FAST 2.0

Freeway, Arterial, Street, and Tactical Transit

Suite of Options Memorandum

April 2025

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Introduction

This memo presents and evaluates a suite of transit infrastructure options that may be appropriate for implementation along primary transportation corridors in the Triangle. The suite of options is based on a review of transit infrastructure from enhanced transit projects, such as Bus Rapid Transit (BRT), already underway in the Study Area and from agencies across the United States. These options will be the basis for recommendations applied to the Priority Corridors (Figure 1) and Regional Network (Figure 2).

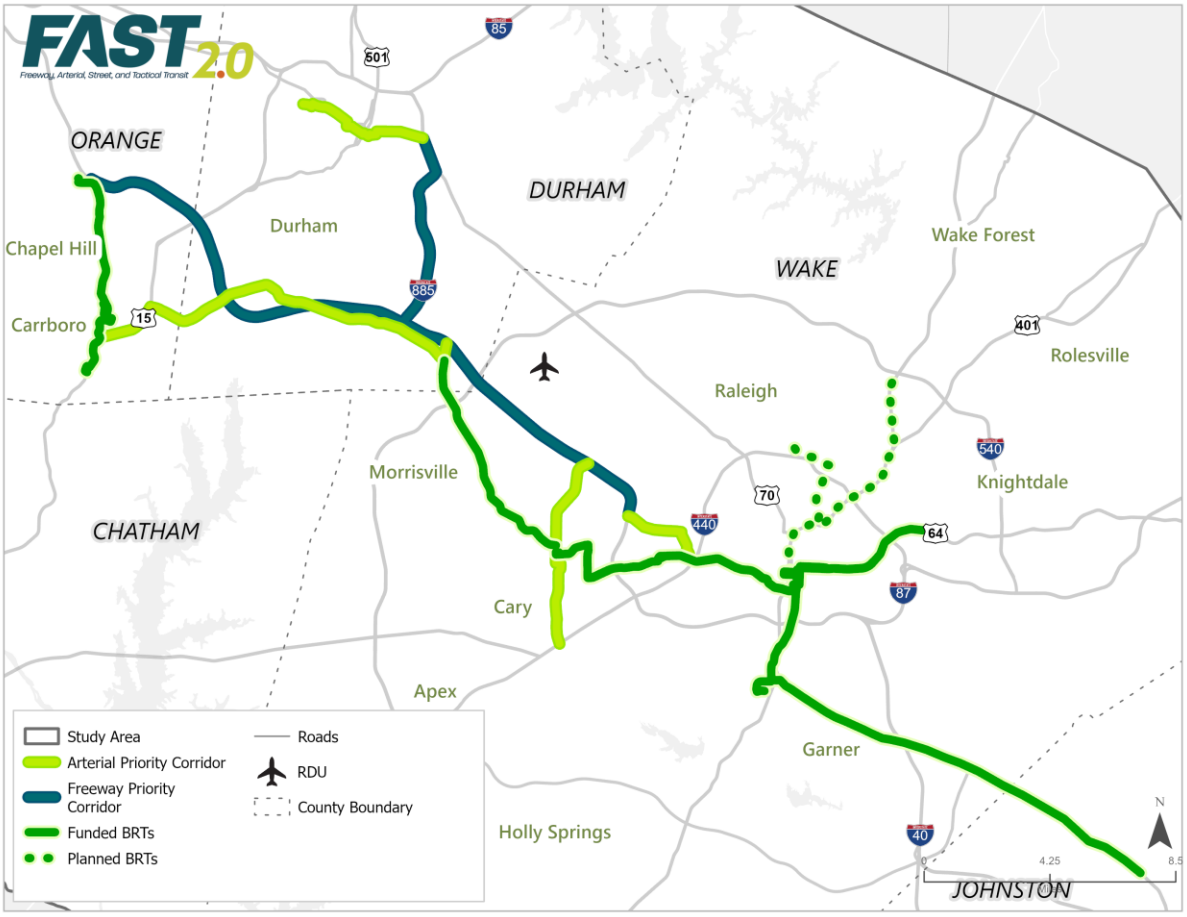


Figure 1: FAST 2.0 Priority Corridors

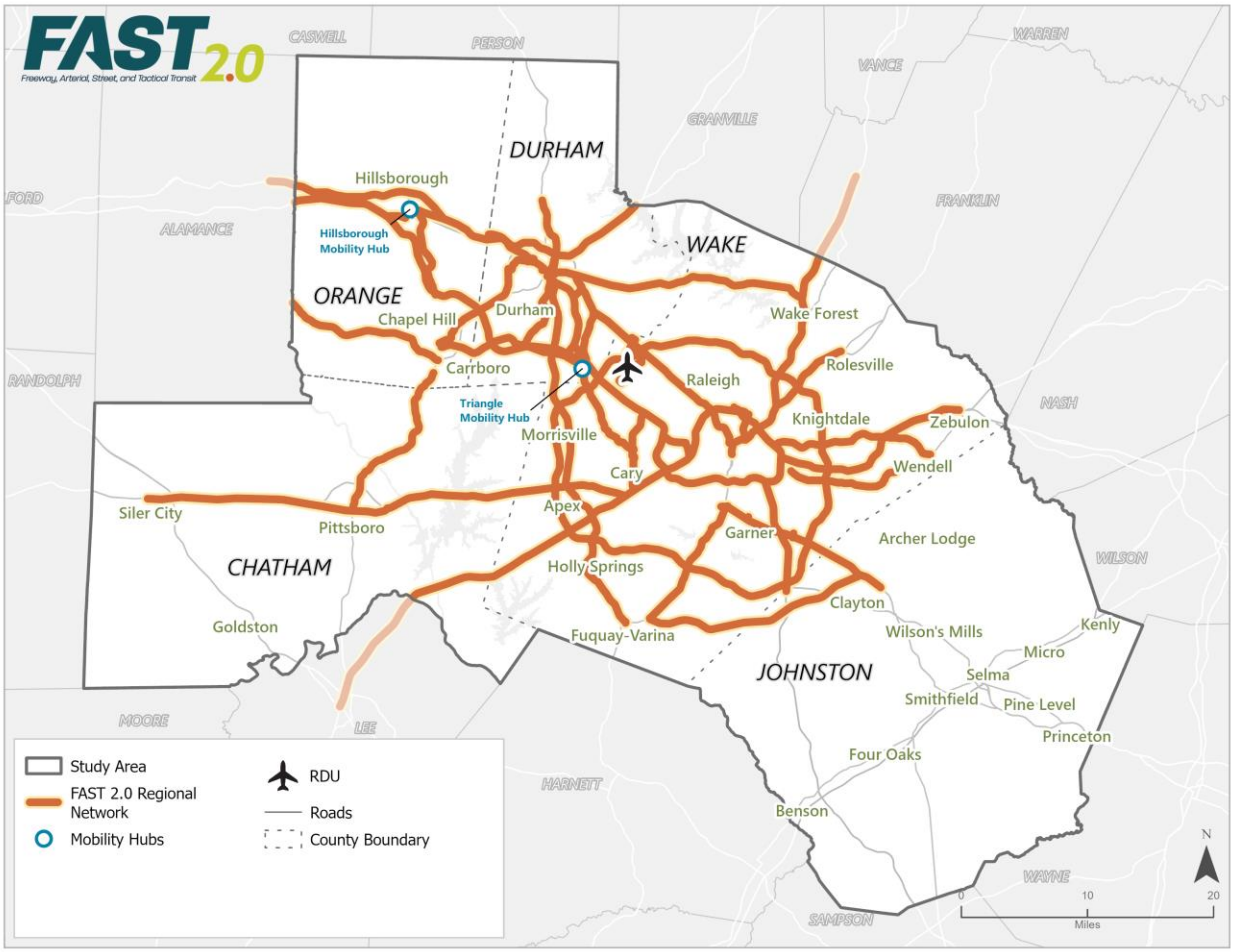


Figure 2: FAST 2.0 Regional Network

This memo expands upon FAST 1.0's *Triangle Implementation Playbook* by including additional factors that will help guide transit infrastructure investment and decisions, in addition to evaluating the suite of transit infrastructure investment options.

This memo is meant to be a resource for the region's planners, engineers, designers, policy and decision-makers. Findings from this memo will be applied to the FAST 2.0 Implementation Plan to identify transit infrastructure options that may be ready for implementation, along with identifying transit infrastructure options that need additional study and coordination to increase readiness.

Design guidance for the transit infrastructure options was taken from the following sources:

- North Carolina Department of Transportation (NCDOT)
- American Association of State Highway Transportation Officials (AASHTO)
- National Association of City Transportation Officials (NACTO)

How to Use This Memo

This Suite of Options memorandum provides an overview of an array of transit infrastructure that could be considered along the priority corridors and regional network. Each type of transit infrastructure is considered one treatment option within the suite of options for this study and is given its own section where a general overview and examples are provided. In addition, design and implementation considerations are explored for each option, including:

- Level of Transit Advantage,
- Physical Suitability,
- Agency Approval Probability,
- Value,
- Funding Probability,
- Public Visibility, and
- Rider Experience.

As an overall summary for each option, these considerations are scored from Fair to Excellent and then compared to similar types of options. For the comparisons, options are grouped based on the type of roadway facility the option would best be suited for and how that option would be applied to the facility. For example, the options were divided between freeways and arterials, then further divided on whether or not they would be applied along the mainline of that facility or as a way to improve access or reliability. In addition, there is a grouping for different types of bus stops. It should be noted that FAST 2.0 corridor recommendations will include multiple options that when combined together will produce greater benefit than a single option.

An introductory section for multimodal infrastructure is provided to highlight how fundamental multimodal access and transit stop infrastructure is to the success of any transit project and should be considered as baseline improvements for all transit projects. All the options in this memo, and how they are grouped together, include:

- Multimodal Infrastructure
  - Bicycle and Pedestrian Access Improvements
  - Bus Stop / Station Design
- Freeways (Facility)
  - Dedicated Freeway Transit Lanes
  - Dynamic Median Shoulder System (DMSS)
  - Bus-on-Shoulder System (BOSS)
  - Transit Use of Express Lanes
- Freeways (Access)
- Freeway Ramp Signals
  - Direct Transit Access Ramps
- Arterials (Facility)
  - Fully Dedicated Transit Lanes
  - Semi-Dedicated Transit Lanes
- Arterials (Signals and/or Access)
  - Queue Jump Lanes
  - Transit Signal Priority
- Types of Bus Stops/Stations
  - Enhanced Stop

- Super Stop
- Mobility Hub

In addition to the physical transit infrastructure noted above, there are technologies that the region could further advance to aid in the FAST 2.0 implementation. Many of these technologies are currently being investigated as part of ongoing planning efforts, so they were not explored further in this memo, but are an important part of successful transit operations. For example, GoTriangle is currently leading the Regional Technology Plan for the Research Triangle Region with 12 regional partners that include many of the FAST 2.0 stakeholders (GoTriangle, GoRaleigh, GoCary, GoDurham, Chapel Hill Transit, Wake County, Durham County, Orange County, CAMPO, Triangle West TPO (formerly DCHC MPO), Central Pines, and NCDOT). The Regional Technology Plan will focus on six different areas of transit technologies including:

- Passenger Real-Time & Trip Planning
- Transit Service Planning Tools
- Transit Signal Priority
- Regionally Integrated Payments
- Regional GTFS Publishing Standards
- Open Transit Data Portal

Multimodal Infrastructure

Bicycle and Pedestrian Access Improvements

Bus stop with a shelter, bench, trash can, wide sidewalk, pedestrian scale lighting, street trees, buffered bike lanes, and transit-supportive land uses. (Source: Alta Planning + Design)

GENERAL OVERVIEW

Description and Intention

Improvements for people walking and biking benefit transit in two ways: The first is by providing a safe and comfortable first-mile/last-mile connection to and from bus stops and stations. The second is by providing an alternative to transit, particularly for shorter trips or times of day when transit is not running as frequently.

Bicycle and pedestrian improvements also provide benefits beyond access to transit, such as increased economic activity along commercial corridors, improved health outcomes, and environmental benefits.

Location and Typology Application

Bicycle and pedestrian improvements to transit stops can be made along most arterial corridors. Specific improvements should be tailored to the roadway and land use context. Higher levels of physical separation, such as curbs, bollards, and berms may be required in higher-speed conditions.

Sidepaths or greenways may be more appropriate along limited-access highways and rural roads.

Level of Transit Advantage

Unlike some of the transit improvements considered in this study, bicycle and pedestrian improvements do not reduce delays or dwell time for the bus. However, safe and comfortable access to the stops is a critical element of a convenient transit system.

Safe, comfortable, and connected bicycle facilities and supporting infrastructure can also expand the range of transit trips, especially with the advent of e-bikes and scooters.

DESIGN CONSIDERATIONS

Physical Suitability

Bicycle and pedestrian improvements can generally be accommodated along most roads in the Triangle, though right-of-way availability may be a limiting factor. Safe street crossings are critical since most transit users will need to cross the street at least once to access a bus stop. Designs such as bus boarding islands and shared cycle track stops can mitigate conflicts between different modes.

Bicycle and pedestrian accommodations are not common along limited-use highways in North Carolina, so new design standards will need to be employed for future improvements like the Triangle Bikeway.

Agency Approval Probability

Bicycle and pedestrian improvements are standard for most new roads and many types of road retrofits in the Triangle region. Bicycle and pedestrian considerations are a key part of NCDOT's Complete Street policy and are included in the County Transit Plans.

Challenges can exist if there is no available right-of-way and cost sharing arrangements can be difficult for some entities, particularly along roads outside of municipal boundaries. Bicycle and pedestrian facilities along limited-access highways are not yet commonplace, such as those proposed for the Triangle Bikeway.

Value

On average, construction projects to improve bicycle and pedestrian facilities generate more jobs than auto-oriented projects and studies have shown increased business revenue along corridors with improved bicycle and pedestrian infrastructure.

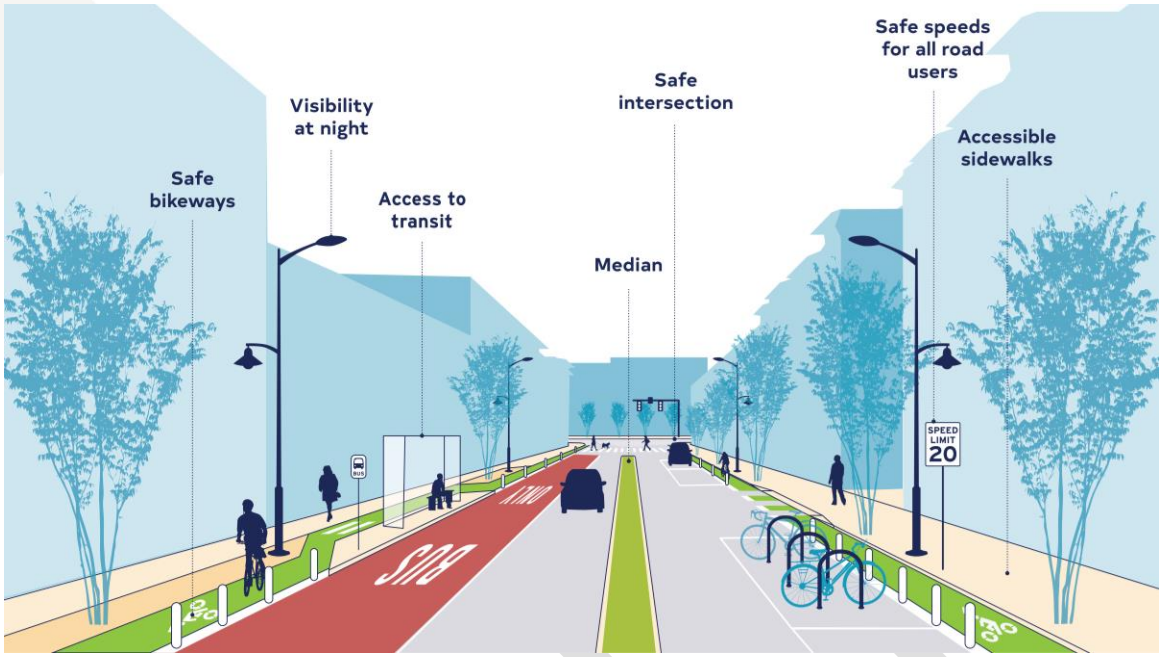
Bicycle and pedestrian improvements at bus stops or along transit corridors also provide value beyond access to transit by offering comfortable and safe forms transit access, direct access to jobs, education, recreation, and services.

Funding Probability

Municipalities throughout the Triangle are prioritizing bicycle and pedestrian improvements, often using local tax dollars to fund them, or to provide matches to outside funding sources. In addition, funding is available in the three County Transit Plans for access to transit projects.

While State funding for standalone pedestrian or bicycle projects is prohibited in North Carolina, improvements can still be made alongside other roadway projects. The region has also been successful in obtaining Federal funding, including CMAQ grants.

Transit stop design from the Walkable Winston-Salem Plan. (Source: Alta Planning + Design)



Elements of safe access to transit for people walking and biking. (Source: Alta Planning + Design)

IMPLEMENTATION EXPERIENCE

Public Visibility

Because they are smaller in scale and more ubiquitous, bicycle and pedestrian improvements are less visible than most other types of transit improvements considered in this study.

The visibility of bicycle and pedestrian projects can be improved with the addition of appropriately scaled lighting, street trees and other landscape elements, public art, and the addition of color such as green pavement markings for bicycles at intersections and driveways where appropriate.

Rider Experience

The rider experience does not just consist of the time spent on a bus. Most transit trips begin and end with walking or biking, so access to transit stops is a critical aspect of the rider experience.

Walking and biking can also be a substitute for shorter transit trips. Knowing that safe and comfortable alternatives exist can make the transit trip less stressful.

OPTION SUMMARY

Rating

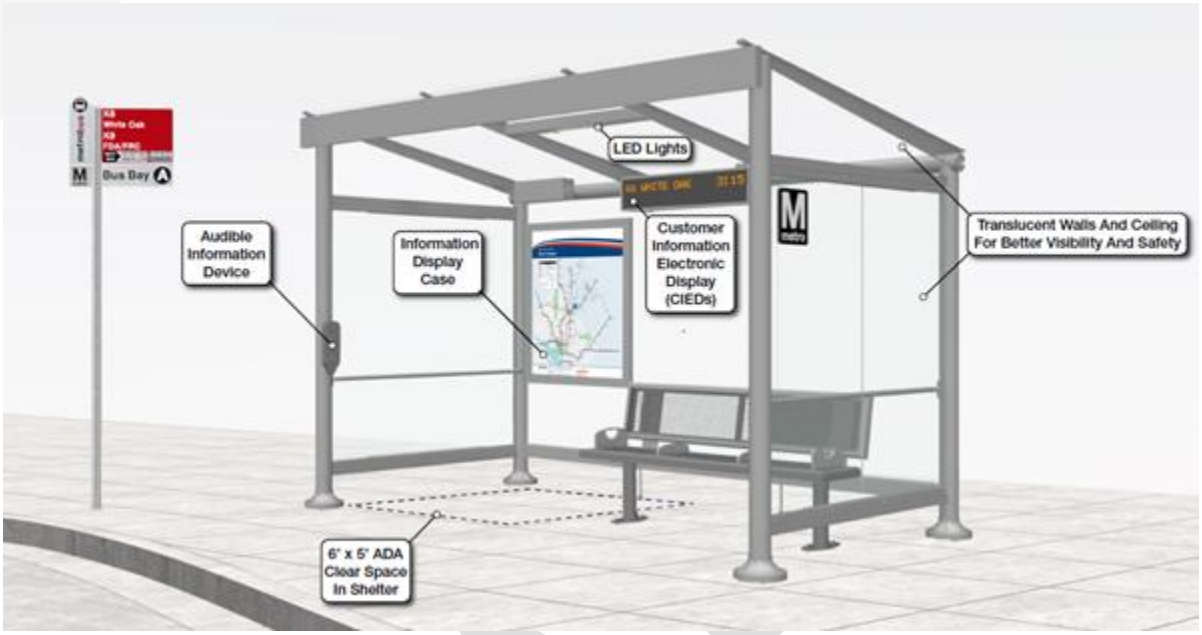
Most transit trips begin and end with walking and biking, so safe and comfortable access to bus stops is critical to high-quality regional transit.

Bicycle and pedestrian improvements are being prioritized throughout the Triangle, so despite funding challenges at the state and federal level, local funding sources are often available.

While these improvements are not as visible as others, making it safer to walk and bike can provide advantages beyond access to transit.

Bicycle and Pedestrian Access Improvements	
Physical Suitability	Great
Agency Approval Probability	Good
Level of Transit Advantage	Great
Value	Excellent
Public Visibility	Good
Funding Probability	Good
Rider Experience	Great

Bus Stop/Station Design



The graphic above highlights common elements of a bus stop. (Source: WMATA)

GENERAL OVERVIEW

Description and Intention

All transit trips begin and end at a designated bus stop or station, so it is important to provide safe and dignified spaces for riders to wait for their bus, ideally providing seating and shelter from the elements at a minimum. Agencies should consider designing a "kit-of-parts" for bus stops/stations, which would allow differing levels of amenities at bus stop/stations based on the ROW, ridership, or transit service type.

Location and Typology Application

Placement is generally recommended to be on the far side of an intersection to allow buses to use priority measures to clear the bus through the intersection with minimal delay. However, ROW and other considerations may require near side or midblock locations. Consideration should also be given to placing bus stops adjacent to pedestrian and bicycle infrastructure to allow riders to safely access the bus stop/station. Stop location and spacing along a route are determined by proximity to transit-supportive land use, transfer opportunities, and transit service type.

Level of Transit Advantage

Providing amenities at bus stops and stations can provide a more comfortable and convenient waiting environment for transit riders and improved passenger experience could help encourage more people to use transit and increase ridership.

DESIGN CONSIDERATIONS

Physical Suitability

The placement and design of each bus stop will be impacted by the availability of ROW. Using a "kit-of-parts" approach can help with scaling amenities for limited ROW locations.

To mitigate delays, bus pullouts should be avoided, and the bus should travel and stop in a curb-lane where on-street parking is not permitted. ADA considerations are paramount with landing pads and curb heights that allow passengers in wheelchairs to board.

Agency Approval Probability

Coordination with NCDOT is required where a bus stop is placed within NCDOT ROW; this approval is managed by the Integrated Mobility Division and the appropriate Division of Highways office.

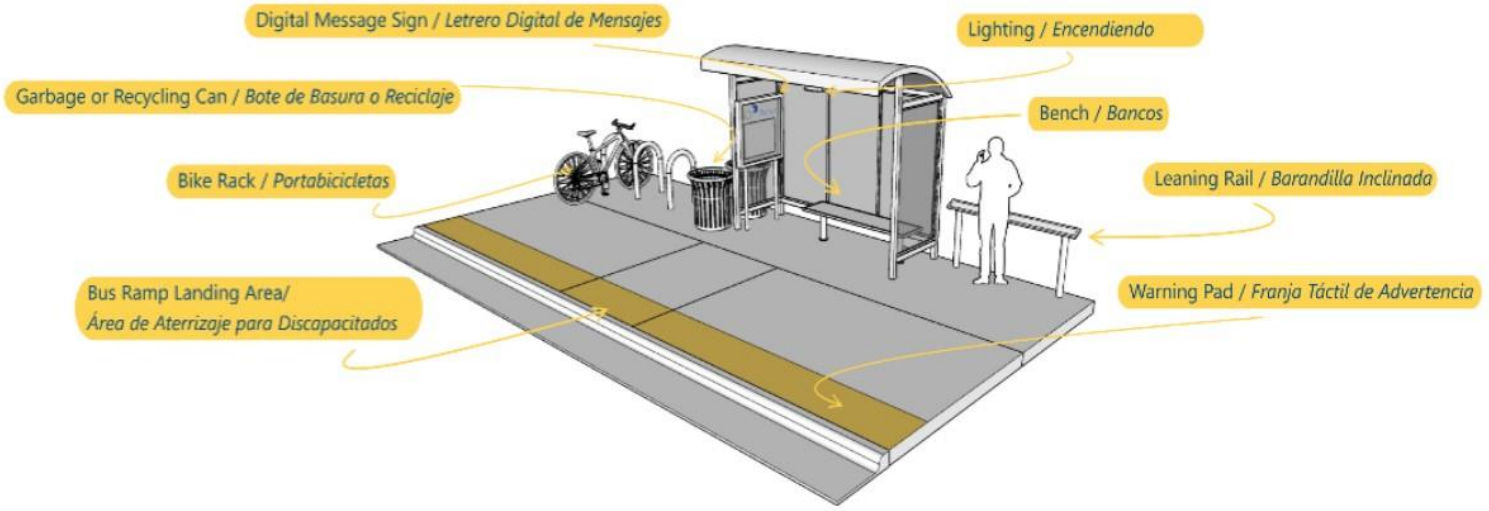
Value

Bus stop improvements are a relatively low-cost way to increase ridership by improving the riders' experience waiting for a bus. The route should not be overburdened by excessive bus stops, as this causes delays on high-capacity transit routes.

Funding Probability

Bus stops are most often funded with a combination of local and federal funding. Funding for bus stops can be bundled with larger transit priority corridor improvements or funded as stand-alone improvements.

In Chapel Hill, the stop on Franklin Street at Couch Road was upgraded with a shelter, a landing pad, a trash can, bike racks, and a solar light in 2024. (Source: GoTriangle)



GoDurham's Better Bus Project incorporated features of an enhanced bus stop to create a standard bus stop along their high ridership corridors, called Transit Emphasis Corridors, shown in the graphic above. (Source: GoDurham)

IMPLEMENTATION EXPERIENCE

Public Visibility
As the place where riders often start and end their transit trip, bus stops are exceptionally high visibility to riders. Including features such as lighting and comfortable amenities such as shelters and benches can encourage mode shift to transit.

Rider Experience
Providing seating and shelter from the elements can elevate the riders' experience, providing safe and dignified spaces for riders to wait for their bus. Real time information displays reduce anxiety as riders know when to plan for their bus arrival. A robust maintenance program should be implemented so that bus stops are regularly cleaned, and trash is removed in a timely manner.

OPTION SUMMARY

Rating
Enhancement of bus stops increases multimodal connectivity with improved bicycle and pedestrian connections to bus stops and can provide a more comfortable and convenient waiting environment for transit riders. All transit trips begin at a designated stop or station, so it is imperative to provide a safe, comfortable waiting area that riders can easily get to by multiple modes.

Bus Stop / Station Design	
Physical Suitability	Great
Agency Approval Probability	Great
Level of Transit Advantage	Great
Value	Good
Public Visibility	Great
Funding Probability	Great
Rider Experience	Great

Freeways (Facility)

Dedicated Freeway Transit Lanes

Dedicated freeway transit lanes on I-35 in Minneapolis. (Source: SEH)

GENERAL OVERVIEW

Description and Intention

Dedicated freeway transit lanes are transit-priority travel lanes, reserved exclusively for transit vehicles, with restrictions for other modes. These lanes are meant to optimize bus operations on a freeway corridor to maximize transit competitiveness and reliability by reducing delays caused by congestion.

Location and Typology Application

Dedicated freeway transit lanes could be applied to interstates and freeways where transit reliability is impacted by congestion. The locations well suited for dedicated freeway transit lanes would also be well suited for a dynamic median shoulder system (DMSS). On the priority corridors, a dedicated freeway transit lane is under consideration as part of the Reimagine Durham Freeway Project, on NC 147 between Fayetteville Street and Duke Street.

Level of Transit Advantage

Dedicated freeway transit lanes provide a high level of transit advantage by ensuring that transit vehicles have a clear, unobstructed path, reducing travel times and improving schedule adherence. These lanes can improve reliability and performance to increase passenger convenience.

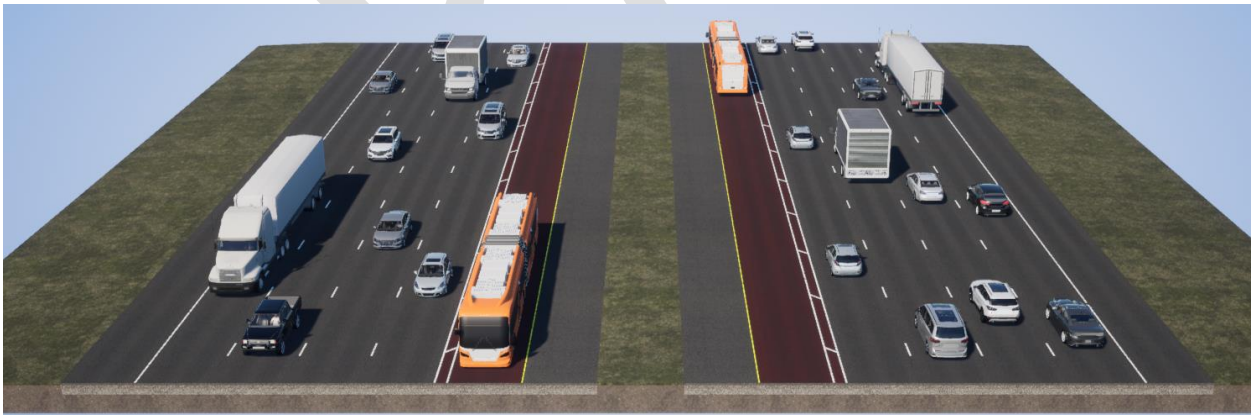
DESIGN CONSIDERATIONS

Physical Suitability
Dedicated freeway transit lanes can be placed on the outer or inner most lanes along a freeway or interstate, but their suitability may be limited by the availability of ROW as they could require adding an additional lane. The need to widen an existing roadway could be mitigated by restriping the existing roadway cross section to minimize the inside median width.

Agency Approval Probability
The use of dedicated freeway transit lanes would be new to the region and would require coordination with NCDOT to understand requirements for design and implementation.

Value
Unless there is an opportunity to repurpose a lane or shoulder, dedicated freeway transit lanes would require widening a roadway to add the desired number of transit lanes, which could require additional ROW and a large amount of funding.

Funding Probability
Dedicated freeway transit lanes could require adding a travel lane along a freeway or interstate, which would increase the cost of the project. These lanes would likely need to be a part of a larger roadway project, where there are multiple sources of funding, and the transit portion of the project would be paid for using transit funding, such as from a federal or local source.



Rendering of potential dedicated freeway transit lanes. (Source: WSP)

IMPLEMENTATION EXPERIENCE

Public Visibility

Dedicated freeway transit lanes are highly visible when applied to a roadway, with the lane markings and signage, being seen by all roadway users. Public education and enforcement can be important to ensure proper use and understanding of the lanes.

Rider Experience

Dedicated freeway transit lanes can greatly benefit the rider experience by helping to reduce travel times and improve schedule adherence. The experience can be excellent when transit vehicles using these lanes pass areas of congestion or gridlock. This can be especially helpful for regional routes that experience congestion along freeways and interstates.

OPTION SUMMARY

Rating

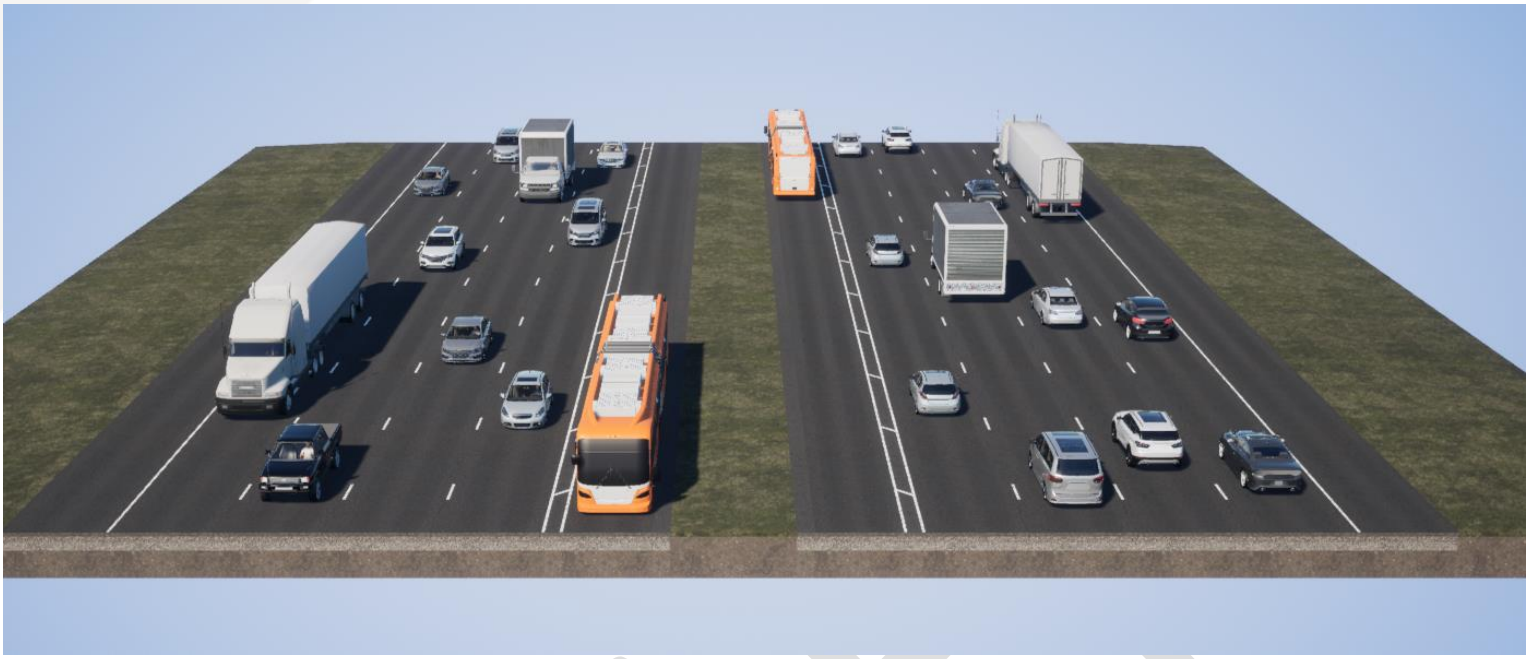
Dedicated freeway transit lanes provide a high level of transit advantage by ensuring that transit vehicles have a clear, unobstructed path, reducing travel times and improving schedule adherence. These lanes are highly visible to the public and can greatly benefit the rider experience by improving reliability. Dedicated freeway transit lanes would require widening to implement within the Study Area, contributing to a high cost of implementation and lower physical suitability.

Dedicated Freeway Transit Lanes	
Physical Suitability	Good
Agency Approval Probability	Good
Level of Transit Advantage	Excellent
Value	Fair
Public Visibility	Excellent
Funding Probability	Good
Rider Experience	Excellent

Freeway (Facility) Rating Comparison

Option Type	Dedicated Freeway Transit Lanes	Dynamic Median Shoulder System	Bus-on-Shoulder System (BOSS)	Transit Use of Express Lanes
Physical Suitability	Good	Good	Excellent	Excellent
Agency Approval Probability	Good	Good	Excellent	Excellent
Level of Transit Advantage	Excellent	Good	Good	Great
Value	Fair	Great	Excellent	Excellent
Public Visibility	Excellent	Great	Great	Good
Funding Probability	Good	Good	Great	Fair
Rider Experience	Excellent	Great	Good	Good

Dynamic Median Shoulder System (DMSS)



Rendering of potential dynamic median shoulder system (DMSS). (Source: WSP)

GENERAL OVERVIEW

Description and Intention

A dynamic median shoulder system (DMSS) would allow buses to utilize the median or inside shoulder. These shoulders would be designed to allow general-purpose traffic to use them for emergencies during all hours of the day, along with allowing buses to travel on the shoulder during all hours of the day. This option is like Bus-on-Shoulder System (BOSS), but within the inside median shoulder. This strategy aims to alleviate congestion and improve bus transit efficiency by providing buses with a dedicated lane during high-traffic periods.

Location and Typology Application

DMSS could be applied to interstates and freeways with inside shoulders wide enough to accommodate buses. On the priority corridors, some possible locations for DMSS include:

1. I-40 between NC 86 and Cary Towne Boulevard
2. Wade Avenue between I-40 and Blue Ridge Road
3. I-885 between I-40 and NC 147

Level of Transit Advantage

DMSS can provide a transit advantage by allowing buses to bypass congested lanes, reducing travel time and improving schedule reliability. This can lead to more consistent and predictable transit service.

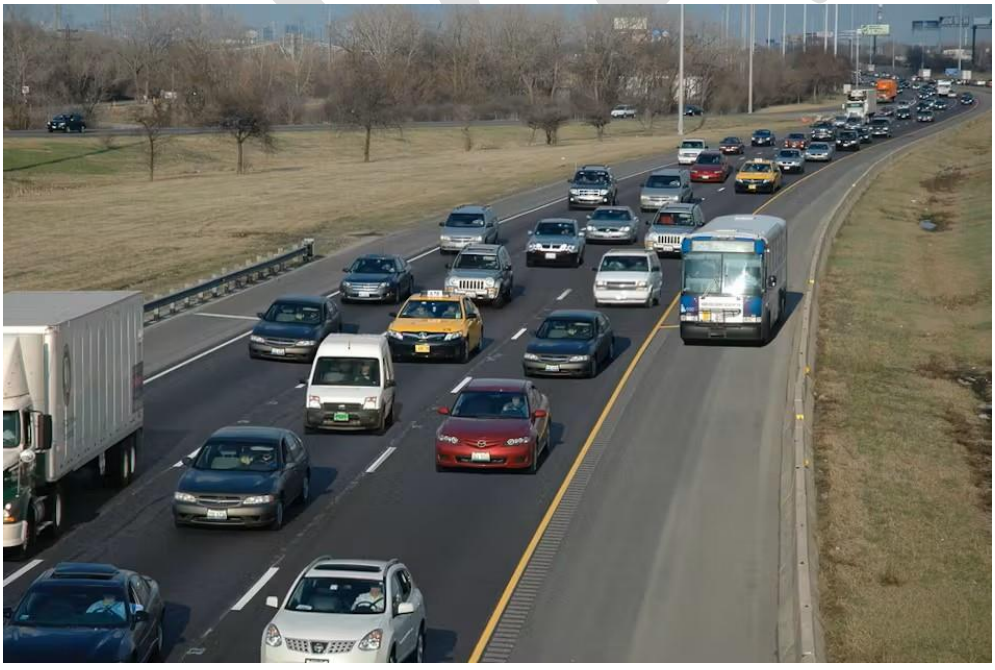
DESIGN CONSIDERATIONS

Physical Suitability
DMSS is most effective for urban and suburban freeway environments where congestion is prevalent and there is sufficient shoulder width to accommodate bus traffic. In cases where sufficient shoulder width is not available, roadway widening would be required and additional hardening may be required to accommodate transit vehicles.

Agency Approval Probability
While there are no current DMSS lanes along NCDOT roadways, there is a good probability of approval, especially since these lanes have been shown in express design projects along I-40. Signage and pavement markings would need to be discussed with NCDOT before implementation.

Value
DMSS can be cost-effective compared to adding new lanes by utilizing existing infrastructure, which could minimize construction costs. The shoulders have the potential to improve transit efficiency and reduce congestion.

Funding Probability
The probability for funding is good, as funding can be sourced from federal, state, and local transportation budgets, and regional focus shifts from train- to bus-based service. Grants and public-private partnerships may also be viable funding sources.



Pace Bus System utilizing the median shoulder on I-55 in Chicago. (Source: Mass Transit)

IMPLEMENTATION EXPERIENCE

Public Visibility

DMSS can provide good visibility to the public with buses being able to use the lanes during congested times. Signage will be prominent also enhancing the visibility. Public awareness campaigns will be necessary to educate drivers about the lane's dual use and ensure compliance.

Rider Experience

DMSS can enhance the rider experience by providing faster and more reliable bus service, reducing delays caused by traffic congestion.

Coordination with NCDOT Traffic Management would be critical to ensure breakdown vehicles are removed from the DMSS lanes.

OPTION SUMMARY

Rating

DMSS can provide a significant transit advantage by allowing buses to bypass congested lanes, reducing travel time and improving schedule reliability, improving the rider experience. However, DMSS would allow general-purpose traffic to use shoulders for emergencies during all hours of the day, periodically limiting the transit advantage that is provided. DMSS does not exist yet in North Carolina and could require widening of the shoulder to accommodate transit usage, which could limit physical suitability and may create the need for additional coordination with NCDOT in order to implement.

Dynamic Median Shoulder System	
Physical Suitability	Good
Agency Approval Probability	Good
Level of Transit Advantage	Good
Value	Great
Public Visibility	Great
Funding Probability	Good
Rider Experience	Great

Freeway (Facility) Rating Comparison

Option Type	Dedicated Freeway Transit Lanes	Dynamic Median Shoulder System	Expanded BOSS	Transit Use of Express Lanes
Physical Suitability	Good	Good	Excellent	Excellent
Agency Approval Probability	Good	Good	Excellent	Excellent
Level of Transit Advantage	Excellent	Good	Good	Great
Value	Fair	Great	Excellent	Excellent
Public Visibility	Excellent	Great	Great	Good
Funding Probability	Good	Good	Great	Fair
Rider Experience	Excellent	Great	Good	Good

Bus-on-Shoulder System (BOSS)

Existing BOSS on I-40 in Wake County (Source: NCDOT)

GENERAL OVERVIEW

Description and Intention

Bus-on-Shoulder System (BOSS) lanes are designated for buses to use the outside shoulder of the roadway during peak traffic hours. This strategy aims to reduce congestion and improve bus transit efficiency by allowing buses to bypass traffic jams and maintain a more reliable schedule.

Currently, BOSS is allowed on certain portions of I-40 and Wade Avenue in the study area. An expanded BOSS network would look at allowing BOSS on additional roadways in the study area.

Location and Typology Application

BOSS could be expanded on the roadways where it is currently allowed and on interstates and freeways with shoulders wide enough to accommodate buses. On the priority corridors, some possible locations for BOSS include:

1. On I-40 from US 15-501 to NC 86
2. On I-40 from Wade Avenue to Cary Towne Boulevard
3. On NC 147 from I-885 to Fayetteville Street

Level of Transit Advantage

BOSS can provide a high level of transit advantage by enabling buses to avoid congested lanes, thereby reducing travel time and improving schedule reliability, which can lead to more consistent and predictable transit service. However, there are limitations to the speed at which buses can travel while using BOSS.

DESIGN CONSIDERATIONS

Physical Suitability

Most effective on highways and major arterial roads where congestion is common, and the shoulder is wide enough to safely accommodate bus traffic. The shoulder must be structurally sound to support the weight and frequency of bus traffic.

Currently, BOSS is allowed on certain portions of I-40 and Wade Avenue in the study area, where the wider shoulders exist.

Agency Approval Probability

Expanding BOSS is likely to have a high probability of approval due to its existing use on NCDOT roadways in the study area and its ability to be implemented without additional infrastructure. Local transit agencies are likely to support expanded BOSS measures that enhance transit efficiency and reliability.

Currently BOSS is only used by select GoTriangle routes, so additional coordination with other transit agencies and NCDOT may be needed to ensure proper driver training and maintenance of roadway shoulders are in place. Local agencies and municipalities may be able to help fund additional maintenance of expanded BOSS to help ensure the lanes are cleared for use.

Value

BOSS can provide a cost-effective treatment option compared to adding new lanes and provides the potential for high return on investment through improved transit efficiency and reduced congestion. The ability for BOSS to utilize existing infrastructure can minimize construction costs.

Funding Probability

BOSS has a high probability of funding due to it being able to use existing shoulders. Any need to expand a shoulder to allow for BOSS could likely be funded from federal, state, and local transportation budgets, particularly those focused on congestion relief and public transit improvements.

BOSS being utilized in Minneapolis. (Source: Metro Transit)

Signage to note BOSS usage. (Source: FHWA)

IMPLEMENTATION EXPERIENCE

Public Visibility
BOSS can be highly visible to the public with buses passing congested traffic. Signage and public awareness campaigns will be necessary to educate drivers about the lane's purpose and to ensure compliance.

Rider Experience
BOSS can enhance the rider experience by providing faster and more reliable bus service, reducing delays caused by traffic congestion. This can help provide a more punctual and efficient transit service.

OPTION SUMMARY

Rating

Expanding BOSS around the Triangle could be a cost-effective treatment option to help reduce travel times and increase schedule reliability. BOSS is treatment already used in the region and would not require additional infrastructure to implement. However, it does not provide infrastructure fully dedicated to transit and its success could be dependent on conditions present at the time, such as friction from debris or stopped vehicles.

Bus-on-Shoulder System (BOSS)	
Physical Suitability	Excellent
Agency Approval Probability	Excellent
Level of Transit Advantage	Good
Value	Excellent
Public Visibility	Great
Funding Probability	Great
Rider Experience	Good

Freeway (Facility) Rating Comparison

Option Type	Dedicated Freeway Transit Lanes	Dynamic Median Shoulder System	Bus-on-Shoulder System (BOSS)	Transit Use of Express Lanes
Physical Suitability	Good	Good	Excellent	Excellent
Agency Approval Probability	Good	Good	Excellent	Excellent
Level of Transit Advantage	Excellent	Good	Good	Great
Value	Fair	Great	Excellent	Excellent
Public Visibility	Excellent	Great	Great	Good
Funding Probability	Good	Good	Great	Fair
Rider Experience	Excellent	Great	Good	Good

Transit Use of Express Lanes

Express lanes on I-77 in Charlotte, North Carolina. (Source: Charlotte Business Journal)

GENERAL OVERVIEW

Description and Intention

Express lanes are designed to manage traffic flow and reduce congestion by using tolls, vehicle eligibility, and dynamic pricing strategies. Transit vehicles can use these lanes to bypass congested general-purpose lanes, improving travel times and reliability. The intention is to provide a faster and more predictable route for buses, especially during peak traffic periods.

Location and Typology Application

Express lanes are typically located on interstates or freeways that experience high levels of congestion. In the Study Area, NCDOT is currently exploring the transit use of express lanes on US 1 in Raleigh between I-540 and Wake Forest.

Level of Transit Advantage

Express lanes can provide a high level of transit advantage by offering a faster, more reliable route for buses, especially during peak traffic periods. This can significantly reduce travel times and improve schedule adherence.

DESIGN CONSIDERATIONS

Physical Suitability
Express lanes are suitable for urban and suburban freeway environments with high traffic volumes. I-540 in the study area is an expressway and toll lanes also exist on I-77 in Charlotte. Unless the lanes are repurposed, roads would have to be widened to accommodate these lanes and would require infrastructure to support toll collection and dynamic lane management.

Agency Approval Probability
There is agency coordination needed to codify public transportation use of tolling facilities, and any costs required to operate in the facility.

Across the nation, transit vehicles are often exempt from the cost associated with the facility and use the toll lanes for free.

Value
Express lanes may be more cost-effective if existing infrastructure is repurposed, otherwise the cost is like adding or widening highway lanes. The cost of the express lanes may be offset from the revenue generated from tolls.

Funding Probability
While some initial planning is ongoing, there are no identified express lanes projects on the immediate horizon for the region, contributing to a low funding probability.

There are a variety of potential funding sources to build new express lanes, including toll revenues, federal and state transportation grants, and public-private partnerships. Transit funding alone would not rise to the level needed to build a new express lane infrastructure.

Bus using express lanes on I-405 in Seattle. (Source: Seattle Transit Blog)

Express buses utilizing I-77 Express Lanes in Charlotte (Source: WFAE)

IMPLEMENTATION EXPERIENCE

Public Visibility

Express lanes could provide good visibility for transit, particularly if transit is able to bypass congested traffic using the express lanes or have signage noting use by transit.

Rider Experience

Express lanes can enhance the rider experience by providing faster and more reliable transit service, reducing delays caused by traffic congestion in general purpose lanes. With the use of express lanes, riders could expect more punctual and efficient transit service, particularly during congested, rush hour periods. This improved rider experience is only possible if the express lanes have free flowing traffic.

OPTION SUMMARY

Rating

Transit use of express lanes can help transit vehicles bypass congested general-purpose lanes, improving travel times and reliability, but existing express lanes need to be present in order to implement this option. The exclusivity of express lanes provides a high level of transit advantage and operational benefits for riders. Bus routes in Charlotte, NC are able to operate in express lanes and planning efforts are underway in the Study Area to consider implementing new express lanes, which would include allowing use by transit vehicles.

Transit Use of Express Lanes	
Physical Suitability	Excellent
Agency Approval Probability	Excellent
Level of Transit Advantage	Great
Value	Excellent
Public Visibility	Good
Funding Probability	Fair
Rider Experience	Good

Freeway (Facility) Rating Comparison

Option Type	Dedicated Freeway Transit Lanes	Dynamic Median Shoulder System	Expanded BOSS	Transit Use of Express Lanes
Physical Suitability	Good	Good	Excellent	Excellent
Agency Approval Probability	Good	Good	Excellent	Excellent
Level of Transit Advantage	Excellent	Good	Good	Great
Value	Fair	Great	Excellent	Excellent
Public Visibility	Excellent	Great	Great	Good
Funding Probability	Good	Good	Great	Fair
Rider Experience	Excellent	Great	Good	Good

Freeways (Access)

Freeway Ramp Signals

Ramp metering in Phoenix, Arizona. (Source: Roads & Bridges)

GENERAL OVERVIEW

Description and Intention

Ramp metering involves traffic signals on freeway on-ramps to control the flow of vehicles entering the freeway, reducing congestion and improving safety. Bypass lanes on the ramps would allow transit vehicles to bypass the ramp meter, providing a faster entry onto the freeway and BOSS lanes. The intention of ramp meters overall is to manage the flow of traffic and pairing with bypass lanes would help prioritize transit vehicles entering a freeway.

Location and Typology Application

Ramp metering can be applied to controlled access freeways where congestion is prevalent, such as along I-540. Expanding ramp metering along I-40 has been explored in other planning efforts and was shown in NCDOT's 2024-2033 STIP, but is not included in the draft 2026-2035 STIP. One spot location for ramp metering could be suitable for ramp metering is I-40 and Harrison Avenue.

Level of Transit Advantage

Ramp metering can provide a moderate transit advantage by reducing delays at freeway on-ramps and improving overall travel times. This can enhance the efficiency and reliability of transit services, especially ones that utilize BOSS lanes.

DESIGN CONSIDERATIONS

Physical Suitability

Ramp metering is suitable for urban and suburban freeways that experience high traffic volumes and congestion at on-ramps. In the Triangle Region, ramp metering is present on I-540.

As ramp metering involves the use of traffic signals on existing ramps, no additional ROW is needed. Including bypass lanes for transit, may require widening the existing ramp.

Agency Approval Probability

Ramp metering is likely to have a high probability of approval, as there are existing locations with ramp metering in the study area on I-540. NCDOT have also conducted numerous studies on applying ramp metering in additional locations throughout the region, including along I-40.

Value

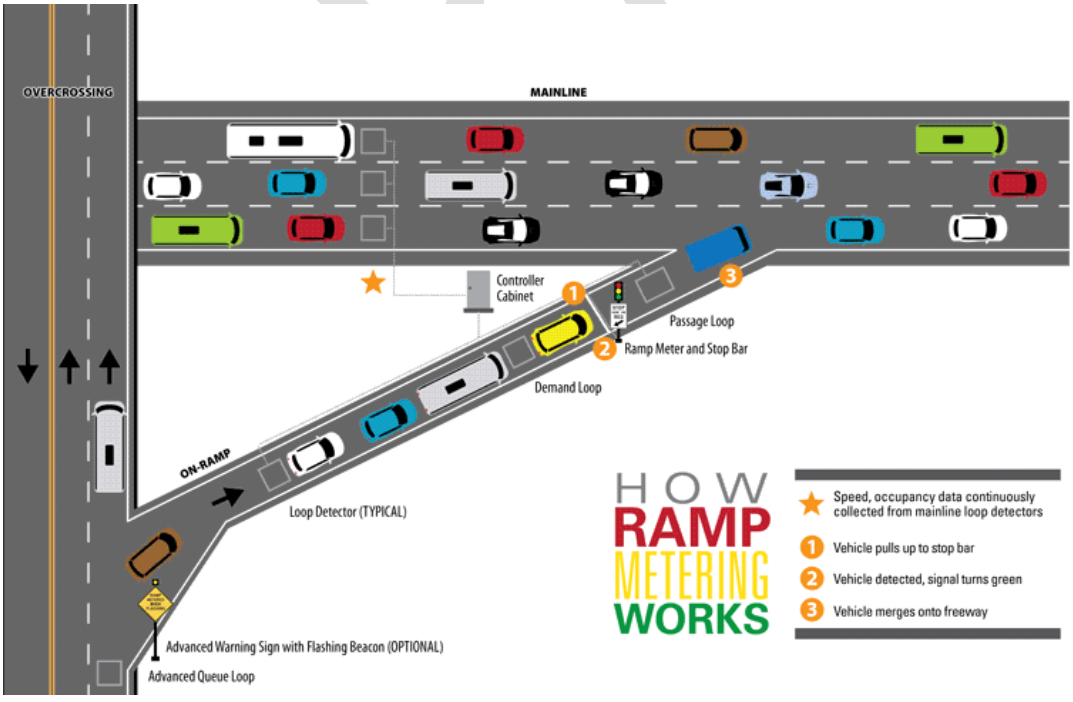
Ramp metering can be a very cost-effective option for congestion management as it uses existing infrastructure and requires minimal additional investment in the form of signals. According to FHWA "The widespread benefits of ramp metering, relative to its costs, make it one of the most cost-effective freeway management strategies."

Adding a bypass lane to increase the benefits for transit also provides a relative low-cost option due to the existing infrastructure present.

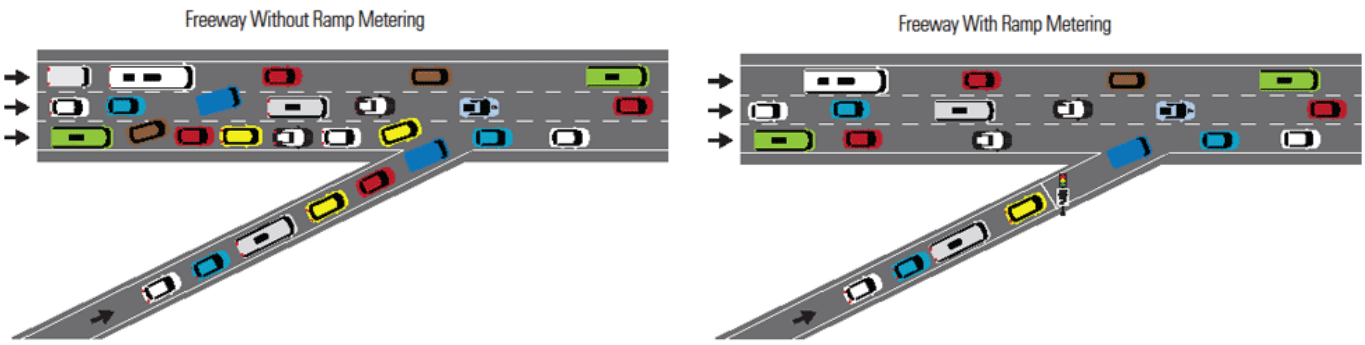
Funding Probability

As ramp metering is a treatment that is not transit specific, any projects would likely need to access larger and more varied funding sources, like federal and state roadway funding. Ramp metering does exist in the region, increasing the likely for funding of future projects.

In the 2024-2033 STIP, NCDOT had a project to introduce ramp metering along I-40 in the study area, but that project is currently not included in the draft 2026-2035 STIP, that is slated for adoption in summer 2025.



Ramp metering configuration (Source: FHWA)



Freeway congestion without ramp metering and freeway congestion with ramp metering. (Source: FHWA)

IMPLEMENTATION EXPERIENCE

Public Visibility

Ramp metering has good public visibility with signage and dedicated traffic signals noticeable to all freeway users. However, the visibility as a transit improvement may be poor without bypass lanes for exclusive transit use.

Rider Experience

Ramp metering can help improve the rider experience by reducing delays at on-ramps and helping with overall congestion on freeways. This can help improve the reliability of the transit service overall.

OPTION SUMMARY

Rating

Freeway ramp signals could help reduce delays at freeway on-ramps and improve overall travel times, which would benefit transit, but would be of most benefit to general traffic. This treatment is already being used in the region, leading to a high likelihood it could be expanded but the 2026-2035 Draft STIP no longer includes ramp metering along I-40 in the study area, making the funding probability in the near- to mid-term less likely.

Freeway Ramp Signals	
Physical Suitability	Great
Agency Approval Probability	Excellent
Level of Transit Advantage	Good
Value	Good
Public Visibility	Good
Funding Probability	Good
Rider Experience	Good

Freeway (Access) Rating Comparison

Option Type	Freeway Ramp Signals	Direct Transit Access Ramps
Physical Suitability	Great	Fair
Agency Approval Probability	Excellent	Good
Level of Transit Advantage	Good	Excellent
Value	Good	Fair
Public Visibility	Good	Excellent
Funding Probability	Good	Fair
Rider Experience	Good	Excellent

Direct Transit Access Ramp

Direct access ramp on I-90 in Bellevue, Washington. (Source: Google Earth)

GENERAL OVERVIEW

Description and Intention

Direct transit access ramps provide access for buses to directly enter and exit the inside median lanes, allowing these vehicles to avoid the need to weave across the other lanes of traffic. The location of direct transit access ramps can be coordinated with DMSS, dedicated transit lanes, or express lanes to increase bus freeway access.

Location and Typology Application

It is recommended that the direct transit access ramps be used to allow transit vehicles to enter and exit from the inside median lanes of a controlled access roadway to grade separated cross street, allowing the transit vehicles to get on and off the controlled access roadway without merging to the outside lane to exit. On the priority corridors, some possible direct transit access ramp locations include:

- I-40 at NC 54
- I-40 at Miami Boulevard
- I-40 at Harrison Avenue
- I-40 at Trinity Road

Level of Transit Advantage

Direct transit access ramps can improve safety, reduce congestion, save time, and increase travel time reliability for transit services on and around freeways.

DESIGN CONSIDERATIONS

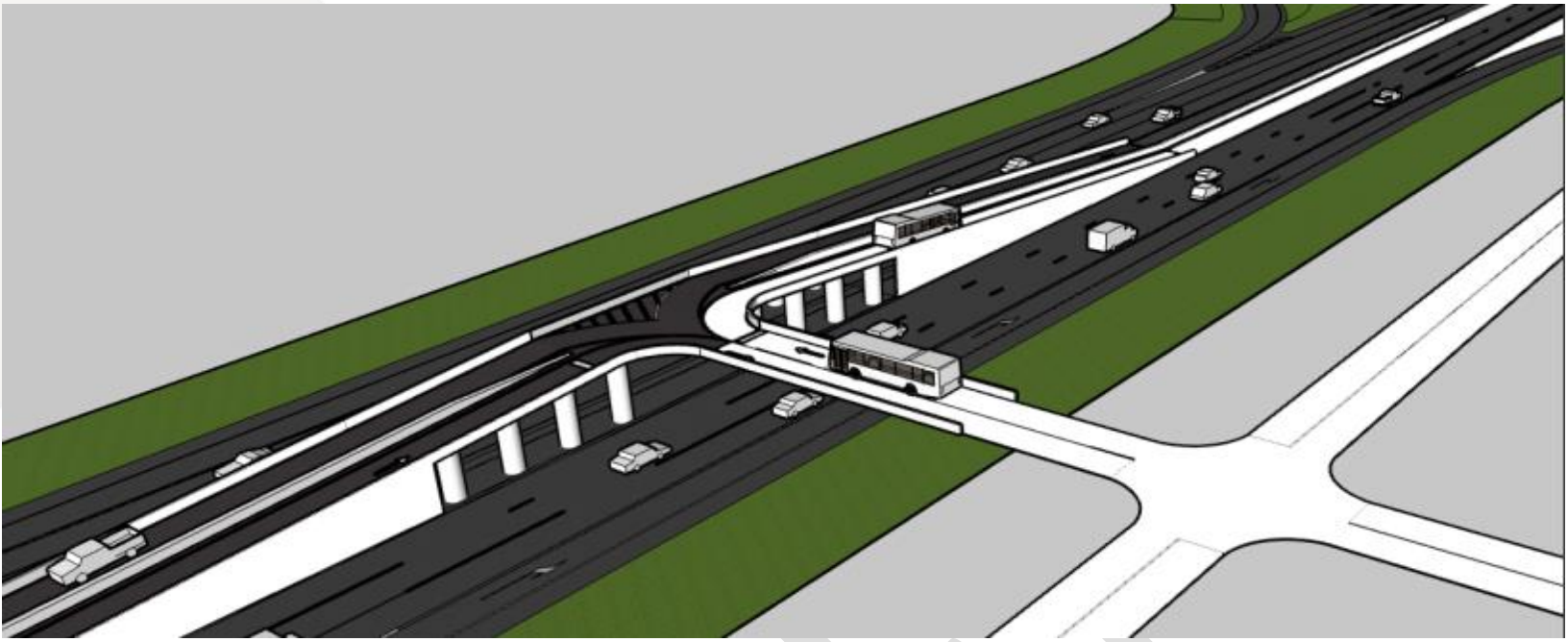
Physical Suitability
Direct transit access transit ramps will require additional ROW and freeway widening at limited locations along I-40, I-885, and NC 147 that will connect to arterial BRT service. To minimize complexity, direct transit access ramps would be designed to connect to existing overpass arterials. Direct transit access ramps could allow bus service from I-40 to quickly and easily connect with RDU airport.

Agency Approval Probability
The direct transit access ramps are federally supported, but the direct transit access ramp design is not in the NCDOT Roadway Design Manual and will require significant agency coordination. Coordination with transit providers, MPOs, and municipalities will also be required to be incorporated into proposed designs.

Value
Direct transit access ramps would require purpose-built structures and associated ROW. Opportunities for cost savings on design and construction can occur through coordination with interstate widening and interchange improvement projects.

Funding Probability
NCDOT STIP Projects do not have direct transit access ramps as part of the design, so no current funding is available. However, federal, state and local transit funding could be combined with highway funding for coordinated roadway widening or resurfacing projects.

Rendering of potential direct transit access ramp. (Source: WSP)



Rendering of direct transit access ramp from FAST 1.0. (Source: NCDOT)

IMPLEMENTATION EXPERIENCE

Public Visibility
Direct transit access ramps would be highly visible at these locations to anyone on the interstate. A Direct transit access ramp at RDU would also be visible to anyone traveling to and from the airport, emphasizing that there is significant transit investment in the region.

Rider Experience
Direct transit access ramps would further enhance the benefits of DMSS, dedicated transit lanes, and express lanes by allowing buses to quickly and reliably enter and exit the freeway without any interference from general purpose traffic.

OPTION SUMMARY

Rating

Direct transit access ramps could provide a highly visible piece of transit infrastructure that could reduce delays and increase travel time reliability for transit services on and around freeways. However, the direct transit access ramps would require widening to accommodate the ramp and would be very costly to implement. Robust coordination would be with NCDOT, as this type of infrastructure does not exist in the region and is not included in the NCDOT *Roadway Design Manual*.

Direct Transit Access Ramps	
Physical Suitability	Fair
Agency Approval Probability	Good
Level of Transit Advantage	Excellent
Value	Fair
Public Visibility	Excellent
Funding Probability	Fair
Rider Experience	Excellent

Freeway (Access) Rating Comparison

Option Type	Freeway Ramp Signals	Direct Transit Access Ramps
Physical Suitability	Great	Fair
Agency Approval Probability	Excellent	Good
Level of Transit Advantage	Good	Excellent
Value	Good	Fair
Public Visibility	Good	Excellent
Funding Probability	Good	Fair
Rider Experience	Good	Excellent

Arterials (Facility)

Fully-Dedicated Transit Lanes

Fully-dedicated curbside transit lane. (Source: NACTO)

GENERAL OVERVIEW

Description and Intention

Fully dedicated transit lanes are a transit-priority travel lane, reserved exclusively for transit vehicles, with restrictions for other modes. These lanes are meant to optimize bus operations in a corridor to maximize transit competitiveness and reliability, by reducing delays caused by mixed traffic.

Locally, these lanes are sometimes referred to RED lanes, as in CAMPO's *RED Lanes Study*.

Location and Typology Application

Fully dedicated transit lanes are recommended for arterial roadways, either in the median or where there are limited curb cuts. These lanes are planned along the Wake BRT corridors, such as New Bern Avenue, Southern Corridor and Western Corridor. Along the priority corridors, possible locations of fully dedicated transit lanes include:

- Harrison Avenue between I-40 and Chapel Hill Road
- Renaissance Parkway between Fayetteville Road and NC 751

Level of Transit Advantage

Fully dedicated transit lanes provide a high level of transit advantage by ensuring that transit vehicles have a clear, unobstructed path, reducing travel times and improving schedule adherence. These lanes can improve reliability and performance to increase passenger convenience.

DESIGN CONSIDERATIONS

Physical Suitability
Fully dedicated transit lanes can be used on the curb side or median of a roadway and are suitable for urban and suburban environments with high transit vehicle volumes and frequent congestion.

Agency Approval Probability
Fully dedicated transit lanes are part of existing projects in the region, creating a higher probability that this treatment would be approval on other roadways throughout the region. However, the roadway owner may differ from the transit agency operating within the lanes and may not want to repurpose general purpose lanes.

Fully dedicated transit lanes are part of the Wake BRT: New Bern Corridor design, in Raleigh, that has gone through the NCDOT review process and is currently being bid for construction. These lanes are also planned for the other Wake BRT corridors (Southern and Western) and the North-South Bus Rapid Transit (NSBRT) project in Chapel Hill.

Value
Fully dedicated transit lanes can be a cost-effective strategy as they often use existing roadway infrastructure and require minimal additional investment, while providing benefits of reduced delays. If these lanes are not able to be incorporated into an existing roadway cross section, the cost is similar to road widening to add the desired number of transit lanes.

Funding Probability
Fully dedicated transit lanes are a common transit infrastructure across the country and eligible for a wide range of funding, including federal funding. Local transit funding is also a likely funding source.

Bus using a fully-dedicated transit lane on Hennepin Avenue in Minneapolis. (Source: City of Minneapolis)

Fully-dedicated transit lane on Renaissance Pkwy in Durham. (Source: GoDurham)

IMPLEMENTATION EXPERIENCE

Public Visibility
Fully dedicated transit lanes are highly visible when applied to a roadway, with the lane markings and signage, being seen by all roadway users. Public education can be important to ensure proper use and understanding of the lanes.

RED lanes are critical to the region's planned BRT projects to enhance transit visibility throughout the region to maintain a safe, convenient, and efficient multimodal system.

Rider Experience
Fully dedicated transit lanes can greatly benefit the rider experience by helping to reduce travel times and improve schedule adherence. The experience can be excellent when transit vehicles using these lanes pass areas of congestion or gridlock.

OPTION SUMMARY

Rating

Fully dedicated transit lanes provide a high level of transit advantage by ensuring that transit vehicles have a clear, unobstructed path. The lanes are highly visible to the general public and provide benefits for riders by reducing travel times and improving schedule adherence. These lanes are planned along several BRT corridors within the Study Area but could require more space to build than semi-dedicated lanes.

Fully Dedicated Transit Lanes	
Physical Suitability	Good
Agency Approval Probability	Good
Level of Transit Advantage	Excellent
Value	Great
Public Visibility	Excellent
Funding Probability	Good
Rider Experience	Excellent

Arterials (Facility) Rating Comparison

Option Type	Fully-Dedicated Transit Lanes	Semi-Dedicated Transit Lanes
Physical Suitability	Good	Great
Agency Approval Probability	Good	Great
Level of Transit Advantage	Excellent	Great
Value	Great	Excellent
Public Visibility	Excellent	Great
Funding Probability	Good	Great
Rider Experience	Excellent	Great

Semi-Dedicated Transit Lanes

Semi-dedicated transit lanes allow right turns. (Source: Massachusetts Bay Transportation Authority (MBTA)

GENERAL OVERVIEW

Description and Intention

Semi-dedicated transit lanes are lanes that reserved for transit travel but allow general purpose vehicles to use the lanes for accessing businesses or to make a turn. These lanes are also often referred to as Business Access & Transit Lanes (BAT Lanes).

These lanes are able provide a dedicated travel lane for transit while maintaining access to businesses and cross streets.

Location and Typology Application

Semi-dedicated transit lanes are suited for arterials where access to businesses is still needed. These lanes are planned along the Wake BRT corridors, such as New Bern Avenue. Along the priority corridors, possible locations of semi-dedicated transit lanes are recommended include:
Trinity Road between Edwards Mill Road and Blue Ridge Road
Harrison Avenue between I-40 and Chapel Hill Road
In Central Durham

Level of Transit Advantage

Semi-dedicated transit lanes provide a high level of transit advantage by ensuring that transit vehicles have a semi-exclusive path, while still providing access to businesses. Semi-dedicated transit lanes can help reduce travel times and improve schedule adherence. These lanes can improve reliability and performance to increase passenger convenience.

DESIGN CONSIDERATIONS

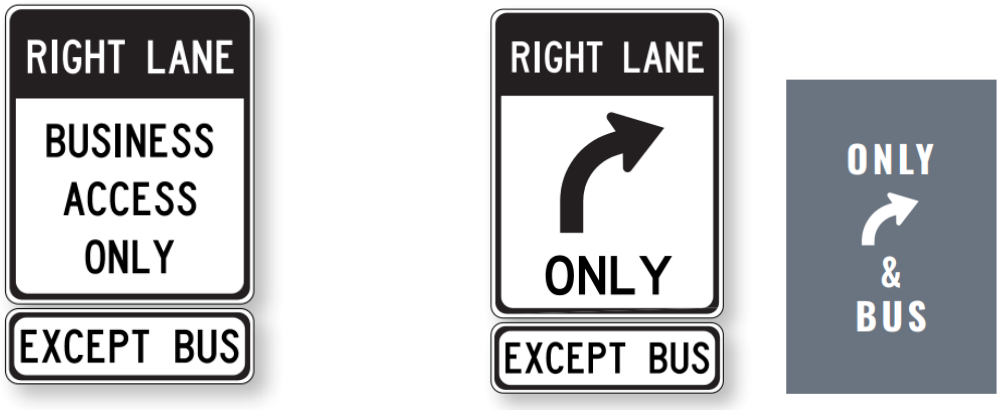
Physical Suitability
Semi-dedicated transit lanes can be used on the curb side of a roadway and are suitable for urban and suburban environments where dedicated transit infrastructure is desired, but where there also may be lots of driveways or cross streets that are not able to be closed to allow for a fully dedicated transit lane.

Agency Approval Probability
Similar to fully dedicated transit lanes, semi-dedicated transit lanes are part of existing projects in the region, creating a high probability that this treatment would be approval on other roadways throughout the region.

Semi-dedicated transit lanes are part of the Wake BRT: New Bern Corridor design, in Raleigh, that has gone through the NCDOT review process and is currently being bid for construction.

Value
Semi-dedicated transit lanes can be a cost-effective strategy as they often use existing roadway infrastructure and require minimal additional investment, while providing benefits of reduced delays and limiting impacts to existing access of businesses.

Funding Probability
Semi-dedicated transit lanes are a common transit infrastructure across the country and eligible for a wide range of funding, including federal funding. Local transit funding is also a likely funding source.



Signage used for BAT lanes in Lane County, Oregon. (Source: Lane Transit District)

Semi-dedicated transit lane in Seattle. (Source: King County Metro)

IMPLEMENTATION EXPERIENCE

Public Visibility

Semi-dedicated transit lanes are highly visible when applied to a roadway, with the lane markings and signage, being seen by all roadway users. Public education can be important to ensure proper use and understanding of the lanes.

Rider Experience

Semi-dedicated transit lanes can greatly benefit the rider experience by helping to reduce travel times and improve schedule adherence. The experience can be excellent when transit vehicles using these lanes pass areas of congestion or gridlock.

OPTION SUMMARY

Rating

Semi-dedicated transit lanes provide a high level of transit advantage by ensuring that transit vehicles have a semi-exclusive path, while still providing access to businesses. The level of transit advantage may not be as high as fully dedicated transit lanes but can still help reduce travel times and improve schedule adherence. These lanes are planned along several BRT corridors within the Study Area.

Semi-Dedicated Transit Lanes	
Physical Suitability	Great
Agency Approval Probability	Great
Level of Transit Advantage	Great
Value	Excellent
Public Visibility	Great
Funding Probability	Great
Rider Experience	Great

Arterials (Facility) Rating Comparison

Option Type	Fully-Dedicated Transit Lanes	Semi-Dedicated Transit Lanes
Physical Suitability	Good	Great
Agency Approval Probability	Good	Great
Level of Transit Advantage	Excellent	Great
Value	Great	Excellent
Public Visibility	Excellent	Great
Funding Probability	Good	Great
Rider Experience	Excellent	Great

Arterials (Signals and/or Access)

Transit Signal Priority

TSP allows buses to communicate with signals to move through intersections. (Source: City of Minneapolis)

GENERAL OVERVIEW

Description and Intention

Transit signal priority (TSP) involves periodically modifying traffic signal timings to give priority to transit vehicles at intersections, reducing delays and improving schedule adherence. TSP allows transit vehicles to communicate with traffic signals along their routes and can work, for example, by extending the green light for a few seconds, allowing a bus to continue moving through that signalized intersection. The intention of TSP is to enhance the efficiency and reliability of transit services by minimizing delays at signalized intersections.

Location and Typology Application

TSP is suitable for use on arterial and surface streets and can be applied to isolated signal locations or along an entire corridor. It is best used directly before or after a bus stop/station to allow a bus to access and exit the stop/station, as well as in congested areas that can regularly impact buses' travel times. Within the study area, TSP is planned along the Wake BRT corridors in Raleigh and the City of Durham recently completed installing TSP technology at 13 traffic lights along Fayetteville Street between Lakewood Avenue and Riddle Road to assist multiple GoDurham routes traveling along Fayetteville Street.

Level of Transit Advantage

TSP can provide a high level of transit advantage by reducing delays at signalized intersections and improving overall travel times. This can significantly enhance the efficiency and reliability of transit services.

DESIGN CONSIDERATIONS

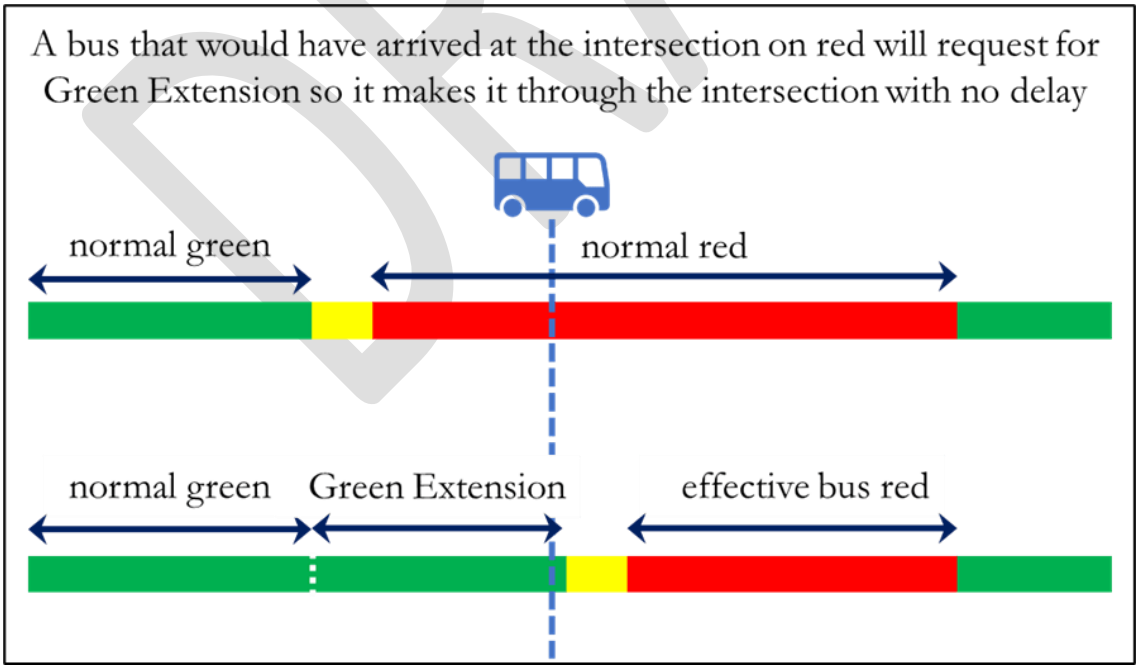
Physical Suitability
TSP can be suitable for urban and suburban environments with frequent signalized intersections and high transit vehicle volumes. It can be used along corridors or in spot locations, where transit vehicles maybe frequently delayed.

Agency Approval Probability
TSP has a high probability of approval, as this infrastructure is starting to be implemented throughout the region. Local municipalities, transit agencies, and NCDOT have all been involved in the planning of TSP throughout the region, so there is familiarity among different agencies. The region is also thinking about how to coordinate TSP efforts and identify opportunities for interoperability between different agencies, such as in GoTriangle's ongoing Regional Technology Plan efforts.

Value
TSP can be a cost-effective treatment as it uses existing traffic signal infrastructure and requires minimal additional investment, while providing notable benefits in terms of reduced delays and improved schedule adherence. The cost of implementing TSP can depend on the size of a traffic signal network and number of traffic signals that are upgraded to include TSP.

Funding Probability
TSP has a high probability of funding due to its cost-effectiveness and ability to be funded from a variety of funding sources.

TSP can be paid for with CMAQ or LAPP funding and can be easily added to planned roadway or signal projects.



This graphic shows how TSP can provide a green extension to buses. (Source: Northeastern University)

IMPLEMENTATION EXPERIENCE

Public Visibility

While some nuances in changing light cycles might be noticed, TSP is not likely to have much, if any, public visibility due to the limited infrastructure used for TSP. There are no special signals, markings, or signage that would indicate to the general public that TSP is in use.

Rider Experience

TSP can enhance the rider experience by reducing delays at intersections, improving overall travel times and providing a more reliable transit service. TSP may provide benefits without even being noticeable by the rider.

OPTION SUMMARY

Rating

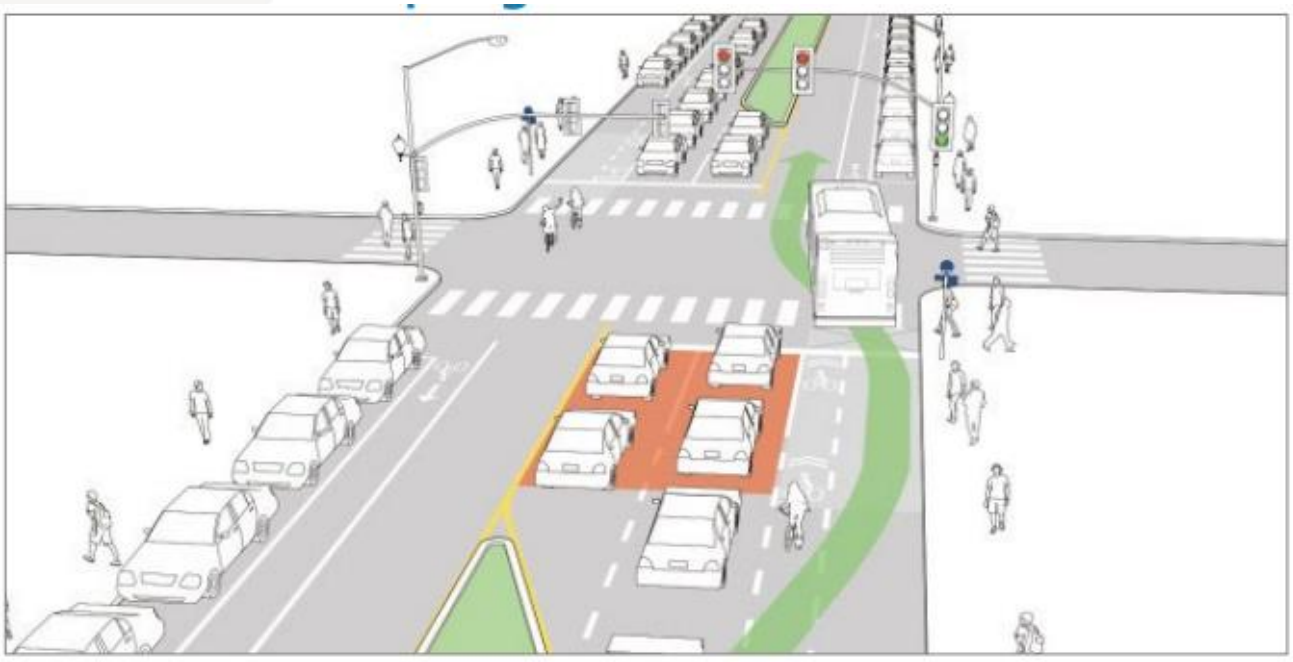
TSP is a well-known treatment option by NCDOT and regional stakeholders, contributing to a high agency approval probability. In addition, TSP ties into existing traffic signal infrastructure, requiring little to no additional physical space to implement. While TSP may not be easily noticeable by riders or the public, it can provide notable benefits in terms of reduced delays and improved schedule adherence.

Transit Signal Priority (TSP)	
Physical Suitability	Excellent
Agency Approval Probability	Excellent
Level of Transit Advantage	Good
Value	Excellent
Public Visibility	Fair
Funding Probability	Great
Rider Experience	Good

Arterials (Signals and/or Access) Rating Comparison

Option Type	Queue Jump Lanes	Transit Signal Priority (TSP)
Physical Suitability	Great	Excellent
Agency Approval Probability	Great	Excellent
Level of Transit Advantage	Good	Good
Value	Great	Excellent
Public Visibility	Great	Fair
Funding Probability	Good	Great
Rider Experience	Good	Good

Queue Jump Lanes



Queue jumps provide buses with a head start at congested intersections. (Source: NACTO)

GENERAL OVERVIEW

Description and Intention

A queue jump lane is a short stretch of bus lane combined with traffic signal priority, allowing buses to bypass waiting vehicles at intersections by getting an early green signal to jump ahead of traffic. The early green signal allows buses to safely merge back into traffic, ahead of waiting vehicles. The intention is to reduce delays at congested intersections and improve the operational efficiency of the transit system.

Some transit systems, like Muni in San Fransico, also allow emergency vehicles to use queue jumps.

Location and Typology Application

A queue jump lane is suitable for use on arterial and surface streets, particularly at congested intersections. Along the priority corridors, possible locations of queue jump lanes include:

- Trinity Road at Blue Ridge Road and at Edwards Mill Road
- NC 54 at several locations (NC 55, Barbee Road, and Fayetteville Road)
- Downtown Durham

Level of Transit Advantage

Queue jump lanes can provide a moderate level of transit advantage by reducing delays at congested intersections and improving overall travel times. This can enhance the efficiency and reliability of transit services.

DESIGN CONSIDERATIONS

Physical Suitability

Queue jump lanes can be suitable for urban and suburban locations with frequent signalized intersections and high transit vehicle volumes. Queue jumps are most suitable for congested intersections where transit might be frequently delayed.

Queue jump lanes need to be big enough to allow the bus to wait at a signalized intersection, in a space separated from vehicle lanes, which can often be accommodated with a space the size of a right-turn lane pocket or several parking spaces.

Agency Approval Probability

Queue jump lanes can be a cost-effective treatment that enhances transit efficiency and reduces delays. While they only require a small amount of space for implementation, local agencies have noted queue jumps need to be considered in proximity to bus stops.

Within the study area, queue jump lanes are planned along the Wake BRT corridors in Raleigh.

Value

Queue jump lanes can be a cost-effective treatment for transit as it often uses existing roadways and traffic signal infrastructure and requires minimal additional investment. Even with lower cost, queue jump lanes can provide great benefits to transit service through reduced delays and improved schedule adherence.

Funding Probability

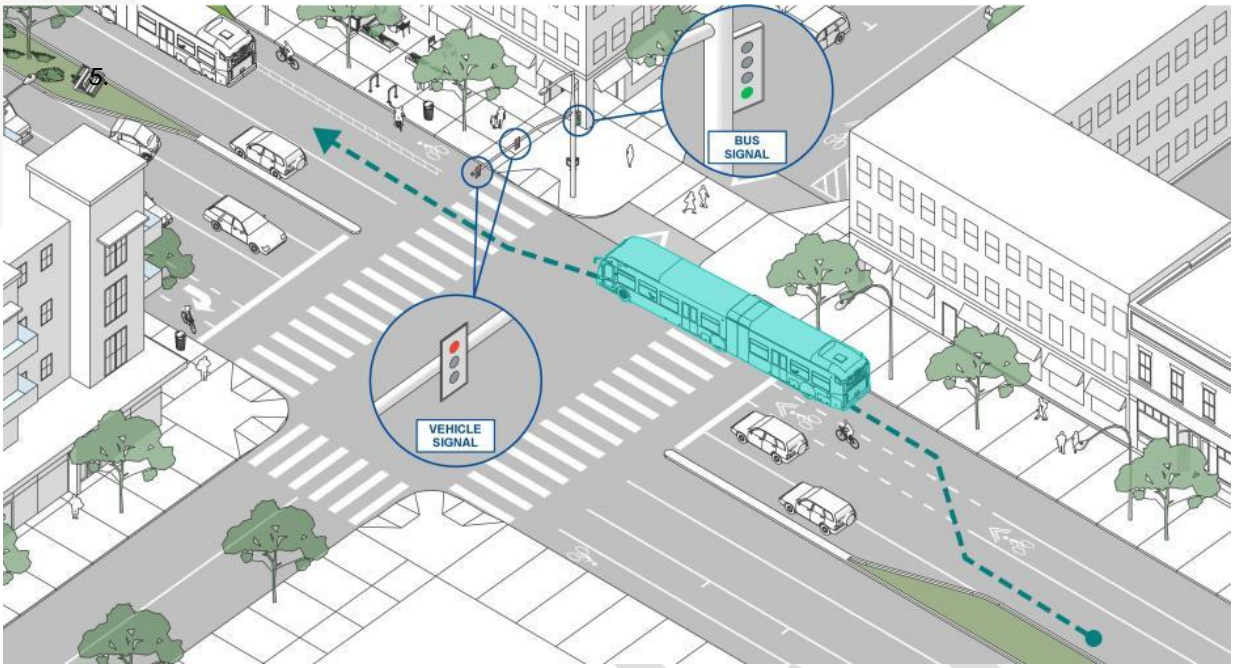
The probability for funding is good as queue jump lanes often use existing roadway and traffic signal infrastructure and requires minimal additional investment. These lanes could use a variety of federal, state, or local funding, including local transit funding. A project to add queue jumps or queue jump lanes could also be a part of a larger signal improvement or roadway project.

The graphic from the City of Madison, shows the special traffic signals used for queue jumps in their system and highlight the meaning of each:

[Red traffic light] [White horizontal line] – This means everyone is stopped at the intersection.

[Red traffic light] [White vertical line] – Buses may go, but all other traffic stays stopped.

[Green traffic light] [White horizontal line] – All traffic may go, buses must merge into the regular flow of traffic.



Buses have a special bus signal that allows them to queue jump at congested intersections. (Source: Valley Transportation Authority)

IMPLEMENTATION EXPERIENCE

Public Visibility
Queue jump lanes are moderately visible, with special traffic signals just for buses, and seeing buses pass in front of waiting traffic.

Rider Experience
Queue jump lanes can enhance the rider experience by reducing delays at intersections, improving overall travel times and providing a more reliable transit service.

OPTION SUMMARY

Rating

Queue jump lanes can be a cost-effective treatment they often use existing infrastructure and require minimal additional investment. Even with lower cost and minimal space needed, queue jump lanes can reduce delays and improve schedule adherence, adding to the rider experience.

Queue Jump Lanes	
Physical Suitability	Great
Agency Approval Probability	Great
Level of Transit Advantage	Good
Value	Great
Public Visibility	Great
Funding Probability	Good
Rider Experience	Good

Arterials (Signals and/or Access) Rating Comparison

Option Type	Queue Jump Lanes	Transit Signal Priority (TSP)
Physical Suitability	Great	Excellent
Agency Approval Probability	Great	Excellent
Level of Transit Advantage	Good	Good
Value	Great	Excellent
Public Visibility	Great	Fair
Funding Probability	Good	Great
Rider Experience	Good	Good

Types of Bus Stops and Stations

Enhanced Bus Stops and Stations

A BRT stop in Minneapolis with enhanced bus stop elements. Source: City of Minneapolis

GENERAL OVERVIEW

Description and Intention

Enhanced bus stops and stations include features such as shelters, seating, real-time arrival information, lighting, and accessibility improvements. The intention is to provide a more comfortable and convenient waiting environment for transit riders. While some of the features maybe common at existing bus stops, an enhanced bus stop and station would include all the features and make them standard for these types of stops and stations.

Location and Typology Application

Enhanced bus stops are standard along BRT corridors and are only suited for arterial roadways, as some of the specific design elements of enhanced bus stops are dependent on the speed of the roadway, such as level boarding, curb height, and setbacks.

In the study area, enhanced stops are planned along the Wake BRT corridors, such as New Bern Avenue, Southern Corridor and Western Corridor.

Level of Transit Advantage

Enhanced bus stops and stations provide a more comfortable and convenient waiting environment for transit riders, rather than provide operational improvements, and the improved passenger experience could help encourage more people to use transit and increase ridership. Some elements of an enhanced bus stops and stations may be able to improve the speed and reliability of the transit service by:

- Reducing merging delays of buses
- Reducing passenger boarding delays by providing level boarding and off-board fare collection

DESIGN CONSIDERATIONS

Physical Suitability

Enhanced bus stops and stations can be suitable for urban and suburban locations with high transit vehicle volumes or where higher frequency service is planned.

While these stops and stations have a relatively small footprint, some urban locations may have limited right-of-way to accommodate these stops. Also, the proximity of buildings and existing utilities, particularly in urban areas or older suburban areas, may limit the physical suitability of these stops and stations.

Agency Approval Probability

The planning, design and installation of enhanced stops and stations often require agency coordination between transit agencies and the roadway owner, which may be a local jurisdiction or NCDOT.

Value

Enhanced bus stops and stations can be a cost-effective improvement aimed at increasing ridership and rider satisfaction. The availability and cost of right-of-way required to install the enhanced bus stops and stations maybe a limiting factor in their cost-effectiveness.

Funding Probability

Enhanced bus stops and stations can be funded with a combination of local and federal funding. Federal funding can help construct these stops and stations as part of larger, new transit projects or as stand-alone improvements.

Rendering of a BRT station along Wake BRT: New Bern Avenue in Raleigh. (Source: Raleigh)

The graphic above highlights elements of an enhanced bus stop. (Source: Spokane Transit Authority)

IMPLEMENTATION EXPERIENCE

Public Visibility
Enhanced bus stops and stations are highly visible to the public and are likely best suited for higher volume or higher density environments, where transit ridership is higher, which would improve the overall visibility of these stops.

Rider Experience
Implementation of enhanced bus stops and stations can yield marked improvements to the rider experience by providing a more comfortable and convenient waiting environment. Riders can expect better protection from the elements and more information about their transit trip with real-time information.

OPTION SUMMARY

Rating

Enhanced bus stops and stations are highly visible to the public and provide a more comfortable and convenient waiting environment for transit riders. Enhanced stations could provide fewer multimodal connections as a mobility hub but possibly at a lower cost. These stations are able to be funded with a variety of funding sources and are already within the Study Area, leading to higher funding and agency approval probabilities.

Enhanced Bus Stops and Stations	
Physical Suitability	Excellent
Agency Approval Probability	Excellent
Level of Transit Advantage	Great
Value	Excellent
Public Visibility	Great
Funding Probability	Excellent
Rider Experience	Excellent

Bus Stops and Stations Rating Comparison

Option Type	Enhanced Bus Stops and Stations	Super Stop Bus Stop	Mobility Hubs
Physical Suitability	Excellent	Great	Good
Agency Approval Probability	Excellent	Excellent	Great
Level of Transit Advantage	Great	Great	Excellent
Value	Excellent	Excellent	Good
Public Visibility	Great	Great	Excellent
Funding Probability	Excellent	Great	Good
Rider Experience	Excellent	Excellent	Excellent

Super Stop Bus Stop

A recently constructed Super Stop on Western Boulevard, used by both GoCary and GoRaleigh. (Source: WSP)

GENERAL OVERVIEW

Description and Intention

A Super Stop bus stop is a stop that is served by multiple routes that have enhanced amenities, such as larger or multiple shelters and real-time information. In addition to multiple routes, a Super Stop could be a location where there is a local bus stop and a BRT station at a single location. These stops are also used to switch between different transit service providers.

The *Wake Bus Plan Short Range Transit Plan* refers to Super Stops as “Enhanced Transfer Points”.

Location and Typology Application

A Super Stop was recently built on Western Boulevard at Jones Franklin Road in Raleigh. These stops are also well suited along BRT corridors, where there are additional local bus routes serving the stop, or at high ridership locations that serve many different routes, such as hospitals or universities.

Level of Transit Advantage

Super Stops are able to provide a more comfortable and convenient waiting environment for transit riders by providing enhanced amenities, which may help boost ridership. These stops can also help improve bus speed and reliability by bringing together multiple routes in one location.

DESIGN CONSIDERATIONS

Physical Suitability

Super Stops can be suitable for stops with multiple routes and transfer opportunities between service providers.

Super Stops have a larger footprint than a traditional bus stop, so locations with limited right-of-way may not be able to accommodate these stops. Also, the proximity of buildings and existing utilities, particularly in urban areas or older suburban areas, may limit the physical suitability of these stops and stations.

Agency Approval Probability

The planning, design and installation of enhanced stops and stations often require agency coordination between transit agencies and the roadway owner, which may be a local jurisdiction or NCDOT. Super Stops are already implemented within the Study Area, highlighting a high likelihood of their approval in the future.

Value

Super Stops can be a cost-effective improvement aimed at increasing ridership and rider satisfaction, while also providing amenities to serve multiple routes and service providers at a single location. The availability and cost of right-of-way required to install the super stop maybe a limiting factor in their cost-effectiveness.

Funding Probability

Enhanced Super Stops can be funded with a combination of local and federal funding. Federal funding can help construct these stops and stations as part of larger, new transit projects, such as a BRT station, or as stand-alone improvements.

On Renaissance Parkway at Southpoint Mall in Durham, this stop was upfitted with two new shelters, benches, an ADA concrete pad, a bus bay, and a bus lane. It is served by both GoTriangle and GoDurham. (Source: GoTriangle)

IMPLEMENTATION EXPERIENCE

Public Visibility

Super Stops are highly visible to the public, especially when multiple buses are present at the stop. These stops are likely best suited for higher volume or higher density environments, where transit ridership is higher and there are multiple bus routes, which would improve the overall visibility of these stops.

Rider Experience

The implementation of Super Stops can yield marked improvements to the rider experience by providing a more comfortable and convenient waiting environment to facilitate transfers. With the use of enhanced amenities, riders can expect better protection from the elements and more information about their transit trip with real-time information.

OPTION SUMMARY

Rating

Super Stops provide a more comfortable and convenient waiting environment for transit riders and can help improve bus speed and reliability by bringing together multiple routes in one location. Super Stops are able to provide connections between multiple routes and transit agencies within a relatively small physical footprint but may be larger than an enhanced stop. There are several super stops already existing in the Study Area, leading to a high agency approval probability.

Super Stop	
Physical Suitability	Great
Agency Approval Probability	Excellent
Level of Transit Advantage	Great
Value	Excellent
Public Visibility	Great
Funding Probability	Great
Rider Experience	Excellent

Bus Stops and Stations Rating Comparison

Option Type	Enhanced Bus Stops and Stations	Super Stop Bus Stop	Mobility Hubs
Physical Suitability	Excellent	Great	Good
Agency Approval Probability	Excellent	Excellent	Great
Level of Transit Advantage	Great	Great	Excellent
Value	Excellent	Excellent	Good
Public Visibility	Great	Great	Excellent
Funding Probability	Excellent	Great	Good
Rider Experience	Excellent	Excellent	Excellent

Mobility Hubs

Rendering of the Triangle Mobility Hub, RTP (Source: GoTriangle)

GENERAL OVERVIEW

Description and Intention

Mobility hubs are spaces where public, shared and active travel modes are co-located alongside improvements to the public realm. Mobility hubs enable people to make smooth and safe transfers between modes, transferring from public transit to other modes such as park and ride lots, shared vehicles, bikes, scooters, or walking. Increasingly, mobility hubs are integrating transportation with other public and business services, such as coworking facilities, shopping, or social and community facilities.

Location and Typology Application

Mobility hubs should be in active areas such as downtown or business centers, neighborhood centers or major activity centers. Mobility hubs currently in the planning stage include:

- Village Transit Center, Durham
- Downtown Cary Multimodal Center, Cary
- Triangle Mobility Hub, RTP
- S-Line Mobility Hubs, various locations in the Triangle

Level of Transit Advantage

Mobility hubs can significantly boost convenience for multi-modal trips and increase travel speed and reliability by bringing together transportation options in one location. They can also connect multiple transit routes and providers to facilitate easy transfers. At a properly designed mobility hub, passenger transfers between modes, e.g. bike-share and bus services, should be speedy and seamless.

DESIGN CONSIDERATIONS

Physical Suitability
Planning for a Mobility Hub should first include definition of the transportation modes which will converge at the facility and the size requirements. A site search will include assessment of the physical suitability of candidate sites and will include elements such as distance from activity centers, topography, land ownership, ROW of adjacent roadways and zoning.

Agency Approval Probability
Agency coordination will be required between the project sponsor, the municipality, transit agencies serving the mobility hub, and local and federal funding partners.

Value
Approximate cost of mobility hubs is dependent on the transportation modes served by the facility. Incorporation of rail track, platform and signal improvements can significantly increase the cost of the project.

Value elements provided by mobility hubs can include:

- Reduced traffic congestion
- Improved air quality
- Community development
- Technology Integration

Funding Probability
Mobility hubs can be funded with a combination of local and federal funding. Public Private Partnerships for Mobility Hubs should be considered to leverage private investment and encourage complementary, adjacent Transit Oriented Development opportunities.

Transit center in San Bernardino, California. (Source: WSP)

IMPLEMENTATION EXPERIENCE

Public Visibility

Mobility hubs are highly visible to the public as they are placed in busy areas such as Downtown centers. Adjacent uses such as retail, dining, day care or health care centers also increase the visibility of the mobility hub. Design elements such as clear and prominent signage, and wayfinding elements along major pedestrian routes and intersections can also increase visibility of the hubs.

Rider Experience

Implementation of mobility hubs can yield marked improvements to the rider experience. Creating protected spaces for riders and pedestrians reduces conflict with vehicular traffic. Safe, well-lit, and active spaces for waiting and transferring can reduce the anxiety riders feel when transferring between modes of transportation.

OPTION SUMMARY

Rating

Mobility hubs can greatly improve the rider experience and boost convenience for multi-modal trips by bringing together transportation options in one location. Given the geographic reach of the FAST 2.0 Study Area, mobility hubs can also provide opportunities for comfortable and accessible regional transfers.

Mobility Hubs	
Physical Suitability	Good
Agency Approval Probability	Great
Level of Transit Advantage	Excellent
Value	Good
Public Visibility	Excellent
Funding Probability	Good
Rider Experience	Excellent

Bus Stops and Stations Rating Comparison

Option Type	Enhanced Bus Stops and Stations	Super Stop Bus Stop	Mobility Hubs
Physical Suitability	Excellent	Great	Good
Agency Approval Probability	Excellent	Excellent	Great
Level of Transit Advantage	Great	Great	Excellent
Value	Excellent	Excellent	Good
Public Visibility	Great	Great	Excellent
Funding Probability	Excellent	Great	Good
Rider Experience	Excellent	Excellent	Excellent