deployed or under development in 11 states, with the largest deployment in Minnesota, at 290 miles of BOSS facilities.
- The Triangle and North Carolina are home to one of the five largest BOSS deployments by mileage.
- With completion of this study, North Carolina has one of the most well-defined sets of BOSS design and operating standards in the USA.

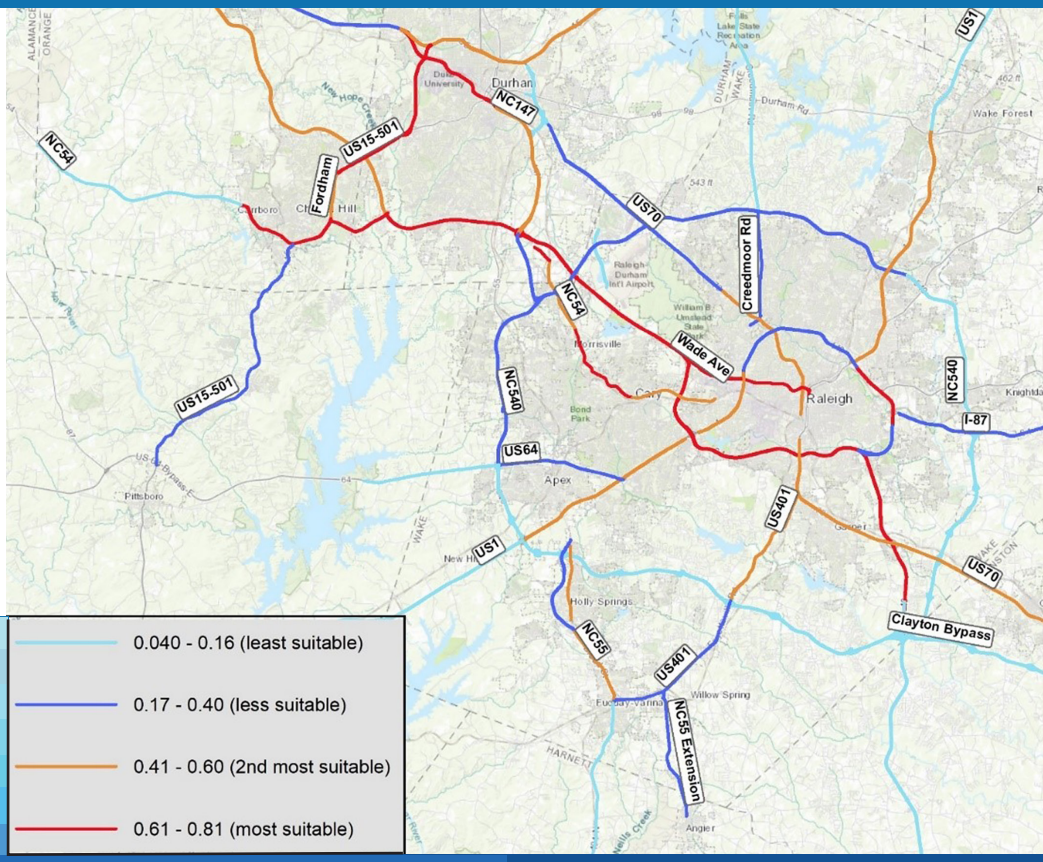


Where in the Triangle would BOSS provide the most benefit?

HIGHEST SCORING CORRIDORS

(RED AND ORANGE ON MAP)

- ATTRACTED MANY TRIPS
- HAD LONGEST RUSH HOUR DELAYS
- HAD LOTS OF BUS SERVICE



BOSS EXPANSIONS:

Primary BOSS Expansion

The best BOSS expansion opportunities are along interstates and connect Key transit destinations such as:

- UNC-Chapel Hill
- Duke University
- Downtown Durham
- Research Triangle Park
- NC State University
- Downtown Raleigh.

The top scoring BOSS Opportunity segments total 75 miles.

Secondary BOSS Expansion

The second-best BOSS expansions connect suburban markets to downtowns along US 1, NC 54, US 70, and US 401.

Intersections where major arterials cross the routes listed above could be excellent locations for future park and ride lots. **The second-best scoring BOSS Opportunity segments total 139 miles**

Which future Triangle projects are the best BOSS implementation opportunities?

This study took a qualitative approach to screen for near-term projects in regional plans that had attributes that were supportive of BOSS implementation, including:

- Existing pavement conditions
- Regional traffic system operations
- 2020-2029 STIP Commitments and SPOT projects

A promising opportunity for the Triangle is to consider an expanded BOSS network through the collection of Traffic System Management and Operations (TSMO) investments that NCDOT has planned in the region to enhance travel time reliability.

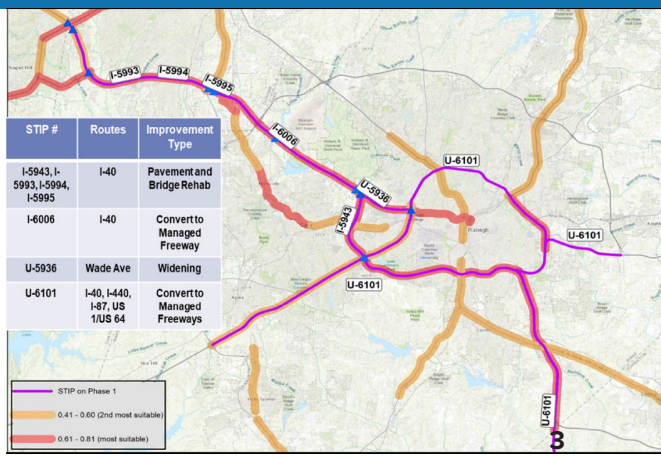
Phase 1 of these TSMO improvements includes 71 miles implemented over the next decade through STIP projects along I-40, I-440, I-87, and US 1. Phase 2 is implemented beyond the next decade encompassing 120 more miles resulting in an expanded, broader regional network along the fully complete I-540 and parts of US 1, US 64, and US 70.

Which Triangle projects scored highly for BOSS benefits AND have TSMO improvements planned?

The study reviewed the STIP for existing projects that are both planned for TSMO investment and also scored in the Top scoring or Second-Best Scoring group of segments for BOSS benefits, and found that the projects in the map to the right with a purple centerline and red or orange outline offer particular promise.

These facilities include:

- US 1 from NC-540 in Apex to I-40 in Raleigh, continuing along I-440 to Wade Avenue
- I-40 from exit 289 to the Johnston County Line
- I-440 from US 1 North to I-87 in East Raleigh



STIP #	Routes	Improvement Type
I-5943, I-5993, I-5994, I-5995	I-40	Pavement and Bridge Rehab
I-6006	I-40	Convert to Managed Freeway
U-5936	Wade Ave	Widening
U-6101	I-40, I-440, I-87, US 1/US 64	Convert to Managed Freeways

Design and Operating Criteria to Standardize Implementation

The study worked to develop detailed design standards for BOSS expansion in the Triangle, with two types of criteria:

Example – Shoulder width: Minimum 11 feet, Recommended 12 feet

Minimum Criteria
Minimum criteria to meet for each design criterion to operate Bus On Shoulder, very useful in evaluating existing facilities for BOSS use

Recommended Criteria
Criteria that allows for robust BOSS operations, very useful in planning to design future facilities to be BOSS-ready from day one

NCDOT is currently working on studies that may update how they design roadway shoulders in general, independent of BOSS operations. When that work is complete, NCDOT can use the BOSS Design Criteria and their revised standards to update the BOSS Implementation and Operations Plan.

Teamwork Makes BOSS Work for the Community

Stakeholder Roles and Responsibilities

Stakeholder	Roles and Responsibilities
NCDOT	Owner and operator of the road; Design, permitting, and approvals; Project implementation; Motorist-oriented information about BOSS; Facility maintenance including sweeping shoulders
GoTriangle	Operates the transit buses; Bus operator training; Public Awareness, Transit Passenger- Other transit oriented information about BOSS; Performance monitoring; Emergency response
NC State Highway Patrol	Responsible for enforcing laws and responding to crashes/incidents
DCHC MPO, CAMPO	Prioritize future BOSS project investment in Metropolitan Transportation Plans
Local Motorists	Support safe BOSS operations by allowing buses to transition safely from travel lanes to shoulders, and across interchange ramps

Study Conducted by:

HDR, Cambridge Systematics

For more information please contact:
Shelby Powell, AICP, Deputy Director
Capital Area MPO 421
Fayetteville St, Suite 203 Raleigh, NC 27601
919-996-4393

CAMPO
NC Capital Area Metropolitan Planning Organization

GO Triangle

Bus on Shoulder System (BOSS)

Implementation Blueprint

STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

DURHAM · CHAPEL HILL · CARRBORO
DCHC
METROPOLITAN PLANNING ORGANIZATION

June 2021

Contents

Figures

Appendices

Introduction

The North Carolina Capital Area Metropolitan Planning Organization (CAMPO) and its partners, GoTriangle, the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC-MPO), and the North Carolina Department of Transportation (NCDOT) initiated a study to create a programmatic approach for identifying, prioritizing, and developing best practices for Bus on Shoulder System (BOSS) deployment in the Triangle and across North Carolina. The Implementation Blueprint is the culmination of the study. The Blueprint documents the steps necessary to develop and implement a successful BOSS project across the state of North Carolina with the goal of enabling any transit agency or MPO to implement their own BOSS project with these partners.

Planning for BOSS Operations

Purpose and Need

The first step in developing a BOSS project is to determine the purpose and need for running buses on the shoulder. The need for BOSS typically originates at the transit agency which identifies routes with poor travel time reliability, a need for express bus service, regional connectivity issues, etc. NCDOT and the local MPO may also propose BOSS implementation. These agencies plan into the future as far as 50 years and can identify the need for BOSS projects through their planning and programming efforts. Specifically, NCDOT monitors the highways to identify current and future congestion. MPOs manage fiscally constrained plans to program the next 30 years of transportation investment. Some common reasons for implementing BOSS operations include the following:

- High congestion level in the corridor impacting bus schedule reliability
- Support for new express bus service strategy in the corridor
- Solution to a regional connectivity issue and, ultimately, a commuter solution for maintaining reliability through traffic congestion areas
- Interim measure until construction of managed lanes or widening of the highway
- Long-term transit solution for the corridor
- Short-term solution for non-typical congestion like in advance of construction projects

Identifying Potential BOSS Segments

As mentioned above, an initial BOSS proposal can come from the transit agency, MPO, or NCDOT but the procedure for identifying potential BOSS segments may be different for each of these agencies. For example, the transit agency will identify BOSS projects through a transit lens which may stem from buses encountering frequent congestion on an express route. In addition, the MPO and NCDOT may be looking into the future and identify anticipated congestion on a future corridor and suggest BOSS elements be incorporated into a programmed project. Regardless of the origin of the BOSS proposal, the design and operating criteria in Appendix A should be met to justify BOSS and to build a successful system.

Transit Agency Roles and Responsibilities in Identifying Potential BOSS Projects

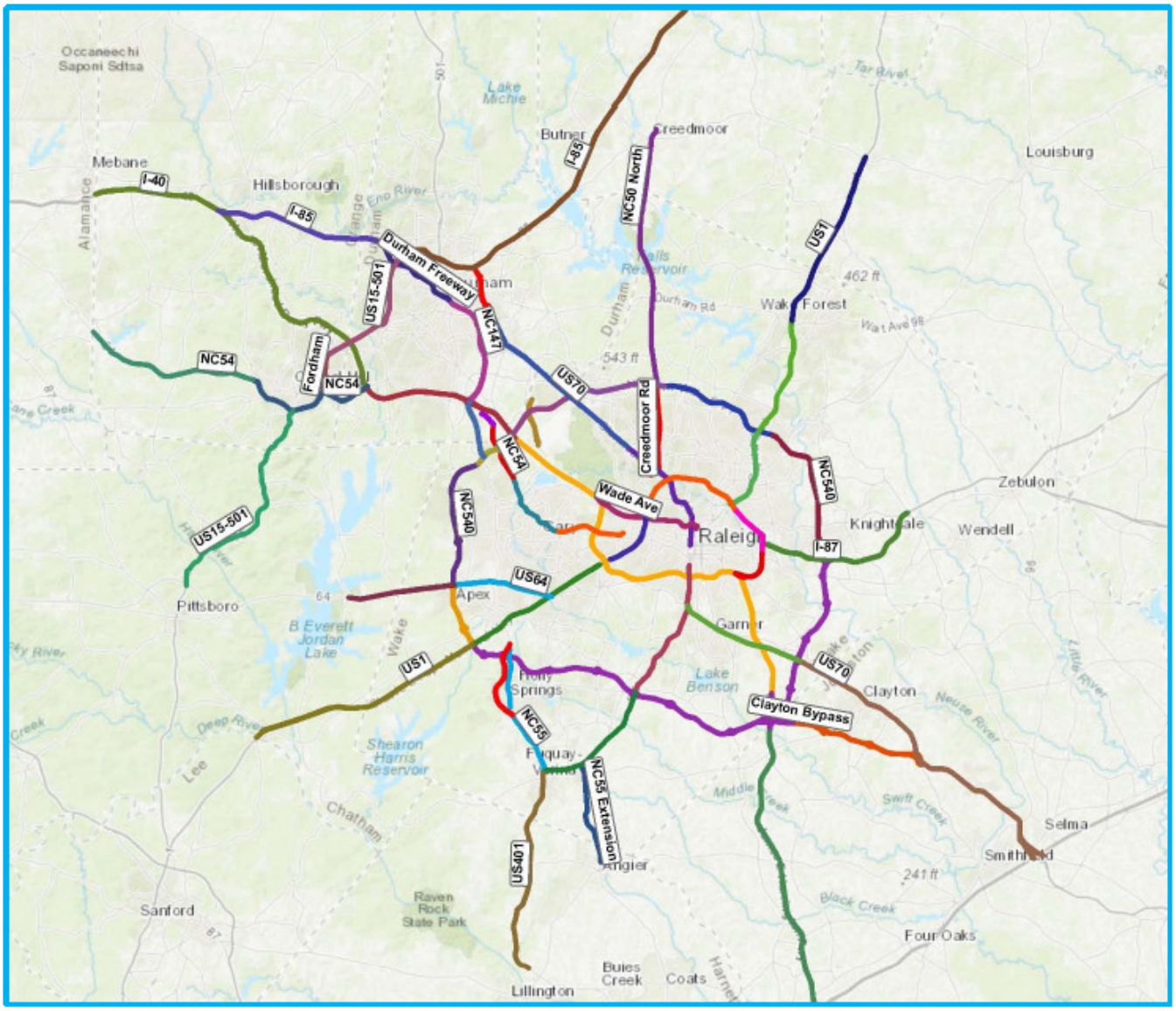
Bus on Shoulder is not a new concept nationally, but our peer review and engagement has found there is little documented guidance for how to approach developing and implementing BOSS. BOSS should be considered as an alternative for improving transit operations and reliability for transit agencies across the state. Transit agencies should evaluate existing transit operations prior to bringing the project to the MPO and/or NCDOT. Existing transit operations analysis should include evaluation of route level ridership, service frequency, hours of operation, travel time, on-time performance, vehicle miles, operating cost, etc.

They should also identify any recurring and non-recurring congestion/delay, and its impact on existing bus operations. This will serve as the foundation for baseline conditions and project justification. Additional roles and responsibilities of the transit agency will be discussed in later sections.

Identifying Subject Roads and Conducting Suitability Analysis

As part of this project, a systematic approach to identify subject roads and analyze their potential suitability for BOSS was developed. The first step relies on GIS to determine which corridors may be candidates for BOSS implementation. Elements considered to identify initial subject roads include transit ridership, volume, volume to capacity ratio (v/c), delay, and transit frequency. A second step focuses on sub-dividing the candidate corridors into unique segments to most accurately measure the level of transit service and congestion in each segment.

Figure 1 BOSS Subject Road Segments for Analysis

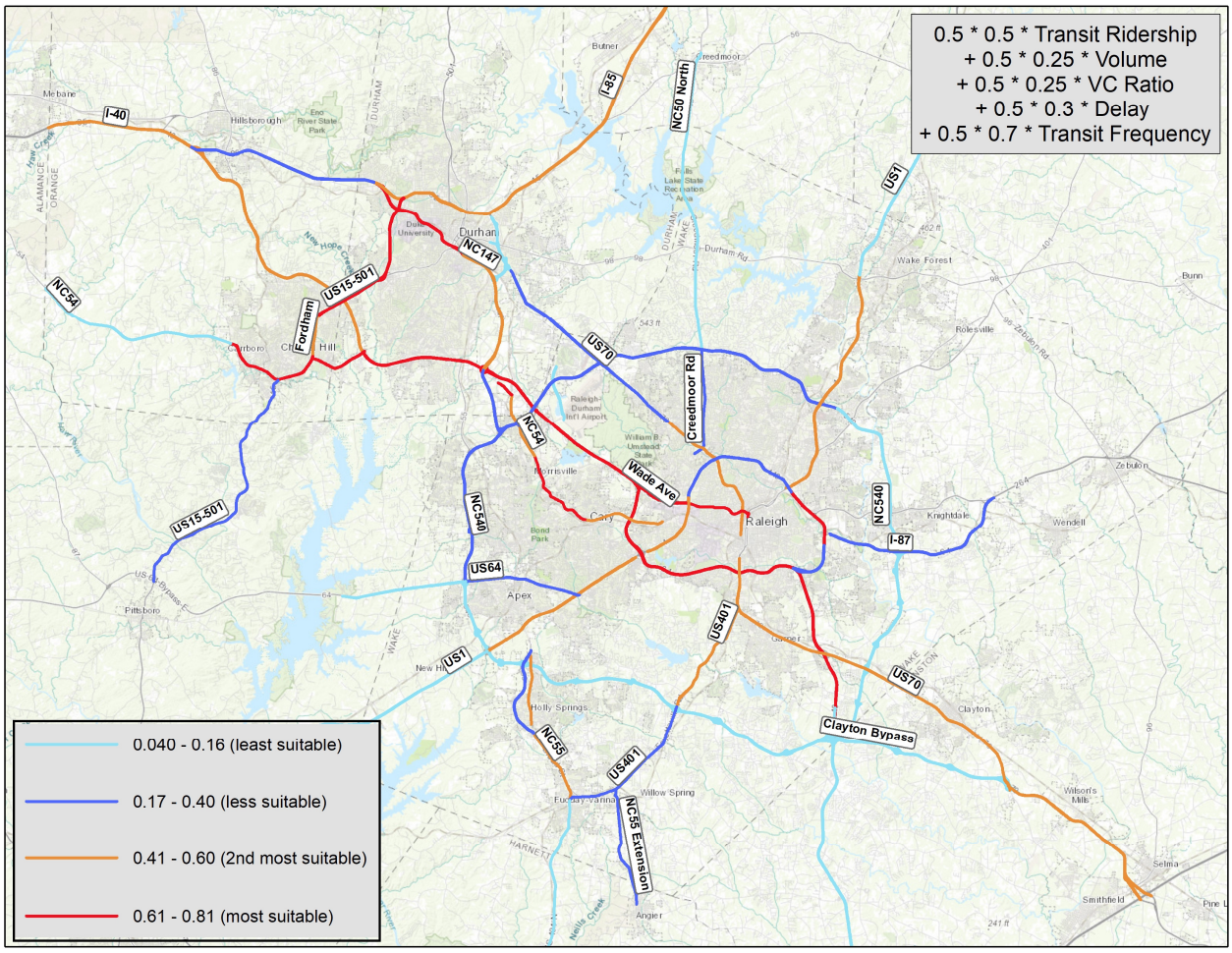


After segmentation, the subject road segments are analyzed according to the methodology described in detail in Appendix B in the BOSS Suitability Metrics Technical Memorandum. This produces an overall suitability map for BOSS implementation that combines travel demand data (transit ridership, travel volumes, congestion) with transit operations data (service frequency, travel time delay).

This portion of the analysis answers the question: "Where is BOSS likely to provide the greatest benefit, regardless of the cost or ease of implementing the project?"

For the Triangle region, the BOSS Corridor Suitability Map in Figure 2 shows those locations in red.

Figure 2. BOSS Corridor Suitability Map



Opportunity Assessment: Incorporating BOSS Elements in Programmed Projects

BOSS is meant to be a low-cost solution to reduce travel time and operating costs, improve on-time performance, and ideally, increase ridership. Incorporating BOSS elements into planned and programmed projects reduces the cost of BOSS which makes BOSS a cost-effective implementation project.

This assessment was undertaken with the goal of using GIS-level roadway data on pavement depth, shoulder width, and shoulder materials to screen the same segments in the BOSS Suitability analysis for ease of construction and for opportunities to incorporate BOSS elements into State Transportation Improvement Plan (STIP) projects. NCDOT staff with expert knowledge of the subject roads concluded that limitations in the GIS data from real-world conditions, and variations along the subject roads themselves

make field review of candidate segments much more important than GIS data in understanding true constructability.

With that in mind, this study recommends that North Carolina communities seeking to be opportunistic about BOSS deployment should look for ways to "nest" BOSS expansion projects within a larger strategic framework of improvements.

Within the Triangle, the ongoing effort to use Intelligent Transportation Systems (ITS) and other technology to enhance freeway performance is a promising framework for the strategic expansion of BOSS. NCDOT's approach combines roadway, interchange, and traffic management technologies to enhance travel time reliability. Deploying BOSS within the regional "ecosystem" of ITS improvements and projects can help to facilitate joint visioning and coordinated decision-making to address both state and local partner interests. Integration with ITS strategies and projects also serves to position BOSS deployment to serve core and secondary transit markets regionally.

In other regions of North Carolina, potential frameworks for BOSS investment could include:

- Two or more limited access roadways that connect and have improvements planned in the next 5-10 years
- A corridor planned for freeway conversion over a decade
- A transit expansion plan focused on particular corridors.

The STIP includes all planned and programmed projects for the next 10 years which are scored through the Strategic Transportation Investments (STI) funding process. When reviewing the STIP, projects that could incorporate BOSS may be eligible for reprioritization and potentially reviewed for rescoping to accommodate BOSS supportive elements. The combination of these future STIP and submitted project priorities represent infrastructure, widening and operational improvements conducive to BOSS.

Finally, one key transit provider recommendation was that if the MPOs, transit agencies and NCDOT could reach an agreement on levels of forecast congestion and transit service that would require wider shoulders in project design, the BOSS network could grow proactively instead of reactively. The more 11 or 12-foot shoulders exist along major corridors to begin with, the more "BOSS-ready" a region will be.

Establish BOSS Team

After the BOSS project has been identified, it is then critical to establish a BOSS team before proceeding with the development of a concept plan, design and operations of the corridor. The BOSS team should include but is not limited to:

- NCDOT
- Transit Agency(s)
- MPO(s)
- Federal Highway Administration (FHWA)
- State and Local Law Enforcement
- Emergency Responders
- Traffic Incident Management Professionals
- Local Jurisdictions

It is important for these groups to identify the potential benefits and impacts of implementing BOSS operations. Early coordination helps define the project and implementation strategies shifting the focus from identifying obstacles when implementing BOSS to finding ways to overcome those obstacles.

The first meeting should fully explain the BOSS concept as well as previous experience in North Carolina. It may be beneficial to present case studies from across the country to demonstrate the BOSS concept's safety record and benefits. This session is meant to be informative and give the initial findings of the

segment. Specific technical information and challenges associated with the study corridor should be shared at subsequent meetings with the end goal of developing potential alternatives.

Development of a BOSS Concept Plan

After a potential BOSS project has been identified and the BOSS team has been established, the next step is to develop a BOSS Concept Plan. This is the responsibility of the original agency that identified the project; however, if the transit agency does not have the resources to complete this task, they should coordinate with the MPO and NCDOT for guidance and technical assistance. A concept plan should clearly identify the problem, demonstrate the need for the project and provide a conceptual design for the operations. It should also include a plan and schedule for the evaluation and identification of steps necessary for the pursuit of BOSS implementation.

If the transit agency is requesting BOSS, they should provide preliminary estimates of potential transit benefits such as running time savings, schedule reliability improvements, and increased ridership. If they are currently running buses on limited access facilities, they should analyze data from the corridor and determine if BOSS would be beneficial in terms of bus operating performance. However, if the transit agency is utilizing an alternate route to bypass congestion, they should review the current route performance and compare with the prospective BOSS corridor to understand the potential benefits. The concept plan must then be presented to the transit agency, MPO, and NCDOT for initial feedback.

Feasibility Analysis

After the BOSS team has met and preliminary information has been provided, it is necessary to conduct a feasibility analysis consisting of reviewing existing conditions, forecasting future conditions, developing and evaluating alternatives, and ultimately, choosing the preferred alternative. Details on each of the analysis elements is discussed in the following sections.

Analysis of Existing Conditions

An analysis of the existing conditions involves a review of the current roadway conditions. These include inventorying the shoulder widths and identifying pinch points, assessing pavement strength, drainage, and utilities, assessing the interchange weave suitability, and conducting a safety analysis. The feasibility analysis will likely rely on the expertise of the MPO and NCDOT.

Shoulder Width and Pinch Points

The shoulders must be a minimum of 10 feet for buses to safely operate on the shoulder; however, 12 feet is ideal as this width is consistent with travel lanes. Buses can merge back into the general purpose lanes at pinch points along the BOSS corridor as needed, but there must be a significant portion of continuous running in order to fully benefit from BOSS operations. The segment length for continuous running depends on the length of the entire corridor with BOSS and should be determined by the BOSS team on a case-by-case basis.

Pavement Condition

The shoulder pavement condition must be evaluated to determine if the shoulder is conducive to running buses. NCDOT is currently updating the pavement depth requirements and should be consulted to determine if the pavement is strong enough to support the continuous running of BOSS. It is also important to take note of the condition of the pavement. If there is a lot of rutting and evidence of wear and tear, repaving may be warranted to ensure the safety of BOSS. Drainage and utilities along the BOSS corridor should be inventoried to determine if there is a need for reinforcements to preserve catch basins as well as provide a smooth bus ride. If there are utilities obstructing the shoulder, buses will merge into the general purpose lanes to avoid pinch points.

Interchange Weave Suitability

The number and complexity of interchanges is critical to the safety and benefits of buses on the shoulder. There are two scenarios for buses to choose when approaching interchanges. If the interchange is complex, buses may find it easier to merge back into the general purpose lanes to eliminate conflict with traffic at the on/off ramps. However, BOSS is permitted to utilize auxiliary lanes or cross on/off-ramps where it is safe.

Safety Analysis

While safety may be a concern when discussing running buses on the shoulder, it has not proven to be an unsafe practice. It is advised that the transit agency and NCDOT monitor BOSS during the life of the project to ensure safety is not negatively impacted.

Additional and more specific guidance can be found in the BOSS Criteria document (Appendix A) developed for this study.

Development of BOSS Operating Scenarios

After the existing conditions have been evaluated, operating scenarios can be developed. The operating and design guidelines (see Appendix A) should be consulted during the development of the scenarios to ensure compliance with the NCDOT requirements for BOSS. Developing operating scenarios should address the shoulder being used (inside or outside) and operating options for when the bus is permitted to use the shoulder (based on speed threshold).

The development of operating scenarios or alternatives should take into consideration the level of implementation required for the scenario. BOSS projects range from low-level implementation to high-level implementation. A low-level implementation project runs buses on the existing infrastructure, merging at any pinch points, minimal BOSS signage, and bus driver training. A high-implementation project is a full build out of the shoulder and pavement structures. The low-medium implementation piggybacks on programmed projects and only running buses on the shoulder where the shoulder has been previously widened and strengthened. Medium-High implementation involves widening all paved shoulders to 11 to 12 feet. The costs associated with implementation can be from $1,000/mile to upwards of $1million+/mile.

Alternatives Design Evaluation

Upon the selection of potential BOSS scenarios, a detailed analysis will be needed for each alternative to determine potential benefits and costs associated with the improvements. The goal of the evaluation is to recommend a preferred alternative and present it to the BOSS team for feedback.

A simplified operating scenario design evaluation can utilize the following criteria:

- Capital cost;
- Operations and Maintenance (O&M) cost;
- Benefit-cost ratio; and
- Funding options.

Capital Costs may include but are not limited to:

Engineering:

Implementation and Operations Plan (IOP) and requirements documents, design and contract documents, testing and acceptance activities, construction engineering, and environmental assessments.

Shoulder reconstruction and widening:

Repaving the shoulder, modifying drainage structures, adding/relocating guardrail, and complete reconstruction or minor widening of the shoulder.

Signage and striping:
Likely installation of static signage only.

Public outreach and marketing:
The transit agency using BOSS will need to market the new service in multiple ways to ensure general motorists are aware of BOSS. Additionally, this may be an opportunity to increase transit ridership by promoting how BOSS can improve transit reliability and reduce travel time for commuters

Transportation Systems Management and Operations:
In lower-cost BOSS projects, advanced TSMO strategies are rarely included. In higher-cost BOSS implementation, ramp meters and dynamic signage systems may be adapted to support BOSS functionality. The potential benefit of ramp metering for BOSS is that slowing traffic on the on-ramp can provide a gap for the bus to traverse the on-ramp, traverse the auxiliary lane, and move back onto the shoulder. The potential benefit of dynamic message signs for BOSS is allowing the region's Traffic Management Center to provide information on shoulder blockages or any other message that may impact the bus operating on the shoulder in real time.

Operations and Maintenance costs may include but are not limited to:

Enforcement:
Additional law enforcement presence needed to enforce the use of the shoulder by buses only.

Driver training:
Transit agencies using BOSS facilities will need to conduct driver training to ensure bus drivers are comfortable operating on the shoulder

Incident Management Assistance Patrol(IMAP):
NCDOT IMAP vehicles help identify and remove debris from the shoulders

Roadway maintenance:
BOSS may require increased maintenance to ensure clear shoulders for BOSS operation.

Benefit-Cost Analysis

Benefit-cost ratio of each alternative is estimated considering life cycle costs and benefits of the project.

The benefits to be quantified in the benefit-cost analysis may include:

- Travel time savings for bus passengers-in areas with very high levels of bus service, travel time savings for motorists may also be able to be measured;
- Safety benefits;
- Transit schedule reliability;
- Emissions savings; and
- Vehicle operating cost savings.

Availability of funding is an important consideration in the selection of the recommended scenario. This should be discussed with the BOSS team for building consensus during the feasibility analysis phase.

Project Development and Implementation and Operating Procedures

After the alternatives have been evaluated and the recommendation has been presented to the BOSS team for their buy-in, the BOSS project moves into the development phase. The development phase includes a high-level environmental screening, development of the Implementation and Operations Plan, action plan, proper approvals and preparing for the implementation of the system.

Project Development

NCDOT has received concurrence from FHWA to identify all BOSS projects as Type III projects which do not require a noise analysis or abatement measures. Refer to Appendix F for the letter concerning 23 CFR 772 Procedures for Abatement of Highway Traffic Noise and Construction Noise and how it applies to BOSS projects.

Statewide Implementation and Operations Plan; Regional Memorandum of Agreement

The Implementation and Operations Plan (IOP) is the guide to design, implementation, and operation of BOSS projects in North Carolina. While NCDOT has developed a statewide IOP (see Appendix C), the IOP should be augmented with a Regional Memorandum of Agreement (MOA) that is customized to the BOSS implementation effort in a specific city or region. The Regional MOA should include:

- Project Background, BOSS corridor limits, goals and desired outcomes of the BOSS project
- Description of roles and responsibilities of each BOSS team
- Standard Operating Procedures for BOSS (authorized users, speed protocols, vehicle interaction protocols, operational scenarios, incident management and response, enforcement)
- Summary of Impacts (infrastructure modifications and traffic operations and control, changes in roles and responsibilities, public outreach and education)
- Performance Measures (ridership, reliability, safety, frequency of use by BOSS operators, and qualitative data)
- Additional information: map of project limit and roadway plans (inclusive of signage and pavement markings)

The NCDOT IOP and the BOSS Operating and Design Criteria should be consulted during the development of the Regional MOA. It is important for this document to fully explain how the BOSS corridor will operate under normal conditions and during incidents or inclement weather. The plan should be presented to the BOSS team to ensure that everyone agrees upon the details of the planned project. It is also critical to clearly define the roles and responsibilities with each team entity in a formal meeting, ultimately leading to a contractual agreement between all parties.

Action Plan

The purpose of the action plan is to document the steps to implementation and to present a timeline for the project. This should be shared with the BOSS team.

Project Implementation

Preparing for implementation consists of obtaining approvals necessary to build the project such as any potential FHWA design exceptions. This will also involve marketing the new service to both transit riders and the public, driver training, and other associated start-up measures. Details for each of these tasks is provided below.

Start-Up Measures

Marketing and Public Awareness Campaign

Marketing and public awareness is critical to the success and safety of the project and is the one of the main responsibilities of the transit agency. Since many areas have not deployed BOSS service, the concept may be confusing to both the transit riders and general motorists operating in the corridor. It is important to ensure that riders understand the purpose of operating on the shoulder and when bus drivers are permitted to operate on the shoulder. Additionally, it is important that general motorists understand that only authorized buses are permitted to use the shoulder. Marketing and public awareness strategies are described in detail in the BOSS Messaging chapter of this study.

Driver Training

Driver training must also be conducted by the transit agency prior to start-up. The driver training plan should include classroom and on-the-road training. During the driver training, it is crucial that operating procedures are clearly defined and expectations for shoulder use are in place (e.g. discretion of transit drivers to use the shoulder or not based on their personal comfort levels). These items are at the discretion of the transit agency but should be clearly defined in the agency's training plan.

Monitoring the System

After implementation is complete, the next step is to monitor the performance of the system. Performance measures may include maintenance, enforcement, benefits, and desired changes (if any). Examples of measurements are listed below.

Maintenance of the shoulder

- Keep the shoulders clear of debris and disabled/abandoned vehicles
- Monitor for wear and ride quality of the shoulder
- Ensure maintenance is performed often enough that BOSS service is not frequently disrupted

Enforcement

- Law enforcement must continually monitor the shoulder to ensure only authorized users are operating on the shoulder
- NCDOT should keep law enforcement up-to-date on authorized users as well as any other changes associated with BOSS operations

Assess Benefits

- Collect before and after travel time and safety data for comparison purposes
- Monitor safety, transit operations (on-time-performance), roadway operations (LOS) and bus ridership counts before and after implementation
- Survey BOSS users to have them rate their experience, and learn where they heard about BOSS

Desired Changes

- Interview the bus drivers for feedback regarding speed, shoulder conditions, passenger reactions, as well as any challenges involving vehicles in the general purpose lanes
- Review routes to determine if there are other buses that could benefit from BOSS
- Assess if there is a need for a change in the bus schedule

Conclusion

The steps outlined in this Implementation Blueprint are the culmination of meetings with the CAMPO BOSS Technical Steering Committee (staff from CAMPO, DCHC MPO, GoTriangle, and NCDOT), the consultant expert panel, as well as the literature review conducted on BOSS across the US. It should be noted that each BOSS project presents different challenges and circumstances. Every project should be evaluated on a case-by-case basis. The appendices provided in the next sections serve as additional resources to be used when developing a BOSS project. BOSS projects must remain consistent with the operating and design criteria developed during this study. It is imperative to consult early and often with the BOSS team to determine BOSS eligibility.

Appendix A: BOSS Operating and Design Criteria

NC Capital Area Metropolitan Planning Organization

GO Triangle

Triangle Region Bus on Shoulder Study

Design and Operating Criteria

DURHAM - CHAPEL HILL - CARRBORO
DCHC
Metropolitan Planning Organization
Planning Tomorrow's Transportation

October 2020

Contents

Tables

Introduction

The North Carolina Capital Area Metropolitan Planning Organization (CAMPO) and its partners, GoTriangle, the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC-MPO), and the North Carolina Department of Transportation (NCDOT) initiated a study to create a programmatic approach for identifying, prioritizing, and developing best practices for Bus on Shoulder System (BOSS) deployment in the Triangle, and across North Carolina. This technical memorandum uses findings from the previous technical memorandum "Peer Review" to prepare minimum criteria and desirable criteria for BOSS facility design and operations on current and future roadways.

Design Guidelines

The BOSS concept has been in operation across the United States for decades and most bus on shoulder systems follow similar design criteria. Design features to be evaluated include lane and shoulder width, use of the inside or outside shoulder, pavement condition, drainage and utilities, placement of rumble strips, signage and pavement markings, and access management and control. Additionally, there are elements such as the placement of park and ride lots and use of ramp metering which may enhance the bus on shoulder system. The following sections provide information on the assessment of these features and the ideal situation for bus on shoulder operations. Refer to Table 1 for the design criteria and recommendations.

Lane and Shoulder Width

General purpose lanes are typically 12-feet wide with a 10-foot outside shoulder depending on the age and maintenance of the particular corridor. In an ideal situation, BOSS would operate on 12-foot shoulders adjacent to a 12-foot travel lane; however, this situation is not common. The majority of BOSS deployments run on a 10-foot shoulder with no safety implications. In areas with barriers such as bridge structures or guardrails, the shoulder should be widened to 11-12 feet to ensure the bus has sufficient space to operate safely and comfortably. Where a continuous shoulder meeting criteria throughout an entire corridor does not exist or is not achievable, BOSS operations may still be beneficial even with small segments requiring buses to merge back into the general purpose lanes to avoid pinch points.

Inside versus Outside Shoulder

The decision to run buses on the inside shoulder versus outside shoulder and vice versa depends on the origin and destination of the BOSS route and the conditions of the shoulder. Most BOSS systems utilize the outside shoulder because it is typically wider and the buses are not required to navigate across multiple lanes of traffic to enter the shoulder. However, the outside shoulder is the designated breakdown lane and encounters on-ramps which present conflict. When determining whether to use the inside or outside shoulder, it is important to look at all elements of the shoulder condition and the planned BOSS route.

Pavement Depth and Pavement Conditions

Pavement depth has not presented a problem for most BOSS systems. In Florida locations where BOSS has been implemented, shoulders are usually 3-inches in depth whereas the general purpose lanes are 7-inches in depth. In BOSS applications with a limited number of buses per day, existing shoulder depth is sufficient. With higher volumes of buses running daily, the shoulder pavement depth may need to be strengthened to avoid shoulder damage. Strengthening of the shoulders is often accomplished at a later date as part of a resurfacing project which happens roughly every 10 years. This approach minimizes the cost at the start of the project and allows for monitoring BOSS operations to determine if BOSS is warranted and should continue along the corridor.

Pavement conditions on the shoulder are important to take note of when planning for BOSS operations. A shoulder is sufficient for BOSS if the pavement is in good or fair shape. Poor pavement conditions including shoulders with deep rutting, inadequate skid resistance, or those not structurally sound can cause discomfort for the bus operator and passengers, damage the bus, and most importantly create unsafe

conditions for BOSS operations. In the case of poor conditions, the shoulder would require resurfacing prior to the start of BOSS operations.

Drainage and Utilities

Drainage and the location of utilities (lighting poles, sign mounts, ITS infrastructure storage cabinets) should be assessed to determine if there are going to be issues with buses running on the shoulder. Although drainage is not typically an issue, Minnesota found that catch basins caused discomfort to bus passengers and heavy vehicle traffic damaged the basins over time. Reinforcement and improvement of the catch basins was a simple solution.

Rumble Strips

Rumble strips are a safety feature of the shoulder to warn drivers they are drifting out of the general purpose lanes. When buses operate on the shoulder, the rumble strips can present an unpleasant ride for the bus operator and passengers. Because the rumble strips are a safety feature, they cannot be removed and can only be relocated. In NC, the rumble strips will be shifted closer to the edge line of the travel lane and possible narrowed to accommodate a wider breadth for buses.

Signage and Pavement Markings

The signage and pavement markings for a BOSS system do not have to be elaborate and most systems use static signage and minimal pavement markings when implementing BOSS. The signage used indicates that buses are authorized to run on the shoulder, the beginning and end of the BOSS segment, and warning of pinch points. Signage along the corridor should be placed at the beginning of the BOSS corridor indicating the beginning of BOSS operations and at the end of BOSS corridor indicating the ending of BOSS operations. There should also be “Authorized Buses Only” or “Buses on Shoulder” placed at minimum every two miles to remind drivers that authorized buses are permitted to operate on the shoulder. Pinch point signs may be used to warn the bus operator to move back into a general purpose lane before shoulder narrowing; however, bus driver training emphasizing the pinch points for the BOSS corridor(s) is sufficient. Pavement markings, if used, are usually only at the start of the BOSS segment which read “Authorized Buses Only”. Dynamic signage has been implemented in some states but it is more costly and does not appear to be more effective than static signage.

Access Management and Control

Managing the integration of BOSS operations at on-ramps, off-ramps, auxiliary lanes, and interchanges can be a challenge. The majority of the time, the answer is simple: bus operators yield to other traffic that is merging on or off of the roadway. Where auxiliary lanes are present, buses will operate in the auxiliary lane for the length and then return back to the shoulder. Ramp metering can be installed to create a larger gap for buses to continue on the shoulder at on-ramps; however, this is not usually necessary for most BOSS systems. If ramp metering is already in place, transit signal priority may be used to hold traffic at the ramp as the bus approaches and clears the ramp. The location of park and ride lots is also important to BOSS operations. If the bus can easily exit the highway to stop at a park and ride lot and return to the interstate via a slip ramp, this improves travel time for the bus. Ramp metering, transit signal priority, and park and ride lots are not critical to the success of BOSS operations. BOSS operations are the most successful where there is daily gridlock, stop-and-go conditions with traffic moving at 15 mph or less.

Table 1. BOSS Design Features

Design Features	Minimum Requirements/Recommendations	Explanation of Requirement/Recommendations	Current Requirment in Existing IOP
Shoulder width (without barrier)	10 ft. minimum; 12 ft. desirable	Buses can safely operate on a 10 ft. shoulder. 12 ft. shoulders emulate general purpose lanes and provide the ideal space for bus operators. BOSS operations on narrower than 10 ft. shoulders does not provide sufficient space for the bus (9.5 ft.) to safely operate.	10 ft. minimum shoulder; 12 ft. desired
Shoulder width (with barrier)	11 ft. minimum; 12 ft. desirable	Shoulders with barriers such as guard rails leave no room for error for the bus operator. This causes discomfort and discourages use of BOSS.	10 ft. minimum shoulder; 12 ft. desired
Shoulder pavement depth and conditions	[Interim recommendation based on FDOT standards] 3 in. depth minimum; 7 in. depth desirable Pavement must be in good or fair shape prior to running buses on the shoulder	In Florida, shoulders are generally 3-in. in depth and the general purpose lanes are 7-in. because they experience high traffic volumes. Overtime, heavy vehicles running on the shoulder may result in damage to the pavement. Shoulders with crumbling pavement can damage the bus and create unsafe conditions for BOSS. Repaving would be required to run buses on the shoulder. At the time these critieria were being developed, NCDOT had begun a process to evaluate and refine its pavement depth standards. We recommend that this criterion be updated to reflect the outcomes of this NCDOT process at a later date.	Not addressed
Rumble strips	Move closer to edge line of travel lane and potentially narrow rumble strip	Rumble strips cause discomfort for the bus operator and riders but cannot be removed because they are a safety feature of the roadway. Moving the rumble strips closer	Rumble strips located concurrent with, or within 6 inches of, pavement edge lines or audible longitudinal pavement markings

		to the edge line of the travel lane accomodates the bus	
Drainage/utilities	Catch basins may require reinforcement/improvement over time Ensure no utilities (lighting poles, sign mounts, ITS infrastructure storage) are in the bus path	Catch basins may be damaged over time with buses travelling over them. If damage is noticed, the catch basins should be reinforced. If there are utilities in the bus path causing a pinch point, the bus would be required to merge into the general purpose lane prior to the utility.	The IOP suggests that NCDOT will identify drainage structures that need to be restrengthened during the feasability study of the BOSS corridor.
Inside vs. outside shoulder	Consider shoulder width, location of entry and exit ramps, segment length, and operating conditions to make this determination	The outside shoulder is generally preferred to eliminate the need for the bus to weave across lanes to access the inside shoulder. The inside shoulder could be beneficial in any of the following scenarios: when the bus is exiting left during AM/PM peak period; when the outside shoulder is narrow and the inside shoulder meets the 10 foot minimum criterion; when the BOSS segment is long and the bus will not encounter interchanges, etc. All elements should be carefully reviewed to determine the best option on a case by case basis.	Not addressed which leads to the interpretation of outside shoulder use only
Frequency of on/off-ramps	Interchange spacing greater than two miles is desirable for optimal BOSS benefits	Interchanges may require the bus to merge back into the general purpose lane; therefore, if there are interchanges very close together, the bus may not benefit from BOSS dependent on the BOSS corridor length.	Not addressed
Signage and pavement markings	At minimum: Static signage indicating the start and end of BOSS operations and authorized buses only approximately every two miles Pavement markings are not more effective than signage and therefore not required.	The minimum signage has proved to be effective in most BOSS systems across the US. Signage present at on ramps is desirable to make oncoming traffic aware of BOSS operations. Dynamic message signs may be useful for alerting buses of shoulder blockages such as emergency	Begin/Shoulder/Authorized Buses Only No Parking Watch for Buses on Shoulder Shoulder/Authorized Buses Only Pinch Point End/Shoulder/Authorized Buses Only

	Desirable: Dynamic message signs to indicate buses are allowed on the shoulder and to warn buses of conflicts ahead	vehicles or broken down vehicles. While these are not necessary for the safety of the corridor, they can be beneficial.	No Pavement markings
Access management and control	Limited access facilities such as interstates with controlled entrances and exits are ideal for BOSS operations Ramp metering at extremely congested on-ramps may be desirable but is not a requirement	Limited access facilities such as interstates and expressways with controlled entrances and exits are required for BOSS operations. Arterial BOSS presents conflicts with bike/ped, traffic signals, etc. Arterial BRT is not bus on shoulder. Ramp metering creates a space for the bus on shoulder to traverse the on/off ramps but is not required. Buses should merge back into the general purpose lane prior to ramps.	Roadway must be an existing freeway or expressway Facility must have full or partial control of access Ramp metering is not addressed.
Park and Ride lots	Easily accessible park and ride lots may encourage transit usage Off-line stations (bus required to exit interstate) - close proximity to an interchange and some level of dedicated bus on/off ramps to/from BOSS lanes desired Online stations (directly adjacent to interstate and exiting is not needed) - desirable but requires additional infrastructure	Park and ride lots are not required for BOSS operations. Park and ride lots for commuters who are using the BOSS corridor may encourage transit usage. If park and ride lots are easily accessible for the bus, the bus will not lose time navigating to and from park and ride lots. Online stations are the ideal situation because they remove the need for the bus to exit the freeway but this requires additional infrastructure and may be costly	Not addressed

Operating Guidelines

Standard operating procedures for BOSS systems largely mirror the operating protocols of the Minneapolis-St. Paul system due the success and expansion of the system. Operating guidelines should be established for speed, operating hours, driver training requirements, authorized users, safety, arterial operations, incident management, law enforcement, and emergency services, maintenance, and start-up measures. The following sections provide best practices for operating a safe and successful BOSS system. Refer to Table 1 for the operating criteria and recommendations.

Speed

Buses should only merge onto the shoulder during congested periods when the speed of the general purpose lanes slow to below 35 mph. When the buses are traveling on the shoulder, their speed should never exceed 35 mph. Additionally, buses should never travel more than 15 mph over the speed of the general purpose lanes. For example, if the general purpose lanes are travelling at 15 mph, the bus is only permitted to travel at 30 mph.

Operating Hours

The buses should be permitted to use the shoulder during recurring and non-recurring congestion to fully benefit from shoulder use. This means that the bus would use the shoulder any time of day or night when the speed of the general purpose lanes drop below 35 mph.

Driver Training Requirements

Driver training to ensure safe BOSS operations is critical to the success of the system and is the responsibility of the transit agency. Drivers should be trained in the classroom and on-the-road. The classroom training should consist of teaching the operating requirements for BOSS. This should be inclusive of speed protocols, operating hours, authorized users, handling of emergency situations that may occur while operating on the shoulder, reporting of blocked shoulders, etc. On-the-road training should begin in a controlled environment. This may include police escorts during initial training and implementation of the BOSS system. Depending on the capabilities of the transit agency, driving simulators may be beneficial prior to conducting on-the-road training.

Authorized Users

Any entity seeking authorization to use BOSS must develop and implement a training program. All drivers must be trained prior to operating on the shoulder. During the start-up of BOSS operations, it is encouraged that only fixed route transit buses operate on the shoulder. If use of shoulder by other buses such as charter buses, school buses, or paratransit vehicles is warranted and approved by the facility owner, those entities must also develop and implement a training program and their drivers must be trained prior to use. There must never be an untrained driver operating on the shoulder.

Safety

BOSS is proven to be a safe practice based on the track record of longstanding systems. Utilizing the proper speed protocols and driver training requirements, BOSS operations are safe. The use of four-way flashers while operating on the shoulder is encouraged. BOSS operating practices should allow the operator to exercise discretion to remain in the general purpose lanes if they feel unsafe using the shoulder. Buses that are approaching an on-ramp or off-ramp should carefully traverse the conflict point if possible or merge back into the general purpose lanes prior to the ramps.

Arterial Operations

Arterial operations are more complex than limited access facilities such as interstates. Arterials generally have frequent traffic signals, on-street parking, hidden driveways, and other features that conflict with

shoulder operations. While freeway BOSS is a more straightforward concept than arterial BOSS, certain arterial roadways with significant levels of access control may still be promising candidates to consider. Arterial BRT, in which the bus has a dedicated travel lane, is preferable in corridors where the conflicts mentioned exist. Arterial BRT features also typically include: transit signal priority, fewer stops, ticket machines at stations to eliminate paying when boarding, low-floor buses and raised curbs at stations, plus wider bus doors and boarding from the front and back, speed up boarding.

HDR reached out to Minneapolis' Metro Transit to determine if there were established criteria for arterial BOSS operations. The Agency suggested that they utilize the same criteria for arterial BOSS operations as they do for interstates and freeways. Given their extensive BOSS system, there is the cultural acceptance and expectation to see buses operating on the shoulder everywhere after decades of operation.

It is recommended that the criteria for arterial operations be consistent with the interstate BOSS criteria with the addition of reviewing the number of intersections with public roadways per mile of road. This number will represent the "interruption index" and will be considered when identifying BOSS facilities. This criterion should give measurable representation of how often a bus on an arterial shoulder must navigate vehicle turning movements as compared to running on an Interstate, US, or NC signed road. The higher the "interruption index" the lower the facility will score in terms of prioritization.

Incident Management, Law Enforcement, Emergency Services

Buses utilizing the outside shoulder are operating in the designated breakdown lane of the interstate facility. Buses are likely to encounter traffic stops, debris, broken down vehicles, and crash and incident scenes. As such, it is important to have an incident management plan specifically for bus on shoulder operations. The incident management plan needs to address the protocols for buses to report blockage of the shoulder and procedures for emergency situations involving the bus including a bus fire (inside shoulder and outside shoulder). Buses must always merge back into the general purpose lanes when approaching an emergency scene and when an emergency response vehicle is approaching the bus.

Maintenance

Maintenance of the corridor is critical to the success of the BOSS system. If the shoulders are blocked by broken down vehicles and debris for an extended amount of time, the bus is unable to use the shoulder and the transit agency loses the benefits of shoulder use. Shoulders should be swept at the same frequency as the general purpose lanes and broken down vehicles and debris should be removed in a timely manner.

During all types of precipitation, bus operators should be trained to use their best judgment when choosing to merge onto the shoulder. If there is high water, bus operators should remain in the general purpose lanes.

Start-up Measures

Prior to BOSS implementation drivers should be fully trained in a classroom setting and on-the-road. Public awareness of the new operation is a critical element of BOSS implementation. Public awareness and education should start a minimum of one-month before the service begins and is the responsibility of transit agencies. Advertisements should be made via radio, television, social media, and print materials, with translated materials available upon request, to inform roadway users and bus riders of the new BOSS service. Installing static signage at least one month ahead of implementation will ensure that the travelling public is aware that buses will be utilizing the shoulder and that only authorized buses are permitted to travel in the shoulder lane under specified conditions. The NCDOT should deploy dynamic message signs (such as those used to indicate road construction or closings) at least 2 weeks prior to buses running on the shoulder

Table 2. BOSS Operating Features

Operating Features:	Requirement/Recommendations	Explanation of Requirement/Recommendations	Requirement in Existing IOP
Operating hours	Anytime the traffic in the general purpose lanes slows to below 35 mph	This is the requirement for most systems. There are systems in the US which only allow BOSS operations during AM/PM peak periods but this excludes the use of shoulders during nonrecurring congestion.	Anytime the traffic in the general purpose lanes slows to below 35 mph
Maximum speed on the shoulder	35 mph	National standard	35 mph
Allowable speed differential between the shoulder and general purpose lanes	15 mph	National standard	15 mph
Authorized users	Identify transit agencies/bus operators - fixed route, paratransit, charter, school buses, etc who can use the shoulder Trained drivers only	There are various types of buses and bus operators. It should be discussed and in writing who the authorized users are and are not. All drivers All drivers utilizing the shoulder must be trained in collaboration with their state DOT	Fixed-route and paratransit as long as they meet the vehicle type requirement which is a standard 40' bus All drivers utilizing the shoulder must be trained in collaboration with NCDOT
Types of buses using shoulder	Standard 40' bus/ paratransit vehicles/ etc.	Standard 40' buses are generally the type of vehicle that uses the shoulder; however, if a transit agency operates articulated buses, these may be allowed if shoulder conditions permit.	Standard 40' bus
Driver training	Classroom training and On-the-road training	Transit agencies should train their drivers in the classroom and on-the-road. Driving simulators may be used in addition if the transit agency has the opportunity.	Classroom and on-the road training by the transit agency(s)
Requirements for shoulder usage	Encourage drivers to use the shoulder when speed conditions are met but discourage use during inclement weather or other unsafe conditions	Drivers should use the shoulder at their discretion when the conditions for shoulder use are met. Drivers should not operate on the shoulder if they feel conditions are unsafe or if there is inclement weather.	At the discretion of the drivers when conditions are met.

Audible/Visual	Use of four-way flashers when operating on the shoulder Use of horn as needed to warn drivers of the bus operating on the shoulder	National standard Horn should be used as needed	Use of four-way flashers when operating on the shoulder
Approaching on/off-ramps Use of auxiliary lane	Bus operators may traverse the interchange if there is ample space to safely do so but must yield to exiting or entering traffic. If there is heavy congestion, bus operators may need to merge back into the general purpose lanes when approaching on/off-ramps Where auxiliary lanes are present, buses will operate in the auxiliary lane for the length and then return back to the shoulder.	This may be left to the transit agency during BOSS training; however, there is a general consensus that buses are permitted to traverse the interchange without merging if it is safe to do so. If there is heavy traffic, the bus operator should be encouraged to merge back into the general purpose lanes. Auxiliary lanes should be used by the bus if safe.	Buses may traverse the interchange if safe to do so or they may choose to merge back into the general purpose lanes. Auxiliary lanes are not addressed in the IOP.
Enforcement of shoulder use	State and local law enforcement should enforce the shoulder use requirements	State and local law enforcement should be a part of the BOSS team to ensure they are aware of the rules of the shoulder, as well as who the authorized users are.	NC State Highway Patrol or other law enforcement agencies and the NCDOT Incident Management Assistance Patrol (IMAP) will coordinate concerning the implementation of an effective enforcement program to ensure the safe operation of freeway and arterial BOSS corridors.
Incident Management/Law Enforcement/ Emergency Services	Emergency response vehicles and law enforcement take precendence over BOSS operations. Bus operators are required to merge back into the general purpose lanes when approching or being approached by these vehicles.	Buses operation the shoulder must always merge back into the general purpose lanes if approaching or being approached by emergency response vehicles and law enforcement	Buses operation the shoulder must always merge back into the general purpose lanes if approaching or being approached by emergency response vehicles and law enforcement
Maintenance needs	The shoulder should be swept as often as the general purpose lanes	If the shoulder is frequently used by buses, it is important to clear the shoulder at the same level as the general purpose lanes and maintain the intergrity of the shoulder by performing proper maintenance structurally	The regional BOSS Team will establish, implement, monitor, and modify the maintenance policies, strategies, and procedures as needed. These may include items such as:

			- A shoulder cleaning strategy to ensure that the shoulder is kept clear of debris - An inclement weather strategy to ensure safe operations of BOSS - A pavement preventive maintenance strategy to ensure pavement integrity in a cost-effective manner
Start-up measures	At minimum, signage should be installed one month prior to the start of BOSS operations Use of roadside dynamic message signs indicating that BOSS operations will begin are encouraged Transit agency is responsible for advertising new service via television, radio, social media, and print materials Police escort for the first two weeks is desirable	Installing signage prior to BOSS implementation gives the motorists along the corridor notice of the change. Dynamic message signs announcing the new service are not required but are a best practice to inform drivers of the upcoming BOSS operations. The transit agency should use a variety of outreach methods to ensure the public knows about the new BOSS operations and understands that only buses are authorized to use the shoulder under certain conditions. This is being done in Florida to help with the jealous motorist issue in which vehicles will purposely block the shoulder so the bus can not bypass traffic	Each regional campaign should be a cooperative effort of NCDOT, local and regional transit agencies, and other public and private partners in each region. While the specifics of each program will depend on the region, each outreach program should utilize multiple communication channels well in advance of the implementation as well as upon commencement of BOSS operation or expansion. The regional BOSS Team will establish, implement, monitor, and modify the public outreach policies, strategies, and procedures as needed.

Equity Considerations in Planning for BOSS

During the development of the BOSS criteria, the project team discussed how to evaluate questions of equity in the deployment of BOSS in the Triangle and across North Carolina. As of 2020, BOSS is still a relatively new transit strategy outside of Minneapolis, with limited deployment in a few states. As such, we did not turn up any significant analysis or discussion linking BOSS and equity in the literature. Nevertheless, there are a few prisms through which we can look at BOSS to assess how it can contribute to a more equitable transit network.

Consider BOSS Trips In the Broader Universe of Transit Trips

BOSS is primarily deployed on major highways that either already have shoulders, or can add them without significant impacts to homes and businesses. BOSS is most often used by bus routes that benefit from running on highway facilities. In most metro areas, buses that travel significantly on highways travel farther distances at higher speeds on longer routes. Since the economic motivation to travel further for high-paying jobs means that longer-haul routes are likely to contain a higher proportion of higher-income earners than the overall transit system in a given region, BOSS facilities are likely to be used by bus riders with a range of incomes, and not primarily transit-dependent riders. In the Triangle region, the only agency using BOSS at present is GoTriangle, which provides longer trips than GoRaleigh, GoDurham, GoCary, and Chapel Hill Transit. While serving riders across the economic spectrum, GoTriangle also has a larger percentage of higher-income riders than other agencies in the region. What does this mean for assessing BOSS and equity?

Bus Service Planning May Play The Greatest Role in Determining Who Uses BOSS

In a transit network where BOSS has no inline stations and is primarily a strategy to improve travel time reliability, the demographics of who rides on BOSS facilities will be significantly determined by the locations served by the bus before and after it enters the BOSS lane, and not by any attribute of the BOSS facility itself. While the CRX bus linking Raleigh and Chapel Hill has park and rides near I-40 where BOSS is available, it is the connections to downtown Chapel Hill and GoRaleigh Station on either end that give low-income riders direct access to the service that spends the most time in the BOSS lane. Downtown Chapel Hill and GoRaleigh Station are both approximately five miles away from the nearest accessible BOSS lane segment.

With Inline Stations, Traditional Title VI Analysis Is Recommended

At this time, as current BOSS facilities are located along limited access freeways where pedestrians are discouraged from walking, and there are no plans to add inline stations to any BOSS facilities in North Carolina. If that were to change, then transit agencies, MPOs, and NCDOT should work together to assess who is being served by the establishment of any bus stops established along a BOSS lane, and whether the access to BOSS services that was being provided was being made available equitably to individuals of all socioeconomic characteristics. The quantitative methods used for Title VI bus service change analysis would be appropriate tools for this work.

Equitable Engagement and Transit Onboard Surveys Can Help with Prioritization

If a transit agency, MPO, or NCDOT wants to prioritize investing in BOSS on routes that have a higher proportion of environmental justice populations, an equitable community engagement process can play a role in identifying which street segments present the greatest on-time performance challenges for these passengers. A route-level transit onboard survey of bus routes serving candidate facilities could also help determine if investing in one BOSS corridor ahead of another is more likely to achieve that goal. That said, even on routes that have higher-than-average incomes than other transit routes, it is usually the

case that almost every route is serving some portion of passengers whose primary mode of transportation is the bus. Given that BOSS is a relatively low-cost investment per mile, ideally this analysis would primarily inform the *order* in which BOSS facilities were added, and not whether BOSS facilities were ultimately constructed.

BOSS Investment Is One Component of A Larger Transit Plan

It is healthy for agencies to ask equity questions about any type of transportation investment. As BOSS is more widely deployed, agencies in North Carolina and nationally will need to develop tools to explore the equity implications of individual BOSS investments using some of the approaches described above.

Finally, at the programmatic level, it is also appropriate to look at the overall cost of investing in BOSS as compared to the entire transit investment program in an individual community or region. Compared to Bus Rapid Transit (BRT), which frequently approaches $10 million per mile when using dedicated lanes, BOSS can often be deployed for $1 million per mile or less, and sometimes for less than $25,000 per mile. In a program that was also investing in existing stops, sidewalk access to bus stops, frequent service networks, and BRT, BOSS investment would likely be a relatively small portion of the overall transit investment package in the community.

Prioritization of BOSS Projects in North Carolina

Bus on shoulder projects may be implemented for a variety of reasons including congestion resulting in poor travel time reliability, improvement of regional connectivity, interim measure until BRT, LRT, or managed lanes are constructed, or to support special events that are recurring in the area. BOSS is traditionally a low-cost, easy to implement solution; therefore, prioritizing BOSS corridors should start with the review of corridors with the minimum requirements for BOSS operations. As mentioned earlier in this technical memorandum, BOSS can be implemented if minimum requirements are met and over time, incremental improvements can be made to create a more advanced system if desired. Advancements may include but are not limited to, fully built out shoulders, park and ride accessibility, ramp metering, dynamic signage, etc. Below is a list of minimum criteria that must be met for BOSS consideration.

Minimum Criteria for BOSS:

- Limited access facility such as interstates and expressways
- Existing paved shoulders which meet the minimum width of 10 ft. and are in good or fair condition, or require minimal upgrades
- Buses are utilizing the facility or if not, there is evidence of a transit market present
- Corridor experiences recurring congestion

Generally, bus on shoulder is suggested by the transit agency utilizing or planning to utilize the corridor for bus operations. As such, the transit agency would present a project justification to the DOT for review. North Carolina is developing a process for prioritizing the need for BOSS operations as a way to be proactive. Determining the potential need should consider the minimum criteria mentioned above to ensure BOSS would be cost-effective and beneficial to transit service.

Conclusion

The current North Carolina BOSS system operating on I-40 in Raleigh is highly utilized by the routes operating in the corridor and has improved travel time reliability. As such, the state is planning to expand the use of BOSS and incorporate it into their plans and policies as a transit improvement strategy. In order to identify potential BOSS corridors, the BOSS technical steering committee has undertaken several tasks to understand how their peers have expanded their BOSS network, develop minimum design and operations criteria to aid in the prioritization of BOSS projects, and determine if the North Carolina BOSS Implementation and Operations Plan (IOP) needs to be updated based on the peer review.

The I-40 BOSS system was designed and is operating based on the MnDOT design and operating criteria established in the 90s. Minnesota currently has the most advanced BOSS network in the country with nearly 400 miles of bus on shoulder facilities in the Minneapolis-St. Paul urbanized area. Like the MnDOT system, the I-40 BOSS corridor is operating on a 10-foot outside shoulder for roughly 20 miles. The corridor has static signage roughly every two miles indicating that buses are allowed to operate on the shoulder as well as signage at the beginning and ending of BOSS operations and at on-ramps to warn oncoming motorists of the BOSS operations. Currently, the only transit agency utilizing the shoulder is GoTriangle and the only buses permitted are standard 40' GoTriangle buses. The bus drivers have been trained by the transit agency in collaboration with NCDOT, and are only allowed to operate on the shoulder during periods of congestion when the speed drops below 35 mph. Buses are not allowed to operate over 35 mph or more than 15 mph over the general purpose lanes.

Based on the peer review, the criteria developed in this technical memorandum is consistent with national BOSS standards. The minimum criteria was compared to the North Carolina BOSS Implementation and Operations Plan (IOP) which outlines the bus on shoulder design and operating criteria, eligibility, and framework for deployment of BOSS developed in 2013. The design and operating criteria in the IOP are relatively consistent with other states as demonstrated in the BOSS design and operating criteria tables above with few elements not addressed and slight variations in criteria. As part of the next steps in the Triangle Region Bus on Shoulder Study, the variations will be reviewed by the BOSS technical steering committee to determine if the findings warrant updates to the current IOP. In addition, the minimum criteria for BOSS prioritization will be finalized and used to identify potential BOSS subject roads in the Triangle.

Shelby Powell – Deputy Director

NC Capital Area Metropolitan Planning Organization

421 Fayetteville Street
Raleigh, NC 27601
(919) 996-4393
Shelby.Powell@campo-nc.us

Appendix B: BOSS Suitability Metrics Technical Analysis Memo

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Think Forward

Memorandum

TO: Patrick McDonough, AICP and Jeff Dayton, PE (HDR)

FROM: Feng Liu, Ph.D., Xuenan Ni, and Alpesh Patel

DATE: March 24, 2021

RE: Task 5 – Screen Each Subject Road Using Multiple BOSS Suitability Metrics

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This memorandum summarizes the task work activities and associated findings for Task 5 – Screen Each Subject Road Using Multiple BOSS Suitability Metrics.

The objective of this task is to provide an initial screening of the potential BOSS roadways using a set of BOSS suitability metrics. This screening analysis involved the following work activities:

- Developed the BOSS suitability metrics
- Developed the BOSS suitability weighting schema
- Analyzed the data to quantify the BOSS suitability metrics, including those from the Triangle Regional Model (TRM), the CAMPO and DCHC MPOs, and transit agencies
- Segmented the BOSS subject roads for analysis
- Scored the BOSS subject road segments
- Prepared the maps of the BOSS suitability metrics and final weighted scores.

In the following, we summarize the results and findings for the analyses.

BOSS Suitability Metrics

The BOSS suitability metrics are grouped into two dimensions: travel demand and transit operations (see Figure 1). The travel demand dimension consists of transit ridership, traffic volume, and congestion level, while transit operations include travel time delay and transit service frequency. This final set of five metrics incorporated the feedback and comments made by stakeholders, including those made in the Technical Steering Committee (TSC) meeting in December 2020.

3 Bethesda Metro Center, Suite 1200
Bethesda, MD 20814
tel 301-347-9100 www.camsys.com fax 301-347-9101

- Transit ridership represents transit demand for regional travel markets that will use individual BOSS subject roadways, with higher transit ridership showing the higher potential for the needs of BOSS services.

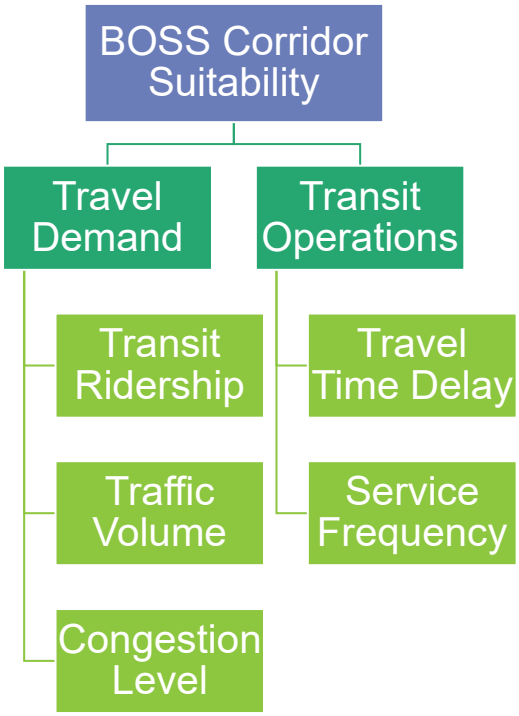
- Traffic volume demonstrates the travel demand in terms of vehicular modes among major origins-destinations in the region, which utilizes BOSS subject roadways and shows the potential for transit demand in the future.

- Congestion level, as measured in terms of volume-capacity ratios for the AM peak period, is used as an indicator for the potential benefits of the BOSS services: the higher the congestion, the higher the potential benefits to provide a BOSS service.

- Travel time delay, in terms of daily total delays, is a proxy measure for affecting transit on-time performance – the more delay, the higher the potential for a BOSS service.

- Transit service frequency specified in the 2035 horizon year of the CAMPO/DCHC MPO MTP measures transit planners' perception of the future transit demand among major activity centers in the region, with more frequent services indicating the higher potential needs for BOSS services.

Figure 1. BOSS Suitability Metrics



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The initial set of metrics included transit on-time performance metrics and pavement conditions (width and depth). Based on the feedback from the TSC members, the transit on-time performance metrics were replaced by travel time delay, so as to minimize the issue related to intentionally scheduling transit services to account for potential delays. The pavement condition metrics were moved to Task 6 for further consideration, based on the TSC meeting discussions.

The TRM model data were used to generate the BOSS suitability metrics, with 2035 as the planning horizon year for this study. The BOSS suitability analysis included the following process:

- BOSS subject roads were identified in Task 4 of the study (see Figure 2). The BOSS subject roads were segmented into operational segments for analysis (see Figure 3).
- Each of the BOSS suitability metrics was generated for each segment using the data assembled from the TRM model and other sources.
- Values of metrics were normalized to index scores with a 0-1 range, typically using the largest value of all segments.
- BOSS suitability metrics were weighted based on the weights provided in Table 1, which were generated as part of discussion among stakeholders and consultants.
- Maps of individual metrics and total weighted metrics were prepared to show the distribution of suitability for the BOSS services in the region.

The segmentation of BOSS subject roads went through a couple of iterations. Initially, the segmentation considered a sufficient length needed for the potential state funding such as SPOT/STI. Later, the initial segments were further split into smaller segments to account for differentiations in roadway characteristics on a long roadway, based on the CAMPO and TSC comments. Examples of further splitting include NC 54, US 401, and I-440.

Table 1. Model Performance by Volume Groups

Dimension	Metric	Metric Weight (within dimension)	Dimension Weight (total suitability)
Travel Demand	Transit Ridership	50%	50%
	Traffic Volume	25%	
	Congestion Level (Volume-to-capacity ratio)	25%	
Transit Operations	Travel Time Delay	30%	50%
	Service Frequency	70%	

Findings

Figures 4 through 8 display the index scores of individual suitability metrics while Figure 9 exhibits the total weighted scores of all suitability metrics. The total weighted scores show most suitable to least suitable corridors to potentially deploy BOSS resulting from Task 5. Major findings from Task 5 include:

- Primary BOSS expansion opportunities occur mostly along major interstates which connect core destinations in the region, such as University of North Carolina-Chapel Hill, Duke University, Downtown Durham, Research Triangle Park, North Carolina State University, and Downtown Raleigh. These destinations anchor mature, core transit markets and therefore validate suitability to operate BOSS. These segments total 75 miles.

- Second tier BOSS expansion opportunities link downtowns to core suburban markets through US 1, NC 54, US 70 and US 401. In the future, Park and Ride facilities strategically located at the intersection of these routes and heavily traveled secondary facilities could serve as collection areas during peak commute periods allowing suburban commuters to opt for transit service. Some of these routes coincide with proposed Bus Rapid Transit (BRT) locations in the Wake County Transit Plan (WCTP) providing an additional dimension of short and longer distance choice rider service opportunity. These segments total 139 miles.

- A prioritization or narrowing of locations should stem from factors outside these metrics, driven by infrastructure factors which impact deployment such as constructability, design/access feasibility, State Transportation Improvement Program (STIP) projects or other planned regional operational improvements.

Figure 2. BOSS Subject Roads

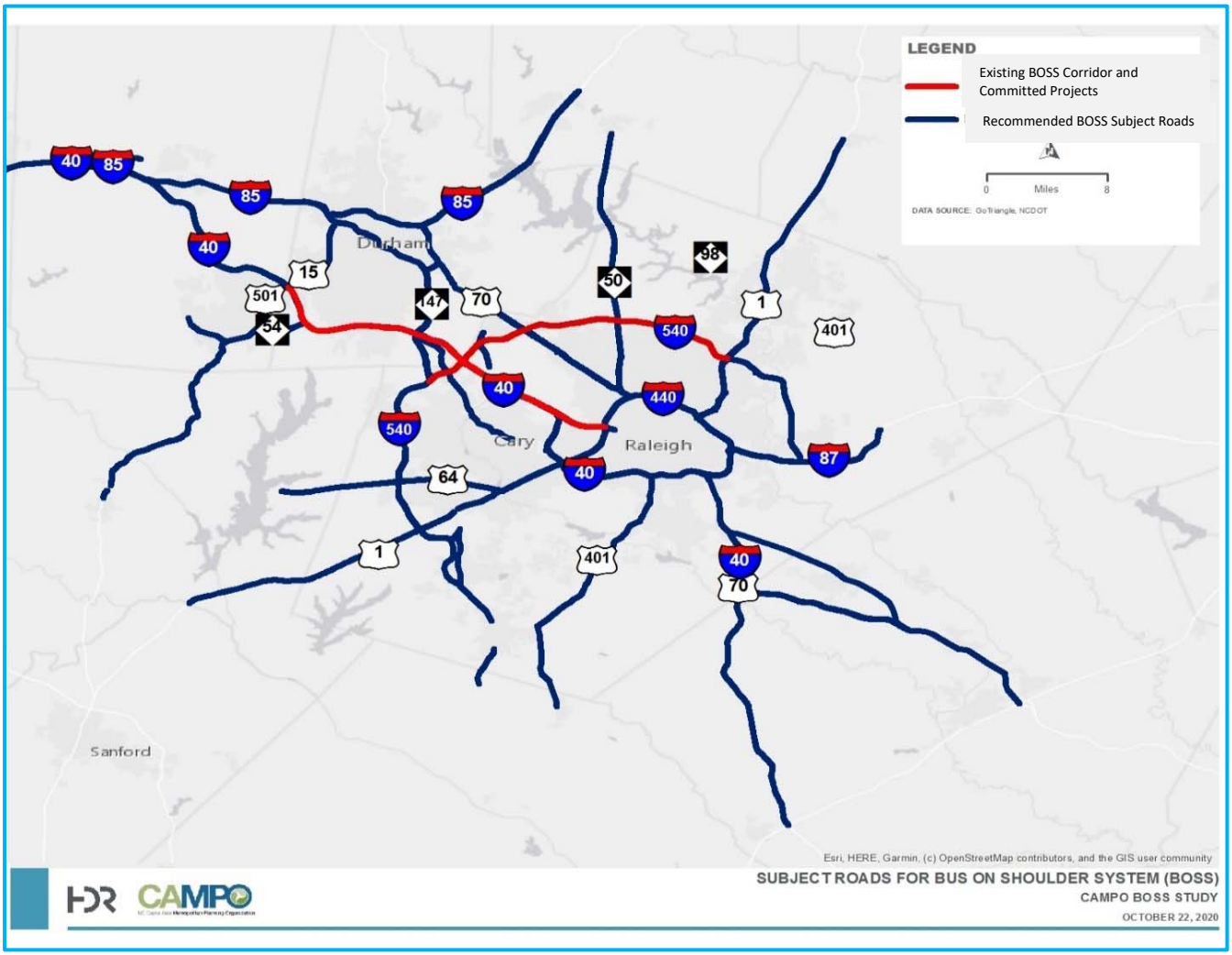

Figure 3. BOSS Subject Road Segmentation

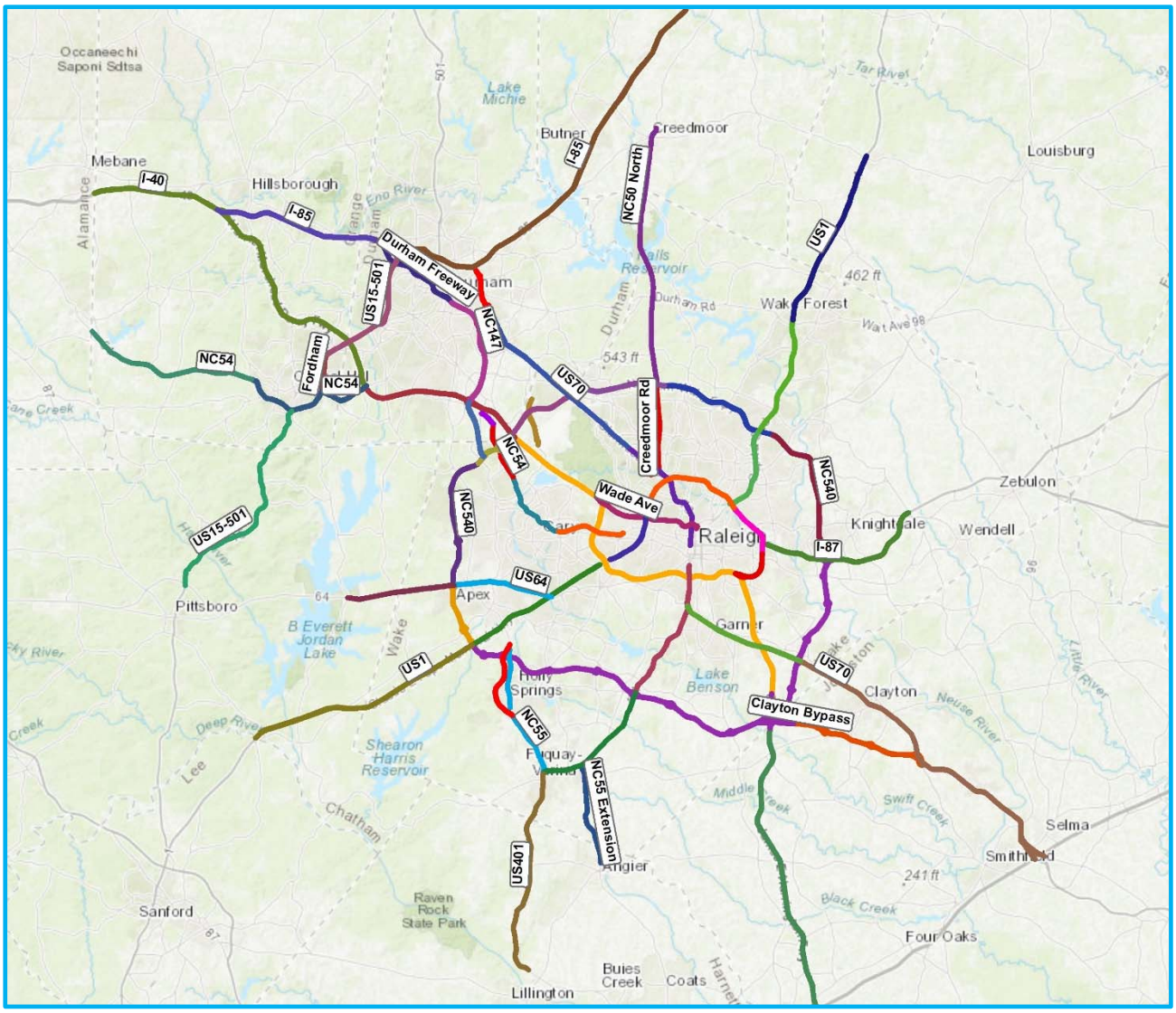

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Figure 4. Transit Ridership Metric Score

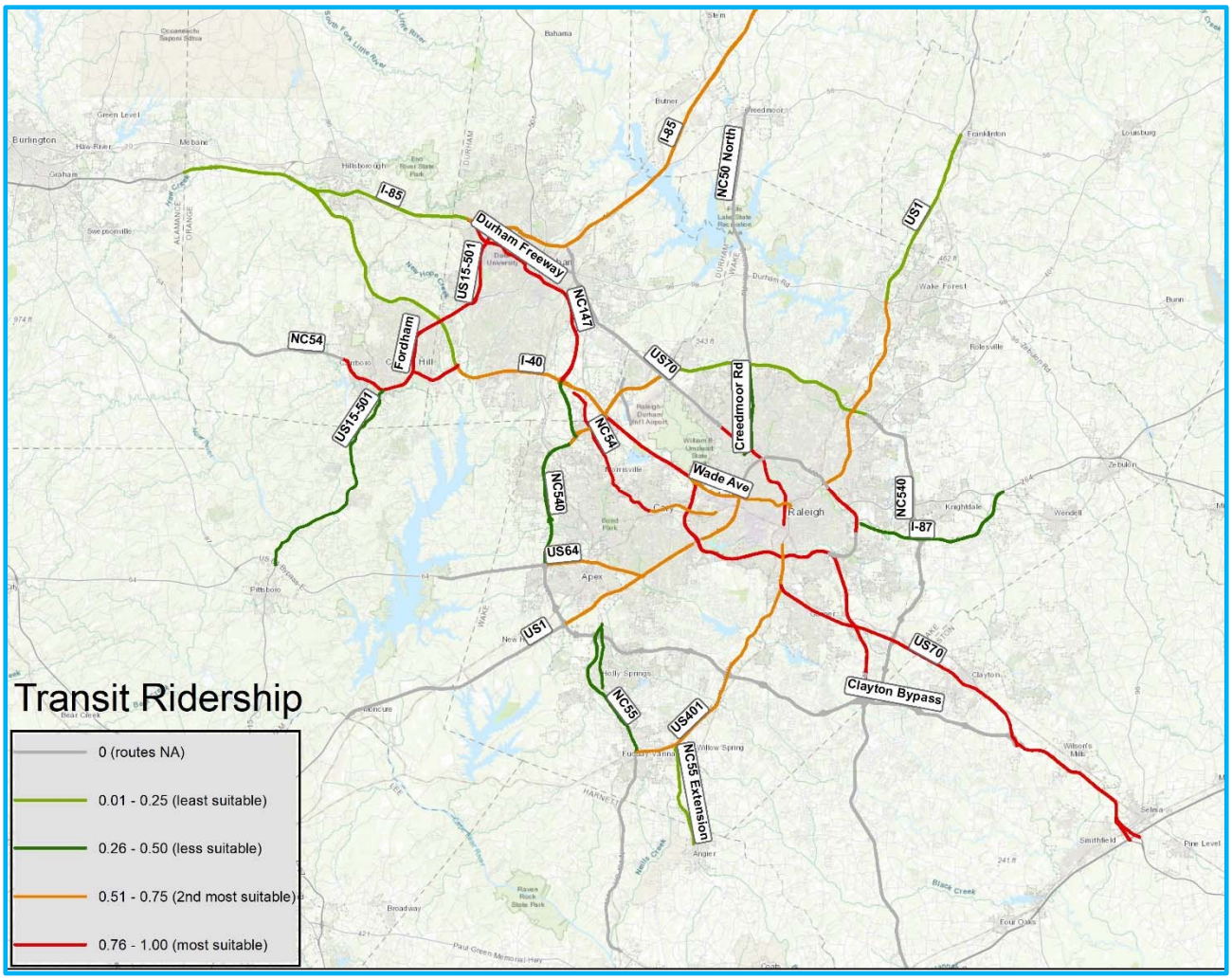

Table 2. Ridership Suitability Metric Score

Ridership Metric Index	Suitability
0.01 – 0.25	Least
0.26 – 0.50	
0.51 – 0.75	
0.76 – 1.00	Most

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Figure 5. Average Daily Volume Metric Score

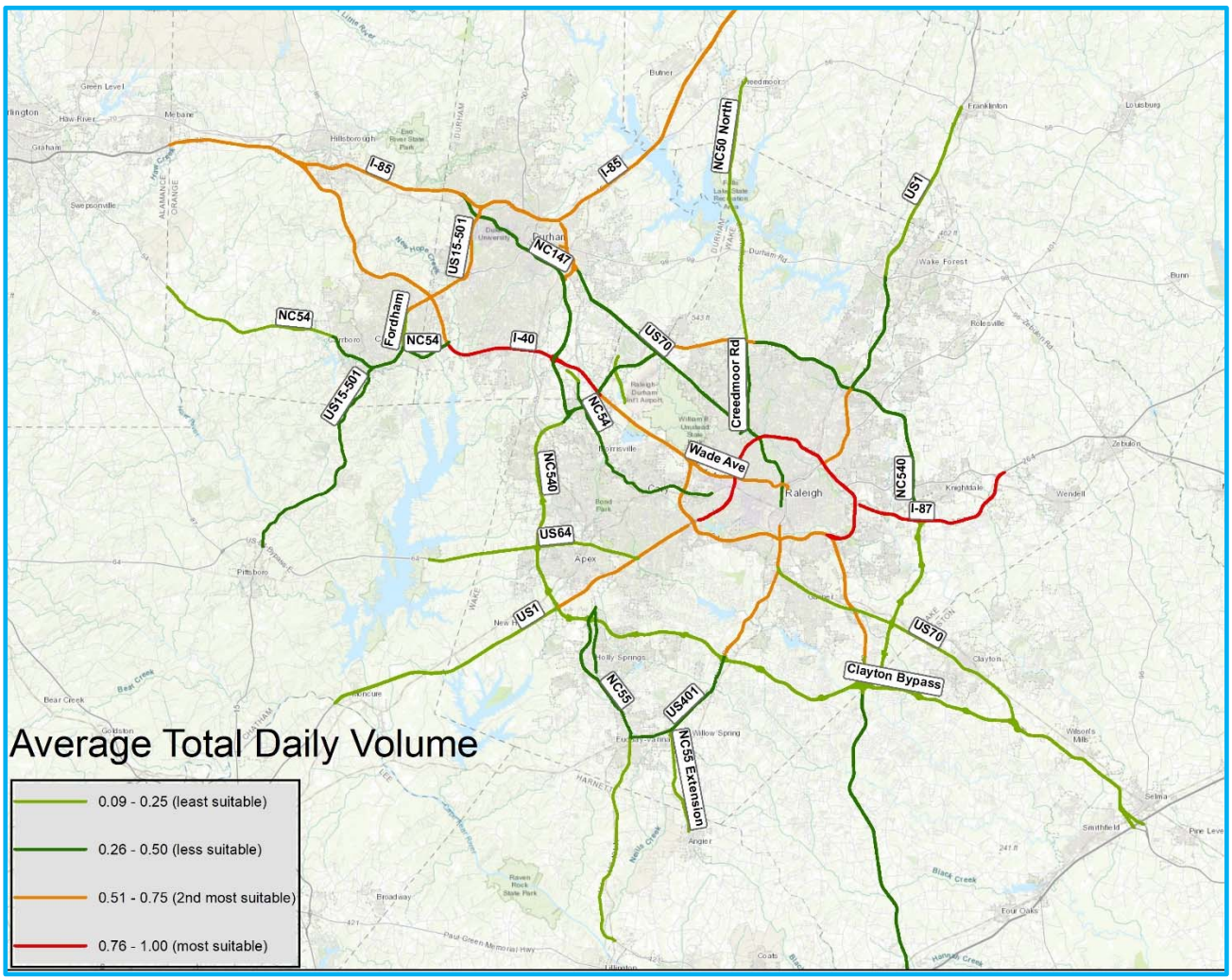

Table 3. Traffic Volume Suitability Metric Score

Traffic Volume Metric Index	Suitability
0.01 – 0.25	Least
0.26 – 0.50	
0.51 – 0.75	
0.76 – 1.00	Most

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Figure 6. Congestion (VC Ratio) Metric Score

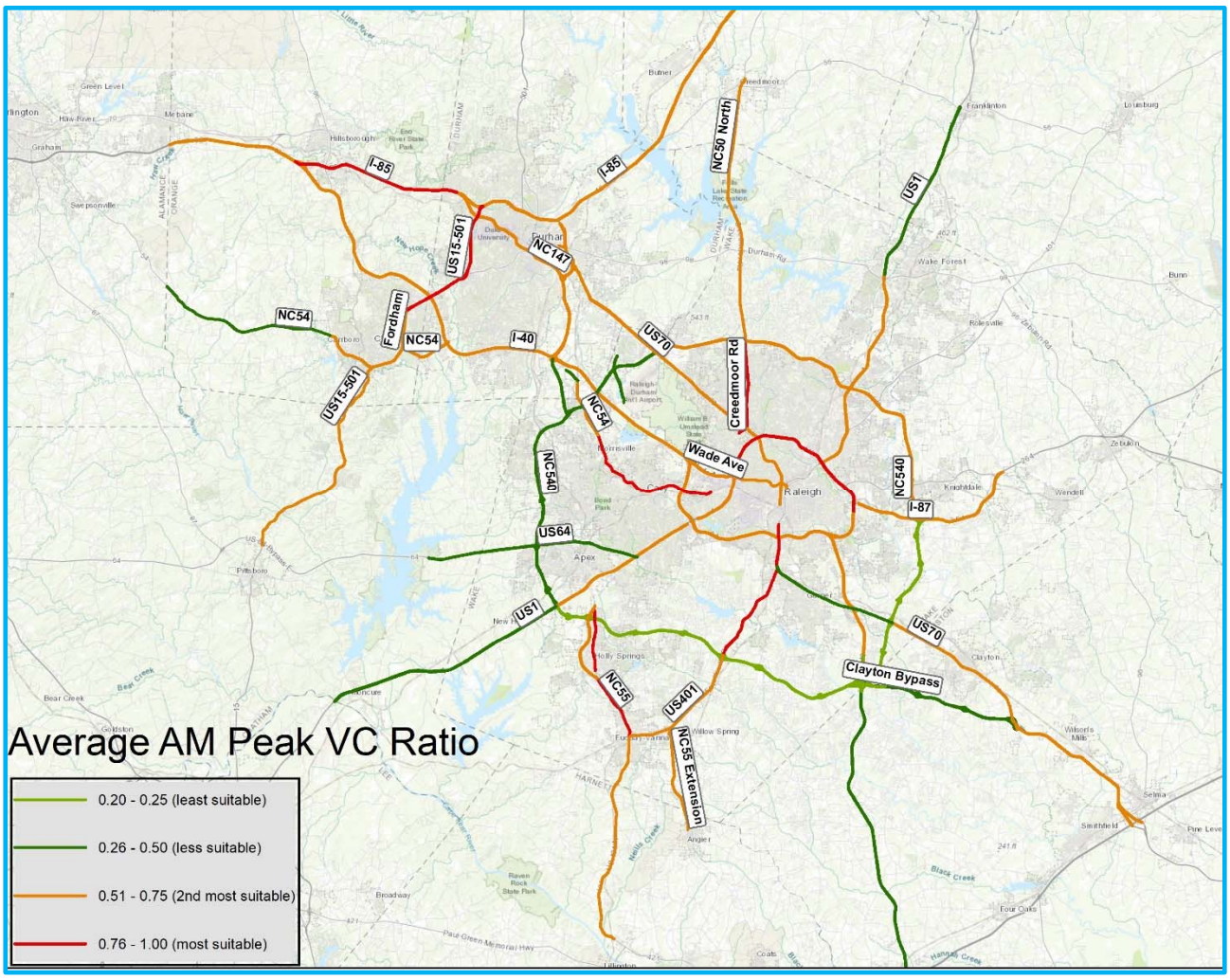

Table 4. Congestion (VC Ratio) Suitability Metric Score

Congestion (VC Ratio) Metric Index	Suitability
0.01 – 0.25	Least
0.26 – 0.50	↓
0.51 – 0.75	↓
0.76 – 1.00	Most

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Figure 7. Travel Time Delay Metric Score

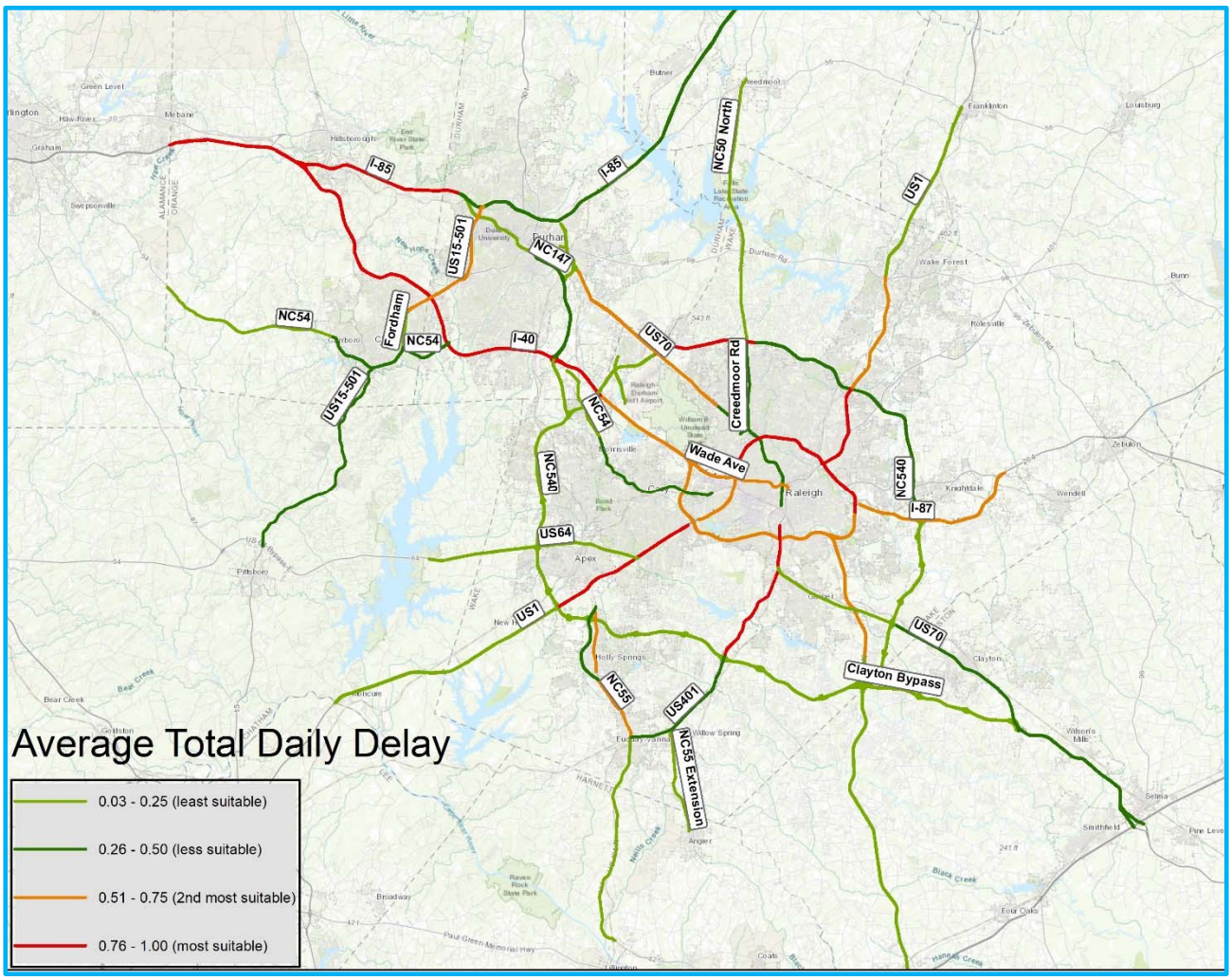

Table 5. Travel Time Delay Suitability Metric Score

Travel Time Delay Metric Index	Suitability
0.01 – 0.25	Least
0.26 – 0.50	
0.51 – 0.75	
0.76 – 1.00	Most

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Figure 8. Transit Service Frequency Metric Score

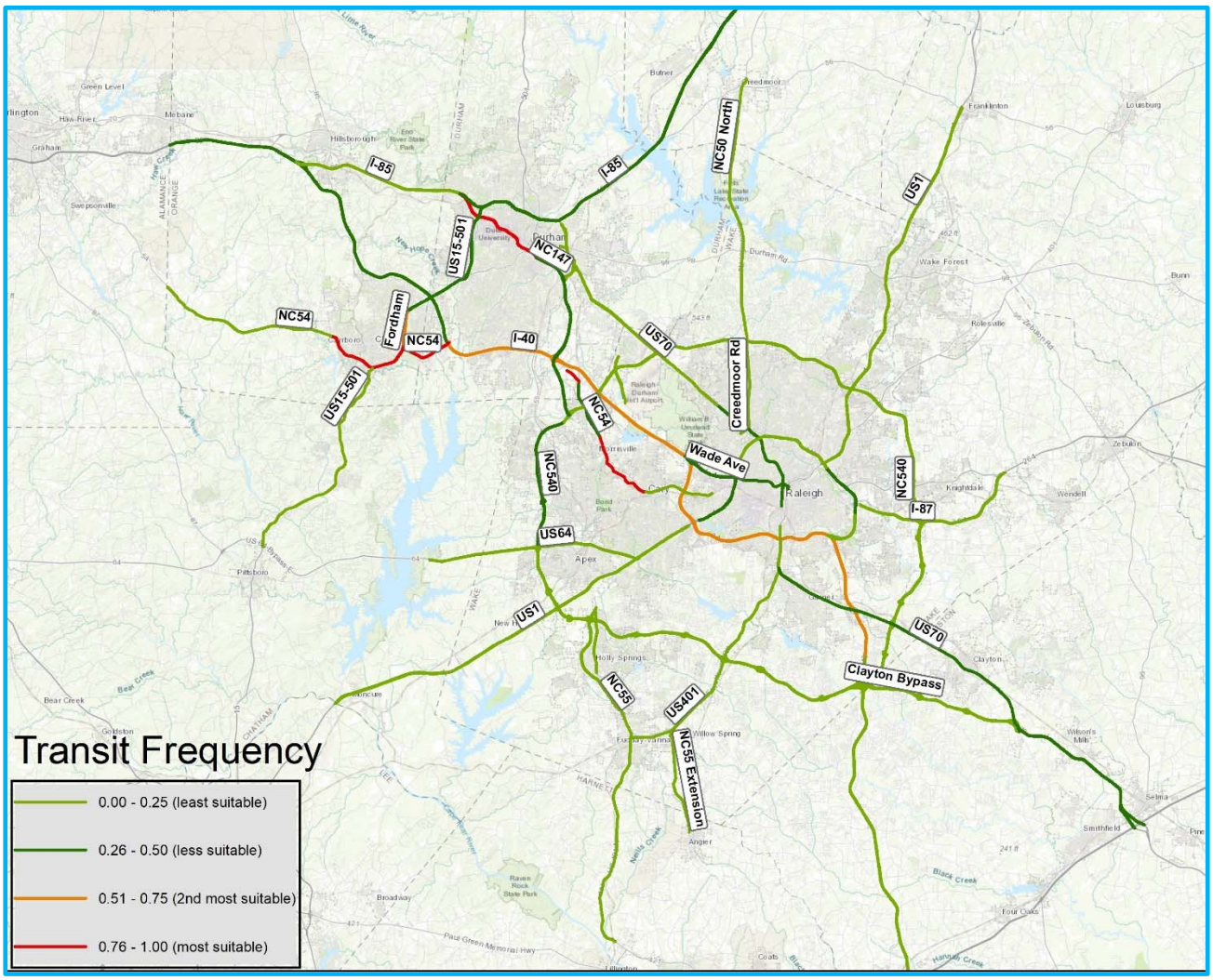

Table 6. Transit Frequency Suitability Metric Score

Transit Frequency Metric Index	Suitability
0.00 – 0.25	Least
0.26 – 0.50	↓
0.51 – 0.75	↓
0.76 – 1.00	Most

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Figure 9. Total Weighted Score

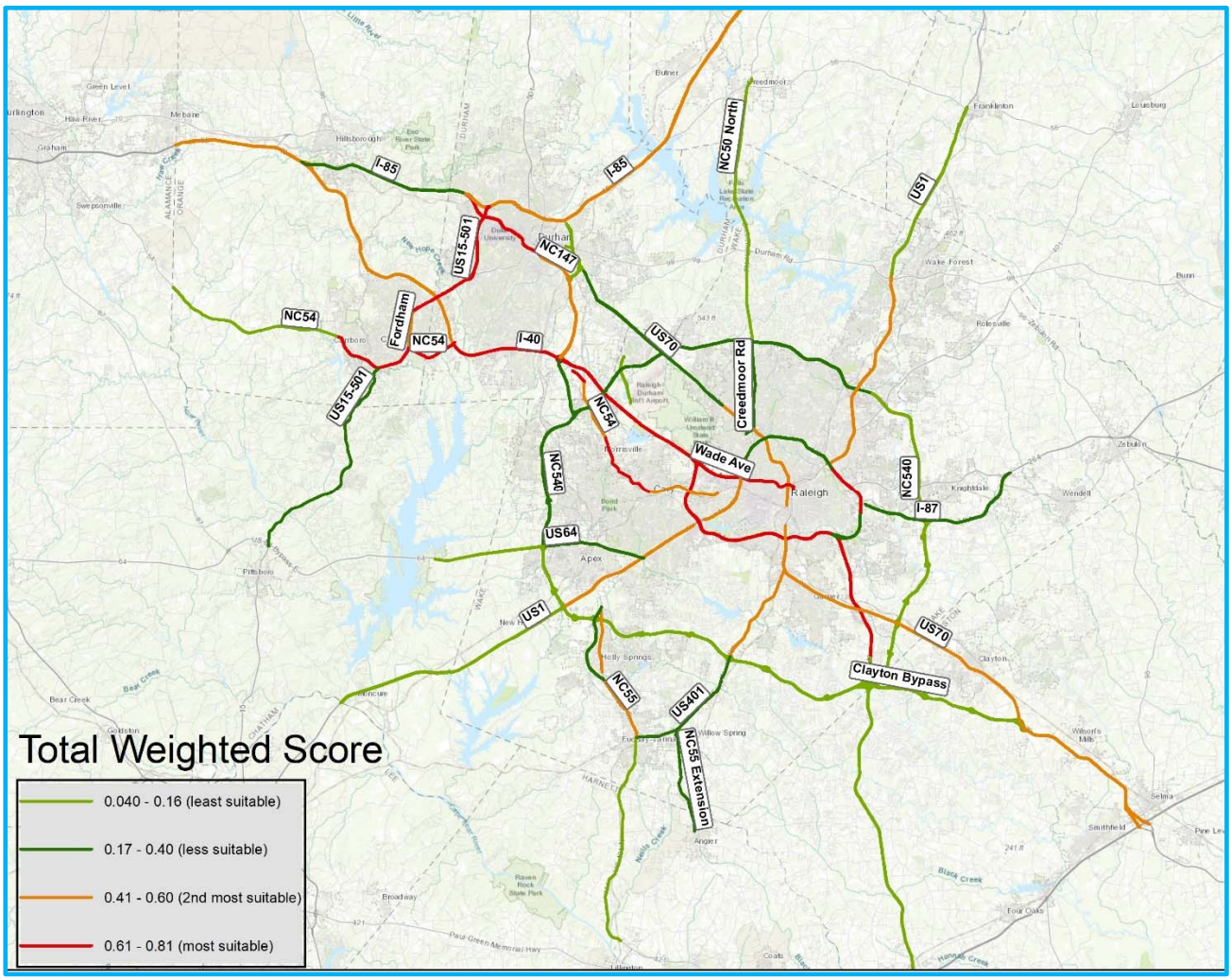

Table 7. Total Weighted Suitability Metric Score

Total Weighted Metric Index	Suitability
0.01 – 0.16	Least
0.17 – 0.40	↓
0.41 – 0.60	↓
0.61 – 1.00	Most

Appendix C: NCDOT BOSS Implementation and Operations Plan

Bus on Shoulder Systems (BOSS)
North Carolina Implementation and Operations Plan (IOP)

Pilot Implementation Coordinating team: I-40 Regional Partnership

I-40 Regional Partnership

I-40 / Research Triangle

Project lead:
Meredith McDiarmid, PE
State Systems Operations Engineer, NCDOT and
Corridor Executive, I-40/Research Triangle

Research Triangle Pilot BOSS Pilot Initiative Coordinators:

John Tallmadge
Director, Commuter Resources
Triangle Transit

Joe Milazzo II, PE
Executive Director
Regional Transportation Alliance (RTA)

Reviewed and approved by:
J. Kevin Lacy, PE
State Traffic Engineer
NCDOT

For review and acceptance by:
John F. Sullivan, III, PE
Administrator, North Carolina Division
FHWA

Revision Date: May 28, 2013

TABLE OF CONTENTS – NORTH CAROLINA BOSS IMPLEMENTATION AND OPERATIONS PLAN

INTRODUCTION

This document outlines an Implementation and Operations Plan (IOP) for the development of BOSS in North Carolina, beginning with a pilot project in the Research Triangle region. Given the extensive experience of Minnesota with bus on shoulder operations, this plan gratefully acknowledges the assistance and support of "Team Transit"– a partnership of regional transit agencies and the Minnesota Department of Transportation that provides overall coordination for bus on shoulder operations in the Minneapolis-St. Paul region.

OVERVIEW OF BUS ON SHOULDER OPERATION

A number of States have implemented policies that permit buses to operate on selected freeway and/or arterial shoulders in order to bypass congestion and maintain transit schedules, as noted in **Exhibit 1** below. These policies allow buses to use shoulders while traveling at slow speeds that are nonetheless faster than mainline traffic when travel is delayed due to a recurring or nonrecurring congestion event. Even under conditions where bus shoulder travel is permitted, however, the primary use of the shoulder: clear zone, clearing area for incidents, area for enforcement activity, vehicle breakdown, etc. remains unchanged. Bus on shoulder operation is a low-cost, fast-implementation treatment that can provide immediate benefits to transit whenever mainline travel is experiencing moderate to heavy degrees of congestion.

Exhibit 1 - States with Active Bus on Shoulder Operations

- Northeast/Mid-Atlantic region: NJ, DE, MD, VA
- South region: FL, GA
- Midwest region: OH, MN, IL, KS
- West region: CA, WA

Note: While the vast majority of bus on shoulder usage remains in the Twin Cities metropolitan area of Minnesota, the mileage in other states has grown over time. No State has ever discontinued the use of bus on shoulder operation for safety reasons once it has been established in the State.

Bus on shoulder operations were first implemented in Minnesota more than 20 years ago, with nearly 300 shoulder-miles of bus on shoulder operations in use today. Minnesota has identified a number of benefits with bus on shoulder operation, including:

- Shorter and more predictable and reliable transit times
- Fewer missed transfer connections
- Increased transit ridership
- Reduced driver overtime
- Decreased operational costs

In some cases, travel times have decreased enough to allow for schedules to be revised, and for a bus to be eliminated on a route.

OVERALL DEVELOPMENT OF BUS ON SHOULDER SYSTEMS (BOSS) IN NORTH CAROLINA

Applicable Statutes and Required Ordinances

Bus on shoulder operation is already permitted by law on freeways and expressways in North Carolina during peak traffic periods (ref: G.S. 20-146.2(b)). For the implementation of BOSS in North Carolina, peak traffic periods will be defined as when freeway or expressway traffic slows to below 35 MPH. NCDOT will enact "no parking" ordinances as appropriate for any segments of freeway and expressway designated for BOSS. In addition, NCDOT will monitor the implementation of BOSS and, if warranted, will request potential modification of the General Statutes, NCDOT policies, or both. Note that based on current law, only facilities with full or partial control of access will be considered for BOSS operation in North Carolina. At the present time, NCDOT will only consider existing or proposed freeway and expressway facilities for BOSS operation.

Regional Partnership within a Statewide Framework

The implementation of BOSS in any area of the state must be initiated at the local or regional level and then developed by the transportation partners in the region in cooperation with the North Carolina Department of Transportation and the Federal Highway Administration. The policies and procedures in this statewide BOSS Implementation and Operations Plan (IOP) must be followed – but the specific implementation elements in a region must emerge from a cooperative process coordinated at the regional level. The North Carolina Department of Transportation is pleased to support the development of a BOSS pilot project in the Research Triangle region and, if successful, the expansion of BOSS in that region and in other warranted areas of the state.

Systems Approach to Implementation in each Region

While significant benefits to transit operation and ridership may be realized from deploying bus on shoulder operation for even a single roadway segment, regions that are considering bus on shoulder operations will be encouraged to examine the potential deployment of a system of bus on shoulder corridors in their area in order to accelerate the potential network benefits from these investments. To emphasize the importance of such a systems approach, this document makes extensive use of the term "Bus on Shoulder Systems (BOSS)" throughout the document.

Institutionalization of BOSS in North Carolina

At this time, the only area designated for Bus on Shoulder implementation is the Research Triangle region, and the only approved county for implementation is Durham. However, more counties and regions may be added over time. **Exhibit 2** below outlines the current list of bus on shoulder implementation areas across North Carolina. The exhibit outlines the effective dates in designated BOSS areas whereby new and reconstruction projects shall be examined for bus on shoulder potential.

Exhibit 2 – Institutionalization of BOSS in North Carolina

Region	Counties	Effective date of required consideration of BOSS
Research Triangle	Durham, Wake, Orange	(to be determined)
Other urban areas	All counties	(to be determined)
Rest of State	All other counties	(to be determined)

Note: BOSS should be considered for all projects on full- or partially-controlled access facilities with current or anticipated fixed route transit service slated for letting on or after the above effective date(s) in each region above, although incorporation into project design shall not be required until the completion and evaluation of a successful pilot project in the Research Triangle region. However, BOSS may be considered for any project that meets the above mentioned criteria in North Carolina at any time.

STATEWIDE OPERATIONAL POLICIES FOR BUS ON SHOULDER SYSTEMS IN NORTH CAROLINA

The core elements of bus on shoulder policies concern restrictions on shoulder usage during congested periods. **Exhibit 3** summarizes the primary operational policies – maximum operating speeds, utilization framework, vehicle restrictions, and driver training requirements – that the NC Department of Transportation has established for the implementation of BOSS in North Carolina.

Exhibit 3 - North Carolina Statewide Operational Policies for BOSS Corridors

Maximum Operating Speeds

1 – Maximum 35 MPH speed for buses using adjacent right shoulder
2 – Maximum 15 MPH speed differential between buses using shoulder and mainline travel speed

Utilization Framework

1 – Minimum number of buses to achieve a minimum time savings per mile must be established by region
2 – Voluntary usage of BOSS corridor by transit operators and drivers
3 – Transit vehicles must use four-way flashers (hazard signals) when traveling in shoulder
4 – No time-of-day restrictions, although transit agencies may voluntarily limit bus on shoulder operations to certain hours
5 - Mainline speeds must be below 35 MPH in the direction of travel
6 – Mainline operating speeds in rightmost lane adjacent to shoulder in the direction of travel dictate when entry is permitted. If traffic in rightmost lane is stopped due to exit ramp being over capacity, bus should not use shoulder.
*See also policies for yielding right-of-way as shown in **Exhibit 5***

Vehicle Restrictions

1 – Buses of different sizes and designs other than the standard transit bus will not be allowed to operate on BOSS corridors
2 – Both fixed route and demand-responsive services are permitted, as long as the vehicles themselves are permitted under vehicle restrictions, are identifiable as a local or regional transit agency bus, and are using four-way (hazard) flashers
3 – Cut-away buses, charter buses, paratransit vans, and maintenance support trucks will not be allowed to operate on BOSS corridors at this time.
4 – No minimum number of passengers (e.g., “deadheading” permitted to remain on schedule)

Driver Training Requirements

1 – Transit agencies in each area must administer driver training program in collaboration with NCDOT
2 – Individual drivers must be trained on both overall BOSS operation and on an individual corridor basis
3 – Contractors to transit agencies permitted if above driver training requirements met

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The maximum operating speeds outlined above can be characterized as simply, “Buses can only travel on the shoulder when speeds in main lanes in the direction of travel are below 35 MPH, and buses cannot travel more than 15 MPH faster than other vehicles on the main line. In addition, the buses’ maximum speed is limited to 35 MPH. **Exhibit 4** provides more detail on the specifics of these operating speed policies.

Exhibit 4 - Travel Speed Examples Associated with Maximum BOSS Operating Speeds

If travel speeds in main lanes in direction of travel are:	Then transit buses on adjacent right shoulder:
65 MPH, 55 MPH, even 35-40 MPH	N/A: Cannot travel on shoulder
Below 35 MPH, 30 MPH, 25 MPH, 20 MPH	Can go up to 35 MPH
15 MPH	Can go up to 30 MPH
10 MPH	Can go up to 25 MPH
5 MPH	Can go up to 20 MPH
Stopped (0 MPH)	Can go up to 15 MPH

In addition to the operational policies outlined above, buses operating on shoulders in North Carolina will be required to safely exit the shoulder when necessary or otherwise yield to all obstructions (static or dynamic) in shoulder. This policy is amplified in **Exhibit 5**.

Exhibit 5 – Policy Affirming that Buses Must Exit Shoulder or Yield Right-of-Way to All Obstructions

1 - Buses must safely exit shoulder when trailing emergency or law enforcement vehicles approach in shoulder

2 - Buses must safely exit the shoulder when the shoulder is blocked, of inadequate width, or otherwise unavailable for any reason

3 - Buses must yield to all other vehicles in shoulder, such as the following:
- Any vehicle merging onto the highway via an entrance ramp
- Any vehicle leaving the highway via an exit ramp
- Any other vehicle that enters or occupies the shoulder (e.g., maintenance)
- A disabled vehicle
- Enforcement activities
- Incident clearing measures

When a transit vehicle must exit the shoulder and enter the mainline of travel, buses will be expected to perform the maneuver in a safe and expeditious manner. Since mainline travel vehicles are not currently required by statute to yield to buses reentering the mainline from shoulder, the Department will monitor the pilot implementation of BOSS and, if conditions warrant, may pursue implementation of a statutory change requiring such yielding of mainline vehicles to buses that are reentering the travel way from the shoulder.
Note: This statute is currently applicable in Minnesota, although based on a site visit there in November 2011, the consensus of transit professionals was that this statute was not widely known or enforced.

STATEWIDE DESIGN CRITERIA FOR BUS ON SHOULDER SYSTEMS

Geometric Design Criteria

Since the maximum speed for bus on shoulder operation is 35 MPH, most speed-related geometric design elements that would apply for a freeway or expressway section will function well for lower speed bus-on-shoulder operation. The primary geometric design criteria for bus on shoulder operation are those that are not specifically related to design or operating speed, including shoulder width, horizontal clearance (shy distance), vertical (overhead) clearance, and pavement strength. Bus on shoulder operational restrictions will be designated for all BOSS-prohibited segments with inadequate shoulder width, insufficient horizontal or vertical clearance, or inadequate bridge or pavement structural strength. **Exhibit 6** summarizes the primary design criteria that are being reviewed for use in North Carolina, with all design criteria contained in an **Appendix** at the end of this document.

Bus on shoulder implementation typically has a very low implementation cost (generally less than $0.5m / mile and sometimes much less) compared with the typical cost of fully grade-separated bus rapid transit, light rail, commuter rail, etc. The primary reason for the low implementation cost is the limited number of roadway changes required due to the lower operating speeds and associated design criteria.

Exhibit 6 – NCDOT Selected Design Criteria for Bus on Shoulder Systems Implementation

Controlling Geometric Design Criteria	**Standard**
Shoulder width on roadway or bridge	
- Minimum	10 feet
- Desired	12 feet
Horizontal clearance (shy distance)	
- Minimum	0 feet
- Desired	2 feet
Design speed	
- Maximum	35 MPH

Note: See Appendix for complete design criteria

Signage Elements

The North Carolina Department of Transportation has established overall guidance for BOSS signage that will provide direct information to motorists and bus operators, while minimizing sign clutter. **Exhibit 7** summarizes the primary elements of signage for BOSS implementation in North Carolina.

Exhibit 7 – Summary of NCDOT Signage, Pavement Marking, and Audible/Tactile Warning Device Elements for Bus on Shoulder Operation

Roadway	Location	Installation	Type	Legend (note)
Mainline	Begin bus on shoulder section	Post-mounted	Regulatory	"Begin / Shoulder / Authorized Buses Only"
Mainline	Along bus on shoulder section	Rumble strip	N/A	Longitudinal along or within 6" of pavement edge
Mainline	Along bus on shoulder section[1]	Post-mounted	Regulatory	"No Parking"
On-ramp	Entering bus on shoulder section[2]	Post-mounted	Warning	"Watch for Buses on Shoulder"
Mainline	After on-ramp merge[3]	Post-mounted	Regulatory	"Shoulder / Authorized Buses Only"
Mainline	Inadequate shoulder width ahead[4]	Post-mounted	Warning	Small icon sign for buses to exit shoulder ahead
Mainline	Inadequate shoulder width begins	Post-mounted	Warning	Type 3 object marker, CM3-R
Mainline	Guardrail or barrier begins[5]	Post-mounted	Warning	Type 3 object marker, CM3-R
Mainline	End of bus on shoulder section	Post-mounted	Regulatory	"End / Shoulder / Authorized Buses Only"

Notes on placement:

[1]Place "No Parking" signs along mainline as required by ordinance. A typical installation may alternate "No Parking Any Time" and "Shoulder / Authorized Buses Only"

[2]Place one sign approximately 200-400 ft upstream from merge point. May use on both sides of two-lane on-ramps.

[3]Place one sign approximately 300-1000 ft downstream of entrance gore

[4]Place one sign on mainline in advance of restricted shoulder width or permanent obstruction

[5]As needed

Courtesy Mn/DOT, Team Transit

Pavement Markings
Bus shoulders are continuous through exit ramps and entrance ramps on freeway and expressway segments, and continuous across acceleration and deceleration lanes. No pavement markings will be used as part of the initial pilot in the Research Triangle region. NCDOT will review the effectiveness of the delineation and either maintain, add, expand, modify, or delete them for future installations as appropriate.

Audible/Tactile Warning Devices
Longitudinal warning devices will be rumble strips located concurrent with, or within 6 inches of, pavement edge lines or audible longitudinal pavement markings to help separate traffic flow on the mainline from shoulder usage. A field inspection can help determine if existing longitudinal warning devices are suitable.

Intelligent Transportation Systems (ITS) and BOSS
ITS shall be integrated into BOSS operations where feasible. See **Exhibit 8** for sample messages for use on overhead dynamic message signs (DMS) in or in advance of BOSS implementation areas.

Exhibit 8 – Intelligent Transportation Systems and BOSS -- Sample Dynamic Message Sign (DMS) Messages

Panel 1
BUSES TRAVELING ON SHOULDER NEXT 15 MILES
BUS TRAVEL PERMITTED ON RIGHT SHOULDER
-CAUTION- AHEAD BUSES TRAVELING ON SHOULDER
SHOULDERS IN USE FOR TRANSIT BUS TRAVEL

STOPPING ON SHOULDER ONLY FOR EMERGENCIES
SHOULDER IN USE FOR AUTHORIZED TRANSIT BUSES
2 RIGHT LANES AND SHOULDER CLOSED AHEAD

RAPID TOWING ENFORCEMENT NOW IN EFFECT
BUS ON SHOULDER DRIVER TRAINING NOW IN EFFECT
TRAINING FOR BUS ON SHOULDER NOW IN EFFECT

Panel 2
SHOULDER USE FOR AUTHORIZED BUSES ONLY
BUS ON SHOULDER MAY MERGE WITH TRAFFIC AHEAD
STOPPING ON SHOULDER ONLY FOR EMERGENCIES
WATCH FOR BUSES MERGING WITH TRAFFIC

SHOULDER TRAVEL FOR AUTHORIZED BUSES ONLY
VEHICLES LEFT UNATTENDED WILL BE TOWED
ACCIDENT AHEAD: SHOULDER CLOSED TO BUS TRAVEL

ABANDONED VEHICLES WILL BE TOWED
BUS ON SHOULDER TRAINING NOW IN EFFECT
TRAINING NOW IN EFFECT FOR BUS ON SHOULDERS

NOTE: The above DMS messages are samples and optional. The display of travel time and other information on dynamic message signs may take priority over the above sample messages at various DMS locations along the corridor. Existing NCDOT policies, procedures, and priorities must be followed.

STATEWIDE BOSS ELIGIBILITY CRITERIA

The most common reason for considering bus on shoulder operations along any corridor in any region will likely be to provide a means for transit operators to avoid recurring congestion in order to improve the attractiveness and operations of transit service during commuting periods. However, any route can experience non-recurring congestion situations due to crashes, weather, road work, etc. – any of which could impact the overall reliability and attractiveness of transit service whenever the travel demand exceeds roadway capacity or otherwise creates unreliability in trip times. Therefore, since nearly 50% of congestion is non-recurring, the only absolute NCDOT requirements for considering BOSS along a freeway or expressway corridor shall be full or partial control of access and the presence of scheduled fixed-route transit service now or within a ten year planning horizon for that corridor, as shown in the simplified eligibility framework as outlined in **Exhibit 9**.

Exhibit 9 - North Carolina Statewide Minimum Eligibility Criteria for Potential BOSS Corridor Designation

Eligibility for potential immediate designation as a BOSS corridor

- Roadway must be an existing freeway or expressway
- Facility must have full or partial control of access
- At least one fixed-route transit bus must currently use the corridor each weekday

Eligibility for shoulder improvements to enable or enhance future BOSS service along a corridor

- Roadway must be an existing or proposed freeway or expressway
- Facility must have or be planned for full or partial control of access before BOSS implementation
- Corridor must be planned for scheduled public transit service within the next 10 years

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PILOT IMPLEMENTATION IN RESEARCH TRIANGLE REGION

I-40 Regional Partnership in the Research Triangle Region (I-40/Research Triangle)
The I-40 Regional Partnership in the Research Triangle region has served as the impetus for advancing BOSS in the area and provides an ongoing coordination mechanism through a regional BOSS Team. The members of the I-40 Regional Partnership in the Research Triangle region who have focused on the implementation of BOSS and other potential improvements to the I-40 corridor include:

- North Carolina Department of Transportation
- Federal Highway Administration
- Triangle Transit
- City of Durham / Durham Area Transit Authority
- City of Raleigh/ Capital Area Transit
- Town of Cary / C-Tran
- Town of Chapel Hill / Chapel Hill Transit
- NC State University Department of Civil Engineering
- NC State University / Wolfline
- Duke University / Duke Transit
- Raleigh-Durham Airport Authority
- Durham-Chapel Hill-Carrboro MPO
- Capital Area MPO
- Durham, Orange, Wake counties
- Research Triangle Foundation of North Carolina
- Regional Transportation Alliance (RTA)

In the Research Triangle pilot region, Triangle Transit, which serves as the area's regional transit agency, has had an existing short-term improvement plan that includes a demonstration bus on shoulder project (unfunded TIP project TD-4944). The I-40/Research Triangle Regional Partnership has been examining the potential for implementing a pilot implementation of Bus on Shoulder Systems (BOSS) since 2010. Representatives from the I-40 Regional Partnership visited the Twin Cities region at the end of October and beginning of November, 2011 to observe first-hand the operation of the bus shoulder system there.

The North Carolina Department of Transportation and Triangle Transit, in cooperation with several I-40 Regional Partnership members including the Federal Highway Administration, the Capital Area Metropolitan Planning Organization, the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization, the Regional Transportation Alliance, and other local and regional partners, have worked together to develop a pilot installation of a Bus on Shoulder System (BOSS) in the Research Triangle area. The implementation of BOSS is expected to help provide transit vehicles and transit patrons in the Research Triangle region a cost-effective and time-efficient alternative to both recurring and non-recurring congestion along the pilot corridor.

The hard costs associated with the 2012 initial BOSS pilot implementation in Durham County are approximately $2,000 / shoulder-mile. The pilot will commence during 2012 and last at least a year. Should the pilot program in the Research Triangle region be successful, BOSS may be expanded to other warranted areas in North Carolina.

REGIONAL FRAMEWORK FOR DEPLOYMENT OF BUS ON SHOULDER SYSTEMS

Overall Implementation Process

The deployment of the pilot BOSS project for the Research Triangle region and for any future implementation in that region or elsewhere will follow a systematic approach. **Exhibit 10** outlines a suggested process, grouped into five focus areas, each with multiple elements. Of course, each region of the state is different and not every element or step of the process may be required or appropriate for each region. In addition, many of these focus areas and elements can occur simultaneously.

Exhibit 10 – Regional BOSS Implementation / Enhancement Process

1. INITIAL PREPARATIONS FOR REGIONAL BOSS IMPLEMENTATION

- Establishment or expansion of regional BOSS Implementation and Operations Team (BOSS Team)
- Review of BOSS North Carolina Implementation and Operations Plan (IOP) by regional BOSS Team
- Outreach to other areas with bus on shoulder operation for current lessons learned and guidance
- Update of BOSS North Carolina Implementation and Operations Plan (IOP) as needed
- Development of specific implementation plan and timeline for region
- Incorporation into regional and statewide transportation planning and programming processes as needed
- Incorporation into regional congestion management processes as needed

2. REGIONAL BOSS CORRIDOR SELECTION, PREPARATION, AND APPROVAL

- Statewide eligibility criteria
- Establishment of BOSS corridor prioritization criteria by regional BOSS Team
- Regional BOSS Team receives, compiles, reviews, and prioritizes requests for candidate corridors
- Field review and analysis of leading candidate BOSS corridors
- NCDOT determination of required infrastructure improvements and/or segment restrictions
- Funding review and implementation of needed infrastructure improvements
- Confirmation by NCDOT Division that all required improvements have been met and restrictions identified
- Final approval by NCDOT of corridor for BOSS operation
- Placement of signage, pavement markings, tactile warning devices, etc. along corridor, including locations of “pinch points” where bus on shoulder operation will be restricted

3. COOPERATIVE DEVELOPMENT/UPDATE OF REGIONAL BOSS IMPLEMENTATION STRATEGIES

- Operational policies, strategies, and procedures
- Maintenance policies, strategies, and procedures
- Enforcement policies, strategies, and procedures
- Public outreach policies, strategies, and procedures

4. DRIVER TRAINING FOR BUS ON SHOULDER OPERATION

- Development of BOSS driver training program in region and/or update for new BOSS corridors
- NCDOT collaboration of BOSS driver training program or program update
- Driver training for BOSS program and/or update for new BOSS corridors
- Agency approval of individual drivers for operation on specific BOSS corridors

5. IMPLEMENTATION AND MONITORING OF BOSS PROGRAM

- Implementation/enhancement of BOSS in region
- Operational, maintenance, enforcement, and public outreach adjustments as needed
- Recommendations for changes to BOSS statewide IOP
- Ongoing monitoring and review of regional BOSS program by BOSS Team

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REGIONAL FRAMEWORK FOR DEPLOYMENT OF BUS ON SHOULDER SYSTEMS:

1. INITIAL PREPARATIONS FOR REGIONAL BOSS IMPLEMENTATION – details of selected items

Establishment or Expansion of Regional BOSS Implementation and Operations Team (BOSS Team)
Implementation of BOSS in reach region shall be coordinated by a regional BOSS Implementation and Operations Team (BOSS Team), which will exhibit primary coordinating responsibility for several elements including corridor selection, implementation guidelines, and driver training. While the membership of each BOSS Team will vary depending on the needs of the region and the location of candidate BOSS corridors, a sample invitee list can be found in **Exhibit 11** below. A primary responsibility of the regional BOSS Team is to become familiar with this statewide BOSS Implementation and Operations Plan (IOP) – including the regional BOSS implementation / enhancement process outlined in Exhibit 10 – and then to establish an implementation timeline consistent with that process and this IOP. It will also be useful to reach out to other areas in North Carolina and elsewhere that utilize bus on shoulder operation for current lessons learned and guidance.

Exhibit 11: Potential Membership in Regional BOSS Team

-- NCDOT Division staff, including division engineer and assistants (operations and maintenance)
-- NCDOT Central office staff – roadway design, transportation mobility and safety including statewide operations, traffic safety, and signing, public transportation, etc. staff
-- NCDOT IMAP staff
-- NCDOT Statewide Transportation Operations Center (STOC) / Transportation Management Center (TMC) staff
-- NCDOT Communications / External Affairs staff
-- NCDOT Planning staff
-- Federal Highway Administration staff
-- Metropolitan Planning Organization (MPO) staff
-- Regional transit agency staff – operations, planning, and TDM, etc.
-- Any municipal, university, or community transit provider with interest in the program
-- State Highway Patrol
-- Any other law enforcement agency with jurisdiction on the pilot corridor
-- Any county government with interest in the program
-- Any appropriate private sector partners with interest in the program

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Incorporation into regional transportation planning processes and MPO congestion management process
Before a Bus on Shoulder System can be deployed or expanded in each region, BOSS must be incorporated into the Transportation Planning process for the area and the region's planned implementation of BOSS must result from that process. If incorporation into Long Range Transportation Plans (LRTPs) or Comprehensive Transportation Plans (CTPs) is required, those steps must be completed prior to implementation of BOSS on any corridor. In addition, for any BOSS segments that require infrastructure improvements, any corresponding projects should be included into the statewide Transportation Improvement Program (STIP) and/or metropolitan Transportation Improvement Programs (MTIP) where necessary.

Most metropolitan planning organizations (MPOs) in North Carolina have an active Congestion Management Process in place. BOSS is a tool that may serve as a response to the challenge of congestion in many of the state's growing regions, and incorporating BOSS into a region's existing Congestion Management Process will maximize the benefits of BOSS and improve harmonization with other congestion management techniques.

REGIONAL FRAMEWORK FOR DEPLOYMENT OF BUS ON SHOULDER SYSTEMS *(continued)***:**

2 – REGIONAL BOSS CORRIDOR SELECTION, PREPARATION, AND APPROVAL – details of selected items

Establishment of Regional BOSS Corridor Prioritization Criteria
While all freeway and expressway corridors with full- or partial-control of access and with fixed-route transit service are theoretically eligible as a BOSS corridor based on the statewide eligibility criteria discussed previously in Exhibit 9, that eligibility does not mean that a corridor will be immediately approved for bus on shoulder operation, and eligibility does not automatically translate into funding for any improvements needed to implement BOSS on a corridor. Since resources are necessarily limited and since the needs and characteristics of region are different, each region in the state that considers implementing and expanding BOSS should cooperatively develop a set of prioritization criteria or factors to help determine which corridors to evaluate in more detail**.** These criteria or factors could include degree of roadway congestion, level of existing/near term bus usage, current shoulder width and obstructions, cost for BOSS implementation, etc. A sample list of possible criteria or factors for potential corridor review and prioritization is shown in **Exhibit 12**. Each region can use some or all of the sample factors outlined in the Exhibit or choose other factors that they wish to use. Each region may choose whether or not to provide a specific fixed weight for each criteria or factor.

Exhibit 12 - Sample Regional Prioritization Criteria for Bus on Shoulder Corridor Designation (partial list)

Possible Prioritization Criteria
Assuming the corridor meets the eligibility criteria listed in Exhibit 9, regions may cooperatively prioritize eligible projects based on factors including the following:

- Duration of congestion each day
  -- *Freeway or expressway speeds below 35 MPH*
- Frequency of congestion per week
  -- *Days with congestion or backups*
- Number of buses per day, regardless of travel speed
- Cost to upgrade and ease of construction
- Length of continuous shoulder width of 10 feet or more
- Anticipated level of time savings, in seconds per mile per day
- Number of buses per day that experience congestion today or anticipated in future
- Connectivity to existing bus-on-shoulder segment to gain Bus on Shoulder Systems benefits
- Connectivity to transit hub, park-and-ride location, etc.
- Availability of funding

Regional BOSS Corridor Review and Prioritization
The regional BOSS Team shall then review and rank each eligible corridor based on the criteria and factors established for the region. A map showing all candidate corridors, with annotations showing individual bus routes or buses per day along the corridor, could be created to facilitate communication. The output of this process is a working priority list of potential regional BOSS corridors to examine further.

Note that project implementation may not occur in precisely the ranking order due to funding and other constraints and opportunities. For example, corridors with lower levels of transit service or recurring congestion could still be added sooner if the cost to upgrade is minimal, and/or corridors ranked as high priorities by a regional BOSS Team may have obstructions that render them infeasible for BOSS operation in the short-term.

Field Review and Analysis of Leading Candidate BOSS Corridors

Once a manageable list of potential BOSS corridors has been identified by the regional BOSS Team, NCDOT and appropriate partner agencies shall designate appropriate staff to conduct a field review and analysis of one or more priority corridors in cooperation with other partners. The following paragraphs provide examples of the possible scope of that work.

The appropriate transit agency or agencies shall provide the Department with current or expected daily transit use along the corridor.

NCDOT shall conduct a field review of the roadway elements along the proposed BOSS corridors including shoulder width, vertical clearance, shy distance, existing bridge and drainage structures, etc. in order to determine existing conditions and initial compatibility with statewide geometric design criteria for BOSS.

NCDOT shall Review the corridor for compliance with geometric design criteria. Additional analysis can occur as needed, for example, a review of structural design of bridges and drop inlets and an examination of possible drainage impacts due to an increase in overall impervious surface area associated with any potential shoulder width expansions or any related needs for right-of-way modifications, utility relocations, permits, etc.

The appropriate staff from NCDOT Transportation Mobility and Safety, the regional Transportation Management Center (TMC) and the Division Traffic Engineering staff shall examine the proposed BOSS corridors for potential traffic operational issues and opportunities that may emerge under BOSS operation. This may include a review of existing speed and congestion data and crash history, an examination of those locations that may require special attention under BOSS operation including interchange areas and restricted shoulder width areas, and other factors as appropriate. The potential for restriping mainline roadways in restricted shoulder width areas can be examined, along with the capacity, operational, and safety impacts of such a possible change. The review may also include the locations of existing or potential dynamic message signs, speed detection units, and other ITS devices.

NCDOT Determination of Required Infrastructure Improvements and/or Segment Restrictions

Upon completion of all field reviews and analyses for the proposed corridors, NCDOT Division and central office staff shall cooperatively compile a list of any required infrastructure improvements, pavement rehabilitation, drainage structure strengthening, relocations of existing signs or other roadside hazards as needed to avoid conflicts with bus mirrors, guardrail adjustments, restriping, permits, etc. that would be required in advance of any implementation of BOSS along the corridor.

The Department shall also identify specific recommended start and end points for the various segments and mark them with signing, and identify any locations where BOSS shall be restricted due to insufficient shoulder width or other factors. This information shall be provided to the regional BOSS Team for its information.

Funding Review and Implementation of Needed Infrastructure Improvements

Members of the regional BOSS Team shall explore funding opportunities for each of the improvements needed as well as additional improvements that may enhance the performance of the corridor. A review of existing or upcoming TIP projects could be one example of a potential funding opportunity. Once funding is secured, the Department will begin the implementation of the needed infrastructure improvements with the BOSS Team.

Placement of Signage, Pavement Markings, Tactile Warning Devices, etc. along Corridor, Including Restrictions
Whether or not a segment requires additional infrastructure improvements or has any BOSS-restricted locations, each segment will require the installation of signage and potentially audible and tactile warning devices, etc. before operation of BOSS. The Division Traffic Engineer and appropriate Transportation Mobility and Safety staff will determine the appropriate installation locations for signage and audible and tactile warning devices.

Confirmation by NCDOT and Corridor Approval for BOSS Implementation
The appropriate NCDOT Division staff will confirm that all required improvements have been implemented, signage and related traffic control devices installed, and restrictions identified. At that point, NCDOT will approve the corridor for BOSS implementation, pending the completion of other elements in the Regional BOSS Implementation / Enhancement Process outlined in **Exhibit 10**.

REGIONAL FRAMEWORK FOR DEPLOYMENT OF BUS ON SHOULDER SYSTEMS *(continued)***:**

3 – COOPERATIVE DEVELOPMENT OF REGIONAL BOSS IMPLEMENTATION STRATEGIES – details of selected items

Operational Policies, Strategies, and Procedures
Each region will need to establish policies and procedures – including interagency and intra-agency communication protocols – to ensure effective operation of BOSS under normal, congested, emergency situations, adverse weather, and other traffic incidents. Examples might include communicating about vehicles or debris in the shoulders, enforcement activity, other traffic incidents, trees or signs that are posing a hazard to bus operations, paving/striping projects, etc. The regional BOSS Team will establish, implement, monitor, and modify the operational policies, strategies, and procedures as needed. **Selected documents associated with the pilot BOSS installation shall be included as an appendix at the end of this document as they are developed.**

Maintenance Policies, Strategies, and Procedures
The regional BOSS Team will establish, implement, monitor, and modify the maintenance policies, strategies, and procedures as needed. These may include items such as:

- A shoulder cleaning strategy to ensure that the shoulder is kept clear of debris
- An inclement weather strategy to ensure safe operations of BOSS
- A pavement preventive maintenance strategy to ensure pavement integrity in a cost-effective manner

Enforcement Policies, Strategies, and Procedures
Members of the regional BOSS Team, including NCDOT, NC State Highway Patrol or other law enforcement agencies and the NCDOT Incident Management Assistance Patrol (IMAP) will coordinate concerning the implementation of an effective enforcement program to ensure the safe operation of freeway and arterial BOSS corridors. These may include items such as:

- Awareness of applicable statutes and operational policies
- Enforcement procedures for speeds, speed differentials, and yielding right-of-way
- Enforcement of unauthorized use of shoulders by motorists
- Enforcement of unauthorized bus on shoulder operation for shoulders not designated for BOSS, etc.
- Coordination with other emergency response vehicles and agencies

Public Outreach Policies, Strategies, and Procedures
As the BOSS pilot implementation in Durham County constitutes the first bus on shoulder installation within 200 miles of North Carolina, an effective public outreach campaign in advance of the pilot implementation as well as future expansion will be critical to the success of the BOSS program. Each regional campaign should be a cooperative effort of NCDOT, local and regional transit agencies, and other public and private partners in each region.

While the specifics of each program will depend on the region, each outreach program should utilize multiple communication channels well in advance of the implementation as well as upon commencement of BOSS operation or expansion. The regional BOSS Team will establish, implement, monitor, and modify the public outreach policies, strategies, and procedures as needed.

Selected documents associated with the pilot BOSS installation shall be included as an appendix at the end of this document as they are developed, including sample Frequently Asked Questions initially developed for the BOSS pilot implementation in Durham County.

REGIONAL FRAMEWORK FOR DEPLOYMENT OF BUS ON SHOULDER SYSTEMS *(continued)***:**

4 - DRIVER TRAINING FOR BUS ON SHOULDER OPERATION – details of selected items

The success of bus on shoulder operation in North Carolina will depend in large measure on the efforts of the individual professional transit drivers who will operate transit vehicles on the shoulder. Therefore, each agency or region must develop a driver training program in collaboration with NCDOT, and each bus driver must be trained on bus on shoulder operation on an overall policy basis as well as on an individual corridor basis. Each transit agency must provide for the training of its drivers. An example of the elements of a possible driver training program curriculum is shown in **Exhibit 13**. Individual agencies will approve their drivers for bus on shoulder operation on a corridor-by-corridor basis.

Exhibit 13 – Sample Bus on Shoulder Systems (BOSS) Driver Training Program Elements

Core Elements
- Purpose of bus on shoulder program
- Operating guidelines
  -- Speed and speed differential
  -- Yielding right-of-way
  -- Interchange areas
  -- Staying on paved shoulder
- Judging operating speeds of mainline traffic
- Signs, pavement markings, and audible warnings
  -- Motoring public
  -- Specific information for bus drivers
- Applicable statutes and enforcement
- Communications
  -- Intra-agency
  -- Inter-agency
  -- Driver to motorist/driver courtesy
- Emergency communication

Corridor-by-Corridor Elements
- Start and end points
- Interchange and/or intersection locations
- Shoulder widths
- Special attention locations
- Restricted locations

Additional Elements
- Agency-specific policies (e.g., evening operation)

As noted in the utilization framework outlined in the statewide operational policies from Exhibit 3, each approved driver still decides whether or not to travel on all or a portion of an available BOSS corridor on a trip-by-trip basis, and each agency can establish additional restrictions on BOSS usage – for example, on nighttime operation – as long as those additional policies are identified and included in initial or follow-up driver training.

REGIONAL FRAMEWORK FOR DEPLOYMENT OF BUS ON SHOULDER SYSTEMS *(continued)***:**

5 - IMPLEMENTATION AND MONITORING OF BOSS PROGRAM – details of selected items

Implementation or Enhancement of BOSS in Region
When all prior elements of the Regional BOSS implementation process outlined in Exhibit 10 have been completed, bus on shoulder is ready for implementation. As implementation day approaches, a more detailed timeline and action steps for each partner should be established, with a particular focus on communications within agencies, among agencies, and with the public.

Operational, Maintenance, Enforcement, and Public Outreach Adjustments as Needed
Adjustments to operational, maintenance, enforcement, and public outreach strategies or policies will almost certainly be needed as the BOSS program moves from planning to implementation in a region. The BOSS Implementation and Operations Team (BOSS Team) in each region should continue to meet on a periodic basis to share information, identify potential improvements, and cooperatively implement those improvements.

Recommendations for Changes to BOSS Statewide IOP
This NC BOSS IOP seeks to cover a number of preparatory, operational, and maintenance areas associated with the deployment of bus on shoulder operation in North Carolina. However, nothing substitutes for actual experience, and the regional BOSS Team should compile a list of recommended changes, additions, or improvements to the BOSS (NC IOP) so as to improve information sharing across the state and with jurisdictions beyond North Carolina.

Ongoing Monitoring and Review of Regional BOSS Program
The pilot project in the Research Triangle region is in essence the initial field research project for the implementation of Bus on Shoulder Systems in North Carolina. The NCDOT Transportation Mobility and Safety Division shall develop a plan to effectively monitor the performance of the initial pilot project and any subsequent BOSS installations that may include:

- Start and end dates for the evaluation of the program
- Designation of “treatment” (i.e., pilot implementation) and “control” (no BOSS implementation) sections
- Data collection and evaluation criteria
- Timeline for reporting results
- Communication with BOSS Team partners about issues that may arise

The results of the research of the pilot BOSS implementation shall be compiled and shared with regional, state, and federal partners to inform the potential next steps for the implementation of BOSS in the region and elsewhere in North Carolina.

REFERENCES AND ACKNOWLEDGEMENTS

Minnesota DOT / "Team Transit"
Many elements of this implementation and operations plan for the development of BOSS in North Carolina rely on extensive experience of Minnesota with bus on shoulder operations in terms of both duration of program (more than two decades) and extent of system (nearly 300 shoulder miles). NCDOT and other partners gratefully acknowledge the assistance and support of "Team Transit"– a partnership of regional transit agencies and the Minnesota Department of Transportation that provides overall coordination for bus on shoulder operations in Minneapolis-St. Paul and vicinity. Representatives from the I-40/Research Triangle Regional Partnership visited the Twin Cities region in October and November, 2011 to observe first-hand the operation of the bus shoulder system there.

For more information on Team Transit in Minnesota, visit the following links:

http://www.dot.state.mn.us/metro/teamtransit/docs/operating_rules_on_shoulder.pdf
http://www.dot.state.mn.us/metro/teamtransit/docs/bus_only_shoulder_guidelines.pdf
http://www.dot.state.mn.us/metro/teamtransit/docs/mn_statutes_2006.pdf
http://www.dot.state.mn.us/metro/teamtransit/visual/Training%20For%20Bus%20Drivers%202.wmv
http://www.dot.state.mn.us/metro/teamtransit/docs/bus_only_shoulder_guidelines.pdf

I-40 Regional Partnership The I-40 Regional Partnership in the Research Triangle region has served as the impetus for advancing BOSS in the area and provides an ongoing coordination mechanism through a regional BOSS Team. The members of the I-40 Regional Partnership in the Research Triangle region who have focused on the implementation of BOSS and other potential improvements to the I-40 corridor include those listed on page 12 of this document.

RTA Volunteers
The RTA would like to acknowledge the assistance of several FAST member firms that have provided past or ongoing assistance with the implementation of BOSS in our region, including CDM Smith, PB Americas, Martin/Alexiou/Bryson, PC, AECOM, and WSP SELLS, as well as all members of the I-40 Regional Partnership in the Research Triangle region.

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APPENDICES

Appendix – NCDOT Design Criteria for Bus on Shoulder Systems Implementation

Bus on Shoulder Systems (BOSS): Geometric Design Criteria

Type of Highway: Urban Multi-Lane Freeway and Expressway; Buses on right shoulders only

CONTROLLING GEOMETRIC DESIGN CRITERIA	STANDARD	NOTES
Design Speed, mph	35	Maximum speed for busses traveling on shoulder, as per operational policy
Shoulder Width, ft	10.0 12.0	10.0 ft minimum, 12.0 ft desirable 12.0 ft in areas of new construction or reconstruction
Bridge Width, ft	10.0 12.0	10.0 ft minimum width, 12.0 ft desirable 12.0 ft in areas of new construction or reconstruction
Grades, max. %	nc	No change (nc) match existing roadway
Front Slopes	6:1	If front slopes are not steeper than 6:1, they may be steepened to 6:1. If front slopes are steeper than 6:1, match existing, except in the following cases: • If fill slope is steeper than 3:1 and higher than 2 ft, provide guardrail. • If fill slope is steeper than 3.5:1 and higher than 5 ft, provide guardrail, unless there is 18 ft between the edge of shoulder and the point where the fill slope becomes steeper than 3.5:1.
Structural Capacity	HS25	For new bridges. For existing bridges to allow shoulder use the shoulder must be structurally adequate (capable of carrying legal loads and does not appear on the inventory of inadequate bridges).
Horizontal Alignment, radius, ft	nc	No change (nc) match existing roadway
Vertical Alignment, Minimum K value	nc	No change (nc) match existing roadway
Stopping Sight Distance, ft	250	Stopping Sight Distance based on 35 mph design speed
Cross Slope, ft/ft	0.02 – 0.04	NCDOT Roadway Standard Drawing 560.02
Superelevation max, ft/ft	nc	No change (nc) match existing roadway
Vertical Clearance, ft	14	AASHTO's A Policy on Geometric Design of Highway & Streets 2011: Chapter 8, pg. 8-4 Tallest Design Vehicle 10'-9"
Horizontal Clearance to Obstructions, ft	0	AASHTO's A Policy on Geometric Design of Highway & Streets 2011: Chapter 8, pg. 8-5 2 ft beyond edge of shoulder is preferable, as a minimum, place at the edge of shoulder.

Appendix – Selected Operational Policy Documents
BOSS Pilot: Reporting & Relaying Incident Details

Purpose:
The following are guidelines to assist communication between the NCDOT's Statewide Transportation Operations Center (STOC), the Triangle Transit Authority (TTA) as well as the North Carolina State Highway Patrol (NCSHP) and Durham Police Department (DPD) in regards to the detection of traffic incidents and how they are relayed to various partners within the Pilot Program of the Bus on Shoulders System (BOSS).

Emergency and Urgent Incidents:
Traffic incidents vary widely in terms of response as well as the level of impact that they have on the mobility and safety of the roadway. For the purpose of the BOSS pilot, the following two categories are proposed in order to assist BOSS partners in distinguishing one incident type from another and determining who the report needs to be delivered to:

- **Emergency Incidents:**
  - Vehicle Accidents
  - Disabled Vehicles involving a medical emergency
  - Toxic or Hazardous Materials
  - Fire-related Incidents
  - Any incident impacting a travel lane
- **Urgent Incidents:**
  - Disabled or Abandoned Vehicles
  - Large or potentially hazardous debris
  - Damage to shoulder or structures

TTA Bus Drivers & Dispatchers:
In the course of traveling on the shoulder for BOSS, TTA Bus Drivers will frequently come across traffic incidents that not only impede their use of the shoulder but also have an impact on regular commuter traffic as well. As trained transportation personnel, TTA drivers possess the knowledge and experience to recognize traffic incidents and to accurately report their location and possible impact to traffic. Just like NCDOT and Law Enforcement personnel, this information can be received and acted upon with confidence.

- Emergency Incidents: Upon detection of any of the emergency incidents listed above, TTA drivers may report the incident to their Dispatchers who, upon receipt of this information, should contact the appropriate Law Enforcement telecommunications centers for DPD or NCSHP.
- Urgent Incidents: Upon detection of any of the urgent incidents listed above, TTA drivers should report this information to their Dispatchers who, upon receipt of this info, should notify the STOC of the incident. STOC 24/7 phone number: 877-627-7862

Law Enforcement Personnel:
As incidents occur on the roadway, they are often relayed to Law Enforcement personnel very shortly after they have occurred. Law Enforcement personnel (including DPD and NCSHP) have a primary responsibility to respond to many of these incidents in order to assure public safety and proper adjudication.

- Emergency Incidents: Upon receipt of a report of any of the previously listed emergency incidents, personnel at the appropriate law enforcement telecommunications center should contact the STOC to relay the incident details such that appropriate response measures can be implemented including
  - Dispatching IMAP to the scene
  - Activating Dynamic Message Signs (DMS) to warn or redirect motorists
- Urgent Incidents: As law enforcement units in the field detect or receive reports of any of the previously listed urgent incidents, they should relay this information to their Dispatchers who should notify the STOC such that the appropriate response measures can be implemented including
  - Activation of Signal 4 (rapid recovery/removal) procedures

STOC Operators:
As incidents are received from any of the BOSS partners previously discussed, STOC Operators should assure that all appropriate response measures are implemented and should keep in regular contact with the reporting agency as well as responders in order to provide updates including:

- Possible ETAs for DOT responders
- Progress of response efforts
- Cancellation or suspension of response measures

Appendix – Selected Maintenance Policy Documents
(to be added)

Appendix – Selected Enforcement Policy Documents
(to be added)

Appendix – Selected Public Outreach Policy Documents
(to be added; see also subsequent pages)

Appendix – Sample BOSS One-Pager

Bus on Shoulder System (BOSS) Pilot in North Carolina's Research Triangle Region

Bus on shoulder operation is a low-cost, fast-implementation treatment that can provide immediate benefits to transit whenever mainline travel is experiencing moderate to heavy degrees of congestion. Bus on shoulder operation will allow transit buses with trained drivers to operate on the shoulders of selected freeways and expressways in order to bypass congestion and maintain transit schedules.

Bus on shoulder operations were first implemented in Minnesota more than 20 years ago, with nearly 300 shoulder-miles in use today. More than 10 states now use bus on shoulder, and no state has discontinued an operating bus on shoulder program for operational or safety reasons once commenced.

In North Carolina, transit buses will only be able to use shoulders when travel speeds are below 35 MPH in the main lanes in the direction of travel, and buses will only travel up to 15 MPH faster than other vehicles in addition to the 35 MPH limiting speed. However, the shoulders will retain their primary use as a breakdown or emergency area, and buses will have to yield to all other vehicles when using the shoulder.

Expected benefits of the program for North Carolina are similar to those identified by Minnesota and other states, and are expected to include some or all of the following:

- Shorter transit travel times
- More predictable and reliable transit schedules
- Fewer missed transfer connections
- Increased transit ridership
- Reduced driver overtime
- Decreased operational costs

The first BOSS pilot implementation in North Carolina will occur on I-40 in the Research Triangle area during 2012. If successful, the program could be expanded to other routes, with the goal of creating a regional Bus on Shoulder System.

Bus on Shoulder Guidelines for North Carolina

If travel speeds in main lanes in direction of travel are:	**Then transit buses on adjacent right shoulder:**
65 MPH, 55 MPH, even 35-40 MPH	N/A: Cannot use shoulder
Below 35 MPH, 30 MPH, 25 MPH, 20 MPH	Can go up to 35 MPH
15 MPH	Can go up to 30 MPH
10 MPH	Can go up to 25 MPH
5 MPH	Can go up to 20 MPH
Stopped (0 MPH)	Can go up to 15 MPH

Revised May 6, 2012

Appendix – Sample FAQs for Bus on Shoulder Systems in North Carolina

Sample FAQs for Bus on Shoulder Systems in North Carolina

Note: The FAQs that follow were initially developed for the pilot implementation of BOSS in Durham County in 2012.

Q. What is bus on shoulder operation?

A. Bus on shoulder operation allows authorized transit buses with trained drivers to operate on the shoulders of selected freeways at low speeds during periods of congestion in order to bypass congested traffic and maintain transit schedules. Bus on shoulder operation is a low-cost treatment that can provide immediate benefits to transit whenever mainline travel is experiencing moderate to heavy degrees of congestion.

Q. What is a Bus on Shoulder System (BOSS)?

A. A regional Bus on Shoulder System (BOSS) is a network of freeway shoulders available for travel by authorized transit buses under congested conditions. North Carolina is seeking to develop such a system in the Research Triangle region and potentially other regions of the state, commencing with a pilot installation on I-40 beginning in 2012.

Q. Where will the Bus on Shoulder System initial pilot segment be located?

A. The pilot section will be located on Interstate 40 in southern Durham County in the Research Triangle region of North Carolina.

- On westbound I-40, the pilot will begin just west of the NC 147 interchange (exit 279) and continue to the US 15-501 interchange (exit 270).
- On eastbound I-40, the pilot will begin at the US 15-501 interchange (exit 270) and continue to the Page Road interchange (exit 282).
- The total length of the pilot is approximately 20 shoulder-miles.

Q. When will buses be able to travel on the shoulder?

A. When traffic in the main lanes in the direction of travel is traveling below 35 MPH, authorized transit buses will be able to travel in the adjacent right shoulder at speeds up to 35 MPH, as long the bus stays within 15 MPH of general purpose travel speeds. This means that buses can travel up to 35 MPH as long as speeds in the main lanes are between 20 MPH and 35 MPH.

Q. Will there be time-of-day restrictions for bus on shoulder operation, for example, only during "rush hours"?

A. No. Approximately 50% of all congestion is "non-recurring", that is, outside of predictable travel periods. Congestion can arise due to either heavy traffic volumes or capacity reductions associated with weather, incidents, and the like. Authorized transit buses will be permitted to travel on bus shoulders in the pilot area during any period of congestion as long as maximum speed thresholds are met.

Q. If I have an emergency, will I still be able to use the shoulder? What if I can't get out of the way of a bus?

A. Shoulder use for emergencies will continue to take precedence over bus on shoulder operation. BOSS operation on the shoulder during peak periods is a subservient use of the shoulder, which means that authorized transit buses traveling in the shoulder will have to yield to all other vehicles. That having been said, unattended vehicles will be rapidly towed away from shoulders in the pilot area.

Appendix – Sample FAQs for Bus on Shoulder Systems in North Carolina *(continued)*

Q. Will all transit buses travel on the shoulders in the pilot section when speed thresholds are met?
A. No. Only authorized transit buses with trained drivers will be permitted to travel on the shoulders during periods of congestion. These drivers will have the option, but not the requirement, of operating on the shoulders in congested conditions. Even when speeds in the main lanes permit shoulder travel, trained bus drivers may always elect to use only portions of the shoulder mileage, or none at all, depending on their professional judgment of the conditions at that time.

Q. Will any signs be installed on I-40 or on the on-ramps to I-40 in the pilot area to alert motorists to the Bus on Shoulder System?
A. Yes. "Shoulder: Authorized Buses Only" and "No parking -- tow away zone" signs will be installed on I-40 in the pilot area. "Watch for buses on shoulder" signs will be installed at I-40 on-ramps in the pilot area. All sign installations will occur in March 2012, prior to the commencement of pilot BOSS operations on I-40 in 2012. In addition, other public outreach will be conducted, including the use of selected overhead dynamic electronic message signs on I-40.

Q. If buses are limited to 15 MPH faster than other vehicles, does that mean that when traffic is stopped on I-40, buses will only be able to travel up to 15 MPH on the shoulder?
A. Yes. While 35 MPH is the maximum shoulder operating speed, buses must also keep within 15 MPH of general purpose travel speeds, and that limitation controls when traffic speed in the main lanes drops below 20 MPH. Therefore, if traffic is stopped, 15 MPH is the limiting speed for bus travel on the shoulder. See the table below for specific speed thresholds under bus on shoulder operation.

Travel Speed examples associated with maximum BOSS operating speeds

If travel speeds in main lanes in direction of travel are:	**Then transit buses on adjacent right shoulder:**
65 MPH, 55 MPH, even 35-40 MPH	N/A: Cannot travel on shoulder
Below 35 MPH, 30 MPH, 25 MPH, 20 MPH	Can go up to 35 MPH
15 MPH	Can go up to 30 MPH
10 MPH	Can go up to 25 MPH
5 MPH	Can go up to 20 MPH
Stopped (0 MPH)	Can go up to 15 MPH

Q. Will urban Interstate speed limits need to be lowered below 65 MPH, 60 MPH, or 55 MPH in order to implement the BOSS program?
A. No. Since bus on shoulder usage only applies during congested conditions when travel in the main lanes is below 35 MPH, no speed limit changes will be needed to implement bus-on-shoulder operation in North Carolina.

Q. If traffic is moving at say 40-45 MPH, my understanding is that the buses cannot travel on the shoulder. How will buses stay on schedule?
A. The goal of the bus on shoulder program is to provide a low-cost way of improving schedule certainty for transit under congested conditions while maintaining a high degree of safety on our freeway system. Bus travel on the shoulder is indeed limited to 35 MPH speeds and below. Once buses can travel at or above 35 MPH in the main lanes they can largely stay on schedule.

Appendix – Sample FAQs for Bus on Shoulder Systems in North Carolina *(continued)*

Q. How much will it cost to get Interstate 40 ready for bus-on-shoulder operation in the Research Triangle region?

A. The direct costs of implementing a pilot Bus on Shoulder System (BOSS) along approximately 20 shoulder-miles of I-40 is approximately $2,000/shoulder-mile, with those costs primarily for signage. This is an incredibly cost-effective improvement to enhance transit reliability. In addition, it may also save area transit agencies money in terms of reduced operating costs.

Q. Allowing buses to travel on the shoulder during peak periods seems like a good idea. Why is this limited to a small section of freeway in one area of the state?

A. More than ten states have implemented bus on shoulder usage during peak periods, and this is North Carolina's first pilot project. The pilot will begin in 2012, and an end date has not been determined, although it is planned to last at least one year. However, if the pilot is successful in terms of both operational and safety performance over time, expansion of bus shoulder operation to other portions of I-40, Wade Avenue Extension, and other freeways in Durham, Orange, and Wake counties will be considered. In addition, other areas in North Carolina may pursue the creation of a Bus on Shoulder System on freeways in their area.

Q. While bus on shoulder may be new to North Carolina, I understand that it has been used elsewhere with success. Which other states are using bus on shoulder operation?

A. More than ten states currently use bus on shoulder operation on one or more roadways, including the following:

- South region: FL, GA
- Northeast/Mid-Atlantic region: NJ, DE, MD, VA
- Midwest region: OH, MN, IL, KS
- West region: CA, WA

The Minneapolis-St. Paul region alone has nearly 300 shoulder-miles of bus shoulder in operation. The Minnesota program began approximately 20 years ago. The North Carolina BOSS program is modeled after the successful bus shoulders program in Minnesota.

Q. Virginia allows all vehicles to travel on the shoulder during peak periods in both Northern Virginia (e.g., I-66) and Hampton Roads (e.g., I-64). What is the reason that North Carolina will restrict shoulder travel during congested periods to just transit buses rather than allowing all vehicles to travel on the shoulder to avoid congestion?

A. North Carolina is pursuing a pilot Bus on Shoulder System (BOSS) program for the Research Triangle region that will improve transit operations during congested periods and enhance the viability of transit as a travel option. BOSS is a low implementation cost program with a number of unique travel, safety, and cost benefits. Some of the benefits associated with BOSS include:

- Small number of vehicles, operated by trained, professional bus drivers
- Slow travel speeds (35 MPH or less)
- High visibility of buses by motoring public and higher vantage point for drivers
- Increased transit schedule reliability and improved attractiveness of transit as a travel option
- Reduced travel time impact of congestion which lowers transit operating costs
- Low implementation cost

NCDOT has previously explored the potential of allowing all vehicles to travel on freeway shoulders such as on I-485 in south Charlotte and may consider doing so again in the future. Any consideration of all allowing all vehicles to travel on freeway shoulders in the future will examine the impact on freeway operations, travel safety, transit schedule reliability, and overall cost.

Appendix – Sample FAQs for Bus on Shoulder Systems in North Carolina *(continued)*

Q. What are the reasons that the Research Triangle region is examining bus-on-shoulder operation for I-40, as opposed to adding an HOV (high-occupancy vehicle), express toll, or other premium lane on the Interstate?
A. Bus on shoulder operation can be implemented much more quickly and less expensively than the creation of a new travel lane since a BOSS uses the existing the freeway shoulder. In addition, the implementation of BOSS now will not preclude the future addition of express lanes on I-40 or other freeways. In fact, successful implementation of BOSS can create a larger base of transit ridership that could use a future express lane.

Q. I don't plan on using transit. How will I benefit from the creation of a regional Bus on Shoulder System?
A. Bus on Shoulder Systems (BOSS) are a very cost-effective way to make bus travel more attractive as well as more efficient, which can increase transit ridership while saving public transit operators money and/or allowing them to provide more transit service options. If more people use transit as a viable and reliable travel option that will improve the performance of our overall transportation system.

Q. Is this initiative primarily being led by NCDOT or are other agencies involved?
The two primary implementation partners for the BOSS initiative are NCDOT and Triangle Transit, which provides regional public transportation services for the Research Triangle area in cooperation with local transit providers.

The Bus on Shoulder System program in the Research Triangle region is an initiative of the I-40 Regional Partnership. The Partnership is a cooperative initiative of the NC Department of Transportation (NCDOT), the Capital Area Metropolitan Planning Organization (MPO), the Durham-Chapel Hill-Carrboro MPO, cities and towns along the corridor, Triangle Transit, RDU Airport, the Research Triangle Park (RTP), the North Carolina State Highway Patrol (SHP), local law enforcement, the Federal Highway Administration (FHWA), the Regional Transportation Alliance (RTA), and other partners. The Partnership is designed to provide an ongoing focus on the Triangle's most critical freeway in order to maintain its long-term viability. Meredith McDiarmid, PE, NCDOT State Systems Operations Engineer, serves as the corridor executive for I-40 in the Research Triangle area (between I-85 and I-95).

Appendix – Sample BOSS Team Documents

Sample Boss Team Invitation

Dear Regional Transit Partner,

The NC Department of Transportation, Triangle Transit, and other members of the I-40 Regional Partnership are focusing on an expected pilot implementation of a Bus on Shoulder Systems (BOSS) project on I-40 in the Research Triangle region later this year. The I-40 Regional Partnership is initiating a regional BOSS Implementation/Operations Team (BOSS Team) which will exhibit primary coordinating responsibility for several elements of the BOSS program including corridor selection, implementation guidelines, and driver training.

The Team's initial focus will be the successful development and execution of a pilot BOSS implementation on the corridor. However, the Team will continue to meet periodically even after the conclusion of a successful pilot in order to maintain the effectiveness of the program and to consider expansion of BOSS to other locations in the region.
We would like to invite you and/or a designee from your organization to become a member of the regional BOSS Team. We will have an optional orientation meeting to what Bus on Shoulder Systems are on Thursday, March 24th, and then our first BOSS Team meeting on Thursday, April 14th. Each meeting will be at 2:30pm at Triangle Transit headquarters in southeast Durham - 901 Slater Road. An expected future meeting schedule can be found below.

Please reply by Monday, March 7 as to whether you and/or a designee would be willing to participate in these Team meetings, and your availability (and/or the availability of your representative/designee) for both the optional orientation meeting in March and the first Team meeting in April.
Thank you for your commitment to regional transportation!

Meredith McDiarmid, PE
NCDOT State Systems Operations Engineer
Corridor Executive, I-40/Research Triangle

John Tallmadge
Director of Commuter Resources
Triangle Transit

Joe Milazzo II, PE
Executive Director
Regional Transportation Alliance

Expected schedule of initial meeting dates (all meetings at Triangle Transit, 901 Slater Rd at 2:30pm)
- Th Mar 24 -- Optional orientation
- Th Apr 14 -- First BOSS I/O Team meeting
- Th May 12 -- Second meeting
- Th June 9 -- Third meeting
- Th July 14 -- Fourth meeting
- Th August 11 -- Fifth meeting
- Th August 25 -- Sixth meeting
- Th September 8 -- Seventh meeting

Appendix – Sample BOSS Team Documents *(continued)*

Sample Boss Team Meeting Agenda

I-40 Regional Partnership
Bus on Shoulder Systems (BOSS) Team Meeting
Meeting 6 -- Friday, December 9, 2011
9:00 - 11:30 am, Triangle Transit

AGENDA

1. **Welcome, introductions, and thank yous** -- *Meredith McDiarmid, PE, NCDOT*

2. **BOSS status update** -- *Meredith McDiarmid, PE, NCDOT*
   -- **Progress to date, critical path items, pending tasks**

3. **Revisions to Implementation and Operations Plan**

4. **Field visit via bus of pilot corridor** – *Tammy Romain, Triangle Transit & Battle Whitley, NCDOT*

5. **Driver training** -- *Tammy Romain, Triangle Transit*

6. **Signage plan preparations** -- *Ron King, PE, NCDOT*

7. **Update on similar initiatives in other states:**
   -- Metro Chicago, IL: I-55
   -- Metro Kansas City, KS: I-35

8. **Public outreach and education** -- *Steve Abbott, NCDOT and Brad Schulz, Triangle Transit*
   -- Media coverage this week: R*aleigh News & Observer 'Road Worrier' column* and editorial

9. **Operations, Communications, and Enforcement Protocols** -- *NCDOT Transportation Mobility and Safety staff*

10. **Other outstanding items**
    -- Review of drainage structures -- *NCDOT*
    -- Other corridor preparation items -- *NCDOT*
    -- Potential pilot corridor extensions -- *NCDOT*
    -- Pilot evaluation framework -- *Triangle Transit and NCDOT*
    -- Other items as identified by BOSS Team

11. **Key milestone dates**

12. **Confirm next two meeting dates:**
    -- Friday, January 6, 2012
    -- Friday, February 3, 2012

Adjourn

Appendix D: NCDOT BOSS Constructability Review

CAMBRIDGE SYSTEMATICS

Think Forward

Memorandum

TO: Patrick McDonough, AICP and Jeff Dayton, PE (HDR)

FROM: Alpesh Patel and Feng Liu, Ph.D. (Cambridge Systematics, Inc).

DATE: March 24, 2021

RE: CAMPO BOSS – Task 6, BOSS Constructability Review

This memorandum summarizes the analysis and associated findings for Task 6 – Review of BOSS Deployment based on the Regional Network and Constructability Considerations.

The objective of this task is to provide a qualitative review of BOSS deployment from prior steps (Peer Review, Subject Roads) and Task 5 Suitability screened through infrastructure feasibility and future NCDOT project commitments. A qualitative approach was deemed appropriate due to existing data limitations and the importance of assessing BOSS deployment through a regional framework. The analysis involved the following work activities:

- Prepared maps of BOSS Suitability miles (Tier 1, Tier 2) within defined constructability "screens".
- Evaluated each "screen" for BOSS supportive, coordination elements including pavement infrastructure, regional traffic system operations, 2020-2029 STIP commitments and SPOT projects.
- Evaluated incremental service opportunities along corridors which facilitate BOSS within a regional framework.
- Shared Task 6 findings with Technical Steering Committee (TSC) in February 2021. TSC feedback is reflected in this memo.

BOSS Suitability within Defined Constructability Screens

The conclusion of Task 5 identified 75 miles of Tier 1 (most suitable) and 139 miles of Tier 2 (2nd most suitable) for BOSS implementation suitability (**Figure 1**). Tier 1 and Tier 2 miles formed the basis of "screening" BOSS supportive infrastructure and project specific improvements. The analysis of each successive screen (starting on page 4) narrowed the focus of optimal locations to coordinate and implement BOSS through NCDOT, CAMPO, DCHCMPO, GoTriangle and other regional partner commitments.

- **Pavement Profiles** – limitations in underlying GIS infrastructure information resulted in an incomplete picture of locations to expand shoulder width to accommodate BOSS. **Figure 2** highlights segmented vs continuous locations with adequate shoulder width along Tier 1 and

1201 Edwards Mill Road, Suite 130
Raleigh, NC 27607
tel 919-741-7698 www.camsys.com **fax** Office Fax

Tier 2 roadways. Field verification of underlying conditions is outside the scope of this study but recommended to inform future decision making.

- **Managed Motorways** – two phases of Managed Motorways are expected to optimize highway capacity and throughput on major Triangle roadways in the future. Managed Motorways is a Traffic System Management and Operations (TSMO) approach combining roadway, interchange and traffic management technologies to enhance travel time reliability. Phase 1 is 71 miles implemented over the next decade through STIP projects along I-40, I-440, I-87, and US 1. Phase 2 is implemented beyond the next decade encompassing 120 more miles resulting in an expanded, broader regional network along all of I-540 and parts of US 1, US 64, and US 70.

  Deploying BOSS within the regional "ecosystem" of Managed Motorways was determined appropriate to facilitate joint visioning and coordinated decision making to serve a cross section of state and local partner interests. Integration with Managed Motorway phases also serves to position BOSS deployment to serve core and secondary transit markets within the region. **Figure 3** highlights both phases of Managed Motorway miles overlapping Tier 1 and Tier 2 BOSS Suitability facilities**. Table 1** highlights the number and percentage of Suitability miles within both phases of Managed Motorways.

- **STIP and SPOT – Table 2** highlights the number of STIP and Prioritization 6 (P6.0) projects which fall within Suitability Tiers and Managed Motorway screens. Eight out of the 18 STIP projects have Right of Way (ROW) dates which fall beyond 2026 meaning they could be subject to reprioritization and potentially reviewed for rescoping to accommodate BOSS supportive elements. Seven of the 18 STIP projects (**Figure 4**) fall within both Suitability Tiers and phase 1 of Managed Motorways. Four of the 19 P6.0 projects which fall on the Suitability Tiers also fall within phase 1 of Managed Motorways.

  The combination of these future STIP and submitted project priorities represent infrastructure, widening and operational improvements conducive to BOSS. The schedule for these improvements also provides adequate lead time for NCDOT and local planning staff (CAMPO and DCHC) to jointly evaluate, coordinate and refine the approach for regional BOSS deployment. Steps to review or adjust submitted P6.0 project scopes should be weighed carefully within the parameters of NCDOT's prioritization and programming process.

Incremental Service Evaluation – Average Costs

Nesting BOSS within the Managed Motorways regional framework widens the range of incremental service opportunity particularly along arterial roadways which serve the Managed Motorway network. BOSS implementation along the shoulders of these facilities (state or US routes) can provide a high value, low-cost solution depending on existing pavement, striping, access and design conditions. **Figure 5** illustrates a spectrum of peer state average per mile costs to implement BOSS – from installing signs (low end of range) to shoulder and structure widening (high end of range). These costs were generated as part of the peer review assessment conducted earlier in the CAMPO BOSS study.

Figure 6 illustrates a high-level application of weighted average costs to improve sections of NC 147 (Durham Freeway) and US 1 (Capital Boulevard) for near term BOSS operation. These sketch level estimates reflect a combination of low to medium level improvements (signs, access management, drainage) based on desktop analysis. These estimates are subject to

further field investigation to confirm "real world" costs. Improvements to 11 miles of the Durham Freeway (from US 15/501 to I-40) are estimated at just under $450K. BOSS Improvements to 12 miles of Capital Boulevard (from NC 98 in Wake Forest to I-440) are estimated at just under $785K. These BOSS improvements to existing conditions along this stretch of Capital Boulevard are independent of any future corridor freeway improvements proposed by the City of Raleigh between I-540 and I-440.

Similar analyses to identify near term, low cost and low risk opportunity to deploy BOSS could be evaluated for other arterials in the Triangle.

Findings

- **Deploy BOSS within an operational "ecosystem"** – the development of a region-based Managed Motorway network combined with state/local coordinated infrastructure improvements provides an effective framework and common vision for BOSS. Coordinated improvements allow BOSS to scale over time, serving core and secondary transit markets within and outside the CAMPO planning area. Coordinated planning will facilitate joint reviews of project scoping and opportunity for BOSS accommodation as NCDOT's prioritization and programming process allows.

- **Explore Incremental Service Opportunities** – the review of other arterial improvements (signs, shoulder repair, access management, drainage) along corridors which connect to Managed Motorways can inform low cost, near term BOSS feasibility. The evaluation of the Durham Freeway and US 1 provides a high-level approach which through field verification can translate into a more tailored planning level methodology to determine localized per mile construction costs.

Figure 1. Suitability Tiers

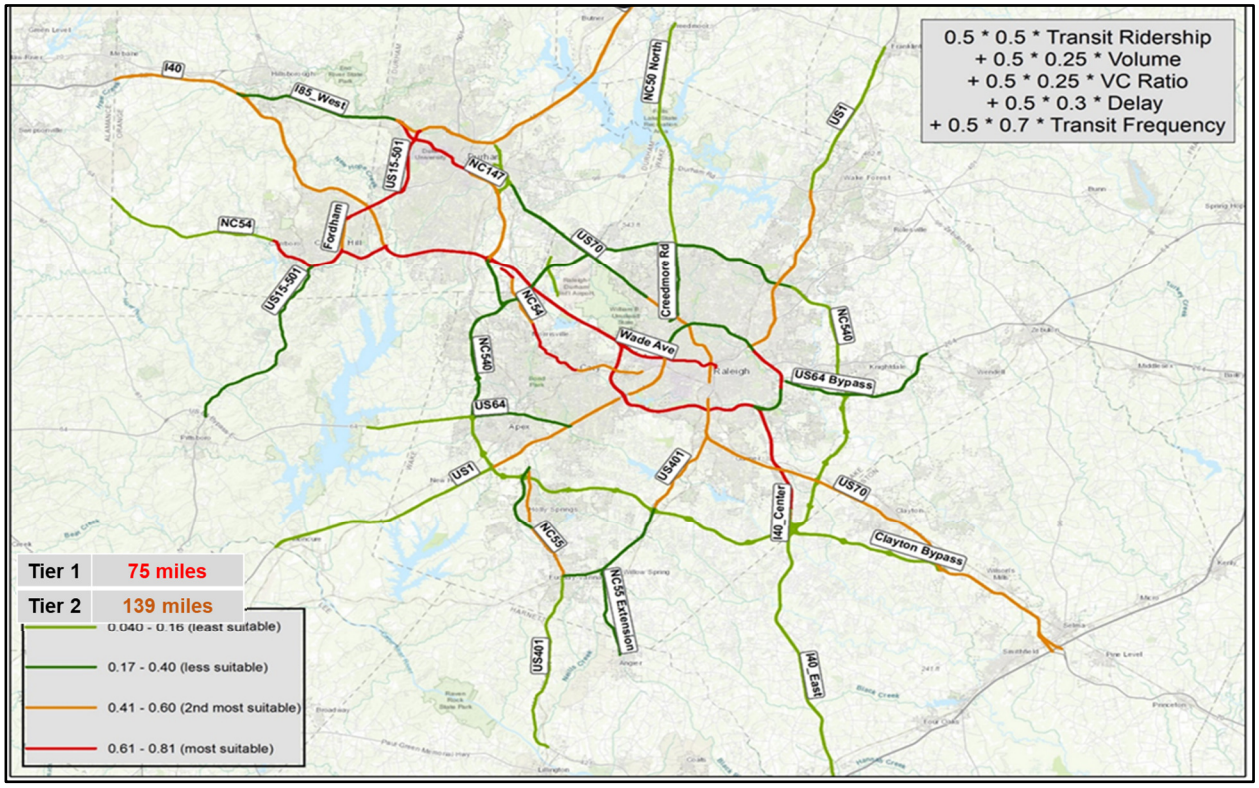


Figure 2. Potential Pavement Expansion Locations

CAMBRIDGE SYSTEMATICS

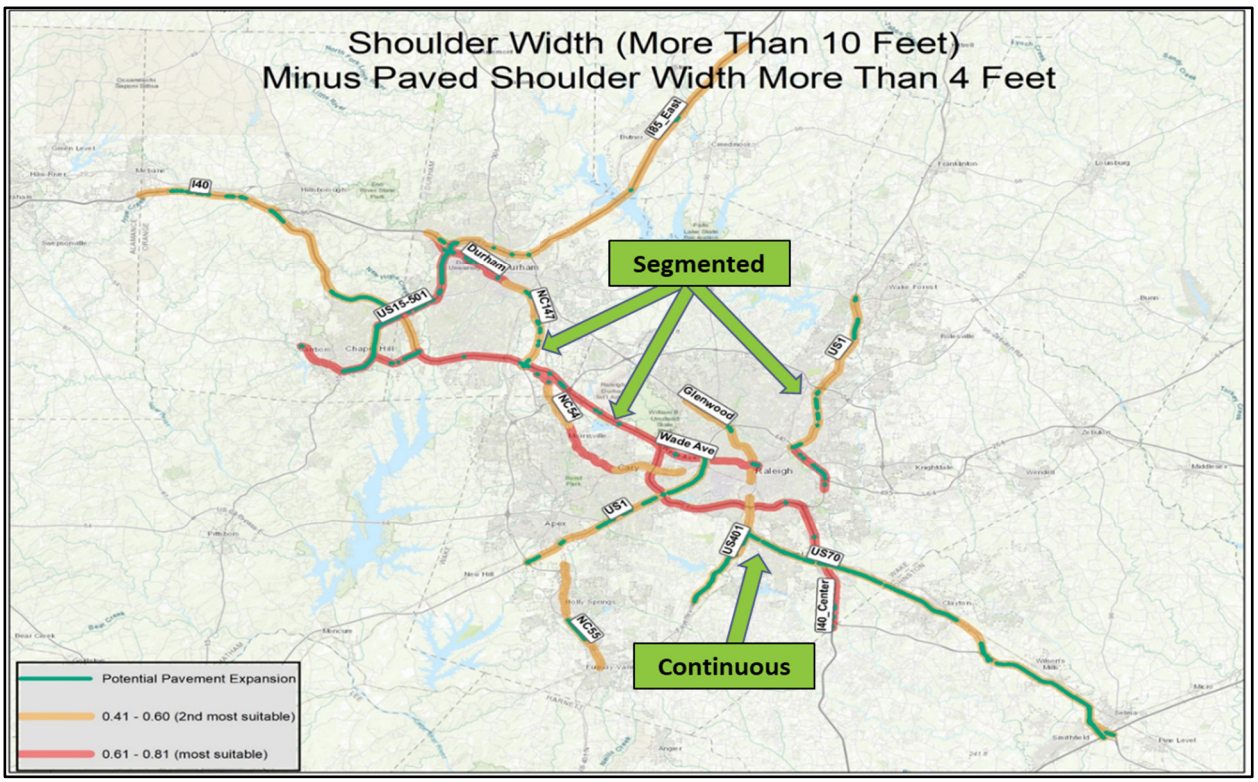
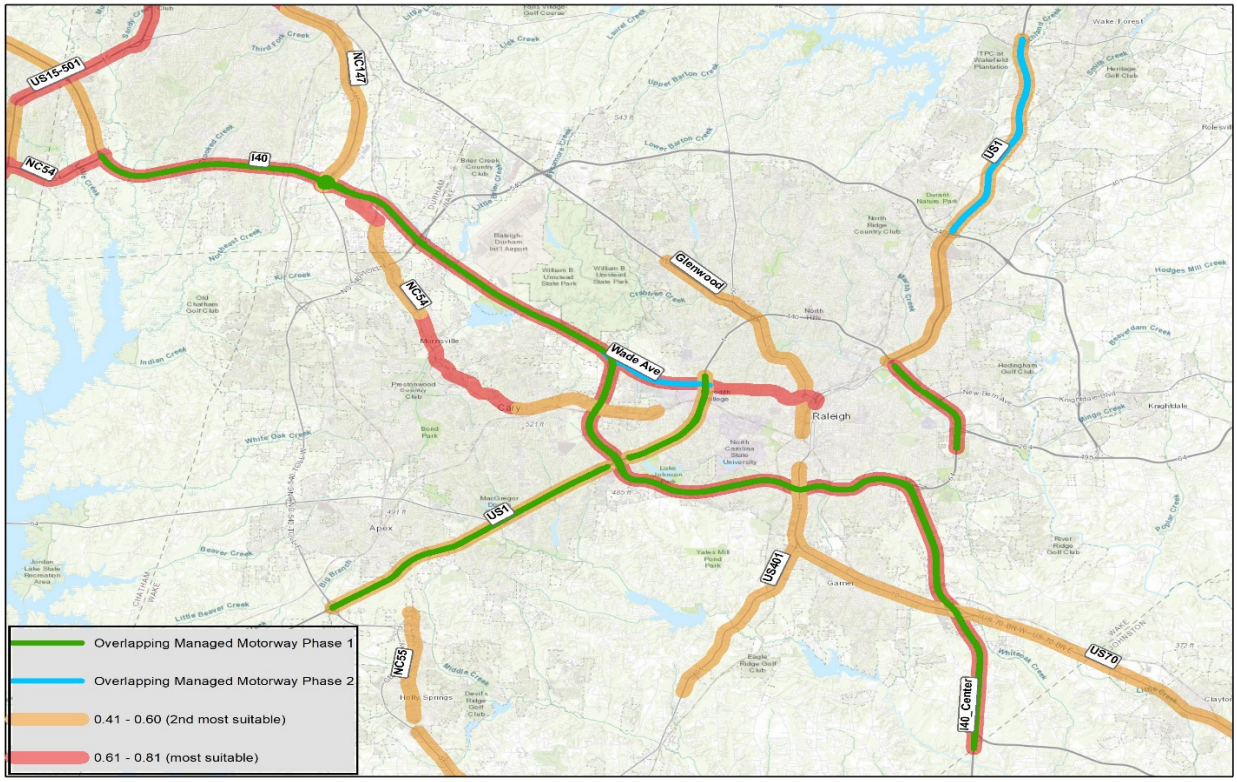


Figure 3. Suitability Tiers within Managed Motorways (Phase 1, 2)



CAMBRIDGE SYSTEMATICS

Table 1. Miles and Percentage of Suitability within Managed Motorways (Phase 1, 2)

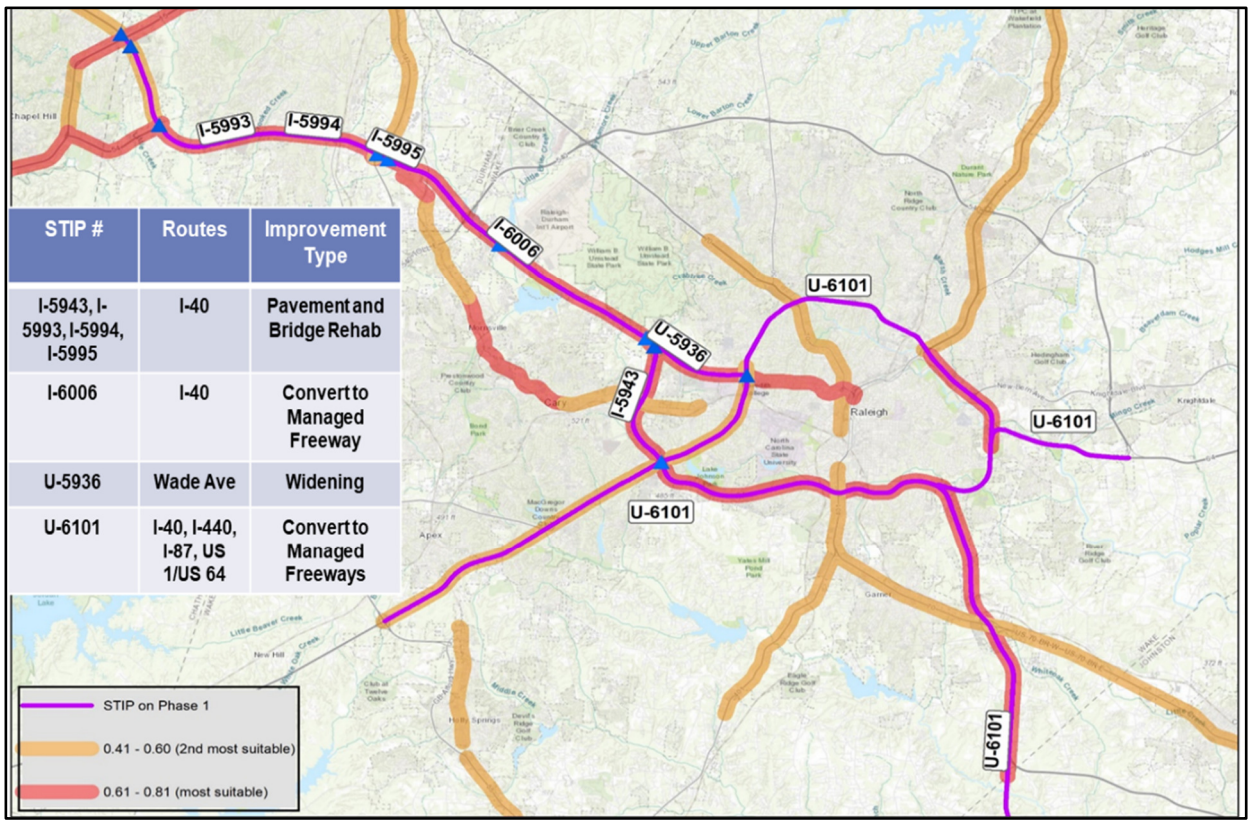
Phase 1 – Managed Motorways (71 miles)		
BOSS Suitability	Tier 1 (75 miles)	44 BOSS Tier 1 miles (or 59%) included in MM 1
	Tier 2 (139 miles)	13 BOSS Tier 2 miles (or 9%) included in MM 1

Phase 2 – Managed Motorways (120 miles)		
BOSS Suitability	Tier 1 (75 miles)	3 BOSS Tier 1 miles (or 4%) included in MM 2
	Tier 2 (139 miles)	10 BOSS Tier 2 miles (or 7%) included in MM 2

Table 2. STIP and P6.0 Projects within Suitability and Managed Motorways (Phase 1, 2)

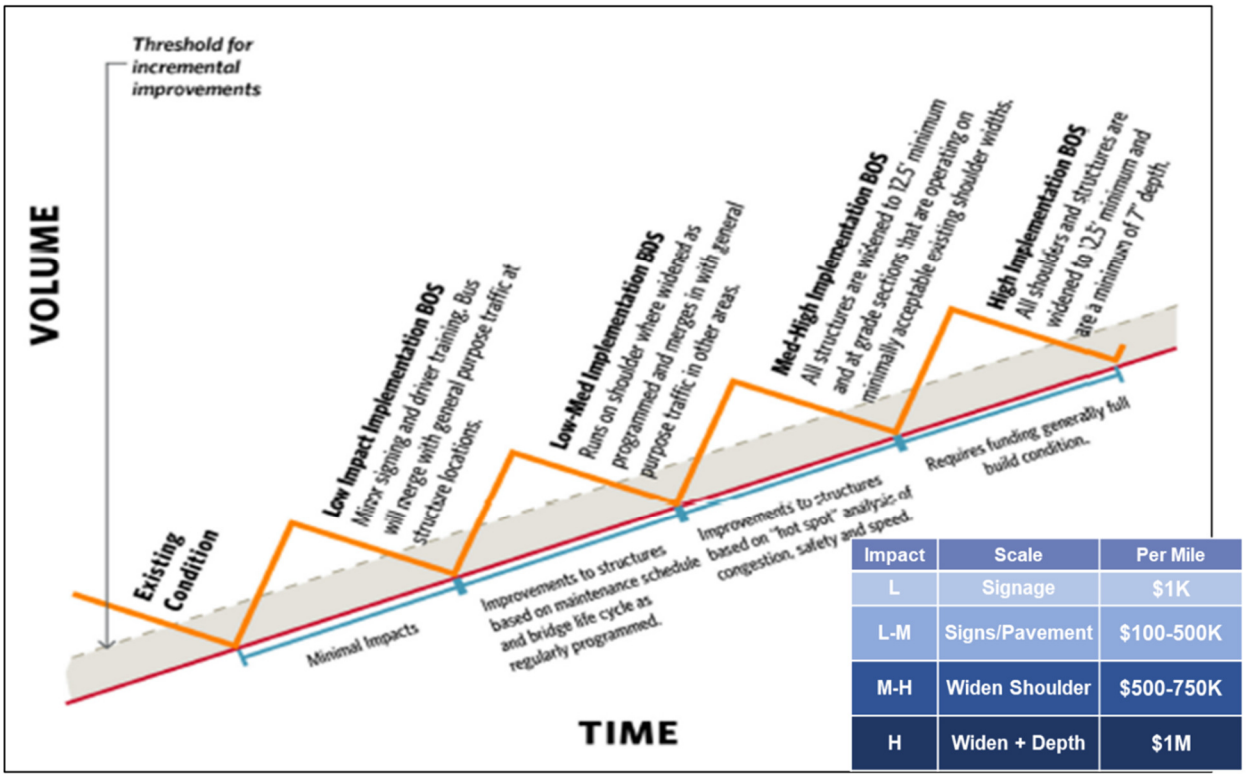
Screen	# of STIP Projects	# of P6.0 Projects	Improvement Type
BOSS Suitability (Tier 1, 2)	18	19	• Pavement Rehab • Widening • Convert to Freeway. • Upgrade Arterials to Superstreet • Other Operational improvements
BOSS Suitability (Tier 1, 2) + Managed Motorways (Phase 1, 2)	7	4	
BOSS Suitability (Tier 1, 2) + Managed Motorways (Phase 1)	7	4	

Figure 4. STIP Projects within Suitability and Managed Motorways (Phase 1)



STIP #	Routes	Improvement Type
I-5943, I-5993, I-5994, I-5995	I-40	Pavement and Bridge Rehab
I-6006	I-40	Convert to Managed Freeway
U-5936	Wade Ave	Widening
U-6101	I-40, I-440, I-87, US 1/US 64	Convert to Managed Freeways

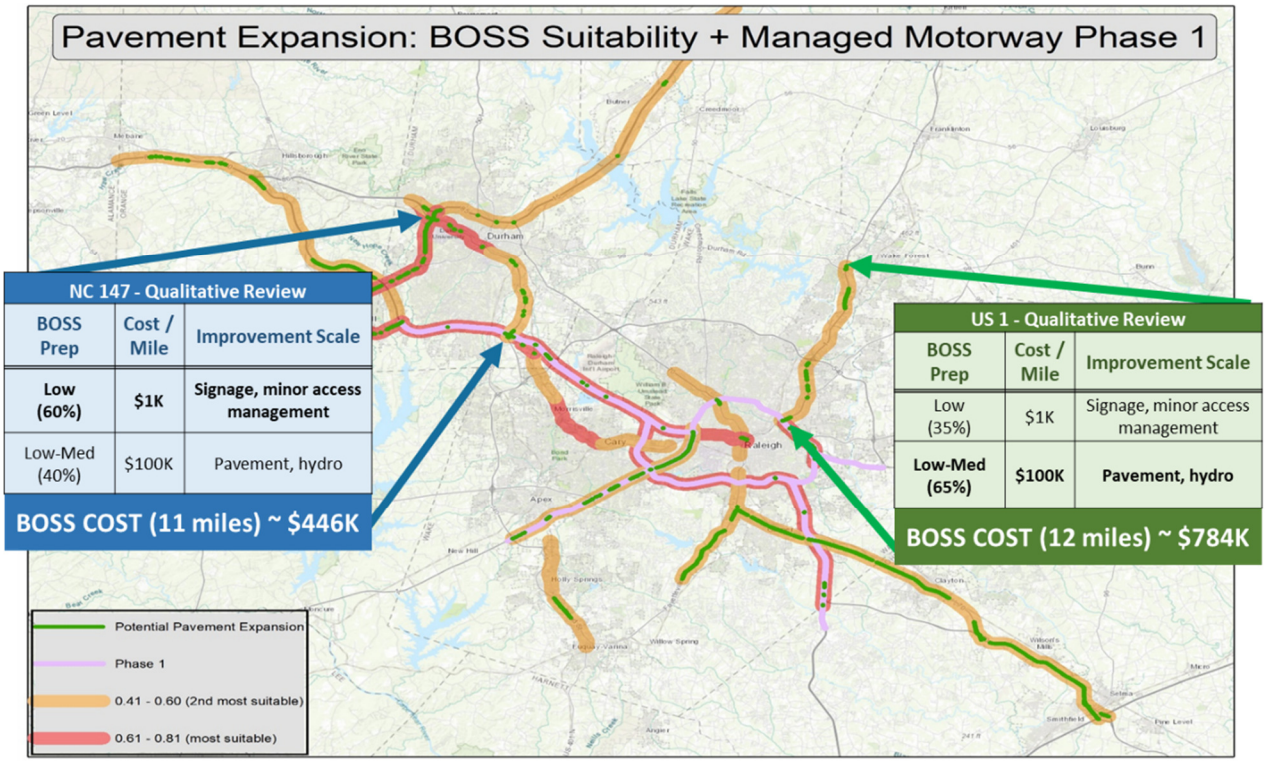
Figure 5. Incremental BOSS Implementation – Average Costs / Mile



Impact	Scale	Per Mile
L	Signage	$1K
L-M	Signs/Pavement	$100-500K
M-H	Widen Shoulder	$500-750K
H	Widen + Depth	$1M

CAMBRIDGE SYSTEMATICS

Figure 6. Incremental Service Costs – Capital Boulevard and Durham Freeway



CAMBRIDGE SYSTEMATICS

Appendix E: BOSS Messaging Strategies

Bus On Shoulder Study Messaging Recommendations

Capital Area Metropolitan Planning Organization

Prepared By HDR, Inc.

May 12, 2021

Contents

Introduction

Since the Bus on Shoulder System (BOSS) introduction, the North Carolina Department of Transportation's (NCDOT) Public Information Plan has been successful in sharing program messaging with key stakeholders. The Plan introduced how the system operates, shared the benefits -- including reliability, safety, and cost savings -- and encouraged ridership.

As the system approaches its 10-year operational anniversary, and new corridors are considered for BOSS implementation, a new set of strategies should be introduced to build upon the foundation established over the past years and ensure the system's long-term success.

The next phase of the public information plan will refresh and elevate the program's brand and messaging (Appendix A) to help increase public awareness of the system and move the targeted audiences closer to a place of familiarity and normalcy with BOSS operations.

History of BOSS Public Communications in The Triangle

In 2012, NCDOT, GoTriangle and the business community organization, the Regional Transportation Alliance (RTA) – all played a role in getting the word out about the introduction of Bus On Shoulder on I-40.

NCDOT's public information office held a press conference at the District Drive Park and Ride lot, where Raleigh residents who ride the CRX and DRX buses to Chapel Hill and Durham board every day. Press releases were sent before and after the beginning of BOSS operations.

Using an earned media approach for visuals, NCDOT reached out to WRAL and WTVD when BOSS operations were first activated, giving the television station helicopters an opportunity to film BOSS operations from above.

GoTriangle also conducted its own promotional campaign, and engaged the media with ride-along events for television crews, and interview opportunities with those who were training the bus operators to use BOSS, and the bus operators themselves.

Joe Milazzo, Executive Director of the Regional Transportation Alliance, spoke regularly about the coming of BOSS at transportation leadership meetings throughout the region to spread the word.

The key message in these events was that BOSS had been successful and safe in other states, with a particular focus on the success achieved in Minneapolis.

Beyond the initial segment opening in Durham County and similar publicity for the expansion into Wake County, the primary channel for BOSS operations has been the BOSS webpages on the NCDOT and GoTriangle websites, which contain general information about BOSS:

- NCDOT webpage: https://www.ncdot.gov/divisions/public-transit/Pages/bus-on-shoulder-system.aspx
- GoTriangle webpage: https://gotriangle.org/news/faqs-about-boss

The remainder of this document focuses on communication strategies and tactics for introducing BOSS in new corridors in North Carolina.

The Three M's: Milestones, Moments, and Modifications

These new strategies should be implemented as the system approaches key milestones, moments, and modifications. Leveraging these opportunities will offer timely and relevant awareness and education for key audiences.

Examples of the three M's include but are not limited to:

Milestones: New BOSS segment opens for operation

Moments: Safety and operational campaigns

Modifications: The BOSS to be used temporarily during a construction project and become more visible on an existing segment due to frequency increases in transit service

Recommendation

Develop a targeted information and engagement campaign that supports specific milestones, moments, or modifications.

Below are examples of two concepts. Concept #1 is a milestone campaign raising awareness of a new BOSS segment opening for operation. Concept #2 is a moment campaign promoting the benefits of a new BOSS line that is in operation.

Concept #1: Milestone

Milestone: Promoting a new BOSS segment that is opening

Timing: 12-month campaign (begins six months before operation and continues for six months after the opening of a new segment)

Campaign Theme: Share the Road with the BOSS

Goals

- Educate motorists on the BOSS and what they can expect when sharing the road
- Create a sense of normalcy and comfort for motorists
- Empower motorists to feel safe on the road

Target Audience

- Motorists currently using the highway system
- New motorists who have relocated to the area
- Motorists in geographic submarkets who were unlikely to have exposure to the BOSS program

Key Messages

It is recommended to develop a series of new key messages that will be shared consistently using a variety of the communication tactics listed below. Key message themes will include:

- When you share the road with the BOSS you can expect…
- When you share the road with the BOSS you will see…
- Why sharing the road with the BOSS is safe…
- Why our region needs to share the road with the BOSS…
- How you benefit from sharing the road with the BOSS…

Communication Tactics

A refresh of communication tactics that were implemented during the pilot and the first public information phase will prove to be an effective and efficient approach to achieve the recommended goals outlined in this memo.

<u>Media Strategy</u>

Create a year-long media strategy that builds off the initial media approach. The media strategy will begin six months before the BOSS system enters full operations on the new route to create timely content for media partners and kick-off the awareness campaign. It is recommended to create one-of-a-kind pitches and engagement activities for regional, local, and hyper-local media. Concepts include:

- Offering media ride-alongs
- Pitching behind the scene interviews with drivers

- Giving on-location access to film
- Distributing prepackaged video segments for digital release

Media communication and engagement will begin six months before operation and continue six months into operations.

Social Media

Following the timing of the media campaign, it is recommended to leverage NCDOT's existing social media platforms to bring key messages to life. A few recommended strategies that can increase engagement on these platforms include:

- Facebook Live: offer an "on-location" Share the Road with the BOSS experience
- Memes: Create a Share the Road with the BOSS meme
- Videos: capture the BOSS live in action
- Augmented/Virtual Reality: create real life experiences that show instead of tell
- Paid and Targeted Advertisement: small investment with huge returns
- Facebook/Instagram Stories: Share the Road with the BOSS series from the perspective of a car

In addition, social content creates connections with community partners, which result in reaching more followers.

Webpage

All communication efforts should drive traffic back to the webpage(s). Therefore, it is critical that a web strategy document be created to guide the coordinated efforts of NCDOT and transit providers. The strategy document will address a variety of topics from the development and management of web content to search engine optimization. The BOSS team can work together to identify a primary webpage.

FAQ Document

Remember the audience. Simplify and update the FAQ document to connect with the public. It is recommended to reduce the document to one page, front and back, and prioritize the content. Content should focus on the five key messages.

Content created for the FAQ can be repurposed in many ways. FAQ Fridays on Social Media offer an opportunity to share some of these questions and answers. Media moments and local bloggers will welcome unique pitches to share questions and clarifying answers via their respected outlets.

BOSS One-Pager

Update the one-pager to compliment the campaign theme and messaging. Updated key messages supported by powerful imagery should be included. Visuals and content created for the one-pager can be repurposed in many ways including posting on the webpage, sharing on social platforms, and distributing to partners with the ask that they share and post via their communication channels.

On-Site Signage

Revisit opportunities to augment overhead boards, with strategically placed portable boards along BOSS routes. Temporary boards provide a canvas to share a message.

Concept #2: Moment

Moment: Promoting the benefits of a new BOSS line that is in operation to educate and attract potential riders

Timing: 12-month campaign that begins after a new BOSS segment has been operational for at least 6 months.

Campaign Theme: My BOSS

Tagline: When I am commuting, my BOSS works for ME

Goals

- Elevate awareness of the system with a focus on reliability, safety, and cost savings
- Educate new audiences on who rides, how to ride and why to ride
- Celebrate the system and its positive impacts to the community.
- Call to Action: Get access to tools that help plan a trip (website, app)

Target Audience

- Potential new riders
- New motorists who have relocated to the area
- Motorists in geographic submarkets who were unlikely to have exposure to the BOSS

Key Messages

Key messages will be developed from BOSS riders -- real, authentic and in their voice.

Communication Tactics

Concept #2 will take an authentic approach, focusing on highlighting BOSS riders. By identifying and using current BOSS riders to tell why and how they use the system, NCDOT will set the stage for achieving the campaign goals. To complement the communication tactics shared in Concept #1, this concept will focus on making BOSS more relatable through the positive experiences of current users.

Partnerships

Establishing strong partnerships with local service providers can elevate the impact of a campaign. Regional partnerships, especially with Transportation Demand Magement (TDM) activities, provide an opportunity to incorporate the My BOSS campaign into annual programs and events.

Visual Assets

Images, testimonials, and videos will take center stage and will be distributed through a variety of existing communication channels including a robust digital effort on social media (paid and organic) and local media like newspapers, radio, and website. This humanizing approach will show that a broad spectrum of people across the community ride the bus already and love it. It will also provide an opportunity to discuss the personal benefits of the system, showcase the communities the system serves, and speak to individuals not currently interested in using the system.

Additionally, throughout the year, this phase will have a call to action built into every key message and visual. This action item will drive traffic to the website where information about the BOSS is easily accessible.

Community Celebration: MY BOSS- 10 Years of Riding with MY BOSS

Applying a community celebration to a variety of moments is a wonderful way to actively engage the community and NCDOT's partners. An example of an appropriate moment is the upcoming 10-year BOSS anniversary on July 16, 2022.

There are numerous ways to celebrate the 10-year anniversary of the BOSS including:

- Pop-up bus events

- Free fare day
- Celebrity bus drivers
- Stuff the Bus -- an event in partnership with local food bank
- Bus shelter art projects
- Media ride-along
- My BOSS, MY RIDE -- sign up and ride for free. (link takes them to website), #MYBOSS

Community events provide an opportunity to capture strong visuals to support ongoing marketing efforts. In addition, they offer an opportunity to re-engage the regional BOSS team/transit partners. The regional BOSS team and transit partners played an important role during the pilot program. As the program approaches its 10 years of service, this welcomes a unique opportunity to reengage these individuals and organizations to assist with outreach and communication. Pulling this group together to assist with the planning and ultimate launch of the 10-year celebration will send a powerful message to the community regarding the success of the BOSS.

Summary

Both concepts provide examples of how-to build off the foundation that was laid during the first phase of messaging. Tailored campaign themes around the BOSS milestones, moments and modifications keep content fresh, interesting, relevant and attract target audiences.

Appendix F: Environmental Assessment Letter

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

BEVERLY EAVES PERDUE
GOVERNOR

EUGENE A. CONTI, JR.
SECRETARY

May 4, 2012

John F. Sullivan, III
Federal Highway Administration
NC Division Office Administrator
310 New Bern Avenue
Suite 410
Raleigh, NC 27601-1418

Dear John,

As you are aware the I-40 Regional Partnership has been working on an operational strategy providing a transit advantage by improving arrival predictability and scheduling and lowering cost for transit buses that use the I 40 corridor in/near the Research Triangle Park. This operational strategy is Bus on Shoulders operations (BOSS).

BOSS allows authorized transit buses with trained drivers to operate on the shoulders of selected freeways at low speeds during periods of congestion in order to bypass congested traffic and maintain transit schedules. Bus on shoulder operation is a low-cost treatment that can provide immediate benefits to transit whenever mainline travel is experiencing moderate to heavy degrees of congestion. This use of the shoulder is subservient to the use of the shoulder as a breakdown lane or for emergency operations and buses must yield to everything in the shoulder. In the case of the BOSS program, buses will not be allowed to travel greater than 35 mph on the existing shoulder and will only be allowed when operating speeds drop below 35 mph. Our intention is to pilot this operations strategy that has proven to be very successful in other states.

One of the primary items that remain to be completed is determining how 23 CFR 772 Procedures for Abatement of Highway Traffic Noise and Construction Noise applies to this activity.

We have reviewed Section 772 and believe that operational strategies and activities fall into what is defined as a Type III project and therefore does not require a noise analysis or abatement measures. The following provides supporting information on how we come to this conclusion and the purpose of this letter is to request your concurrence.

It is clear that Section 772 will typically apply to this type of activity based on the 772.7 because we will likely use Federal-aid highway funds to carry out a variety of operational strategies. When reviewing the definition of a Type I project we find the following:

(1) The construction of a highway on a new location. BOSS will not involve construction of a highway on new locations, only signs installed on u-channel posts will be added.

(2) The physical alteration of an existing highway that includes a substantial horizontal or vertical alteration. We will not be changing the horizontal or vertical alignment of I 40 and no physical alterations will be made other than adding signs. BOSS will horizontally shift noise sources (buses) no more than 12 feet closer to any noise receptor; therefore, it will not halve the distance between the traffic noise source and any noise receptor. We do not believe BOSS meets the definition or intent of this definition of a Type I project.

(3) The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a HOV lane, HOT lane, Bus Lane, or truck climbing lane. We will not be adding an additional lane. We will allow transit busses with trained drivers to use the existing paved shoulder for subservient use only

MAILING ADDRESS:
TRANSPORTATION MOBILITY AND SAFETY DIVISION
1561 MAIL SERVICE CENTER
RALEIGH NC 27699-1561

TELEPHONE: 919-773-2800
FAX: 919-771-2745

WEBSITE: WWW.NCDOT.ORG

LOCATION:
750 NORTH GREENFIELD PARKWAY
GARNER NC 27529

when traffic speeds drop below 35 mph. Since we are not adding a lane, we do not believe BOSS meets the definition or intent of this definition of a Type I project.

(4) The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane. We are not adding an auxiliary lane. Nothing will be added except for signs. BOSS is subservient use of an existing shoulder; therefore, we do not believe BOSS meets this definition of a Type I project.

(5) The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange. This is not applicable to the BOSS activities.

(6) Restriping existing pavement for the purpose of adding a through –traffic lane or auxiliary lane. We will not be restriping to narrow travel lanes in order to add additional capacity. The number of travel lanes and shoulders will remain constant and the pavement markings will remain in place. We also believe this definition applies where the existing pavement is used to add substantial new capacity. The BOSS program will not add to the overall capacity of the roadway; however, it will provide an operational advantage to mass transit.

(7) The addition of a new or substantial alteration of a weight station, rest stop, ride-share lot or toll plaza. This is not applicable to the BOSS activities.

The definition of a Type II project is a Federal or Federal-aid highway project for noise abatement on an existing highway. NCDOT does not have a Type II Traffic Noise Policy and does not participate in Type II projects. This definition is not applicable to the BOSS activities.

In addition to our understanding that BOSS does not meet the definition of a Type I project, we also considered the overall intent of the noise abatement, which we believe is to identify and reduce increased noise impacts resulting from highway projects. In the case of the BOSS program, buses will not be allowed to travel greater than 35 mph on the existing shoulder and will only be allowed when operating speeds drop below 35 mph. Through discussions with Greg Smith, NCDOT's Traffic Noise & Air Quality Group Leader, we understand that the level of traffic noise generated at 35 mph is approximately half of that produced with the same traffic mix at 65 mph. Consequently, when BOSS becomes active, traffic noise levels are approximately half of those under normal traffic operating speeds. Any traffic noise analysis performed for BOSS operational conditions would certainly indicate a significant decrease in predicted noise levels, not a predicted increase, for which 23 CFR 772 was intended to address.

In summary, we believe that the BOSS program is an operational project that does meet the 23 CFR 772 definition or requirements of a Type I project. Therefore, BOSS and other operational projects are Type III projects and do not require a noise analysis or abatement consideration under the same CFR.

Thank you for reviewing our findings. Let me know if you concur or if you need additional information concerning our review of the BOSS program.

Sincerely,

J. Kevin Lacy, PE
State Traffic Engineer

JKL

cc: Wally Bowman, PE,
Deborah M. Barbour, PE
Clarence Coleman, PE,
Meredith McDiarmid, PE,
Greg Smith, PE

5/9/12 Clarence W. Cole

MAILING ADDRESS:
TRANSPORTATION MOBILITY AND SAFETY DIVISION
1561 MAIL SERVICE CENTER
RALEIGH NC 27699-1561

TELEPHONE: 919-773-2800
FAX: 919-771-2745

WEBSITE: WWW.NCDOT.ORG

LOCATION:
750 NORTH GREENFIELD PARKWAY
GARNER NC 27529

Appendix G: BOSS Peer Review

CAMPO
NC Capital Area Metropolitan Planning Organization

GO Triangle

Triangle Region Bus on Shoulder Study

Peer Review Technical Memorandum

STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

DURHAM - CHAPEL HILL - CARRBORO
DCHC
Metropolitan Planning Organization
Planning Tomorrow's Transportation

October 2020

Contents

Figures

Tables

Introduction

The North Carolina Capital Area Metropolitan Planning Organization (CAMPO) and its partners, GoTriangle, , the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC-MPO), and the North Carolina Department of Transportation (NCDOT) initiated a study to create a programmatic approach for identifying, prioritizing, and developing best practices for Bus on Shoulder Systems (BOSS) deployment in the Triangle, and across North Carolina. The initial task involved soliciting feedback from the Technical Steering Committee (TSC) to understand how the current BOSS corridor is functioning - including what is working, what is not working, and what are some of their interests for expanding and enhancing the BOSS. Additionally, the TSC selected three peer review states to research—California, Florida, and Minnesota. This Technical Memorandum (TM) is the result of the peer reviews of California, Florida, and Minnesota, guided by the topics and questions generated from the initial TSC meeting as well as innovative design and operating concepts. The TM concludes with a discussion of the implications of this peer review for North Carolina, and some early insights that may be explored in detail in later portions of this study.

California

California has been evaluating the feasibility of freeway and arterial bus on shoulder strategies since the early 2000s. For a variety of reasons, pilot programs for Bus on Shoulder have been the state's focus rather than the implementation of permanent BOSS strategies. The San Diego region implemented a successful Pilot in San Diego in 2005-2009. This Pilot was initially intended to temporarily provide transit service as a permanent passenger rail solution was under construction. Once the passenger rail was implemented and operating, the BOSS Pilot was discontinued. The success of the initial 2005-2009 pilot project prompted both state and regional agencies to consider other BOSS pilots. This Pilot was also the impetus for generating more statewide interest in the potential for BOSS solutions, not only in San Diego but across the state. In 2020, regional and state agencies across California are evaluating and implementing BOSS Pilots, evaluating the BOSS and corridor feasibility, and implementing permanent BOSS solutions to bypass congestion, enhance person throughput, and improve travel time reliability. Because BOSS is a low-cost solution to improving travel time, California is utilizing BOSS to complement longer-term and higher-cost corridor solutions such as managed lanes and bus rapid transit (BRT) projects. The placement of park and ride lots, the combination of street-level and freeway bus stops, use of ramp metering, and vehicle-to-infrastructure technology are examples of how California has enhanced their BOSS systems.

Design

Design Standards: California does not have currently have official statewide or regional standards for all elements of BOSS design. The California Department of Transportation (Caltrans) is currently developing statewide guidelines, while regional agencies such as the Association of Monterrey Bay Area Governments (AMBAG), San Diego Association of Governments (SANDAG), and (San Francisco Bay Area) Metropolitan Transportation Commission (MTC) have developed or are currently developing BOSS feasibility documents for corridors and systems. Without legal authority, California's state and regional agencies are treating all BOSS strategies as Pilots which allow the temporary use of shoulders on California's state transportation system. Due to the lack of standards and legal authority, BOSS design studies for pilots tend to be regionally-specific about all design elements. Shoulder widths range from 10 ft. to 12 ft., BOSS strategies predominantly consider outside shoulder use, and corridor strategies tend to be low-tech using static signage and some striping to note shoulder usage by buses.

Operations

Operating Protocols: Due to the lack of BOSS standards at both the statewide and regional levels in California, BOSS operating protocols and features tend to be developed independently by agencies as part of their system or corridor study analysis. While this tends to be the case, California agencies use the

Minnesota DOT BOSS Program as the guidance for developing BOSS operating protocols for pilot programs developed statewide. In this process, California agencies also ensure that the unique characteristics of the traveling public and facilities under evaluation are integrated into the system or regional BOSS under analysis. For example, in the San Francisco Bay Area, bus operators can move to the shoulder when the general purpose lanes are traveling at less than 35 miles per hour, which is the Minnesota BOSS standard. However, the operating hours for a BOSS corridor under design in the San Francisco Bay Area are 5 AM to 8 PM to be consistent with the region's managed lanes hours. The operating hours for BOSS in Minnesota are focused on the morning and afternoon peak commuter periods of travel.

Funding, Prioritization, Implementation

Pilot to Permanent: To date, the BOSS strategies in California have included the 2006-2009 transit-only lane pilot in San Diego, which was discontinued after the permanent passenger rail project was constructed in the corridor. The current San Diego BOSS Pilot is also considered a Transit-Only Lane strategy with the potential to convert this Pilot into a permanent solution in the future. The San Francisco Bay Area is in the process of designing and implementing BOSS Pilots for two major freeway corridors, currently intended as temporary strategies with the potential to convert to permanent solutions in the future if warranted. The San Francisco Bay Area also recently conducted a BOSS study to identify feasible BOSS corridors for design and implementation which was used to identify several additional locations for BOSS feasibility analysis and planning. Permanent BOSS facility design will soon be underway for a freeway corridor in the Monterey-Santa Cruz region (California's Central Coast).

Florida

Florida implemented their first BOSS pilot project in 2007 operating on a 9-mile stretch of the Don Shula Expressway and the Snapper Creek Expressway in Miami. Due to the success of the three-year project, it was extended in 2010 and is still in operation today. In 2015, the Florida Department of Transportation (FDOT) initiated a study to develop statewide guidance and criteria for BOSS operations in Florida. The statewide guidance was developed as a one-stop-shop for agencies to use to evaluate appropriate locations for BOSS projects, providing checklists for project justification, design criteria, operating criteria, implementation, and post-implementation of BOSS. Since the statewide guidance has been in place, the state has two planned BOSS projects, one in Tampa which has moved into construction, and a second project in Miami that is slated to move into construction in July 2022.

Design

Shoulder Features

Width: The Statewide Guidance document indicates that the minimum width criteria for BOSS is 10 feet with no barrier and 11.5 feet with a barrier which was determined through a peer review of other systems. However, when designing the pilot projects, the transit agencies suggested that they preferred an 11.5 ft. shoulder minimum to emulate a general purpose lane and ensure safety and comfort for the bus operators. In Tampa, the minimum shoulder width is being accomplished through the shifting of the general purpose lanes toward the median and adding pavement to provide a full-depth shoulder in the existing right-of-way. While the project is more costly than running buses on an existing 10 ft. shoulder, when compared to the construction of a transit-only lane, the BOSS solution is significantly cheaper and less involved.

Inside versus Outside: Bus on shoulder operations can utilize the inside shoulder (left) or the outside shoulder (right) and it is dependent upon the corridor features and transit operations. The planned projects in Florida are a primary example. The Tampa project will utilize the outside shoulder due to the length of the route. The bus is operating on the shoulder for five miles to improve regional connectivity from St. Petersburg to downtown Tampa, exiting northbound via a right-hand exit. The bus will make an interim stop at a park and ride lot and merge back onto the interstate continuing to the final stop.

The Miami project will utilize the inside shoulder for similar reasons. The buses will travel on the inside shoulder in the eastbound direction and exit to the left. Although this is a short, three-mile segment across a causeway connecting Miami to Miami Beach, the eastbound travel time is time-sensitive for the commuters during the AM peak period traveling to Miami Beach to work at hotels and restaurants. The bus will be required to maneuver across three lanes westbound to exit via a right-hand exit.

Rumble Strips: Rumble strips exist along the shoulder as a safety precaution for vehicles drifting out of the travel lane and therefore should not be removed. However, when planning for BOSS operations, it was decided that the rumble strips would create an unpleasant ride for both the bus operators and riders. The FDOT assessed moving the rumble strips to the center of the shoulder to allow the bus to straddle the rumble strips. After review, it was determined this would result in a safety deficiency for the corridor. FDOT took an innovative approach and plans to install profile thermoplastic along the edge line of the travel lane which provides the safety of the original rumble strips while allowing the bus a smooth ride. The profile thermoplastic will be used installed in Tampa and Miami and is likely to become a standard for future BOSS corridors.

Operations

Maintenance: Maintaining the BOSS corridor is critical to the success of BOSS operations. FDOT suggests that the shoulders used for bus operations be swept and cleared of debris at the same level as the general purpose lanes. The Department has a maintenance contract which will be expanded to include clearing the shoulders as appropriate. Additionally, the FDOT Road Rangers patrol congested areas and high incident locations of the freeway, and provide a direct service to motorists by quickly clearing travel lanes of minor incidents and assisting motorists. The Road Rangers will assist in BOSS operations by ensuring disabled vehicles and debris are removed from the shoulder in a quick and efficient manner.

Funding, Prioritization, Implementation

Selection of BOSS Projects: The FDOT developed a prescriptive approach to selecting BOSS projects which relies on the transit agency to initiate and propose the need for BOSS operations. The Department has established a set of minimum thresholds for consideration of BOSS to ensure it is justifiable for the proposed corridor. The established minimum thresholds for consideration of BOSS are:

- Limited access facility;
- Congested speeds of 35 mph for > 15 minute periods at least one day per week;
- Six buses operating on the facility per day;
- Projected Increase in ridership by >10%;
- Improved travel times along the routes >20%; and
- Minimum 10 feet shoulder width where there is no barrier, minimum 11.5 feet width where there is a barrier.

The minimum thresholds may not be met at the time of proposal but the agency is required to assess the future conditions of the corridor to determine if the thresholds will be met in the next 3-5 years. Once the project justification and thresholds have been met or will be met, the transit agency must develop a concept plan consisting of a general project description, information on potential BOSS segments and preliminary estimates of potential benefits in terms of running time savings, schedule reliability improvements, and increased ridership. The justification and operational analyses can then be taken to the Department to gain support and request approval to proceed with planning for BOSS operations. If approved, the Department will participate on the BOSS team and funding will be programmed for shoulder improvements as appropriate.

Incremental Implementation: Bus on shoulder can be implemented as a low-cost solution with minimal impacts to the current infrastructure. A low-impact implementation BOSS would run buses on the existing shoulder, merge at pinch points, and use static signage which would cost roughly $1,000 per mile. The project can be improved with time and resources which may include adding shoulder pavement during a planned and programmed resurfacing project for a low-medium implementation project or fully build out shoulders and structures for a high implementation project. A high implementation project would cost over $1,000,000 per mile. The costs are dependent upon the corridor features and are based on the type of signage, technology, structures present, etc. The figure below provides the incremental implementation alternatives.

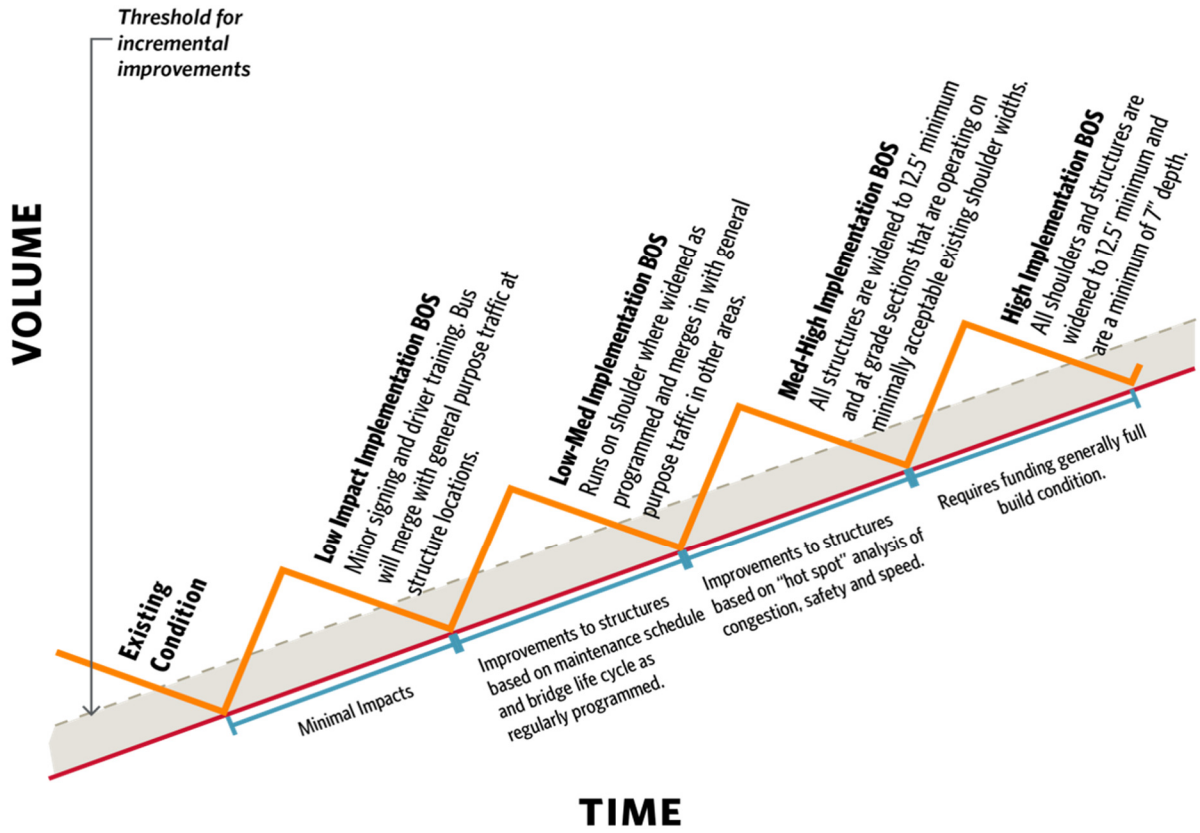


Figure 1. Incremental Implementation Alternatives

Public Awareness and Engagement

Demonstration Video: There are a variety of strategies to make the public aware of the new BOSS service(s). The FDOT worked with the Pinellas Suncoast Transit Authority (PSTA) to develop a short video demonstrating how the buses will operate on the 5-mile BOSS segment from St. Petersburg to downtown Tampa. The video provided the justification for running buses on shoulder, basic design characteristics, and operating requirements to ensure the public understood the who, what, when, and why.

State Patrol Escort: The BOSS team for the Florida project includes the state and local police to ensure buy-in from the troops who will be enforcing the BOSS operations. During the first two weeks of BOSS operations, the state highway patrol will serve as an escort for the buses operating on the shoulder.

Minnesota

Minneapolis-St. Paul, Minnesota is often considered the prototype system for bus on shoulder. What began as a low-cost, congestion relief solution on an arterial highway, soon developed into a robust network after a severe flood in 1993 shut down a major bridge that crossed northbound Interstate 35 (I-35). The DOT needed a quick way to gain more access on the alternative route bridges to continue moving people and cars. Realizing the potential of the BOSS concept, the program continued and has expanded over the past 20 years into a comprehensive BOSS network with over 400 miles of roadways, including along four major interstates. Since the beginning, Minnesota has continued to keep the BOSS projects in operation.

Design

Outside Shoulders: Metro Transit, SouthWest Transit, Minnesota Valley Transit Authority, Maple Grove Transit and Plymouth Metrolink all use and benefit from the extensive bus-only shoulders in the Twin Cities Metropolitan Region. Working side by side with the Minnesota Department of Transportation (MnDOT) and the State Patrol, bus shoulders were created using the existing shoulder infrastructure as much as possible. Design typically consists of only static signage and reconstruction of catch basins to eliminate the sump and to stiffen up the area around the structure with additional concrete. MnDOT has created a standard plate for this application. Where shoulders have been rebuilt as part of a larger mainline preservation project, and there is a current bus only shoulder, a 7-inch bituminous section is considered, depending on the number and frequency of buses. This provides a thicker section than the standard 3-inch section.

Bus-Only Ramps: With a robust bus-only shoulder network, the Minnesota Metro transit agencies along with MnDOT have implemented additional travel time saving measures for bus travel off the freeway system by allowing buses to exit and enter park and rides to/from freeway exit and entrance ramps. These slip ramps have been incorporated at a number of locations, eliminating the wait times at intersections.

Layover Areas: Integrating a full range of ideas into the transit network provides a more complete system. Bus layover areas provide opportunities to position the fleet of buses to better serve their customers. By eliminating the need to return to the bus garage after their shift, buses can remain closer to their starting destinations, creating a better work environment for the drivers and less stress. Recognizing these opportunities in the available right of way is a great partnership between agencies.

Inline Stations: The Metropolitan Council, the regional planning agency for the Twin Cities area, has been aggressive in implementing arterial and freeway Bus Rapid Transit. With a series of active lines, including the Orange Line designated to run along I-35W and the Red Line running on Trunk Highway 77 (TH 77), a number of “Inline Stations” have been constructed. Two center-running stations on I-35W and one center station on TH 77 have been or are under construction. With a re-thinking of light rail transit (LRT) in many corridors, additional bus amenities such as these make buses using a combination of BRT, BOSS, and mixed traffic facilities a comparable alternative.

Operations

Arterial BOSS: The implementation of bus-only shoulders is not limited to freeways or interstates in Minnesota. Buses running on arterials or expressways with signals also benefit from BOSS operations. Most of the advantages occurring with “queue jumping” at signals. Minnesota has several arterials that are utilizing shoulders with great success and minimal accidents.

Figure 2. Arterial BOSS with Inline Stations

Funding, Prioritization, Implementation

BOSS Team: In the early 1990s, Metro Transit was experiencing decreasing ridership and travel time reliability due to congestion, and MnDOT was faced with the challenge of relieving congestion and providing better service opportunities with little investment. These problems combined with the pressure from the Metropolitan Council to promote transit led to the Center for Transportation Studies (CTS) at the University of Minnesota to host a workshop to develop innovative solutions to congestion in the Twin Cities. Stakeholders at the workshop included MnDOT, Metro Transit and other transit agencies, and transit advocacy groups. The workshop led to the development of Team Transit. Team Transit consists of CTS, the Minnesota State Patrol, representatives from the Twin Cities and other municipalities served by transit, MnDOT, and Metro Transit. Initial support for Team Transit came from the Commissioner of Transportation and the former Commissioner of Transportation. These high-level individuals sent the message that bus on shoulder was possible and the focus should not be on identifying obstacles to implementation but rather finding ways to overcome the obstacles. As Team Transit became a permanent entity, involvement and responsibilities shifted to a Team Transit project manager from MnDOT who worked with Metro Transit, primarily Metro Transit Facilities Manager, to identify potential locations and secure funding for bus-only shoulders.

The development of Team Transit required MnDOT to become more involved in transit and changed the philosophy of the Department. In the past, MnDOT was not involved in transit because federal funding could not be allocated to transit projects. With the development of the team, MnDOT and Metro Transit sat at the table and began working together to implement transit advantages. The two entities originally had separate project managers, however, Team Transit realized the need for one contact person for BOSS and a full-time position was funded by MnDOT. The partnership between MnDOT and Metro transit provided the long-term support BOSS efforts needed to become part of the transportation system. Also, MnDOT began considering BOSS during construction and reconstruction of roads which led to a more efficient use of funds. Team Transit continues to work together and emphasizes the need for BOSS champions within all stakeholder groups. The Team meets every three months to discuss transit needs and to review planned MnDOT projects. The transit providers in the Twin Cities continue to identify where transit advantages are needed and if feasible, advantages are integrated into MnDOT projects.

Dedicated Funding Source: With several successful projects and showing a willingness to be creative, the State Legislature passed a bill that dedicated a portion of the Transportation Budget specifically to Team Transit projects. Criteria was established for types of projects, with accountability back to the legislature. FTA funding including Urbanized Area Formula Program (Section 5307) and Capital Program for Fixed Guideway Modernization (Section 5309) provided additional funding for operational costs. Metro Transit

received funding through the Congestion Mitigation Air Quality Improvement Program (CMAQ), which is jointly administered by the FHWA and the FTA. Money from CMAQ was used for regional transportation improvements that provided transit advantages, including ramp-meter bypasses and park and ride facilities.

Bus on Shoulder System Characteristics

Table 1. Key Characteristics of BOSS Systems

BOSS System Location (Opening Year)	Type of Roadway	Shoulder Used/Width	Authorized Users	When are BOSS Operations Permitted	Max. Shoulder Operating Speed	Public Education
San Diego, California (2005)	Interstate and arterials	Right shoulder (outside); Minimum 10 ft.	Trained bus operators	When general purpose lanes slow to 35 mph	15 mph faster than general purpose lanes; 35 mph maximum	Broadcast and print media, online information
San Francisco Bay, California (in design)	Interstate	Right shoulder (outside); Minimum 10 ft.	Trained bus operators	When general purpose lanes slow to 35 mph; 5AM-8PM	15 mph faster than general purpose lanes; 35 mph maximum	News media, print media, social media, information on transit agency website
Minneapolis-St. Paul, Minneapolis (1991)	Over 400 miles of interstates and state highways; arterials	Right shoulder (outside); Minimum 10 ft.	Metro Transit (fixed route), Transit Team (paratransit), and registered charter buses	When general purpose lanes slow to 35 mph	15 mph faster than general purpose lanes; 35 mph maximum	A public campaign was conducted when the Twin Cities initially implemented BOSS. This involved some short media ads about yielding to buses on shoulders and billboards in the corridors running BOSS. They have not had any new engagement for 10+ years since things are now more common place in Minnesota.
Miami, Florida (2007)	State limited access toll roads (Don Shula	Right shoulder (outside); Minimum 10 ft.	Trained MDT bus operators	When general purpose lanes slow to 25 mph	15 mph faster than general purpose lanes;	News media, print media, social media, press releases on transit agency website

	Expressway and Snapper Creek Parkway)				35 mph maximum	
Miami, Florida (in design)	Interstate	Left shoulder (inside); 11.5 ftt.-12 ft.	Trained MDT bus operators and trained Miami Beach Trolley bus operators	When general purpose lanes slow to 35 mph	15 mph faster than general purpose lanes; 35 mph maximum	Broadcast and print media, online information, special mailings to existing SunPass users, as well as a wide variety of targeted strategies to reach people in the communities most likely to use the facility, police escorts during first two weeks of operations
Tampa, Florida (under construction)	Interstate	Right shoulder (outside); 11.5 ftt.-12 ft.	Trained PSTA bus operators	When general purpose lanes slow to 35 mph	15 mph faster than general purpose lanes; 35 mph maximum	Broadcast and print media, online information, educational video of bus operating on the shoulder and explaining the rules of BOS as well as the BOS route

Peer Review Implications and Recommendations for North Carolina

1. **NC Transit Agencies Should Act as BOSS Catalysts:** Drawing on Florida's example, the study partners should consider establishing a formal process where any North Carolina transit agency can submit a BOSS proposal to NCDOT and their MPO. While there are many facilities in the region that may fit the physical requirements for BOSS, those where a reasonable transit market exists will most likely to be successful. Aligning the interest of the transit agency in the process with travel time savings for their customers should help elevate the most-needed BOSS candidate segments for consideration. If any MPO or NCDOT has a proposal for a BOSS facility, they should bring it to the transit agency that would be the most logical to submit the project, and request that the transit agency make a submittal.

2. **Establish a BOSS Team in Each NC Metro Area with BOSS Projects:** Developing a BOSS team consisting of all area stakeholders including the DOT, Expressway Authorities, transit agencies, MPOs/ TPOs, Federal Highway Administration (FHWA), state and local law enforcement, traffic Incident management; and local jurisdiction representatives is key to the success of the project. It is important to get buy-in from all parties to ensure stakeholder responsibilities are defined and agreed upon. To avoid the varying standards by metro area that have emerged as part of California's experience, once a transit agency has submitted a promising BOSS project, NCDOT should lead the formation of a BOSS team in that region. As in Minneapolis, a BOSS Champion should be identified at all participating agencies. We recommend having both a Highway Division-level BOSS Champion in every active BOSS region, as well as developing a Statewide BOSS Champion, perhaps within the Transportation Planning Branch of NCDOT.

3. **Identify Processes to Screen for "Low Hanging Fruit" BOSS Projects:** BOSS is intended to be a low-cost, easy to implement solution to improve travel time reliability of transit buses. Therefore, corridors should be selected that currently have buses utilizing the roadway facility which encounter congestion frequently, especially during peak periods, and 10 foot shoulders. These corridors will not require infrastructure improvements in the near-term. Static signage and minimal pavement markings can be used throughout the corridor which costs roughly $1,000 per mile. NCDOT, the MPOs, and transit agencies should identify moments in funding processes, from LAPP at CAMPO or STP-BG at DCHC, to small dollar investments in safety – that can use methods from this study to identify these ultra-low capital implementation opportunities.

4. **Use Highway Scoping Processes to Generate BOSS Pilots**: As California demonstrates, BOSS can be used as a short-term solution to congestion while transit-only lanes, BRT, or managed lanes are being planned and programmed. This provides relief to the corridor quickly with little effort. NCDOT should amend its scoping processes for highway projects to include a consulting step with transit agencies to determine if a temporary BOSS Pilot during a construction project would be appropriate.

5. **Recognize BOSS Benefits in Park and Ride Lot Evaluation in SPOT:** Connecting BOSS systems with park and ride lots encourages use of transit by choice riders. The most effective use of park and ride lots is to have them right off the interstate where the bus can easily exit, stop at the park and ride, and merge back on the interstate facility. In the future, an inline station could be developed to remove the need for buses to exit the interstate to save travel time. In the near term, NCDOT should consider amending the SPOT criteria for park and ride lots to add criteria that take into account synergy with BOSS facilities.

Conclusion

Bus on shoulder systems have been in operation is the US since the 90s. As the oldest and most developed BOSS network, the Minneapolis- St. Paul system remains the prototype system to date, and most BOSS systems follow the same design and operating criteria. BOSS outside of Minneapolis-St. Paul is often implemented as a short-term, low-cost solution to congestion prior to the construction of BRT and managed lanes. Given the short-term use of BOSS, most systems utilize the existing infrastructure, static signage, and minimal pavement markings. The more advanced BOSS systems have park and ride lots, inline stations, dedicated bus ramps, and vehicle-to-infrastructure technology.

The current North Carolina BOSS system is very similar to the Minneapolis system in terms of design and operating criteria. While the twin cities have a much more robust system with nearly 400 miles of BOSS, NC has the potential to create a larger BOSS network with time and resources. While there have been intermittent engagements on the future of BOSS in the Triangle over the past decade, the current study presents an opportunity to form a more enduring BOSS team. The BOSS team in Minneapolis is the primary reason MnDOT has been so successful in expanding their system. While CAMPO is leading the effort to identify subject roads, the support of the area MPOs, DOT, transit agencies, state patrol, etc. on the technical steering committee, indicates that there are champions for BOSS.

Given the success of the current system which runs on 10-foot paved shoulders, uses static signage and minimal pavement markings, these will remain the minimum design requirements. NCDOT is designing new roadways with fully built out the shoulders (12 ft.) which is desired as it emulates a general purpose lane. As part of the incremental approach which was discussed in the Florida review, NCDOT and partners can advance their network over time with the addition of park-and-ride lots, ramp metering, dedicated bus ramps, and other improvements.

Shelby Powell – Deputy Director

NC Capital Area Metropolitan Planning Organization

421 Fayetteville Street
Raleigh, NC 27601
(919) 996-4393
Shelby.Powell@campo-nc.us

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DATE: July 28, 2021

TO: DCHC MPO Board
FROM : Aaron Cain, MPO Staff
SUBJECT: D-O LRT Corridor in CTP

Summary. The Durham City-County Planning Department has brought to the attention of DCHC MPO staff an issue regarding reservation of land along the former Durham-Orange Light Rail Transit (D-O LRT) corridor. Durham's Unified Development Ordinance requires that land needed for future transportation corridors identified in the Comprehensive Transportation Plan (CTP) must be reserved through its development review process. The Durham City-County Planning Department, on behalf of the City of Durham, has requested that the D-O LRT corridor be removed from the CTP as part of Amendment #3. GoTriangle staff has resisted this request as it could eliminate an important future transportation corridor between Durham and Chapel Hill that could be repurposed for another technology such as bus rapid transit (BRT).

The TC is asked to discuss and provide guidance to MPO staff as it finalizes CTP Amendment #3, which is expected to come before the TC for a recommendation in August and to the Board for adoption in September.

Background. In 2017 the DCHC MPO Board adopted its first CTP in conjunction with the North Carolina Department of Transportation (NCDOT). One element that was included in the CTP was the Locally Preferred Alternative (LPA) alignment for the D-O LRT. In 2019, the D-O LRT project was discontinued and no further work has been done to advance the project. However, the D-O LRT corridor remains identified in the DCHC MPO Comprehensive Transportation Plan (CTP) as a possible future transit corridor.

The Durham City-County Unified Development Ordinance (UDO) states that land for transportation corridors identified in the CTP must be reserved when a site plan or rezoning with a development plan is requested on the property. The Durham City-County Planning Department has stated concerns about this requirement and its application to the 2016 North Carolina Supreme Court case *Kirby v. NCDOT* (56PA14-2), in which the court determined that NCDOT's use of the Map Act was an unconstitutional taking and required NCDOT to compensate landowners for property held in reserve for future transportation projects. The City of Durham is concerned about the continued enforcement of this exaction for a project which is widely known to no longer be viable, and for which no specific future use of the corridor has been identified in an adopted plan. Therefore, the City, and potentially the County, are vulnerable to civil action that could have substantial financial implications.

Conversely, GoTriangle has identified the D-O LRT corridor as a possible future BRT corridor serving Durham and Chapel Hill, particularly the off-road segments that could greatly aid future transit timeliness and efficiency. Loss of access to this corridor could have detrimental effects on future transit development between Durham and Chapel Hill. While no specific project has been identified, the Durham Transit Plan is expected to be concluded within the next six months, and may identify high capacity transit between Durham and Chapel Hill as a primary need for which further study can locate an appropriate route, which could include this corridor. If the D-O LRT corridor is removed from the CTP, due to the amount of development occurring between Durham and Chapel Hill along US Highway 15/501, access to the land for the corridor that is not currently within public right-of-way is unlikely to be available again without the costly condemnation of structures and utilities.

This issue is not applicable to the Town of Chapel Hill because its development ordinance does not require reservation of land based on the CTP.

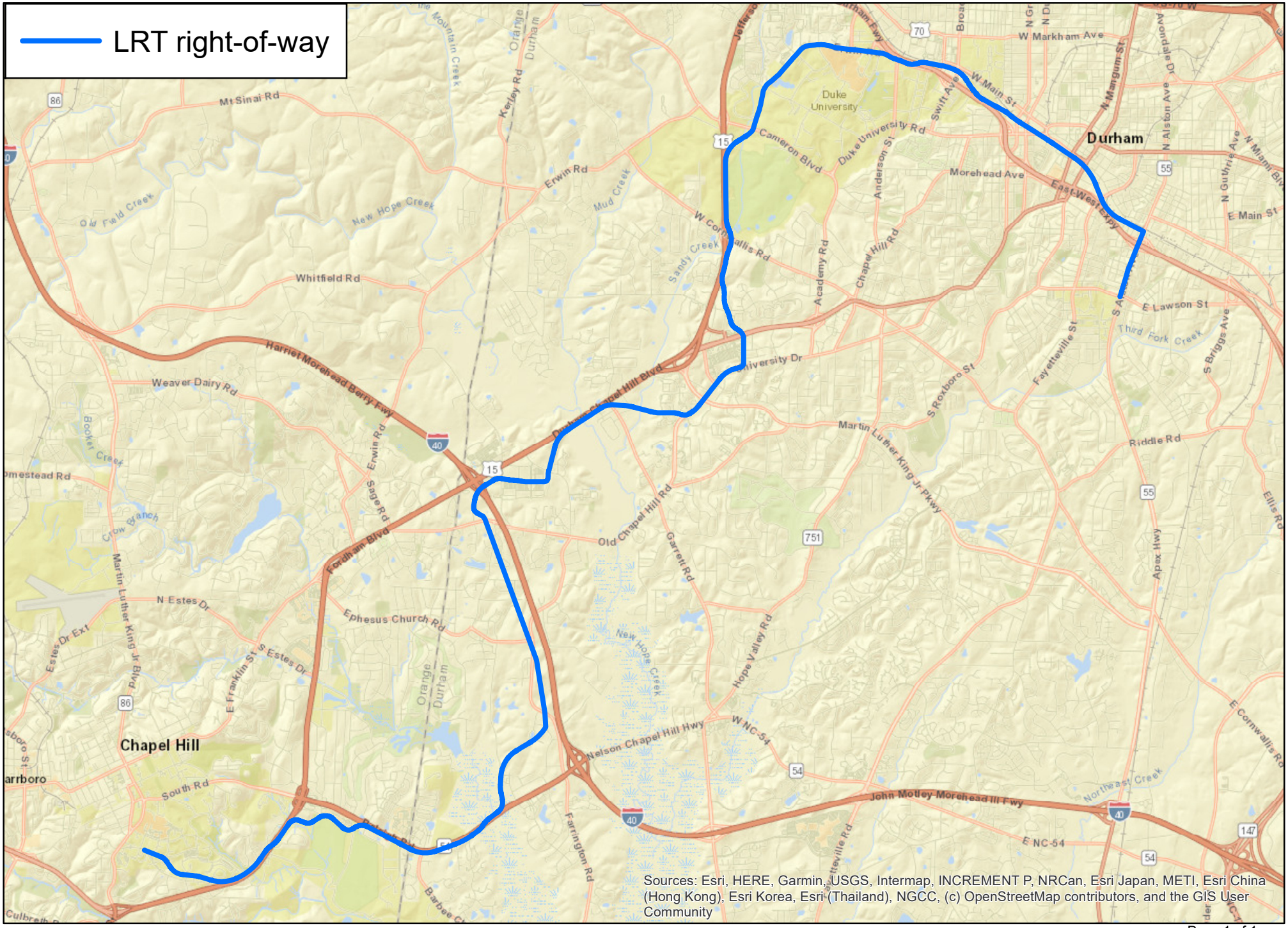
Issues and Analysis. Conversations on this issue between MPO, Durham City-County Planning, the City Attorney's Office, and GoTriangle began in spring 2021. The parties requested that the MPO staff reach out to the UNC School of Government for guidance. Adam Lovelady of the School of Government concluded that the scenario presented is directly analogous to the situation in *Kirby*, and therefore all parties are susceptible to legal action if reservations are still required for the D-O LRT corridor. There are two primary reasons for legal risk: 1) *Kirby* stated that government regulation exacting land for future transportation corridors is an eminent domain power, and not a police power, and therefore cannot be enforced without compensation within a reasonable timeframe (the court did not state in *Kirby* what that timeframe is, so there is risk for any long-term project), and 2) transit corridors also must pass the "Nollan/Dolan" tests of proportionality and rational nexus. Projects must be able to demonstrate that there will be a benefit to those who must reserve land, which is difficult to do with an undefined project. D-O LRT had an adopted Locally Preferred Alternative (LPA), had completed an Environmental Impact Study (EIS), was in the engineering phase, in the pipeline for federal funding, and had a dedicated local funding source, all of which created a definitive timeline for the project. No project is currently defined, underway, or currently being studied for the corridor, so continued reservation of land is less justifiable.

Recommendation. MPO staff recommends that the D-O LRT corridor be removed from the CTP as part of the adoption of Amendment #3. Staff furthermore recommends that language be inserted in Amendment #3 that describes future high-capacity transit corridors between Durham and Chapel Hill, and the necessity of these corridors for the future transportation needs of our region, without specifying the exact location of future facilities.

While MPO staff agree with GoTriangle that it may be difficult in the future to gain access to land not within the public right-of-way for a future transportation project, the legal risk is too great, based on the decision and potential remedy in Kirby, for it to remain. Should a future study identify a corridor and an LPA with a timeline for development, MPO staff will work to include the LPA in the CTP so that the corridor can be reserved. In addition, the MPO is open to further discussions on potential funding sources for right-of-way acquisition for the corridor.

Amendment #3 changes
LRT to BRT

DCHC MPO Comprehensive Transportation Plan (CTP)
Amendment #3 : Light Rail Transit (LRT)



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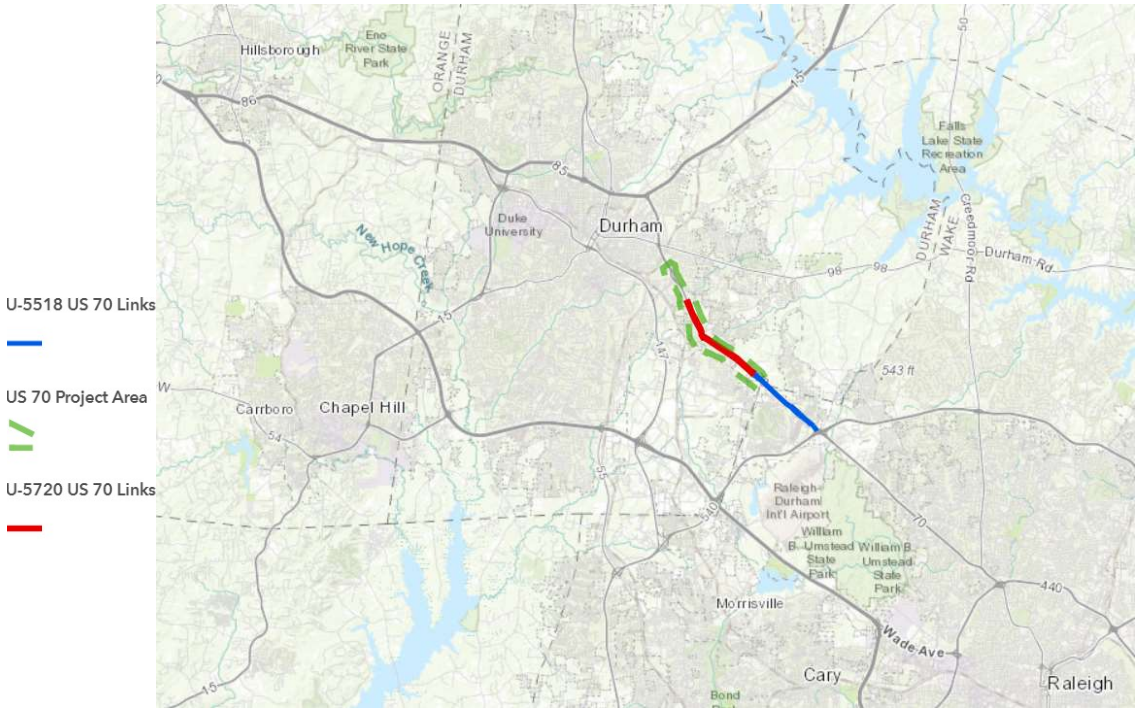
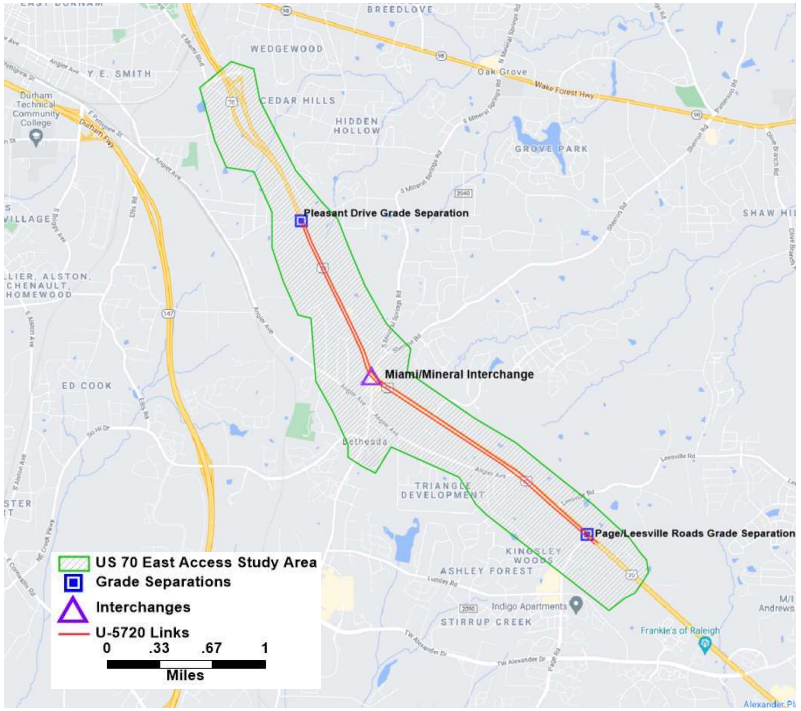
US 70 East Access and Connectivity Study

Jacob Ford, Transportation Modeler

U-5720 Background

- NCDOT STIP U-5720 conversion of US 70 from rural highway to freeway
- Wake County side of US 70 (U-5518) is proceeding ahead with environmental assessment beginning this Fall; ROW not scheduled to begin until FY 2027





US 70 Access and Connectivity

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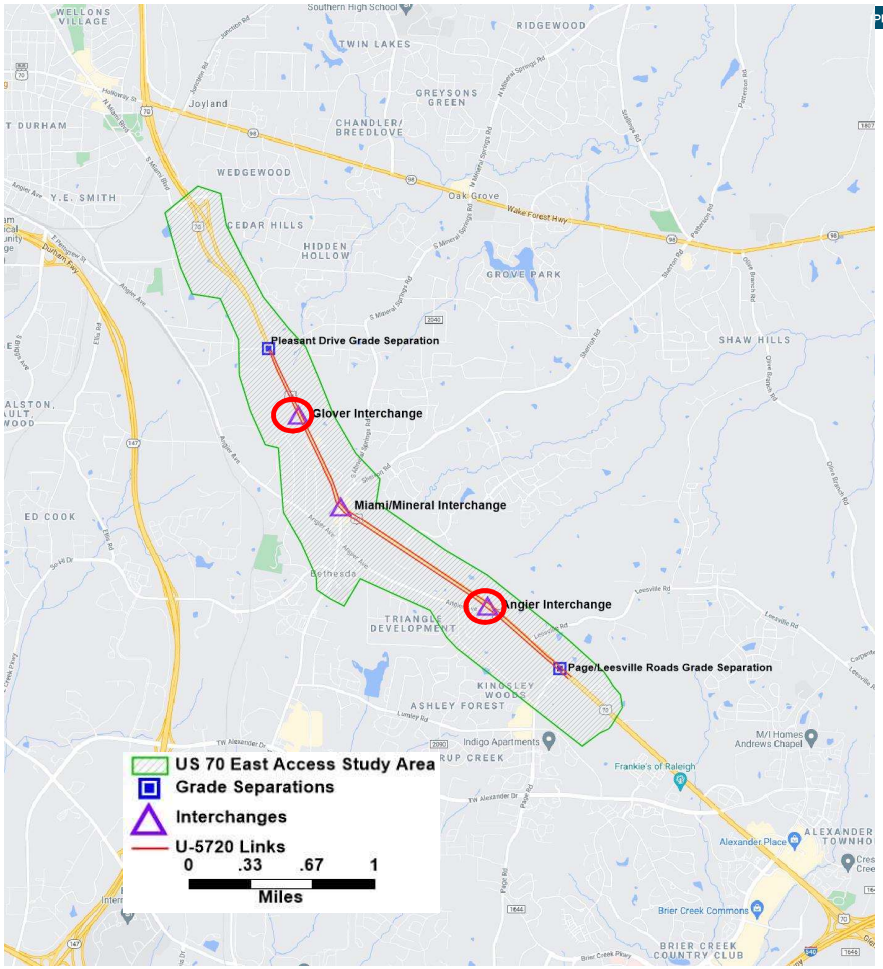
- 2045 MTP and CTP includes three interchanges, NCDOT public meeting planned only one at Miami/Mineral Springs
- City and County have requested multiple times to reconsider U-5720 to include greater number of interchanges.
- Concerns include:
  - High growth area
  - Existing businesses and communities along US 70 lose access
  - Environment Justice concerns for minority community
  - Limited Bike/Ped Access
  - Transit (GoDurham) limited drop off/pick up



Study Overview

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PURPOSE AND GOALS OF STUDY

- Analysis of existing conditions
  - Local priorities
  - Environmental impact
  - Modal access
- Future Conditions
- Public Engagement
- Alternatives evaluation
- Strategies
- Action Plan

PROJECT TIMELINE

- Developing RFI in coordination with US 70 West (Orange County) Project
  - October 2021: Project Management and Coordination
  - Spring 2022: Existing Conditions Analysis
  - Fall 2022: Public Engagement
  - Spring 2023: Final Plan
- Study approved in UPWP

Request for Board Letter to NCDOT

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- As previously mentioned, NCDOT proceeding with Environmental Assessment on Wake County portion of US 70
- Request Board endorse and send letter requesting NCDOT to delay Environmental on US 70 in order for Access and Connectivity Study to be completed in Durham County
- Study will proceed regardless of NCDOT decision
- Questions and/or Feedback

CITY OF DURHAM

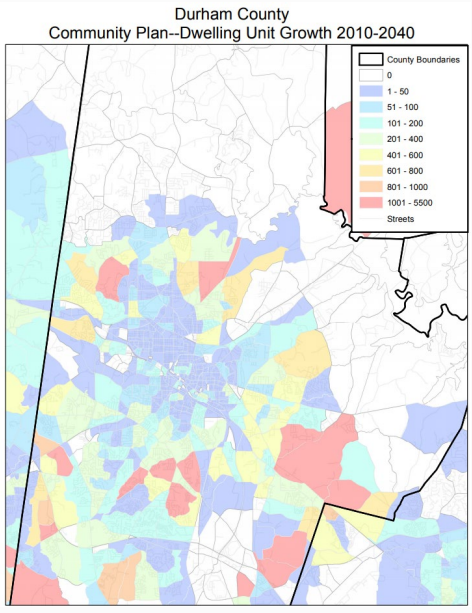
Memo

Date: November 30, 2018

To: Elmo Vance, NCDOT
Through: Terry Bellamy, City of Durham Transportation
From: Ellen Beckmann, City of Durham Transportation
Subject: U-5720 Concepts

Thank you for the opportunity to comment on TIP project U-5720, US 70 upgrade from the East End Connector to Wake County. This is a significant project for the City of Durham with tremendous implications for growth in the eastern part of Durham County and effects on how our residents travel through our community. The City has reviewed the two concepts presented at the October/November 2018 public meetings and has the following comments.

As the Triangle grows, this centrally located area along US 70 near Research Triangle Park and with easy access to Durham and Raleigh will become increasingly developed with new residents and employment. While today there are some pockets of undeveloped land along US 70 between Durham and Raleigh, with growth pressure and the anticipated completion of the City's southeast regional sewage lift station in 2021, the City expects that many of the large tracts of land will be proposed for new subdivisions and developments in the coming years. The DCHC MPO's 2040 socio-economic forecasts expect this area to be in the highest category for dwelling unit growth in the county. The US 70 project needs to be designed to anticipate and accommodate this growth including providing adequate access to existing and future residents of Durham.



The two proposals for US 70 are not consistent with the adopted DCHC MPO and NCDOT Comprehensive Transportation Plan (CTP) in their current form. The CTP envisions three interchanges along this route: Glover Road/Lynn Road extension, Miami Blvd/Mineral Springs Road, and Angier Avenue as well as grade separated crossings at Pleasant Drive and Page Road/Leesville Road. The concepts at the public meetings showed one interchange at Miami Blvd/Mineral Springs Road and grade separated crossings at Pleasant Drive and Page Road/Leesville Road. This is a significant decrease in connectivity for eastern Durham County, restricts access for residents of Durham to utilize the upgraded US 70 facility, and does not address the anticipated growth. US 70 would be a barrier for our community with this limited number of access points and connections.

In addition, the conceptual designs require that all residents in eastern Durham County will need to use the Miami Blvd/Mineral Springs Road interchange to access the facility. This is a very congested

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intersection today, and funneling all access to this interchange will likely require widening of Sherron Road, Mineral Springs Road, Miami Boulevard as well as wide, multi-lane interchange ramps that will be difficult for pedestrians and cyclists to safely traverse. It will also result in circuitous and lengthy routes for many residents to get to US 70. Distributing access to US 70 at multiple interchanges will better serve eastern Durham County residents.

We understand that NCDOT plans to conduct a Service Road Study for this project. We enthusiastically support this and request that NCDOT consult the City on this study. The concepts presented to the public did not indicate where service roads would be provided and many of our residents were puzzled about how their neighborhoods would be connected to the future road network. There are multiple options for service roads depending on which concept is selected, and the location of these service roads is also affected by the provision of the additional interchanges that we are requesting. We would like to work closely with you on determining the solution for access on US 70.

The adopted CTP also includes multiple bicycle and pedestrian facilities both along and crossing US 70. A parallel multi-use path along US 70 is included in the CTP. The path could be located along the access roads as long as these result in a complete connected facility. A future greenway is planned to cross US 70 at Leesville Road, and bicycle facilities are planned to cross US 70 at Pleasant, the Glover/Lynn Connector, Miami/Sherron, Angier, Leesville, and Page. Bicycle facilities that cross US 70 at interchanges should be separated facilities such as multi-use paths or protected bike lanes and should not be located with crossings of free-flow right-turn movements. Pedestrian facilities are recommended on all roads in Durham by policy of the CTP and our adopted pedestrian plan. Many existing pedestrian facilities exist on US 70 and intersecting roadways. The function of these existing facilities should be replaced at no cost to the City of Durham.

The following comments are specific design considerations moving from west to east along US 70. Efforts should be made to minimize impacts to the two churches at Lynn Road and US 70. There have been multiple pedestrian crashes, including a fatality in August 2018, at the crossings of Lynn Road and Pleasant Drive. Despite very poor or non-existent pedestrian facilities, there is evident desire for the public to cross US 70 at these locations. Go Durham also currently has a bus route on Pleasant Drive and US 70 that may be changed with this project, but will likely still operate in the area and pedestrian access across US 70 to the bus stops will still be needed.

The CTP includes a Lynn Road Extension that would connect Lynn Road to US 70 south of Pleasant Drive and also connect to an extension of Glover Road to the west. We are requesting that NCDOT construct this road with the US 70 project, perhaps utilizing the shown re-routing of Lynn Road in the concept plans and using it as a parallel service road. It should also include an interchange with US 70 to the south of Pleasant Drive. This interchange is critical for ensuring that the residents of east Durham have adequate access to the upgraded US 70 facility. The selection of the north or south concept should be based on which option can most easily and with the least amount of impacts include this interchange and service road.

For the Miami Boulevard/Mineral Springs Road interchange, we strongly prefer the tight diamond interchange over the single point urban interchange (SPUI). Interchange designs with free-flow right-turn movements like SPUIs or DDIs are less preferred due to the conflicts that they pose for bicycle and pedestrian traffic. The Fayetteville and I-40 SPUI is the interchange with the most crashes in Durham County, and we do not want to replicate this problem in another location. The Bethesda community along Miami Boulevard is home to many community resources such as Bethesda Elementary School,

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churches, Ruritan Club, Fire and EMS Station, restaurants, etc. While traffic congestion is a concern, maintaining pedestrian and bicycle access and neighborhood cohesion is also important in this area. A separated bicycle and pedestrian crossing of US 70 is the preferred solution at this interchange, and we suggest using the existing alignment of Mineral Springs/Miami that is expected to be abandoned for this connection.

We urge NCDOT to develop an alternative for the relocation of Mineral Springs to Sherron that minimizes the impact to existing residences. A lower design speed is encouraged, or a roundabout could be used at the point where the new road diverges from the existing road. We also recommend connecting Copper Leaf Parkway across US 70 to Angier Avenue or a service road to maintain access to the Brightleaf at the Park neighborhood.

The concept plans need to include an interchange between Miami and Page roads. The CTP envisions an interchange at Angier and an extension of Angier to the Northern Durham Parkway. This is critical to serve existing and future development. This project should also include the construction of a portion of Northern Durham Parkway to connect the existing road to US 70. There also needs to be a connection from Leesville to US 70. We are open to options that provide these connections through service roads, and we would like to explore these options further with NCDOT. Between the two concepts, the south option is preferred between Miami and Page as it provides the opportunity to use the existing US 70 as a service road to provide better access to the large undeveloped parcels on the north side.

This is a complex project with many different options for connectivity and access. We appreciate your attention to our comments and requests. We also look forward to working with you further on developing this transformational project for east Durham. The project will improve traffic congestion between Durham and Raleigh, but it should not create a barrier for residents of Durham as many freeway projects have done in the past. The residents of east Durham also need full consideration of adequate access to the roadway so they can experience the benefits of this project and not just the relocations and negative impacts. Please let us know if you have any questions about our comments on this project.

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DATE: August 11, 2021

TO: Pam Williams, Project Manager, NCDOT
FROM : DCHC MPO Board
SUBJECT: US 70 Access Study and Impact on U-5720

Dear Ms. Williams,

The Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO), in conjunction with the City of Durham and Durham County, will be undertaking a study to look at access, multimodal accommodations, and connections in the US 70 corridor from the East End Connector to T.W. Alexander Drive. This study is being scoped to be complementary to the work being done by NCDOT project U-5720, and not in conflict with the project. However, while we do not feel that this study will affect the work that NCDOT is currently doing to determine the best alignment for the new roadway, there are other aspects that may be affected and necessitate an adjustment in NCDOT's project schedule. The DCHC MPO requests that those aspects of the project be delayed to provide time for our US 70 Access Study to be completed. We request and hope that NCDOT will be an important partner in this study.

NCDOT's project U-5720 was recently unfrozen after almost eighteen months of inactivity. Though we are aware that NCDOT has recently started working on the project again, particularly doing engineering work to determine which alignment, the "northern" or the "southern" route is most appropriate, the project schedule does not have it going into ROW until FY 2027, and construction is scheduled beyond FY 2029. It seems there isn't a definitive need to complete the planning process so quickly, and the five-plus year gap between planning and ROW presents an opportunity for additional study of the corridor. There are three main purposes for this study: 1) gaining a better understanding of the local street network upon completion of the project, 2) addressing multimodal considerations, and 3) ensuring appropriate public engagement.

As has been stated to NCDOT staff in the past (see attached letter dated November 30, 2018), there is concern about resulting local traffic patterns once the project is completed due to the fact that the current proposed design includes only one direct access point to US 70 (at an interchange at Miami Boulevard) between the East End Connector and Aviation Parkway Extension. This will result in limited access for existing businesses and neighborhoods, limited connectivity of the roadway network, and limited access to US 70 for Eastern Durham County. In addition, much of the US 70 corridor is majority minority, signifying the importance of fully understanding impacts on equitable transportation. This study will examine the effects on local traffic and potential opportunities for additional access to US 70 at a finer grain than has previously been completed and can help the design for the roadway by NCDOT engineers as it moves forward.

In the work already done for U-5720, connections for all modes of traffic across and along US 70 are not explicitly addressed, including multimodal connections shown in the 2045 MTP and the CTP Amendment #3. This US 70 Access Study will also look at multimodal connections and accommodations that will allow the corridor to be as efficient as possible for all users. This includes not only the bicycle and pedestrian facilities as shown in the MTP and CTP Amendment #3, but also transit accommodations. While there is not currently an emphasis on transit service in this corridor (there is one local GoDurham route that goes to Brier Creek), there are potential opportunities for transit improvements, along with an additional regional transit service to RDU or Raleigh, as a supplement to transit work done on NC 147 and I-40. Roadway connectivity is essential for

providing shorter and more direct trips for walking, biking, and transit, and the U-5720 project has not considered the effect of the project on these modes.

Concurrently with this study, the Durham City-County Planning Department is updating the Durham Comprehensive Plan. One of the key study areas in the development of the Comprehensive Plan, due to current and expected growth, is the Southeast Durham Focus Area, through which U-5720 passes. The Southeast Durham Focus Area study is well underway, and residents have identified transportation concerns as a high priority. Both the US 70 Access Study and the Comprehensive Plan's work on the Southeast Durham Focus Area will inform the U-5720 project on how best to address these issues.

The DCHC MPO, the City of Durham, and Durham County emphasize the need for equitable public engagement for all projects, and a large project such as U-5720 is no exception. As this is a very fast-growing area in the County and this project passes through two communities of concern on the northern end of the project, special attention will need to be made for engagement on this project. The DCHC MPO, the City, and the County believe the present level of engagement for U-5720 has not been sufficient, and this proposed MPO-led study can better engage the community using a unified, coherent process for a fast-growing corridor and not inordinately delay progress on U-5720.

MPO, City, and County staff welcome an opportunity to discuss these concerns, and how the US 70 Access Study can be incorporated into the design and schedule of U-5720. Please reach out to the project manager, Jacob Ford of DCHC MPO, at Jacob.Ford@durhamnc.gov, to discuss these matters further.

Sincerely,

Wendy Jacobs
Chair, DCHC MPO

DURHAM - CHAPEL HILL - CARRBORO
DCHC
Metropolitan Planning Organization
FUNDING DATABASE

101 City Hall Plaza
Durham, NC 27701
919.560.4366

TIP Amendment Request - GoDurham Replacement Bus and Paratransit vans

Amendment Request Details

Type	TIP Modification (funding change < $1M)
Status	Initial Submission
Request Date	07/01/2021
Jurisdiction/Agency	City of Durham
Requestor	Tom Devlin
Requestor E-mail	tom.devlin@durhamnc.gov
DCHC Approval Date	

STIP	TIP 2020 - 2029 (Current)	Proposed STIP	TIP 2020 - 2029 (Current)
Amendment #	Original		
TIP #	TA-4923	Proposed TIP #	

Project Information

Project Name	GoDurham Replacement Bus and Paratransit vans
Project Description	Replacement Bus and Paratransit Van purchase. 5307 Grants
Additional Details	

Existing Project Schedule

This is the existing schedule from TIP Project TA-4923. Revisions should be made in the proposed schedule box below.

FY	Phase/Work	Funding Source	Federal Share	State Share	Local Share	Total
Prior Year	Capital	STBGDA	$3,218,400	$0	$804,600	$4,023,000
		Funding Totals:	**$3,218,400**	**$0**	**$804,600**	**$4,023,000**

Proposed Project Schedule

FY	Phase/Work	Funding Source	Federal Share	State Share	Local Share	Total
Prior Year	Capital	STBGDA	$3,218,400	$0	$804,600	$4,023,000
2022	Capital	5307 (FUZ)	$663,734	$	$165,934	$829,668
		Funding Totals:	**$3,882,134**	**$0**	**$970,534**	**$4,852,668**

Explanation for Request

To program funding for the purchase of twelve (12) Paratransit vans in FY22.

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

PUBLIC TRANSPORTATION DIVISION
FLEX Request Form

Date: 7/12/2021
MPO: Durham – Chapel Hill - Carrboro
Contact Name: Tom Devlin
Contact Email: Tom.devlin@durhamnc.gov Contact Phone: 919-560-4366 x36507

INSTRUCTIONS

- Please complete this form and save as a pdf with this name (FLEXTypeMPOAcronymTransitSystemAcronymYYYYMMDD of request), email to DOTPTDSTIP@ncdot.gov, copy Jason Wimmer, ajwimmer@ncdot.gov, 919-707-4686.

Copy the information and repeat as needed for each request.

Source of funding to be flexed (*click on the appropriate box and change default value to checked*)

☐ CMAQ (Congestion Mitigation and Air Quality)
☒ STPDA - Surface Transportation Program Direct Attributable
☐ STBGDA – Surface Transportation Block Grant Direct Attributable

FFY18-22 Federal Fiscal Year Funds were apportioned.

Source of FTA recipient funding (*click on the appropriate box and change default value to checked*)

☒ 5307 (Urbanized Area Formula Grant)
☐ 5311 (Rural Area Formula Grant)

MTIP Approval Date: (if in next two months, note) _____

STIP#	Transit Partner	Description	TrAMS Temporary FAIN	FFY of funds	Federal $ Amount	Local $ Amount	Total $ Amount
TA-4923	GoDurham	Replacement Bus/Paratransit	1060-2021-4	FFY18	$ 447,679	$111,920	$559,599
TA-4923	GoDurham	Replacement Bus/Paratransit	1060-2021-4	FFY19	$1,047,000	$261,750	$1,308,750
TA-4923	GoDurham	Replacement Bus/Paratransit	1060-2021-4	FFY20	$463,895	$115,974	$579,869
TA-4923	GoDurham	Replacement Bus/Paratransit	1060-2021-4	FFY21	$579,869	$144,967	$724,836
TA-4923	GoDurham	Replacement Bus/Paratransit	1060-2021-4	FFY22	$487,437	$121,859	$609,296

If STIP Amendment is needed, please attach STIP Amendment Form. Otherwise, please copy and paste the MTIP information.

STIP Amendment Form Attached:

☒ Yes

☐ No

Signed: _____ Date: 07/12/2021

101 City Hall Plaza
Durham, NC 27701
919.560.4366

DURHAM - CHAPEL HILL - CARRBORO
DCHC
Metropolitan Planning Organization
FUNDING DATABASE

TIP Amendment Request - GoDurham Replacement Bus

Amendment Request Details

Type	TIP Amendment (funding change ≥ $1M)
Status	Initial Submission
Request Date	07/12/2021
Jurisdiction/Agency	City of Durham
Requestor	Tom Devlin
Requestor E-mail	tom.devlin@durhamnc.gov
DCHC Approval Date	

STIP	TIP 2020 - 2029 (Current)	Proposed STIP	TIP 2020 - 2029 (Current)
Amendment #	Original		
TIP #	TA-4923	Proposed TIP #	

Project Information

Project Name	GoDurham Replacement Bus
Project Description	Paratransit vehicle and bus purchases. STPDA Grant.
Additional Details	

Existing Project Schedule

This is the existing schedule from TIP Project TA-4923. Revisions should be made in the proposed schedule box below.

FY	Phase/Work	Funding Source	Federal Share	State Share	Local Share	Total
Prior Year	Capital	STBGDA	$3,218,400	$0	$804,600	$4,023,000
		Funding Totals:	**$3,218,400**	**$0**	**$804,600**	**$4,023,000**

Proposed Project Schedule

FY	Phase/Work	Funding Source	Federal Share	State Share	Local Share	Total
Prior Year	Purchase	STBGDA	$3,218,400	$0	$804,600	$4,023,000
2023	Purchase	STBGDA	$3,025,880	$	$756,470	$3,782,350
		Funding Totals:	**$6,244,280**	**$0**	**$1,561,070**	**$7,805,350**

Explanation for Request

Flexing FY18-22 STPDA funds from FWHA to FTA to purchase three electric buses and seven ACCESS Vehicles. Temporary FTA Application is 1060-2021-4.
Year of Apportionment:
FFY18 - $447,679
FFY19 - $1,047,000
FFY20 - $463,895
FFY21 - $579,869
FFY22 - $487,437

Total Federal Share is $3,025,880.

REVISIONS TO THE 2020-2029 STIP

HIGHWAY PROGRAM

DURHAM-CHAPEL HILL-CARRBORO METROPOLITAN PLANNING ORGANIZATION

STIP MODIFICATIONS

* I-3306A **	- DURHAM-CHAPEL HILL-CARRBORO	I-40, I-85 IN ORANGE COUNTY TO DURHAM COUNTY.	GARVEE ROW	FY 2021 -	$618,000	(NHP)
ORANGE	METROPOLITAN PLANNING ORGANIZATION	WIDEN TO SIX LANES, IMPROVE NC 86 INTERCHANGE,		FY 2022 -	$618,000	(NHP)
PROJ.CATEGORY		AND INSTALL ITS.		FY 2023 -	$618,000	(NHP)
STATEWIDE		***PROJECT TO UTILIZE GARVEE BONDS. DESCRIPTION***		FY 2024 -	$618,000	(NHP)
		MODIFIED TO REFLECT CORRECT SCOPE.		FY 2025 -	$618,000	(NHP)
				FY 2026 -	$618,000	(NHP)
				FY 2027 -	$618,000	(NHP)
				FY 2028 -	$618,000	(NHP)
				FY 2029 -	$618,000	(NHP)
				POST YR-	$3,704,000	(NHP)
			RIGHT-OF-WAY	FY 2021 -	$2,400,000	(S(M))
			UTILITIES	FY 2021 -	$628,000	(NHP)
			GARVEE CON	FY 2021 -	$4,376,000	(NHP)
				FY 2022 -	$4,376,000	(NHP)
				FY 2023 -	$4,376,000	(NHP)
				FY 2024 -	$4,376,000	(NHP)
				FY 2025 -	$4,376,000	(NHP)
				FY 2026 -	$4,376,000	(NHP)
				FY 2027 -	$4,376,000	(NHP)
				FY 2028 -	$4,376,000	(NHP)
				FY 2029 -	$4,376,000	(NHP)
				POST YR-	$26,253,000	(NHP)
			CONSTRUCTION	FY 2021 -	$31,150,000	(NHP)
				FY 2021 -	$4,250,000	(S(M))
				FY 2022 -	$31,150,000	(NHP)
				FY 2022 -	$4,250,000	(S(M))
				FY 2023 -	$31,150,000	(NHP)
				FY 2023 -	$4,250,000	(S(M))
				FY 2024 -	$31,150,000	(NHP)
				FY 2024 -	$4,250,000	(S(M))
					$219,531,000	

*** INDICATES FEDERAL AMENDMENT**

** Highlighted projects were included in TIP Amendment #6.

REVISIONS TO THE 2020-2029 STIP

HIGHWAY PROGRAM

DURHAM-CHAPEL HILL-CARRBORO METROPOLITAN PLANNING ORGANIZATION

STIP MODIFICATIONS

* I-3306AC ORANGE **PROJ.CATEGORY** REGIONAL	- DURHAM-CHAPEL HILL-CARRBORO METROPOLITAN PLANNING ORGANIZATION	I-40, NC 86 UPGRADE TO SUPERSTREET FROM NORTHWOOD DRIVE TO RAMP C/D AT I-40 INTERCHANGE. ***PROJECT BREAK RE-ADDED TO SCHEDULE SUPERSTREET COMPONENT FOR SEPARATE LETTING.***	RIGHT-OF-WAY UTILITIES CONSTRUCTION	FY 2024 - FY 2024 - FY 2026 -	$550,000 $450,000 $4,350,000 $5,350,000	(NHP) (NHP) (NHP)
P-5701 ORANGE **PROJ.CATEGORY** DIVISION	- DURHAM-CHAPEL HILL-CARRBORO METROPOLITAN PLANNING ORGANIZATION	NORFOLK SOUTHERN H LINE, MILEPOST 41.7 IN HILLSBOROUGH. CONSTRUCT PLATFORM, PASSENGER RAIL STATION BUILDING, SITE ACCESS, UTILITIES AND PARKING. ***TO ASSIST IN BALANCING FUNDS, DELAY CONSTRUCTION FROM FY 21 TO FY 22.***	CONSTRUCTION	FY 2022 - FY 2022 - FY 2023 -	$3,315,000 $570,000 $3,315,000 $7,200,000	(T) (O) (T)
P-5706 DURHAM **PROJ.CATEGORY** STATEWIDE	- DURHAM-CHAPEL HILL-CARRBORO METROPOLITAN PLANNING ORGANIZATION	NORFOLK SOUTHERN H LINE, EAST DURHAM RAILROAD SAFETY PROJECT. PROJECT WILL STRAIGHTEN EXISTING RAILROAD CURVATURE BETWEEN CP NELSON AND CP EAST DURHAM AND INCLUDES A COMBINATION OF GRADE SEPARATIONS AND CLOSURES AT ELLIS ROAD SOUTH END (734737A), GLOVER ROAD (734735L), AND WRENN ***TO ALLOW ADDITIONAL TIME TO COMPLETE PLANNING AND DESIGN DELAY RIGHT OF WAY FROM FY 21 TO FY 22.***	RIGHT-OF-WAY CONSTRUCTION	FY 2022 - FY 2023 - FY 2024 - FY 2027 - FY 2027 - FY 2028 - FY 2028 - FY 2029 - FY 2029 -	$3,109,000 $3,109,000 $3,109,000 $10,891,000 $167,000 $10,891,000 $166,000 $10,891,000 $167,000 $42,500,000	(T) (T) (T) (T) (O) (T) (O) (T) (O)

*** INDICATES FEDERAL AMENDMENT**

REVISIONS TO THE 2020-2029 STIP

HIGHWAY PROGRAM

DURHAM-CHAPEL HILL-CARRBORO METROPOLITAN PLANNING ORGANIZATION

STIP MODIFICATIONS

* U-4726	- DURHAM-CHAPEL HILL-CARRBORO METROPOLITAN PLANNING ORGANIZATION	VARIOUS, DURHAM-CHAPEL HILL-CARRBORO (DCHC) MPO. BICYCLE, PEDESTRIAN, AND TRANSPORTATION ALTERNATIVES PROGRAM (TAP)–ELIGIBLE PROJECTS.	RIGHT-OF-WAY	FY 2021 -	$1,526,672	(BGDA)
CHATHAM				FY 2021 -	$381,668	(L)
DURHAM			CONSTRUCTION	FY 2021 -	$428,750	(BGANY)
ORANGE		***ADD RIGHT OF WAY AND CONSTRUCTION IN FY 21 AND CONSTRUCTION IN FY 22 NOT PREVIOUSLY PROGRAMMED, AT THE REQUEST OF THE MPO.***		FY 2021 -	$4,277,881	(BGDA)
PROJ.CATEGORY				FY 2021 -	$1,176,662	(L)
DIVISION				FY 2022 -	$4,706,631	(BGDA)
				FY 2022 -	$1,176,662	(L)
					$13,674,926	

*** INDICATES FEDERAL AMENDMENT**

REVISIONS TO THE 2020-2029 STIP

HIGHWAY PROGRAM

STATEWIDE PROJECT

STIP ADDITIONS

M-0552ADIV STATEWIDE **PROJ.CATEGORY** DIVISION	- STATEWIDE PROJECT	VARIOUS, ROADWAY DESIGN - OPEN ROADS DESIGNER (ORD) TRANING AND DEVELOPMENT. ***PROJECT ADDED AT THE REQUEST OF THE ROADWAY DESIGN UNIT.***	IMPLEMENTATIO	FY 2022 - FY 2023 - $324,000	$216,000 $108,000	(T) (T)
M-0552AREG STATEWIDE **PROJ.CATEGORY** REGIONAL	- STATEWIDE PROJECT	VARIOUS, ROADWAY DESIGN - OPEN ROADS DESIGNER (ORD) TRANING AND DEVELOPMENT. ***PROJECT ADDED AT THE REQUEST OF THE ROADWAY DESIGN UNIT.***	IMPLEMENTATIO	FY 2022 - FY 2023 - $324,000	$216,000 $108,000	(T) (T)
M-0552ASW STATEWIDE **PROJ.CATEGORY** STATEWIDE	- STATEWIDE PROJECT	VARIOUS, ROADWAY DESIGN - OPEN ROADS DESIGNER (ORD) TRANING AND DEVELOPMENT. ***PROJECT ADDED AT THE REQUEST OF THE ROADWAY DESIGN UNIT.***	IMPLEMENTATIO	FY 2022 - FY 2023 - $432,000	$288,000 $144,000	(T) (T)
M-0552BDIV STATEWIDE **PROJ.CATEGORY** DIVISION	- STATEWIDE PROJECT	VARIOUS, ROADWAY DESIGN - TRAINING AND DEVELOPMENT FOR MISCELLANEOUS PROJECTS. ***PROJECT ADDED AT THE REQUEST OF THE ROADWAY DESIGN UNIT.***	IMPLEMENTATIO	FY 2022 - FY 2023 - $150,000	$75,000 $75,000	(T) (T)
M-0552BREG STATEWIDE **PROJ.CATEGORY** REGIONAL	- STATEWIDE PROJECT	VARIOUS, ROADWAY DESIGN - TRAINING AND DEVELOPMENT FOR MISCELLANEOUS PROJECTS. ***PROJECT ADDED AT THE REQUEST OF THE ROADWAY DESIGN UNIT.***	IMPLEMENTATIO	FY 2022 - FY 2023 - $150,000	$75,000 $75,000	(T) (T)

*** INDICATES FEDERAL AMENDMENT**

REVISIONS TO THE 2020-2029 STIP

HIGHWAY PROGRAM

STATEWIDE PROJECT

STIP ADDITIONS

M-0552BSW STATEWIDE **PROJ.CATEGORY** STATEWIDE	- STATEWIDE PROJECT	VARIOUS, ROADWAY DESIGN - TRAINING AND DEVELOPMENT FOR MISCELLANEOUS PROJECTS. ***PROJECT ADDED AT THE REQUEST OF THE ROADWAY DESIGN UNIT.***	IMPLEMENTATIO	FY 2022 - FY 2023 -	$100,000 $100,000 $200,000	(T) (T)
* TU-0005 STATEWIDE **PROJ.CATEGORY** PUBLIC TRANS	- STATEWIDE PROJECT	NCDOT, 5303 METROPOLITAN TRANSPORTATION PLANNING FUNDS FOR FTA GRANTS ***ADD PROJECT IN FY 22 AT THE REQUEST OF THE INTEGRATED MOBILITY DIVISION. NEW PROJECT DEVELOPED FOR FEDERAL FUNDING AWARD.***	PLANNING	FY 2022 - FY 2022 - FY 2022 -	$2,647,000 $331,000 $331,000 $3,309,000	(5303) (S) (L)

STIP MODIFICATIONS

M-0479ADIV STATEWIDE **PROJ.CATEGORY** DIVISION	- STATEWIDE PROJECT	VARIOUS, STATEWIDE PROJECT DEVELOPMENT AND ENVIRONMENTAL ANALYSIS, PRELIMINARY ENGINEERING FOR ATLAS SAP INTEGRATION PROJECT. ***ADD PROJECT BREAK AT THE REQUEST OF THE ENVIRONMENTAL ANALYSIS UNIT.***	ENGINEERING	FY 2021 - FY 2022 - FY 2023 - FY 2024 - FY 2025 - FY 2026 - FY 2027 - FY 2028 - FY 2029 -	$450,000 $450,000 $450,000 $450,000 $450,000 $450,000 $450,000 $450,000 $450,000 $4,050,000	(T) (T) (T) (T) (T) (T) (T) (T) (T)

*** INDICATES FEDERAL AMENDMENT**

REVISIONS TO THE 2020-2029 STIP

HIGHWAY PROGRAM

STATEWIDE PROJECT

STIP MODIFICATIONS

M-0479AREG STATEWIDE **PROJ.CATEGORY** REGIONAL	- STATEWIDE PROJECT	VARIOUS, STATEWIDE PROJECT DEVELOPMENT AND ENVIRONMENTAL ANALYSIS, PRELIMINARY ENGINEERING FOR ATLAS SAP INTEGRATION PROJECT. ***ADD PROJECT BREAK AT THE REQUEST OF THE ENVIRONMENTAL ANALYSIS UNIT.***	ENGINEERING	FY 2021 - FY 2022 - FY 2023 - FY 2024 - FY 2025 - FY 2026 - FY 2027 - FY 2028 - FY 2029 - $4,050,000	$450,000 $450,000 $450,000 $450,000 $450,000 $450,000 $450,000 $450,000 $450,000	(T) (T) (T) (T) (T) (T) (T) (T) (T)
M-0479ASW STATEWIDE **PROJ.CATEGORY** STATEWIDE	- STATEWIDE PROJECT	VARIOUS, STATEWIDE PROJECT DEVELOPMENT AND ENVIRONMENTAL ANALYSIS, PRELIMINARY ENGINEERING FOR ATLAS SAP INTEGRATION PROJECT. ***ADD PROJECT BREAK AT THE REQUEST OF THE ENVIRONMENTAL ANALYSIS UNIT.***	ENGINEERING	FY 2021 - FY 2022 - FY 2023 - FY 2024 - FY 2025 - FY 2026 - FY 2027 - FY 2028 - FY 2029 - $5,400,000	$600,000 $600,000 $600,000 $600,000 $600,000 $600,000 $600,000 $600,000 $600,000	(T) (T) (T) (T) (T) (T) (T) (T) (T)
M-0479BDIV STATEWIDE **PROJ.CATEGORY** DIVISION	- STATEWIDE PROJECT	VARIOUS, STATEWIDE PROJECT DEVELOPMENT AND ENVIRONMENTAL ANALYSIS, PRELIMINARY ENGINEERING FOR ATLAS ENVIRONMENTAL ANALYSIS UNIT GROUPS. ***ADD PROJECT BREAK AT THE REQUEST OF THE ENVIRONMENTAL ANALYSIS UNIT.***	ENGINEERING	FY 2021 - FY 2022 - FY 2023 - FY 2024 - FY 2025 - FY 2026 - FY 2027 - FY 2028 - FY 2029 - $1,350,000	$150,000 $150,000 $150,000 $150,000 $150,000 $150,000 $150,000 $150,000 $150,000	(T) (T) (T) (T) (T) (T) (T) (T) (T)

*** INDICATES FEDERAL AMENDMENT**

REVISIONS TO THE 2020-2029 STIP

HIGHWAY PROGRAM

STATEWIDE PROJECT

STIP MODIFICATIONS

M-0479BREG STATEWIDE **PROJ.CATEGORY** REGIONAL	- STATEWIDE PROJECT	VARIOUS, STATEWIDE PROJECT DEVELOPMENT AND ENVIRONMENTAL ANALYSIS, PRELIMINARY ENGINEERING FOR ATLAS ENVIRONMENTAL ANALYSIS UNIT GROUPS. ***ADD PROJECT BREAK AT THE REQUEST OF THE ENVIRONMENTAL ANALYSIS UNIT.***	ENGINEERING	FY 2021 - FY 2022 - FY 2023 - FY 2024 - FY 2025 - FY 2026 - FY 2027 - FY 2028 - FY 2029 - $1,350,000	$150,000 $150,000 $150,000 $150,000 $150,000 $150,000 $150,000 $150,000 $150,000	(T) (T) (T) (T) (T) (T) (T) (T) (T)
M-0479BSW STATEWIDE **PROJ.CATEGORY** STATEWIDE	- STATEWIDE PROJECT	VARIOUS, STATEWIDE PROJECT DEVELOPMENT AND ENVIRONMENTAL ANALYSIS, PRELIMINARY ENGINEERING FOR ATLAS ENVIRONMENTAL ANALYSIS UNIT GROUPS. ***ADD PROJECT BREAK AT THE REQUEST OF THE ENVIRONMENTAL ANALYSIS UNIT.***	ENGINEERING	FY 2021 - FY 2022 - FY 2023 - FY 2024 - FY 2025 - FY 2026 - FY 2027 - FY 2028 - FY 2029 - $1,800,000	$200,000 $200,000 $200,000 $200,000 $200,000 $200,000 $200,000 $200,000 $200,000	(T) (T) (T) (T) (T) (T) (T) (T) (T)
* TM-0027 STATEWIDE **PROJ.CATEGORY** PUBLIC TRANS	- STATEWIDE PROJECT	NCDOT, 5311 ADMINISTRATIVE FUNDS FOR FTA GRANTS ***MODIFY FUNDING FOR FY 22 AT THE REQUEST OF INTEGRATED MOBILITY DIVISION.***	ADMINISTRATIVE	FY 2022 - FY 2022 - FY 2022 - $22,906,000	$896,000 $7,680,000 $14,330,000	(S) (L) (5311)

*** INDICATES FEDERAL AMENDMENT**

REVISIONS TO THE 2020-2029 STIP

HIGHWAY PROGRAM

DURHAM-CHAPEL HILL-CARRBORO METROPOLITAN PLANNING ORGANIZATION

STIP MODIFICATIONS

C-4928	- DURHAM-CHAPEL HILL-CARRBORO METROPOLITAN PLANNING ORGANIZATION	SR 1317 (MORREENE ROAD), NEAL ROAD TO SR 1320 (ERWIN ROAD) IN DURHAM. CONSTRUCT BIKE LANES AND SIDEWALKS.	RIGHT-OF-WAY	FY 2022 -	$2,146,000	(BGANY)
DURHAM				FY 2022 -	$302,000	(BGDA)
PROJ.CATEGORY				FY 2022 -	$489,000	(L)
DIVISION		***TO ALLOW ADDITIONAL TIME REQUIRED TO OBTAIN RIGHT OF WAY FUNDING AUTHORIZATION AND TO COMPLETE RIGHT OF WAY ACQUISITION DELAY RIGHT OF WAY FROM FY 21 TO FY 22 AND CONSTRUCTION FROM FY 22 TO FY 23.***	CONSTRUCTION	FY 2023 -	$2,331,000	(CMAQ)
				FY 2023 -	$3,144,000	(BGDA)
				FY 2023 -	$1,369,000	(L)
					$9,781,000	
P-5701	- DURHAM-CHAPEL HILL-CARRBORO METROPOLITAN PLANNING ORGANIZATION	NORFOLK SOUTHERN H LINE, MILEPOST 41.7 IN HILLSBOROUGH. CONSTRUCT PLATFORM, PASSENGER RAIL STATION BUILDING, SITE ACCESS, UTILITIES AND PARKING.				
ORANGE						
PROJ.CATEGORY						
DIVISION		***PROJECT WILL BE SEGMENTED AS SHOWN BELOW; SCHEDULES AND FUNDING WILL BE APPLIED TO INDIVIDUAL BREAKS.***				
P-5701A	- DURHAM-CHAPEL HILL-CARRBORO METROPOLITAN PLANNING ORGANIZATION	NORFOLK SOUTHERN H LINE, MILEPOST 41.7 IN HILLSBOROUGH. CONSTRUCT PASSENGER RAIL STATION BUILDING, SITE ACCESS, UTILITIES AND PARKING.	CONSTRUCTION	FY 2022 -	$3,145,000	(T)
ORANGE				FY 2022 -	$570,000	(O)
PROJ.CATEGORY				FY 2023 -	$3,145,000	(T)
DIVISION					$6,860,000	
		NEW PROJECT BREAK ADDED AT THE REQEUST OF THE RAIL DIVISION.				
P-5701B	- DURHAM-CHAPEL HILL-CARRBORO METROPOLITAN PLANNING ORGANIZATION	NORFOLK SOUTHERN H LINE, MILEPOST 41.7 IN HILLSBOROUGH. CONSTRUCT STATION PLATFORM AND REALIGN CURVE AT MILEPOST 41.4.	CONSTRUCTION	FY 2022 -	$500,000	(T)
ORANGE				FY 2023 -	$500,000	(T)
PROJ.CATEGORY					$1,000,000	
DIVISION		***NEW PROJECT BREAK ADDED AT THE REQEUST OF THE RAIL DIVISION.***				

*** INDICATES FEDERAL AMENDMENT**

REVISIONS TO THE 2020-2029 STIP

HIGHWAY PROGRAM

STATEWIDE PROJECT

STIP ADDITIONS

M-0553A STATEWIDE **PROJ.CATEGORY** EXEMPT	- STATEWIDE PROJECT	VARIOUS, INTEGRATED PROJECT DELIVERY ***PROJECT ADDED AT THE REQUEST OF TECHNICAL SERVICES.***	ENGINEERING	FY 2022 - FY 2023 -	$4,500,000 (T) $6,000,000 (T) $10,500,000
M-0553B STATEWIDE **PROJ.CATEGORY** EXEMPT	- STATEWIDE PROJECT	VARIOUS, PROVIDE ASSISTANCE TO INFORMATION TECHNOLOGY FOR PRECONSTRUCTION DELIVERABLES ***PROJECT ADDED AT THE REQUEST OF TECHNICAL SERVICES.***	ENGINEERING	FY 2022 - FY 2023 -	$1,000,000 (T) $1,000,000 (T) $2,000,000
M-0554DIV STATEWIDE **PROJ.CATEGORY** DIVISION	- STATEWIDE PROJECT	VARIOUS, NCDOT MITIGATION ORDER TO DIVISION OF MITIGATION SERVICES (DMS). ***PROJECT ADDED AT THE REQUEST OF THE ENVIRONMENTAL ANALYSIS UNIT.***	IMPLEMENTATIO	FY 2022 - FY 2023 -	$7,500,000 (T) $7,500,000 (T) $15,000,000
M-0554REG STATEWIDE **PROJ.CATEGORY** REGIONAL	- STATEWIDE PROJECT	VARIOUS, NCDOT MITIGATION ORDER TO DIVISION OF MITIGATION SERVICES (DMS). ***PROJECT ADDED AT THE REQUEST OF THE ENVIRONMENTAL ANALYSIS UNIT.***	IMPLEMENTATIO	FY 2022 - FY 2023 -	$7,500,000 (T) $7,500,000 (T) $15,000,000
M-0554SW STATEWIDE **PROJ.CATEGORY** STATEWIDE	- STATEWIDE PROJECT	VARIOUS, NCDOT MITIGATION ORDER TO DIVISION OF MITIGATION SERVICES (DMS). ***PROJECT ADDED AT THE REQUEST OF THE ENVIRONMENTAL ANALYSIS UNIT.***	IMPLEMENTATIO	FY 2022 - FY 2023 -	$10,000,000 (T) $10,000,000 (T) $20,000,000

*** INDICATES FEDERAL AMENDMENT**

REVISIONS TO THE 2020-2029 STIP

HIGHWAY PROGRAM

STATEWIDE PROJECT

STIP MODIFICATIONS

* C-5600	- STATEWIDE PROJECT	VARIOUS, STATEWIDE CMAQ PROJECTS TO IMPROVE AIR QUALITY WITHIN NONATTAINMENT AND MAINTENANCE AREAS.	ENGINEERING	FY 2020 -	$817,000	(CMAQ)
STATEWIDE				FY 2020 -	$204,000	(S(M))
PROJ.CATEGORY		***ADD ENGINEERING, RIGHT-OF-WAY, CONSTRUCTION, IMPLEMENTATION, AND OPERATIONS IN FY 21 AND FY 22 NOT PREVIOUSLY PROGRAMMED.***		FY 2021 -	$817,000	(CMAQ)
EXEMPT				FY 2021 -	$204,000	(S(M))
				FY 2022 -	$817,000	(CMAQ)
				FY 2022 -	$204,000	(S(M))
			RIGHT-OF-WAY	FY 2020 -	$817,000	(CMAQ)
				FY 2020 -	$204,000	(S(M))
				FY 2021 -	$817,000	(CMAQ)
				FY 2021 -	$204,000	(S(M))
				FY 2022 -	$817,000	(CMAQ)
				FY 2022 -	$204,000	(S(M))
			CONSTRUCTION	FY 2020 -	$4,901,000	(CMAQ)
				FY 2020 -	$1,226,000	(S(M))
				FY 2021 -	$4,901,000	(CMAQ)
				FY 2021 -	$1,226,000	(S(M))
				FY 2022 -	$4,901,000	(CMAQ)
				FY 2022 -	$1,226,000	(S(M))
			IMPLEMENTATIO	FY 2020 -	$817,000	(CMAQ)
				FY 2020 -	$204,000	(S(M))
				FY 2021 -	$817,000	(CMAQ)
				FY 2021 -	$204,000	(S(M))
				FY 2022 -	$817,000	(CMAQ)
				FY 2022 -	$204,000	(S(M))
			OPERATIONS	FY 2020 -	$817,000	(CMAQ)
				FY 2020 -	$204,000	(S(M))
				FY 2021 -	$817,000	(CMAQ)
				FY 2021 -	$204,000	(S(M))
				FY 2022 -	$817,000	(CMAQ)
				FY 2022 -	$204,000	(S(M))
					$30,633,000	

*** INDICATES FEDERAL AMENDMENT**

REVISIONS TO THE 2020-2029 STIP

HIGHWAY PROGRAM

STATEWIDE PROJECT

STIP MODIFICATIONS

* C-5601	- STATEWIDE PROJECT	VARIOUS, CMAQ PROJECTS TO IMPROVE AIR QUALITY ACROSS MULTIPLE NONATTAINMENT AND MAINTENANCE AREAS.	ENGINEERING	FY 2020 -	$118,000	(CMAQ)
STATEWIDE				FY 2020 -	$29,000	(L)
PROJ.CATEGORY				FY 2021 -	$118,000	(CMAQ)
EXEMPT				FY 2021 -	$29,000	(L)
				FY 2022 -	$118,000	(CMAQ)
				FY 2022 -	$29,000	(L)
			RIGHT-OF-WAY	FY 2020 -	$118,000	(CMAQ)
				FY 2020 -	$29,000	(L)
				FY 2021 -	$118,000	(CMAQ)
				FY 2021 -	$29,000	(L)
				FY 2022 -	$118,000	(CMAQ)
				FY 2022 -	$29,000	(L)
			CONSTRUCTION	FY 2020 -	$704,000	(CMAQ)
				FY 2020 -	$176,000	(L)
				FY 2021 -	$704,000	(CMAQ)
				FY 2021 -	$176,000	(L)
				FY 2022 -	$704,000	(CMAQ)
				FY 2022 -	$176,000	(L)
			IMPLEMENTATIO	FY 2020 -	$118,000	(CMAQ)
				FY 2020 -	$29,000	(L)
				FY 2021 -	$118,000	(CMAQ)
				FY 2021 -	$29,000	(L)
				FY 2022 -	$118,000	(CMAQ)
				FY 2022 -	$29,000	(L)
			OPERATIONS	FY 2020 -	$118,000	(CMAQ)
				FY 2020 -	$29,000	(L)
				FY 2021 -	$118,000	(CMAQ)
				FY 2021 -	$29,000	(L)
				FY 2022 -	$118,000	(CMAQ)
				FY 2022 -	$29,000	(L)
					$4,404,000	

*** INDICATES FEDERAL AMENDMENT**

REVISIONS TO THE 2020-2029 STIP

HIGHWAY PROGRAM

DURHAM-CHAPEL HILL-CARRBORO METROPOLITAN PLANNING ORGANIZATION

STIP MODIFICATIONS

C-4928	- DURHAM-CHAPEL HILL-CARRBORO METROPOLITAN PLANNING ORGANIZATION	SR 1317 (MORREENE ROAD), NEAL ROAD TO SR 1320 (ERWIN ROAD) IN DURHAM. CONSTRUCT BIKE LANES AND SIDEWALKS.	RIGHT-OF-WAY	FY 2022 -	$2,146,000	(BGANY)
DURHAM				FY 2022 -	$302,000	(BGDA)
PROJ.CATEGORY				FY 2022 -	$489,000	(L)
DIVISION		***TO ALLOW ADDITIONAL TIME FOR PLANNING AND DESIGN, DELAY RIGHT OF WAY FROM FY 21 TO FY 22 AND CONSTRUCTION FROM FY 22 TO FY 23.***	CONSTRUCTION	FY 2023 -	$2,331,000	(CMAQ)
				FY 2023 -	$3,144,000	(BGDA)
				FY 2023 -	$1,369,000	(L)
					$9,781,000	
C-5183B	- DURHAM-CHAPEL HILL-CARRBORO METROPOLITAN PLANNING ORGANIZATION	SR 1945 (S. ALSTON AVE.), SR 1171 (RIDDLE RD.) TO CAPPS ST.	CONSTRUCTION	FY 2022 -	$565,000	(CMAQ)
DURHAM				FY 2022 -	$141,000	(L)
PROJ.CATEGORY		***TO ALLOW ADDITIONAL TIME FOR PLANNING AND DESIGN, DELAY CONSTRUCTION FROM FY 21 TO FY 22.***			$706,000	
EXEMPT						
U-5823	- DURHAM-CHAPEL HILL-CARRBORO METROPOLITAN PLANNING ORGANIZATION	WOODCROFT PARKWAY EXTENSION, SR 1116 (GARRETT ROAD) TO NC 751 (HOPE VALLEY ROAD) IN DURHAM. CONSTRUCT ROADWAY ON NEW ALIGNMENT.	RIGHT-OF-WAY	FY 2022 -	$301,000	(BGANY)
DURHAM				FY 2022 -	$75,000	(L)
PROJ.CATEGORY			UTILITIES	FY 2022 -	$1,295,000	(BGANY)
DIVISION				FY 2022 -	$324,000	(L)
		TO ALLOW ADDITIONAL TIME FOR PLANNING AND DESIGN, DELAY RIGHT OF WAY FROM FY 21 TO FY 22.	CONSTRUCTION	FY 2025 -	$1,438,000	(BGANY)
				FY 2025 -	$360,000	(L)
					$3,793,000	

*** INDICATES FEDERAL AMENDMENT**

REVISIONS TO THE 2020-2029 STIP

HIGHWAY PROGRAM

STATEWIDE PROJECT

STIP ADDITIONS

* TM-0036 STATEWIDE **PROJ.CATEGORY** PUBLIC TRANS	- STATEWIDE PROJECT	STATEWIDE, 5310 STATE ADMINISTRATIVE FUNDS ***ADD PROJECT AT THE REQUEST OF THE INTEGRATED MOBILITY DIVISION.***	ADMINISTRATIVE	FY 2022 -	$567,000 $567,000	(5310)

*** INDICATES FEDERAL AMENDMENT**

RESOLUTION TO MODIFY THE 2020-2029 TRANSPORTATION IMPROVEMENT PROGRAM FOR THE DURHAM-CHAPEL HILL-CARRBORO METROPOLITAN PLANNING AREA

AMENDMENT #7
September 1, 2021

A motion was made by MPO Board Member _____ and seconded by MPO Board Member _____ for the adoption of the following resolution, and upon being put to a vote, was duly adopted.

WHEREAS, the Transportation Improvement Program (TIP) is a staged multiple year listing of all federally funded transportation projects scheduled for implementation within the Durham-Chapel Hill-Carrboro Metropolitan Planning Area which have been selected from a priority list of projects; and

WHEREAS, the document provides the mechanism for official endorsement of the program of projects by the MPO Board; and

WHEREAS, the inclusion of the TIP in the transportation planning process was first mandated by regulations issued jointly by the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) and no project within the planning area will be approved for funding by these federal agencies unless it appears in the officially adopted TIP; and

WHEREAS, the procedures for developing the TIP have been modified in accordance with certain provisions of the MAP-21 Federal Transportation Act, Fixing America's Surface Transportation (FAST) Act, and guidance provided by the State; and

WHEREAS, projects listed in the TIP are also included in the State TIP (STIP) and balanced against anticipated revenues as identified in both the TIP and the STIP; and

WHEREAS, the North Carolina Department of Transportation and the MPO Board have determined it to be in the best interest of the Urban Area to amend the FY 2020-2029 Transportation Improvement Program as described in the attached sheets; and

WHEREAS, the United States Environmental Protection Agency Designated the DCHC MPO from nonattainment to attainment under the prior 1997 Ozone Standard on December 26, 2007; and

WHEREAS, the DCHC MPO certifies that this TIP amendment is consistent with the intent of the DCHC MPO 2045 Metropolitan Transportation Plan (MTP); and

WHEREAS, in accordance with 23 CFR 450.326 (d), the TIP shall include, to the maximum extent practicable, a description of the anticipated effect of the TIP toward achieving the performance targets identified in the metropolitan transportation plan, linking investment priorities to those performance targets; and

BE IT THEREFORE RESOLVED that the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization Board hereby approves Amendment #7 to the FY 2020-2029 Transportation Improvement Program of the Durham-Chapel Hill-Carrboro Urban Area, as approved by the Board on December 11, 2019. As part of this amendment, the MPO has established performance management targets for transit safety to meet requirements described in the Federal Transit Administration (FTA) Public Transportation Agency Safety Plan (PTASP) Final Rule requiring providers of public transportation systems that receive federal funds under FTA's Urbanized Area Formula Grants to develop and adopt a PTASP that includes safety performance targets for transit-related fatalities, injuries, safety events, and system reliability (state of good repair). Public transit projects included in the STIP align with the transit safety planning and target setting process undertaken by the transit agencies and MPOs. While the North Carolina DOT aided with the development of a template for the initial Public Transportation Agency Safety Plans (PTASPs), each large urban transit provider is responsible for implementing its PTASP, which includes transit safety targets. Investments are made in alignment with PTASPs with the intent of keeping the state's public transit operations, vehicles, and facilities safe and meeting transit safety targets. State and federal funding sources that can be used by transit agencies for operations, vehicles, and facility improvements are outlined in the Public Transportation Project Funding section of the NCDOT 2020-2029 Current STIP. Individual transit agencies determine the use of these sources for capital and operating expenses based on their local needs.The DCHC MPO also amends projects as described in the "FY 2020-2029 TIP Amendment #7 Summary Sheet" on this, the 1st day of September, 2021.

_____

Wendy Jacobs, MPO Board Chair

Durham County, North Carolina

I certify that Wendy Jacobs personally appeared before me this day acknowledging to me that she signed the forgoing document.

Date: September 1, 2021

_____

Frederick Brian Rhodes, Notary Public
My commission expires: May 10, 2025

DURHAM • CHAPEL HILL • CARRBORO
DCHC
METROPOLITAN PLANNING ORGANIZATION

Technical Committee
July 28, 2021

Transportation Improvement Program Amendment #7
Summary Sheet

- **C-4928** Morreene Road Bike-Ped: Delay ROW from FY21 to FY22 and construction from FY22 to FY23 to allow additional time for planning and design.
- **C-5183B** Alston Avenue: Delay construction from FY21 to FY22 to allow additional time for planning and design.
- **M-0479ADIV** Statewide Project Development and Environmental Analysis Preliminary Engineering for Atlas SAP Integration: Add project break at request of the Environmental Analysis Unit.
- **M-0479AREG** Statewide Project Development and Environmental Analysis Preliminary Engineering for Atlas SAP Integration: Add project break at request of the Environmental Analysis Unit.
- **M-0479ASW** Statewide Project Development and Environmental Analysis Preliminary Engineering for Atlas SAP Integration: Add project break at request of the Environmental Analysis Unit.
- **M-0479BDIV** Statewide Project Development and Environmental Analysis Preliminary Engineering for Atlas Environmental Unit Groups: Add project break at request of the Environmental Analysis Unit.
- **M-0479BREG** Statewide Project Development and Environmental Analysis Preliminary Engineering for Atlas Environmental Unit Groups: Add project break at request of the Environmental Analysis Unit.
- **M-0479BSW** Statewide Project Development and Environmental Analysis Preliminary Engineering for Atlas Environmental Unit Groups: Add project break at request of the Environmental Analysis Unit.
- **M-0552ADIV** Roadway Design Open Roads Designer Training and Development for division projects: Project added at the request of the Roadway Design unit.
- **M-0552AREG** Roadway Design Open Roads Designer Training and Development for regional projects: Project added at the request of the Roadway Design unit.
- **M-0552ASW** Roadway Design Open Roads Designer Training and Development for statewide projects: Project added at the request of the Roadway Design unit.
- **M-0552BDIV** Roadway Design Training and Development for Miscellaneous division projects: Project added at the request of the Roadway Design unit.
- **M-0552BREG** Roadway Design Training and Development for Miscellaneous regional projects: Project added at the request of the Roadway Design unit.
- **M-0552BSW** Roadway Design Training and Development for Miscellaneous statewide projects: Project added at the request of the Roadway Design unit.
- **M-0553A** Integrated Project Delivery: Project added at the request of Technical Services.
- **M-0554DIV** NCDOT Mitigation Order to Division of Mitigation Services: Project added at the request of the Environmental Analysis Unit.
- **M-0554REG** NCDOT Mitigation Order to Division of Mitigation Services: Project added at the request of the Environmental Analysis Unit.
- **M-0554SW** NCDOT Mitigation Order to Division of Mitigation Services: Project added at the request of the Environmental Analysis Unit.
- **M-0553B** Provide Assistance to Information Technology for Preconstruction Deliverables: Project added at the request of Technical Services.

- **P-5701** Hillsborough Passenger Rail Station: Delay construction from FY21 to FY22 to assist in balancing funds. Project will also be segmented, schedules and funding will be applied to individual breaks.
- **P-5701A** Hillsborough Passenger Rail Station Building, Site Access, Utilities and Parking: New project break added at the request of the Rail Division.
- **P-5701B** Hillsborough Passenger Rail Station Platform Construction and Realign Curve at Milepost 41.4: New project break added at the request of the Rail Division.
- **P-5706** East Durham Railroad Safety Project: Delay ROW from FY21 to FY22 to allow additional time to complete planning and design.
- **TA-4923** GoDurham Bus Replacement and Paratransit Vans: Program funding for the purchase of twelve (12) Paratransit vans in FY22 and flexing FY18-22 STPDA funds from FHWA to FTA to purchase three electric buses and seven ACCESS vehicles.
- **TM-0027** 5311 Administrative Funds for FTA Grants: Modify Funding for FY22 at request of Integrated Mobility Division.
- **TM-0036** 5310 State Administrative Funds: Add project at the request of the Integrated Mobility Division.
- **TU-0005** NCDOT 5303 Metropolitan Transportation Planning Funds for FTA Grants: Add project in FY22 at the request of the Integrated Mobility Division. New Project Developed for Federal Funding Award.
- **U-4726** DCHC Bicycle and Pedestrian Projects: Add ROW and Con in FY21 and construction in FY22 not previously programmed.
- **U-5823** Woodcroft Parkway Extension: Delay ROW from Fy21 to FY22 to allow additional time for planning and design.

MEMORANDUM

To: DCHC MPO Board

From: DCHC MPO Lead Planning Agency

Date: August 11, 2021

Subject: **Lead Planning Agency (LPA) Synopsis of Staff Report**

This memorandum provides a summary status of tasks for major DCHC MPO projects in the Unified Planning Work Program (UPWP).

- • Indicates that task is ongoing and not complete.
- ✓ Indicates that task is complete.

Major UPWP – Projects

Comprehensive Transportation Plan (CTP) – Amendment #3

- ✓ Release Amendment #3 for public comment – April 2021
- ✓ Public hearing for Amendment #3 – May 2021
- • Adopt Amendment #3 – September 2021

2050 Metropolitan Transportation Plan (MTP)

- ✓ Approve Public Engagement Plan – September 2020
- ✓ Approve Goals and Objectives – September 2020
- ✓ Approve land use model and Triangle Regional Model for use in 2050 MTP – January 2021
- ✓ Release Deficiency Analysis – May 2021
- • Release Alternatives Analysis for public comment – August 2021
- • Release Preferred Option for public comments – October 2021
- • Adopt 2050 MTP and Air Quality Conformity Determination Report – March 2022

Triangle Regional Model Update

- ✓ Completed
- • Rolling Household Survey – nearing completion

Prioritization 6.0 - FY 2023-2032 TIP Development

- ✓ LPA Staff develops initial project list – March-April 2019
- ✓ TC reviews initial project list – May 2019
- ✓ Board reviews initial project list (including deletions of previously submitted projects) – June 2019
- ✓ SPOT On!ine opens for entering/amending projects – October 2019
- ✓ MPO submits carryover project deletions and modifications – December 2019
- ✓ Board releases draft SPOT 6 project list for public comment – February 2020
- ✓ Board holds public hearing on new projects for SPOT 6 – March 2020
- ✓ Board approves new projects to be submitted for SPOT 6 – March 2020
- ✓ MPO submits projects to NCDOT – July 2020

- ✓ LPA staff conducts data review – Spring 2021
- ✓ LPA updates local ranking methodology – May 2021
- ✓ Board approves local ranking methodology – June 2021
- MPO staff applies local ranking methodology for Regional projects – August 2021
- Board releases MPO initial Regional points list for public input/comments – September 2021
- Approval of Regional Impact points – October 2021
- MPO applies local ranking methodology for Division projects – November 2021
- Board releases MPO initial Division points list for local input/public comments – December 2021
- Approval of Division Needs points – January 2022
- Draft STIP Released – February 2022
- Board of Transportation adopts FY2023-2032 STIP – June 2022
- MPO Board adopts FY2023-2032 MTIP – September 2022

US 15-501 Corridor Study

- ✓ 3rd public workshop: evaluate alternative strategies – October 2019
- ✓ Stakeholder meetings to discuss Chapel Hill cross-section, northern quadrant road, New Hope Commons access – completed August 2020
- ✓ Board releases final draft for public comment – September 2020
- ✓ Board holds public hearing on final draft – October 2020
- ✓ Release RFI for second phase of study – March 2021
- ✓ Develop RFQ for second phase of study – May 2021
- Update Board on second phase of study – October 2021

Regional Intelligent Transportation System

- ✓ Project management plan
- ✓ Development of public involvement strategy and communication plan
- ✓ Conduct stakeholder workshops
- ✓ Analysis of existing conditions
- ✓ Assessment of need and gaps
- ✓ Review existing deployments and evaluate technologies
- ✓ Identification of ITS strategies
- ✓ Update Triangle Regional Architecture
- ✓ Develop Regional Architecture Use and maintenance
- ✓ Develop project prioritization methodology
- ✓ Prepare Regional ITS Deployment Plan and Recommendation

Project Development/NEPA

- US 70 Freeway Conversion
- NC 54 Widening
- NC 147 Interchange Reconstruction
- I-85
- I-40

Safety Performance Measures Target Setting

- ✓ Data mining and analysis
- ✓ Development of rolling averages and baseline
- ✓ Development of targets setting framework
- ✓ Estimates of achievements
- Forecast of data and measures

MPO Website Update and Maintenance

- ✓ Post Launch Services – Continuous/On-going
- ✓ Interactive GIS – Continuous/On-going
- ✓ Facebook/Twitter management – Continuous/On-going
- ✓ Enhancement of Portals – Continuous/On-going

Upcoming Projects

- Congestion Management Process (CMP)
- State of Systems Report

Contract Number: C202581 **Route:** SR-1838
Division: 5 **County:** Durham
TIP Number: EB-4707A
Length: 0.96 miles **Federal Aid Number:** STPDA-0537(2)
NCDOT Contact: James M. Nordan, PE **NCDOT Contact No:** (919)220-4680
Location Description: SR-1838/SR-2220 FROM US-15/501 IN ORANGE COUNTY TO SR-1113 IN DURHAM COUNTY.
Contractor Name: S T WOOTEN CORPORATION
Contract Amount: $4,614,460.00
Work Began: 05/28/2019 **Letting Date:** 04/16/2019
Original Completion Date: 02/15/2021 **Revised Completion Date:** 06/12/2022
Latest Payment Thru: 07/07/2021
Latest Payment Date: 07/16/2021 **Construction Progress:** 56.95%

Contract Number: C203394 **Route:** I-885, NC-147, NC-98 US-70
Division: 5 **County:** Durham
TIP Number: U-0071
Length: 4.009 miles **Federal Aid Number:**
NCDOT Contact: Liam W. Shannon **NCDOT Contact No:** (919)835-8200
Location Description: EAST END CONNECTOR FROM NORTH OF NC-98 TO NC-147 (BUCK DEAN FREEWAY) IN DURHAM.
Contractor Name: DRAGADOS USA INC
Contract Amount: $141,949,500.00
Work Began: 02/26/2015 **Letting Date:** 11/18/2014
Original Completion Date: 05/10/2020 **Revised Completion Date:** 02/22/2021
Latest Payment Thru: 06/22/2021
Latest Payment Date: 06/30/2021 **Construction Progress:** 93.84%

Contract Number: C203567 **Route:** NC-55
Division: 5 **County:** Durham
TIP Number: U-3308
Length: 1.134 miles **Federal Aid Number:** STP-55(20)
NCDOT Contact: James M. Nordan, PE **NCDOT Contact No:** (919)220-4680
Location Description: NC-55 (ALSTON AVE) FROM NC-147 (BUCK DEAN FREEWAY) TO NORTH OF US-70BUS/NC-98 (HOLLOWAY ST).
Contractor Name: ZACHRY CONSTRUCTION CORPORATION
Contract Amount: $39,756,916.81
Work Began: 10/05/2016 **Letting Date:** 07/19/2016
Original Completion Date: 03/30/2020 **Revised Completion Date:** 02/11/2021
Latest Payment Thru: 06/15/2021
Latest Payment Date: 06/28/2021 **Construction Progress:** 78.36%

Contract Number: C204211 **Route:** I-40, I-85, NC-55 NC-98, US-15, US-501 US-70
Division: 5 **County:** Durham
TIP Number: U-5968
Length: 0.163 miles **Federal Aid Number:** STBG-0505(084)
NCDOT Contact: James M. Nordan, PE **NCDOT Contact No:** (919)220-4680
Location Description: CITY OF DURHAM.
Contractor Name: BROOKS BERRY HAYNIE & ASSOCIATES, INC.
Contract Amount: $19,062,229.77
Work Began: 02/18/2020 **Letting Date:** 04/16/2019
Original Completion Date: 08/01/2024 **Revised Completion Date:** 04/09/2025
Latest Payment Thru: 06/30/2021
Latest Payment Date: 07/12/2021 **Construction Progress:** 41.66%

Contract Number: C204256 **Route:** NC-98, SR-1800, SR-1809 SR-1811, US-70
Division: 5 **County:** Durham
TIP Number:

Length: 15.89 miles **Federal Aid Number:** STATE FUNDED
NCDOT Contact: James M. Nordan, PE **NCDOT Contact No:** (919)220-4680
Location Description: 1 SECTION OF US-70, 1 SECTION OF NC-98, AND 3 SECTIONS OF SECONDARY ROADS.
Contractor Name: CAROLINA SUNROCK LLC
Contract Amount: $3,782,133.02
Work Began: 03/13/2020 **Letting Date:** 10/16/2018
Original Completion Date: 11/30/2019 **Revised Completion Date:** 07/15/2021
Latest Payment Thru: 06/22/2021
Latest Payment Date: 06/29/2021 **Construction Progress:** 87.97%

Contract Number: C204520 **Route:** US-501
Division: 5 **County:** Durham
TIP Number:
Length: 17.68 miles **Federal Aid Number:** STATE FUNDED
NCDOT Contact: James M. Nordan, PE **NCDOT Contact No:** (919)220-4680
Location Description: 1 SECTION OF US-501, 1 SECTION OF US-501 BUSINESS, AND 32 SECTIONS OF SECONDARY ROADS.
Contractor Name: CAROLINA SUNROCK LLC
Contract Amount: $3,513,381.26
Work Began: 03/02/2021 **Letting Date:** 10/20/2020
Original Completion Date: 07/01/2022 **Revised Completion Date:**
Latest Payment Thru: 03/15/2021
Latest Payment Date: 03/22/2021 **Construction Progress:** 5.94%

Contract Number: C204630 **Route:** SR-1110, SR-1158, SR-1308 SR-1454, SR-1457, SR-1458 SR-1521, SR-1550, SR-1558 SR-1559, SR-1566, SR-1578 SR-1582, SR-1593, SR-1640 SR-1669, SR-1675, SR-1709 SR-1753, SR-1754, SR-1775 SR-1778, SR-1779, SR-1791 SR-1792, SR-1814, SR-1825 SR-1827, SR-1926, SR-1945 SR-2334, SR-2335, SR-2336 SR-2354, SR-2355, SR-2356 SR-2357, SR-2385, SR-2386 SR-2443, SR-2444, SR-2619
Division: 5 **County:** Durham
TIP Number:
Length: 25.324 miles **Federal Aid Number:** STATE FUNDED
NCDOT Contact: James M. Nordan, PE **NCDOT Contact No:** (919)220-4680
Location Description: 44 SECTIONS OF SECONDARY ROADS.
Contractor Name: FSC II LLC DBA FRED SMITH COMPANY
Contract Amount: $5,523,385.60
Work Began: 06/02/2021 **Letting Date:** 04/20/2021
Original Completion Date: 11/15/2022 **Revised Completion Date:**
Latest Payment Thru: 06/30/2021
Latest Payment Date: 07/07/2021 **Construction Progress:** 5.05%

Contract Number: DE00301 **Route:** SR-1902
Division: 5 **County:** Durham
TIP Number: B5512
Length: 0.238 miles **Federal Aid Number:** STATE FUNDED
NCDOT Contact: James M. Nordan, PE **NCDOT Contact No:** (919)220-4680
Location Description: BRIDGE 89 OVER LICK CREEK ON SR 1902 KEMP RD
Contractor Name: FSC II LLC DBA FRED SMITH COMPANY
Contract Amount: $987,000.00
Work Began: 04/26/2021 **Letting Date:** 03/10/2021
Original Completion Date: 11/08/2021 **Revised Completion Date:**
Latest Payment Thru: 06/22/2021
Latest Payment Date: 06/29/2021 **Construction Progress:** 27%

Contract Number: DE00304 **Route:** US-15501
Division: 5 **County:** Durham
TIP Number: SM-5705AA, SM-5705B, SM-5705I SM-5705X, W-5705
Length: 0.432 miles **Federal Aid Number:** HSIP-0015(057)
NCDOT Contact: James M. Nordan, PE **NCDOT Contact No:** (919)220-4680
Location Description: MULTIPLE LOCATIONS ON US 15 501
Contractor Name: JSMITH CIVIL LLC
Contract Amount: $1,258,791.50
Work Began: 04/19/2021 **Letting Date:** 03/10/2021
Original Completion Date: 11/19/2021 **Revised Completion Date:**
Latest Payment Thru: 06/30/2021
Latest Payment Date: 07/09/2021 **Construction Progress:** 43.38%

Contract Number: DE00310 **Route:** I-885
Division: 5 **County:** Durham
TIP Number: U-0071
Length: 20 miles **Federal Aid Number:** STATE FUNDED
NCDOT Contact: Liam W. Shannon **NCDOT Contact No:** (919)835-8200
Location Description: NC540 NC885 I885
Contractor Name: TRAFFIC CONTROL SAFETY SERVICES, INC.
Contract Amount: $580,657.50
Work Began: 04/26/2021 **Letting Date:** 01/13/2021
Original Completion Date: 11/12/2021 **Revised Completion Date:** 05/11/2022
Latest Payment Thru: 06/07/2021
Latest Payment Date: 06/28/2021 **Construction Progress:** 17.72%

NCDOT DIVISION 5
Durham Project List _ 5-Year Program
June 2021

Comprehensive Project List

Data as of : 05/25/2021

Project ID	Responsible Group	Description	R/W Plans Complete	R/W Acq. Begins	Letting Type	Let Date	Project Manager Name	ROW $	UTIL $	CONST $	COMMENTS
U-6021	DIVISION	SR 1118 (FAYETTEVILLE ROAD),FROM WOODCROFT PARKWAY TO BARBEE ROAD IN DURHAM. WIDEN TO 4-LANE DIVIDED FACILITY WITH BICYCLE / PEDESTRIAN ACCOMMODATIONS.	2/16/2029	2/16/2029	Division Design Raleigh Let (DDRL)	1/1/2040	BENJAMIN J. UPSHAW	$7,611,000		$13,770,000	Project is suspended due to funding.
U-6118	DIVISION	NC 55 FROM MERIDIAN PARKWAY TO I-40 INTERCHNAGE IN DURHAM	1/16/2026	7/16/2027	Division Design Raleigh Let (DDRL)	1/1/2040	ZAHID BALOCH	$2,000,000		$10,000,000	Post-year project
U-6120	DIVISION	NC 98 (HOLLOWAY STREET) FROM SR 1938 (JUNCTION ROAD) TO SR 1919 (LYNN ROAD) IN DURHAM. CONSTRUCT SAFETY IMPROVEMENTS AND WIDEN TO ADD MEDIAN, BICYCLE LANES, SIDEWALKS, TRANSIT STOP IMPROVEMENTS, AND TRAFFIC SIGNALS WHERE NEEDED.	12/29/2023	7/21/2028	Division Design Raleigh Let (DDRL)	1/1/2040	ZAHID BALOCH	$5,000,000		$11,000,000	Post-year project
U-5516	DIVISION	AT US 501 (ROXBORO ROAD) TO SR 1448 (LATTA ROAD) / SR 1639 (INFINITY ROAD) INTERSECTION IN DURHAM. INTERSECTION IMPROVEMENTS.	10/18/2024	10/18/2024	Division Design Raleigh Let (DDRL)	10/20/2026	JOHN W. BRAXTON JR	$6,341,000	$2,075,000	$12,400,000	Project is suspendend due to funding.
U-5717	DIVISION	US 15 / US 501 DURHAM CHAPEL-HILL BOULEVARD AND SR 1116 (GARRETT ROAD) CONVERTING THE AT-GRADE INTERSECTION TO AN INTERCHANGE	4/23/2019	4/23/2019	Division Design Raleigh Let (DDRL)	10/21/2025	JOHN W. BRAXTON JR	$53,500,000		$32,000,000	ROW acquisition is suspended due to funding.
SM-5705AH	DIVISION	NC 98 at SR 1815 (Mineral Springs Road).,,Construct right turn lanes on both approaches of SR 1815 (Mineral Springs Road).	2/3/2023	2/10/2023	Division POC Let (DPOC)	4/10/2024	Stephen Davidson			$560,000	Project is suspended due to funding.
W-5705AI	DIVISION	US 501 BUSINESS (ROXBORO STREET) AT SR 1443 (HORTON ROAD) /SR 1641 (DENFIELD STREET)	11/23/2021	11/23/2021	Division POC Let (DPOC)	11/9/2022	STEPHEN REID DAVIDSON	$210,000		$630,000	Preliminary design underway
W-5705T	DIVISION	SR 1815 / SR 1917 (SOUTH MINERAL SPRINGS ROAD) AT SR 1815 (PLEASANT DRIVE)	9/15/2021	9/15/2021	Division POC Let (DPOC)	6/22/2022	STEPHEN REID DAVIDSON	$85,000		$800,000	Preliminary design underway
HI-0001	DIVISION	I-85/US 15 FROM NORTH OF SR 1637 (REDWOOD ROAD) IN DURHAM COUNTY TO SOUTH OF US 15 / SR 1100 (GATE ONE ROAD) IN GRANVILLE COUNTY. PAVEMENT REHABILITATION.			Division POC Let (DPOC)	9/22/2021	TRACY NEAL PARROTT			$2,200,000	
48937	DIVISION	Widen NC 54 Eastbound from Falconbridge Road to FarringtonRoad to provide a continuous right turn lane from west of Falconbridge road to I-40.			Division POC Let (DPOC)	9/8/2021	Stephen Davidson				Preliminary design underway

NCDOT DIV 7 PROJECTS LOCATED IN DCHCMPO - UNDER DEVELOPMENT

TIP/WBS #	Description	LET/Start Date	Completion Date	Cost	Status	Project Lead
U-6245 49187.1.1 49187.2.1 49187.3.1	Construct paved shoulders, turn lanes and overlay on SR 1146 (West Ten Road) from SR 1114 (Buckhorn Road) to west of SR 1137 (Bushy Cook Road)	Oct. 2020	Nov. 2020	$829,000	Construction 100% complete - Pending Final Inspection	Chad Reimakoski
P-5701 46395.1.1 46395.3.1	Construct Platform, Passenger Rail Station Building at Milepost 41.7 Norfolk Southern H-line in **Hillsborough**	10/19/2021	FY2023	$7,200,000	PE funding scheduled 7/1/2020	Matthew Simmons
I-3306A 34178.1.3 34178.1.4 34178.1.5 34178.2.2 34178.3.GV3	I-40 widening from I-85 to Durham Co. line (US 15/501 Interchange) in **Chapel Hill**	8/17/2021	FY2024	$175,600,000	Planning and design activities underway, RFQ Advertisement DB 11/3/20	Laura Sutton
SS-6007R 49557.1.1 49557.3.1	Traffic signal revisions and high visibility crosswalk installation on SR 1010 (East Franklin Street) at Henderson Street.	Mar. 2022	Jun. 2022	$12,600	Funds approved March 2021	Dawn McPherson
SS-4907CD 47936.1.1 47936.2.1 47936.3.1	Horizontal curve improvements on SR 1710 (Old NC 10) west of SR 1561/SR 1709 (Lawrence Road) east of Hillsborough. Improvements consist of wedging pavement and grading shoulders.	Jun. 2022	Nov. 2022	$261,000	Planning and design activities underway	Chad Reimakoski
SS-6007E 49115.1.1 49115.3.1	All Way Stop installation and flashing beacon revisions at the intersection of SR 1005 (Old Greensboro Road) and SR 1956 (Crawford Dairy Road/Orange Chapel Clover Garden Road)	Jun. 2022	Sept. 2022	$28,800	Funds approved 3/5/20 but not released	Dawn McPherson
I-5958 45910.1.1 45910.3.1	Pavement Rehabilitation on I-40/I-85 from West of SR 1114 (Buckhorn Road) to West of SR 1006 (Orange Grove Road)	11/17/2026	FY2028	$8,690,000	PE funding approved 10/10/17	Chris Smitherman

NCDOT DIV 7 PROJECTS LOCATED IN DCHCMPO - UNDER DEVELOPMENT

TIP/WBS #	Description	LET/Start Date	Completion Date	Cost	Status	Project Lead
I-5967 45917.1.1 45917.2.1 45917.3.1	Interchange improvements at I-85 and SR 1009 (South Churton Street) in **Hillsborough**	10/19/2027	FY2030	$16,900,000	PE funding approved 9/8/17, Planning and Design activities underway, Coordinate with I-0305 and U-5845	Laura Sutton
I-5959 45911.1.1 45911.3.1	Pavement Rehabilitation on I-85 from West of SR 1006 (Orange Grove Road) to Durham County line	11/16/2027	FY2029	$11,156,000	PE funding approved 10/10/17, Coordinate with I-5967, I-5984 and I-0305	Chris Smitherman
R-5821A 47093.1.2 47093.2.2 47093.3.2	Construct operational improvements including Bicycle/Pedestrian accommodations on NC 54 from SR 1006 (Orange Grove Road) to SR 1107 /SR 1937 (Old Fayetteville Road).	6/20/2028	FY2031	$50,700,000	PE funding approved 10/10/17, Planning activities underway, Coordinating with NC54 West Corridor Study	Chris Smitherman
U-5845 50235.1.1 50235.2.1 50235.3.1	Widen SR 1009 (South Churton Street) to multi-lanes from I-40 to Eno River in **Hillsborough**	7/18/2028	FY2031	$49,238,000	PE funding approved 5/14/15, Planning and Design activities underway, Coordinate with I-5967	Laura Sutton
I-5984 47530.1.1 47530.2.1 47530.3.1	Interchange improvements at I-85 and NC 86 in **Hillsborough**	11/21/2028	FY2031	$20,900,000	PE funding approved 10/10/17, Planning and Design activities underway, Coordinate with I-0305 and I-5959	Laura Sutton
I-0305 34142.1.2 34142.2.2 34142.3.2	Widening of I-85 from west of SR1006 (Orange Grove Road) in Orange Co. to west of SR 1400 (Sparger Road) in Orange Co.	1/1/2040	FY2044	$132,000,000	PE funding approved 6/5/18, Planning and design activities underway, Project reinstated per 2020-2029 STIP (funded project) and delete project I-5983	Laura Sutton

North Carolina Department of Transportation

6/7/2021

Active Projects Under Construction - Orange Co.

Contract Number	TIP Number	Location Description	Contractor Name	Resident Engineer	Contract Bid Amount	Availability Date	Completion Date	Work Start Date	Estimated Completion Date	Progress Schedule Percent	Completion Percent
C202581	EB-4707A	IMPROVEMENTS ON SR-1838/SR-2220 FROM US-15/501 IN ORANGE COUNTY TO SR-1113 IN DURHAM COUNTY. DIVISION 5	S T WOOTEN CORPORATION	Nordan, PE, James M	$4,614,460.00	5/28/2019	2/15/2021	5/28/2019	3/1/2022	68.5	49.5
C204078	B-4962	REPLACE BRIDGE #46 OVER ENO RIVER ON US-70 BYPASS.	CONTI ENTERPRISES, INC	Howell, Bobby J	$4,863,757.00	5/28/2019	12/28/2021	6/19/2019	12/28/2021	84.31	98
DG00461		REHAB. BRIDGE #031 ON SR 1010 (E. FRANKLIN ST.) OVER BOLIN CREEK & BOLIN CREEK TRAIL	M & J CONSTRUCTION CO OF PINELLAS COUNTY INC	Howell, Bobby J	$2,456,272.12	11/12/2018	7/15/2019	3/15/2019	5/15/2021	100	99.97
DG00462		REHAB. BRIDGES 264, 288, 260, 543 IN GUILFORD COUNTY AND BRIDGE 031 IN ORANGE COUNTY	ELITE INDUSTRIAL PAINTING INC	Snell, PE, William H	$967,383.15	8/1/2019	1/1/2020				
DG00483		RESURFACE SR 1010 (MAIN STREET/FRANKLIN STREET) FROM SR 1005 (JONES FERRY ROAD) TO NC 86 (COLUMBIA STREET)	CAROLINA SUNROCK LLC	Howell, Bobby J	$845,631.59	5/18/2019	8/7/2020				
DG00485	U-5846	SR 1772 (GREENSBORO STREET) AT SR 1780 (ESTES DRIVE), CONSTRUCT ROUNDABOUT	FSC II LLC DBA FRED SMITH COMPANY	Howell, Bobby J	$3,375,611.30	5/28/2019	3/1/2022	7/29/2019	6/10/2022	73	86.99
DG00503		MILL AND RESURACE US 70 FROM ALAMANCE COUNTY LINE TO NC 86 & NC 86 FROM PAVEMENT JOINT NORTH OF W. CORBIN TO US 70	FSC II LLC DBA FRED SMITH COMPANY	Howell, Bobby J	$1,601,700.79	7/1/2021	11/1/2021				
DG00507		AST RETREATMENT OF 48 SECONDARY ROADS IN ALAMANCE COUNTY AND ONE SECONDARY ROAD IN ORANGE COUNTY	WHITEHURST PVING CO., INC	Hayes, PE, Meredith D	$1,042,639.12	7/1/2021	6/30/2022				
DG00517		SR 1146 (WEST TEN ROAD) FROM JOINT WEST OF SR 1114 (BUCKHORN ROAD) TO SR 1120 (MT. WILLING ROAD)	CAROLINA SUNROCK LLC	Howell, Bobby J	$659,647.14	4/1/2021	10/30/2021				

Chatham County - DCHC MPO - Upcoming Projects - Planning & Design, R/W, or not started - Division 8--July 2021								
Contract # or WBS # or TIP #	**Route**	**Description**	**Let Date**	**Completion Date**	**Contractor**	**Project Admin.**	**STIP Project Cost**	**Notes**
U-6192	US 15-501	Add Reduced Conflict Intersections - from US 64 Pitts. Byp to SR 1919 (Smith Level Road) Orange Co.	After 2031	TBD	TBD	Greg Davis (910) 773-8022	$117,700,000	Right of Way 1/2026
R-5825	NC 751 at SR 1731 (O'Kelly Chapel Road)	Upgrade and Realign Intersection	11/8/2022	TBD	TBD	Greg Davis (910) 773-8022	$1,121,000	