

WAKE FOREST TO RALEIGH COMMUTER RAIL CONCEPTUAL INFRASTRUCTURE ANALYSIS

*Summary Report
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Prepared By:

HNTB

Wake Forest to Raleigh Commuter Rail Conceptual Infrastructure Analysis

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Executive Summary

NCDOT Rail Division (NCDOT) and GoTriangle have completed the *Wake Forest to Raleigh Commuter Rail Conceptual Infrastructure Analysis*. The intent of the study is to determine the possible scope and cost of infrastructure improvements that could be required to support a commuter rail service on the existing rail line between Wake Forest, NC and Raleigh, NC. This rail line is owned and operated by CSXT Transportation (CSXT) and is known as the 'S' Line. GoTriangle currently owns contiguous property along a portion of the east side of the corridor that it acquired from CSXT in 2003.

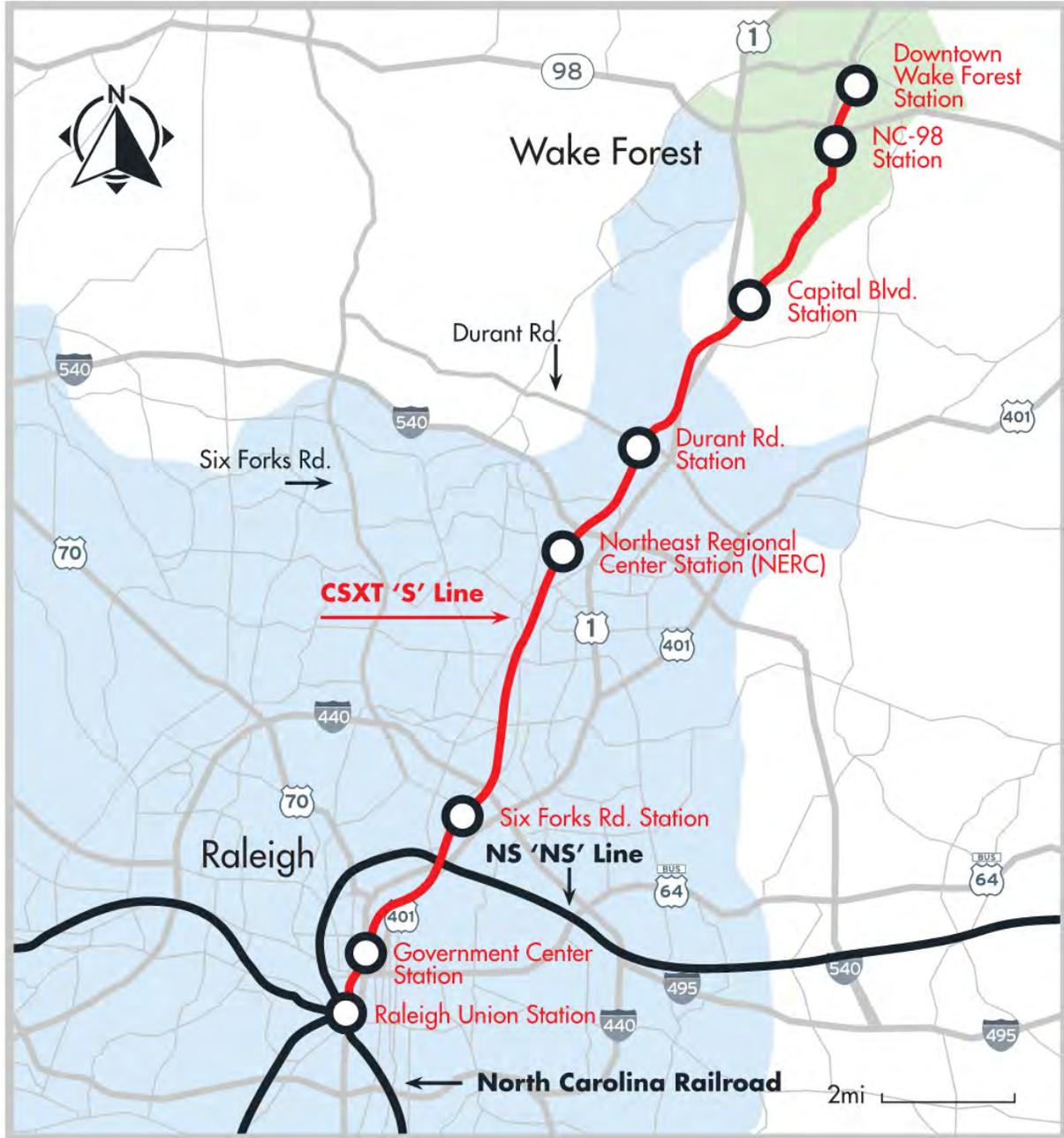
This study and report were prepared using available information and without the direct involvement of the three affected railroads, CSXT, Norfolk Southern (NS) Railway, and North Carolina Railroad. Further coordination with the railroads would be critical for confirming the assumptions of this document and laying the groundwork for future studies and agreements. The railroads were provided a draft of this study for review prior to publication, and revisions addressing their comments were incorporated into the study, as appropriate. The received formal responses to the report are provided as appendices to this document.

Two commuter rail service scenarios were evaluated including the development of potential station locations, train run-time analyses, commuter train schedules, infrastructure needs, right-of-way requirements and capital cost estimates. Ridership projections, environmental screening and operation & maintenance costs are not included in this study.

Based upon discussions with NCDOT Rail Division and GoTriangle, two commuter train service scenarios were evaluated, one with 20 round trips daily and the other with 10 round trips daily. Example commuter train schedules were developed for both service scenarios to identify where infrastructure improvements would be needed to support the commuter rail services. Between downtown Wake Forest and Raleigh Union Station, the study estimated the scheduled travel time to be 34 minutes for southbound and 35 minutes northbound using a simplified schedule analysis methodology.

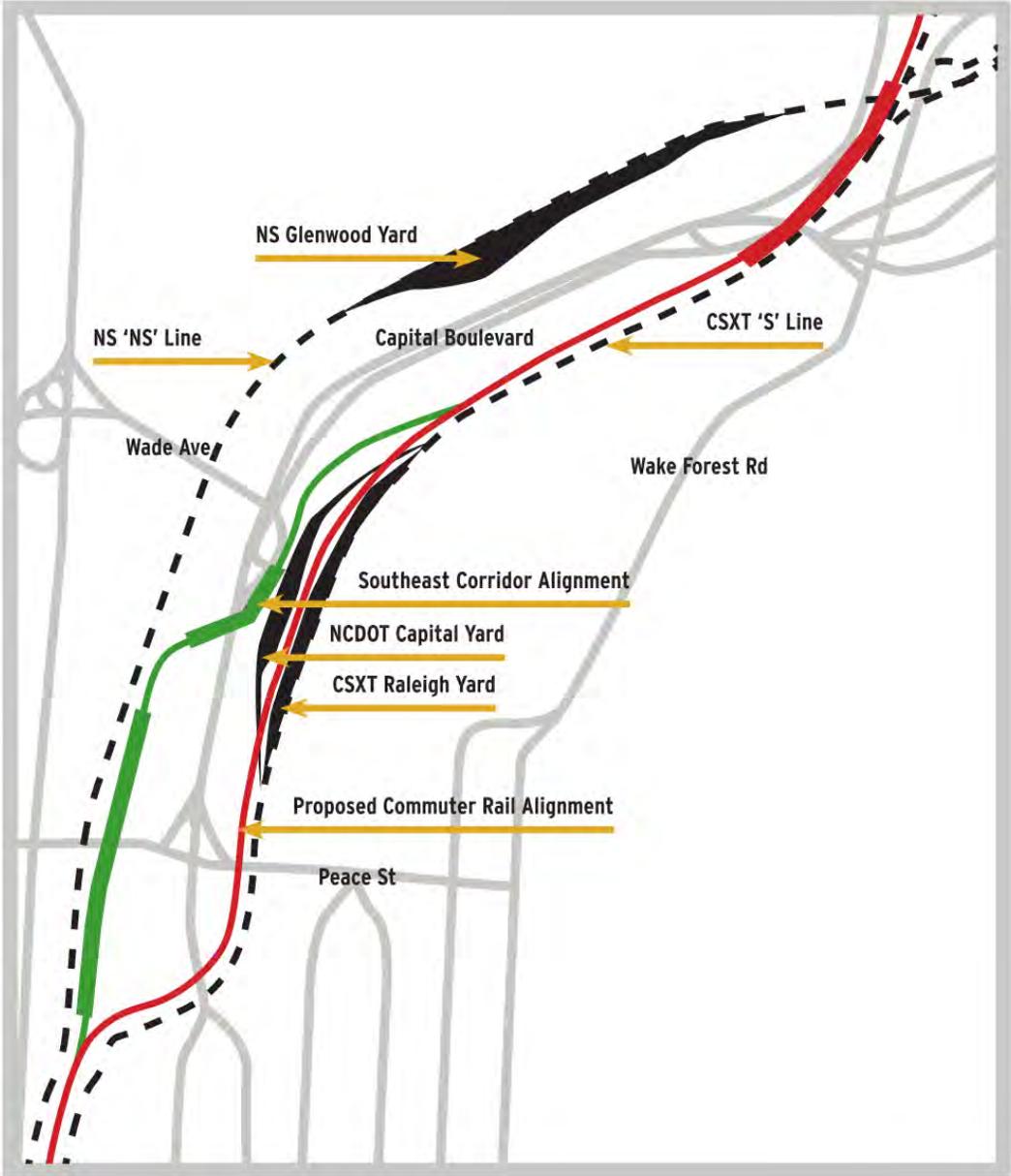
Because the study corridor is currently a low speed single track freight railroad, either proposed commuter rail service scenario would require a significant amount of new infrastructure to ensure reliable operations. As the study corridor is a component of the Raleigh-Richmond Southeast Corridor (SEC), a large portion of the infrastructure to support commuter rail service could be constructed to incrementally implement infrastructure needed for the SEC project. Additional track infrastructure over and above that needed for the SEC is identified where commuter trains need to pass one another and where freight trains stop and switch industries. The resulting proposed infrastructure solution is similar between the two service scenarios.

Figure 1 – Study Limits and Potential Station Locations



Both service scenarios propose a grade separation of the NS 'NS' Line north of downtown Raleigh. Due to the lower speed nature of its trains and the ability to mix its train operations with CSX's freight operations, this study proposes the commuter tracks follow the CSX tracks through CSX Raleigh Yard rather than building the expensive new largely elevated rail corridor into downtown Raleigh proposed under the SEC study as shown in Figure 2.

Figure 2 – Downtown Raleigh Alignments



The ten-daily roundtrip service scenario requires the implementation of a commuter rail service on the NCRR Corridor between West Durham and Garner as envisioned in previous studies and the adopted Wake County Transit Plan. Prerequisite agreements and infrastructure improvements on the NCRR Corridor would need to be completed prior to implementation of this service scenario, including any track and signal improvements needed at Boylan to connect the 'S' line and NCRR Corridor commuter services.

The probable cost of the infrastructure improvements and trains identified for the two commuter service frequencies is similar despite one operating twice as many trains as the other. This is primarily due to the accommodation of existing CSXT freight traffic. The estimated cost, including equipment, additional right-of-way and contingency, is as follows:

Twenty Daily Roundtrips (8-2-8-2) Service Scenario - **\$435.7M**

Ten Daily Roundtrips (4-1-4-1) Service Scenario - **\$373.4M**

The estimated costs above are order of magnitude current-year estimates based on historical pricing and available information. They do not include operating costs, value of existing rights of way, or any improvements on the NCRR corridor.

With significant investment in infrastructure improvements, the CSXT 'S' Line corridor could accommodate a commuter rail service operating as many as 40 trains a day. Further study would require railroad coordination and all applicable railroad agreements would need to be in place before any implementation of commuter rail service could occur.

Several areas of further study have been identified regarding the infrastructure proposed in this study:

1. It is recommended that further evaluation include detailed coordination and the necessary agreements with the freight railroads to confirm feasibility, scope and cost of the service.
2. The location of potential stations should be refined based on a ridership/revenue study.
3. Preliminary engineering would be required to determine the actual impacts to the businesses along White St. in downtown Wake Forest.
4. The impacts to the existing TransFlo terminal and the CSXT Raleigh Yard would need to be carefully evaluated and coordinated with CSXT. Future expansion plans for this facility and NCDOT Capital Yard would also need to be reconciled with track infrastructure proposed for this commuter rail study.
5. In the event both this commuter service and the Richmond-Raleigh SEC project were completed, coordination with Amtrak would be necessary to determine the logistics of boarding commuter trains and SEC intercity passenger trains (operating on the 'S' line) on a single 'S' Line platform at Raleigh Union Station given Amtrak's preferences regarding platform access control.

1. Introduction

The greater 'Triangle' region of North Carolina, consisting of Raleigh, Durham, Chapel Hill and surrounding communities, has experienced tremendous population growth in recent decades. One of the busiest corridors in the region, Capital Boulevard (US-1), is a major commuter route into Raleigh from points north and east, including Wake Forest. The drive from downtown Wake Forest to Raleigh Union Station takes an estimated twenty-eight to thirty minutes with no traffic interference. This number increases substantially during peak hours to a maximum of over fifty minutes for morning and evening alike¹. This impacts those who drive their own vehicles as well as those who use current fixed route bus service.

The primary function of a commuter rail service is not necessarily to provide a commuting method that is faster than driving, rather, the intent is to provide a commuting method that is more consistent than driving. Commuter trains are not affected by the increased travel times associated with peak hour travel on the roadway network. With its proximity to Capital Boulevard, the CSXT 'S' Line offers the opportunity to take commuters off the roadway and onto a commuter rail service.

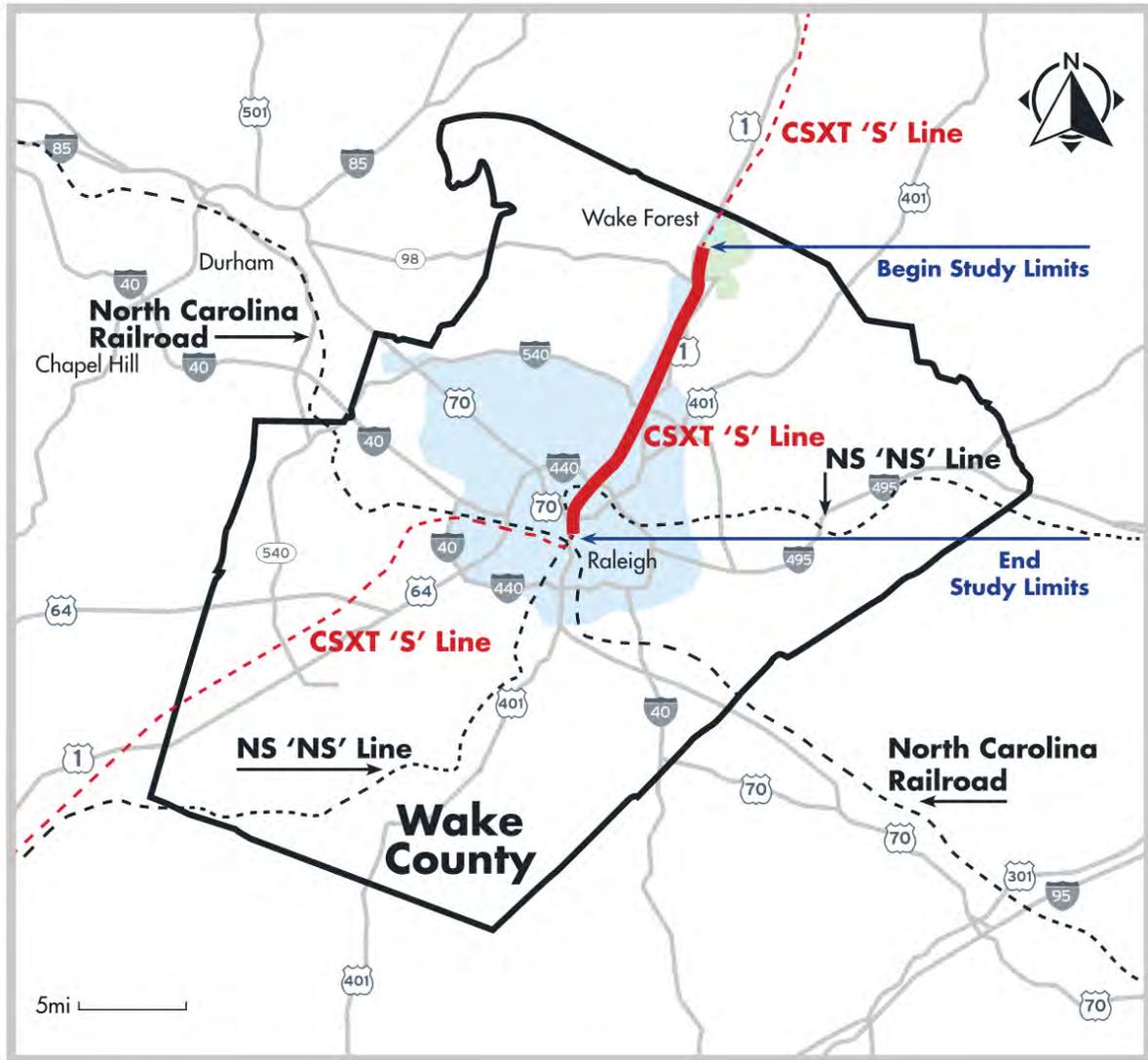
NCDOT and GoTriangle initiated the *Wake Forest to Raleigh Commuter Rail Conceptual Infrastructure Analysis* to evaluate possible infrastructure improvements on the existing rail line between Wake Forest, NC and Raleigh, NC resulting from two assumed commuter rail operational scenarios. This rail line is owned and operated by CSXT and is known as the 'S' Line.

The study limits begin in downtown Wake Forest (milepost S-140.5) and end in downtown Raleigh (milepost S-157.1); a total length of 16.6 miles. As illustrated in Figure 3, the study limits are completely contained within the boundaries of Wake County.

Two commuter rail service scenarios were evaluated including the development of potential station locations, completion of train run-time analyses, creation of example commuter train schedules, identification of infrastructure needs and right-of-way requirements and calculation of capital cost estimates. Ridership projections, environmental screening and operation & maintenance costs are not included in this study.

¹ Source: Center for Urban Affairs & Community Services. "Traveling to Work in Wake: Exploring the Commuter Rail Option". NC State University: June 2016

Figure 3 – Study Limits Map



2. Other Studies in the Area

Southeast Corridor (1990's to Present)

The CSXT 'S' line between Richmond, VA and Raleigh, NC is part of a federally-designated high speed rail corridor, referred to as the 'Southeast Corridor'. Studies of intercity passenger rail in the Southeast Corridor date to the 1990s. A Tier 1 Environmental Impact Statement (EIS) of the Washington DC to Charlotte, NC corridor was completed in 2002. A Tier II EIS for the Richmond to Raleigh segment of the Southeast Corridor, which includes the limits of this commuter rail study, was completed in October 2015. The Federal Railroad Administration is expected to issue the Record of Decision for the Tier II EIS in mid-2017.

Some of the infrastructure improvements proposed in this study to support commuter rail service on the CSXT 'S' line are consistent with the incremental improvements proposed under the Southeast Corridor project. Commuter rail improvements needed that are not included in the Southeast Corridor have been configured to not preclude the proposed Southeast Corridor infrastructure improvements proposed under the Southeast Corridor project.

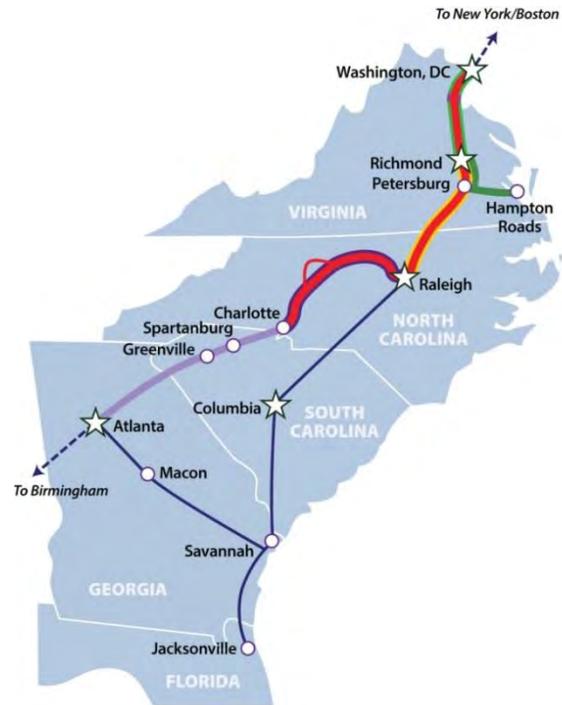
GoTriangle Durham-Wake County Corridor Alternatives Analysis (2011)

The Durham-Wake County Corridor Alternatives Analysis (AA) evaluated commuter rail transit, light rail transit, and bus rapid transit alternatives along 3 corridors between Durham and Garner. The study concluded that commuter rail along the existing NCRR corridor was a feasible alternative. The Durham-Wake corridor along the NCRR intersects with the CSXT 'S' line at the southern limits of this commuter rail study at Raleigh Union Station. Thus, commuter rail service to Wake Forest is proposed to be a third leg of a commuter rail network into downtown Raleigh.

GoTriangle Wake County Corridor Alternatives Analysis (2011)

The Wake County Corridor Alternatives Analysis (AA) evaluated a Transportation System Management (enhanced bus service) and light rail transit from Cary to downtown Raleigh and continuing to northeast Raleigh. The study concluded that light rail transit along this corridor is a feasible alternative. The AA proposed LRT tracks beside the NCRR corridor from NW Cary Parkway to Raleigh Union Station, then along the east side of the CSXT 'S' Line, within the limits of this commuter rail study area, from Raleigh Union Station to just south of I-540. The LRT utilized a

Figure 4 - Southeast Corridor



Source: www.sehsr.org

separate corridor immediately east of the main track on property purchased by GoTriangle from CSXT in 2003. The LRT AA identified several locations along the CSXT 'S' Line as logical station locations. The adopted Wake County Transit Plan (2016) did not recommend pursuing this LRT project. Therefore, accommodating the proposed LRT project was not included in this commuter rail study.

Wake County Transit Plan - Commuter Rail Elements (2016)

In May and June of 2016, the Wake County Transit Plan was formally adopted by the required local governing boards. The Transit Plan vision includes an approximately 37-mile commuter rail corridor between Garner and West Durham. After the successful half-cent sales tax referendum in November 2016, further study on this commuter rail corridor will begin in the Spring of 2017 as part of the Wake County Major Investment Study.

NSR/TTA/NCRR Commuter Rail Service Study (2015)

The NSR/TTA/NCRR Commuter Rail Service Study evaluated the infrastructure needed to support various commuter train service scenarios along the NCRR corridor between Mebane, NC and Selma, NC. Train schedules developed by the *Wake Forest to Raleigh Commuter Rail Conceptual Infrastructure Analysis* interface with train schedules developed by the NSR/TTA/NCRR Commuter Rail Service Study in one of the two service scenarios. The study intersects with the CSXT 'S' Line at Raleigh Union Station. Passengers could transfer from a future 'S' line commuter platform through the station building to the existing platform on the NCRR Corridor to access intercity passenger trains operating on the on the NCRR Corridor.

NC State Wake County Commuter Rail Study (2016)

The NC State Center for Urban Affairs & Community Studies presented the *Traveling to Work in Wake: Exploring the Commuter Rail Option* study in June 2016. This study reviewed the socio-demographic characteristics of several corridors in Wake County that could possibly support commuter rail service. The studied corridors included the CSXT 'S' Line between Wake Forest and Raleigh, which is the subject of this commuter rail study, as well as Knightdale-Raleigh, Clayton-Raleigh, Fuquay-Varina – Raleigh, Apex to Raleigh and Durham to Raleigh. The report indicates that the current move toward walkable spaces and transit-oriented development in Raleigh, along with the multi-modal transit facility, already under construction, are likely to benefit the move towards commuter rail².

² Source: Center for Urban Affairs & Community Services. "Traveling to Work in Wake: Exploring the Commuter Rail Option". NC State University: June 2016

3. Planned Projects in the Study Area

Raleigh Union Station – TIP P-5500

NCDOT and the City of Raleigh are working together to build a passenger train station at 510 W. Martin Street in downtown Raleigh that will replace the existing Amtrak station on Cabarrus Street. One of the busiest Amtrak stations in the southeastern United States, the Cabarrus Street station lacks a platform large enough to serve the longer trains that come into the station.³ This project will construct two new station tracks on either side of a new center island platform. Construction began in January 2016 and is anticipated to be complete in late 2017. Raleigh Union Station is located at the southern end of the study limits and is designed to accommodate future SEC trains through later construction of a platform along the S line tracks.

NCDOT Capital Yard Lead Project

This is a NCDOT Rail Division project to reconfigure the tracks leading to the NCDOT Capital Yard in Raleigh both northward and southward from the facility reducing the number of conflicts between deadheading passenger trains and CSXT freight trains. This project is scheduled to begin construction in October 2017 and be completed by May 2018.

Capital Boulevard Expressway Project - TIP U-5307

NCDOT is planning to rebuild Capital Boulevard (US-1) into a controlled access facility from I-540 to Purnell Rd (in Wake Forest). The project crosses over the CSXT 'S' line at MP 144.8. NCDOT anticipates entering construction in 2021.

Rogers Road Grade Separation – TIP P-5707

NCDOT is planning to replace the current Rogers Road at-grade crossing south of Wake Forest with a new bridge in the coming years. This project was also identified as a necessary improvement for the Southeast Corridor. NCDOT is entering the design phase of the project and anticipates beginning construction in early 2020.

Durant Road Grade Separation – TIP P-5720

NCDOT is planning to replace the current Durant Road at-grade crossing with a new bridge in the coming years. This project was also identified as a necessary improvement for the Southeast Corridor. NCDOT is entering the design phase of the project and anticipates beginning construction in 2020.

New Hope Church Road Grade Separation – TIP P-5715

NCDOT is planning to replace the current New Hope Church Road at-grade crossing with a new bridge in the coming years. This project was also identified as a necessary improvement for the

³ Source: <https://www.ncdot.gov/projects/raleighunionstation/>

Southeast Corridor. NCDOT is entering the design phase of the project and anticipates beginning construction in 2021.

Southeast Corridor Grade Separations

Southeast Corridor identifies many proposed grade separations that close existing at-grade crossings and build new bridges over or under the track. The grade separation projects below are included in the NCDOT Strategic Transportation Investments (STI) plan but have yet to be funded:

- Ligon Mill Road
- Gresham Lake Road
- Millbrook Road
- Wolfpack Lane

4. Assumptions

The following assumptions have been made to simplify the analysis required for this commuter rail study:

1. Proposed commuter trains would operate on the same tracks as freight trains, becoming what is known as a shared use corridor. This is opposed to a completely isolated system separated from existing tracks by a set distance. Commuter trains would operate at a maximum speed of 79 mph.
2. Infrastructure improvements proposed to support the commuter rail service need to support existing CSXT freight train operations as they currently exist.
3. Raleigh Union Station (RUS), a new Amtrak station currently under construction in downtown Raleigh to replace the existing station, is considered to be an existing facility. Phase I track improvements being constructed under the RUS project are also considered to be existing for the purposes of this study. Phase 2 track improvements are not included. It is assumed that the configuration of the station tracks and platform relative to the study corridor would require a separate platform to be built to support a commuter rail service on the CSXT 'S' Line.
4. The Capital Yard Lead project which extends the lead tracks on both ends of NCDOT's Capital Yard is considered to be completed and in service.
5. Commuter traffic proposed under this study would either follow the existing CSXT S-line through Raleigh Yard or follow the new rail corridor proposed under the SEC project to access downtown Raleigh.
6. The study does not assume a specific platform boarding height for commuter stations and allows for a multitude of platform height options.
7. State-supported 'Piedmont' and 'Carolinian' passenger train schedules are derived from NCDOT Rail Division's 5th Frequency Operating Plan dated January 10, 2012. This plan increases passenger train frequency between Raleigh and Charlotte from 3 daily round trips to 5 daily round trips by 2018.

8. Commuter train schedules for the West Durham to Garner commuter rail service are derived from the *NSR/TTA/NCRR Commuter Rail Service Study (August 2015)* '8-2-8-2' service scenario.
9. Commuter train equipment would consist of 'push-pull' train sets. These trains can be operated from both ends and do not need to be 'wyed', or turned around, at each end station before proceeding in the opposite direction.
10. NS freight train operations within the study area are not included in the analysis. Due to concerns with switching operations of the Norfolk Southern yard conflicting with commuter train schedules, the commuter tracks would be grade separated from the Norfolk Southern 'NS' Line where they cross south of Whitaker Mill Road, as proposed under the Southeast Corridor.
11. This study does not identify roadway grade crossing closures or grade separations that are not directly needed to support the commuter rail operations.
12. The ten-daily roundtrip (4-1-4-1) service scenario assumes the implementation of a commuter rail service on the NCRR Corridor between West Durham and Garner as envisioned in previous studies and the adopted Wake County Transit Plan. Prerequisite agreements and infrastructure improvements on the NCRR Corridor will also need to be completed prior to implementation of the 4-1-4-1 service scenario, including any track and signal improvements needed at Boylan to connect 'S' line and NCRR Corridor commuter services.

5. Existing CSXT 'S' Line Infrastructure

History

The existing rail corridor between Wake Forest, NC (MP S-140.5) and Raleigh, NC (MP S-157.2) is the 'S' Line owned and operated by CSXT Transportation. The 'S' Line, named after a CSXT predecessor, the Seaboard Air Line Railroad, was once a busy mainline railroad connecting Richmond, VA to Raleigh, NC. Over time, the 'S' line became a redundant route for CSXT and was taken out of service between Centralia, VA and Norlina, NC. The remaining portion of the 'S' line, including the segment within the limits of this commuter rail study, became a branch line only utilized by local CSXT freight trains.

Right-of-Way

The existing right-of-way is nominally 80' wide centered about the alignment of the original single main track, based on CSXT valuation maps. North of Durant Road (MP S-147.3), the original single track alignment and right-of-way dimensions are mostly intact. South of Durant Road, right-of-way acquisitions associated with multiple curve realignments and the addition of a second main track in the past cause the width of the right-of-way to vary significantly. The acquisitions appear to maintain 40' -50' from the centerline of track to the right-of-way boundary.

In 2003, GoTriangle purchased 32 parcels of land within the CSXT right-of-way boundary. These parcels are located between the Wake Forest Road overhead bridge (MP S-150.2) and the Morgan Street overhead bridge (MP S-157.0) and form a continuous corridor on the east side of the existing main track.

Mainline Track and Yards

Within the study limits, the CSXT 'S' line consists of a single mainline track with no passing sidings. Maximum authorized train speed is 25 mph except in the vicinity of Raleigh Yard where train speed is restricted to 10 or 20 mph.

The NS 'NS' Line crosses the CSXT 'S' line at-grade at Control Point (CP) "Edgeton" located at MP S-154.7, south of the Whitaker Mill Road at-grade crossing. There are two interchange tracks located in the southeastern corner of the crossing where CSXT and NS exchange freight cars.

Between the bridges over Capital Boulevard (MP S-155.0) and Peace Street (MP S-156.3), there are two rail yards on the west side of the existing main track. The CSXT Raleigh Yard, consisting of 3 yard tracks, is where CSXT local trains originate and/or terminate. 2 additional tracks located immediately west of the yard are utilized by a CSX Transflo facility for transloading operations.

Adjacent to the CSXT Raleigh Yard is the NCDOT Capital Yard. NCDOT Capital Yard is where the NCDOT sponsored "Piedmont" passenger trains are maintained. "Piedmont" trains use the S-line to get from NCDOT Capital Yard to Raleigh Union Station.

At the Jones Street at-grade crossing (MP S-156.8), the NS 'NS' Line runs becomes parallel to the west side of the CSXT 'S' Line at CP "Southern Junction" where a single left-hand crossover connects the two lines to each other. Within the limits of this control point, the east leg of the Boylan wye diverges towards Cabarrus St.

Figure 5 – CP "Southern Jct."



Industrial Spur Tracks

There are 10 active and inactive industrial spur tracks on the CSXT 'S' Line within the study limits that are connected to the main track with a turnout. CSXT switches the active industrial customers on an as-needed basis. Based on field observations it appears that 4 of the 10 industrial tracks are currently switched by CSXT.

Table 1 – Industrial Spur Tracks

Milepost	Industry Spur Name	Active/Inactive
S-145.7	N/A	Inactive
S-146.4	Mallinckrodt	Active
S-147.3	Neuse House Track	Inactive
S-148.0	Carolina Builders	Inactive
S-150.0	84 Lumber Company	Active
S-150.7	C&F Foods Company	Active
S-152.5	Diamond Hill Plywood Company	Active
S-153.9	N/A	Inactive
S-154.3	N/A	Inactive
S-155.0	N/A	Inactive

Railroad Bridges

There are 14 railroad structures over roads or waterways within the study limits. As noted below, two of the bridges are currently wide enough to accommodate a 2nd track.

Table 2 – Railroad Bridges

Milepost	Name	Structure Type	Length
S-140.5	Roosevelt Ave	Ballast Deck	50'
S-146.2	Neuse River	Ballast Deck	346'
S-147.9	Jeffrey's Branch #1	Concrete Arch Culvert	12'
S-148.9	Jeffrey's Branch #2	Concrete Arch Culvert	20'
S-150.5	Spring Forest Rd	Ballast Deck (Double Track)	133'
S-150.9	Atlantic Ave	Ballast Deck (Double Track)	184'
S-153.8	Six Forks Rd	Ballast Deck	150'
S-154.0	Crabtree Creek	Ballast Deck	300'
S-154.8	Closed Roadway	Open Deck	35'
S-154.8	Pigeon House Branch	Concrete Arch Culvert	14'
S-154.8	Pigeon House Branch	Concrete Arch Culvert	14'
S-155.0	Capital Blvd (US-1)	Ballast Deck	172'
S-156.3	Peace St	Ballast Deck	100'
S-156.5	Capital Blvd (US-1)	Ballast Deck	98'

Overhead Roadway Bridges

There are 7 existing overhead roadway bridges within the study limits:

Table 3 – Overhead Roadway Bridges

Milepost Limits	Road Name	Structure Type
S-141.5	NC-98 Bypass	Roadway Bridge
S-144.8	Capital Blvd (US-1)	Dual Roadway Bridges
S-149.1	I-540	Dual Roadway Bridges
S-150.2	Wake Forest Rd	Roadway Bridge
S-153.3	I-440	Roadway Bridge
S-156.9	Hillsborough St	Roadway Bridge
S-157.0	Morgan St	Roadway Bridge

Railroad-Roadway At-Grade Crossings

There are 18 existing at-grade crossings within the study limits:

Table 4 – Railroad-Roadway At-Grade Crossings

Milepost	Road Name	Warning Devices	Surface Type
S-140.8	E. Elm St	Lights/Gates	Timber/Asphalt
S-141.0	E. Holding Ave	Lights/Gates/Eastbound Cantilever	Timber/Asphalt
S-141.2	Private Rd	Crossbucks Only	Timber/Asphalt
S-141.8	Friendship Chapel Rd	Lights/Gates	Timber/Asphalt
S-142.5	Rogers Rd	Lights/Gates	Concrete/Rubber

S-143.1	Seawell Dr	Crossbucks Only	Timber/Asphalt
S-143.8	Ligon Mill Rd	Lights/Gates	Timber/Asphalt
S-147.2	Private Rd	Crossbucks Only	Timber/Asphalt
S-147.3	Durant Rd	Lights/Gates/Cantilevers	Concrete/Rubber
S-148.4	Gresham Lake Rd	Lights/Gates	Rubber/Asphalt
S-151.3	Millbrook Rd	Lights/Gates/Cantilevers	Concrete/Rubber
S-152.3	New Hope Church Rd	Lights/Gates/Cantilevers	Asphalt Only
S-153.1	Wolfpack Ln	Lights/Gates/Cantilevers	Timber/Asphalt
S-154.5	Whitaker Mill Rd	Lights/Gates/Westbound Cantilever	Asphalt Only
S-156.6	Harrington St	Lights/Gates/Northbound Cantilever	Timber/Asphalt
S-156.7	West St	Lights/Gates	Timber/Asphalt
S-156.8	Jones St	Lights/Gates/Westbound Cantilever	Timber/Asphalt
S-157.1	Hargett St	Lights/Gates/Eastbound Cantilever	Rubber/Asphalt

Railroad Signals and Communications

Most of the CSXT 'S' line within the study limits is unsignalized, otherwise known as 'dark territory'. Train movements are governed by Direct Train Control (DTC) authorities provided verbally via radio by the CSXT train dispatcher in Jacksonville, FL. These authorities are written down by the train crew and repeated back to the dispatcher before any movement can occur.

The at-grade crossing with the NS 'NS' line at 'Edgeton' is signalized but is not controlled by a dispatcher. The signal has a default state that allows CSXT trains to cross at any time. If an NS train needs to cross, the NS crew must use a push-button located adjacent to the crossing which temporarily sets the signals on CSXT to 'stop' and gives NS a signal to proceed.

Within the limits of CSXT Raleigh Yard, train movements are governed by 'Yard Limits' operating rules. Trains must obtain verbal authority via radio from the CSXT train dispatcher or the employee responsible for yard operations, known as the yard master. Similar to DTC, these authorities are written down by the train crew and repeated back before any movement can occur.

Beginning at Southern Junction, south of CSXT Raleigh Yard, the CSXT 'S' Line is equipped with a modern Traffic Control System (TCS). Train movements are governed by signal located on masts beside the track. Train crews do not have to communicate with the CSXT dispatcher to proceed if the signal indications allow train movement.

Table 5 – Train Control Methods

Milepost Limits	Train Control
S-140.5 to S-154.7	Direct Train Control (DTC)
S-154.7 to S-156.8	Yard Limits
S-156.8 to S-157.1	Traffic Control System (TCS)

Table 6 – Railroad Signal Locations

Milepost	Description
S-153.9	Southbound Approach Signal to Edgeton
S-154.7	Southbound Edgeton Signal
S-154.8	Northbound Edgeton Signal
S-156.0	Northbound Approach Signal to Edgeton
S-156.6	Southbound Approach Signal to CP "Southern Jct."
S-156.8	Southbound CP "Southern Jct." Signal
S-157.1	Northbound CP "Southern Jct." Signal

Also, two Automatic Equipment Identification (AEI) scanners are located within the study limits, one on either side of CSXT Raleigh Yard. These pieces of equipment read 'data tags' located on each locomotive and railcar for the purposes of tracking the equipment. One is located just north of the Whitaker Mill Road at-grade crossing (MP S-154.5) and the other is located between the West Street and Jones Street at-grade crossings.

6. Existing CSXT 'S' Line Train Operations

Current train operations on the study corridor are limited to CSXT local freight train activity based out of CSXT's Raleigh Yard and deadheading passenger train movements between the NCDOT Yard and Raleigh Union Station. NS freight trains operate over a very short stretch of the corridor in downtown Raleigh and are ignored for the purposes of this study. Through field observations and the following is a summary of typical train operations within the study corridor.

Freight Trains

CSXT currently operates 4 local freight trains on the 'S' line that traverse all or part of the study limits. The first two trains described below operate from CSXT Raleigh Yard northward and traverse most the study limits. The last two trains operate from CSXT Raleigh Yard southward and traverse only the southernmost mile of the study limits.

Table 7 – Existing CSXT Freight Trains

Train Description	Frequency
Henderson to Raleigh Local	Mon-Fri
Raleigh to Youngsville Local	Mon-Fri
Raleigh to Hamlet Local	Mon-Fri
Hamlet to Raleigh Local	Mon-Fri

The Henderson to Raleigh local train operates during the overnight hours, typically entering the study limits southbound between 10:30 pm and 1:30 am. The train switches cars at Raleigh Yard, then returns to Henderson northbound, exiting the study limits typically between 12:30 am and 3:30 am. This train does not switch any industries within the study limits.

The Raleigh to Youngsville local train typically departs Raleigh Yard northbound around 10:30 am and switches all of the industries within the study limits on an as needed basis. Switching activities at each industry can take an hour or more during which time the train is occupying the main track. The train typically exits the study limits northbound between 2:00 pm and 4:00 pm to switch industries further up the line. The train then returns to Raleigh Yard, typically re-entering the study limits southbound between 5:30 pm and 7:30 pm.

The Raleigh to Hamlet local train typically departs Raleigh Yard southbound around 9:30 am after the arrival of the Amtrak Silver Star at Raleigh Union Station. This train is assembled overnight and occupies the CSXT 'S' Line main track in the yard through the morning rush hour.

The Hamlet to Raleigh local train originates in Hamlet, NC and typically arrives in Raleigh Yard from the south between 3:30 pm and 6:00 pm.

Deadheading Passenger Trains

The State of North Carolina supports the operation of the Amtrak "Piedmont" intercity passenger trains that operate between Raleigh, NC and Charlotte, NC. Currently, there are two daily round-trips with plans to expand to four round-trips daily by 2018. The NCDOT Capital Yard, located at MP S-156.2 (north of the Peace Street bridge), is the maintenance and layover facility for these trains. Approximately 45 minutes prior to each departure from Raleigh Amtrak Station, the train leaves Capital Yard to the south, traverses approximately 1 mile of the study corridor, and then exits the corridor to reach the station. Upon arrival from Charlotte, the train returns to Capital Yard from the south approximately 20 minutes later.

Interface with Commuter Rail

All the existing CSXT freight and Amtrak passenger train movements in the corridor are incorporated into the schedule development described in Section 10 below.

7. Potential Station Locations

Potential station locations have been identified to support the development of train schedules and probable infrastructure costs. Exact station locations and layouts are not specified and should be a topic of future study. A total of 8 potential station locations were determined based upon a consideration of the following criteria:

Distance Between Stations – Spacing between stations is typically between 2 miles and 5 miles which is consistent with the typical average station spacing for existing commuter rail systems in North America. The closer spacing at the end point stations reflect multiple stops in urban areas.

Connectivity to Road Network – Stations are located such that commuters can easily access the station from major roadways. This extends the potential ‘ridershed’ into areas of potential ridership. Connecting bus service would also be more feasible if the station is located adjacent to major roadways.

Park and Ride Potential – Stations locations consider the potential to locate park and ride lots. The determination is based solely on available land at each location. No analysis of parking lot configurations or number of parking spaces is conducted.

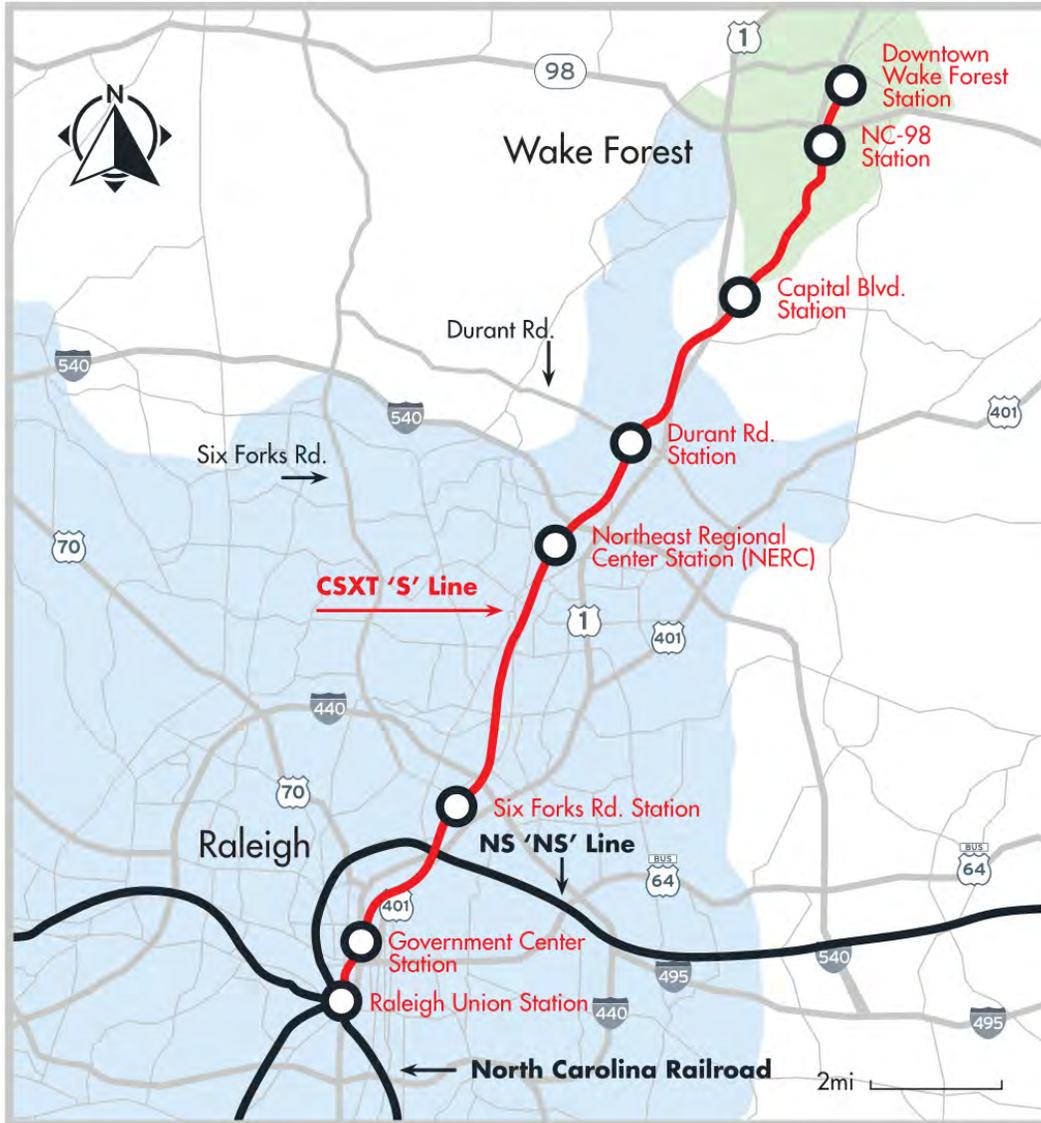
Pedestrian Access – Stations locations also consider the potential for pedestrian access. The determination is based solely on the geographic proximity of urban cores, residential areas (neighborhoods, apartments) and commercial centers.

The following station locations have been assumed in this study:

Table 8 – Potential Station Locations

Milepost	Station Name	Park and Ride	Distance Between Stations (mi)
S-140.5	Downtown Wake Forest Station	No	
			1.0
S-141.5	NC-98 Station	Yes	
			2.7
S-144.2	Capital Blvd Station	Yes	
			3.2
S-147.4	Durant Rd Station	Yes	
			1.8
S-149.2	Northeast Regional Center Station (NERC)	Yes	
			4.6
S-153.8	Six Forks Station	Yes	
			2.7
S-156.5	Government Center Station	No	
			0.7
S-157.1	Raleigh Union Station	No	

Figure 6 – Potential Station Locations



8. Proposed Commuter Train Service Scenarios

Two commuter train service scenarios were evaluated, referred to as '8-2-8-2' and '4-1-4-1'. The designation refers to how many round trips are scheduled during the morning, mid-day, afternoon and evening. For example, the 8-2-8-2 service scenario runs 8 round trips during the morning peak hours, 2 round trips around mid-day, 8 round trips during the afternoon peak hours and 2 round trips in the evening. This scenario provides a 30-minute headway between trains, which is generally regarded as a frequency that commuters find to be convenient. 4-1-4-1, with one-hour headways, may be less attractive to riders but could interface with the commuter rail services currently being studied for the area by others, as discussed below. Previous studies on the NCR Corridor, including the NSR/TTA/NCR Commuter Rail Service Study, evaluated service scenarios for other corridors ranging from 3-0-3-0 to 8-2-8-2.

8-2-8-2 Service Scenario

This service scenario assumes the operation of 40 commuter trains per day between Wake Forest Station and Raleigh Union Station. This includes 8 morning round-trips, 2 mid-day round trips, 8 afternoon round trips, and 2 evening round-trips. A maintenance facility at the NC-98 Station is proposed to maintain the equipment. The NCDOT Capital Yard could be used to store trains and serve as a layover facility, however the available capacity at this facility would need to be evaluated. It is assumed that this service would be a stand-alone service and would not interface directly with other proposed commuter rail services but would allow for transfers to/from potential Durham to Garner service at Raleigh Union Station.

4-1-4-1 Service Scenario

This service scenario assumes the operation of 20 commuter trains per day between Wake Forest Station and Raleigh Union Station that would interface with the proposed West Durham to Garner commuter rail service currently included in the adopted Wake County Transit Plan. This includes 4 morning round-trips, 1 mid-day round trip, 4 afternoon round trips, and 1 evening round-trip between Wake Forest and West Durham via Raleigh Union Station. As illustrated in Figure 7, half of the trains currently proposed in the West Durham to Garner '8-2-8-2' service scenario are routed to/from Wake Forest instead of Garner.

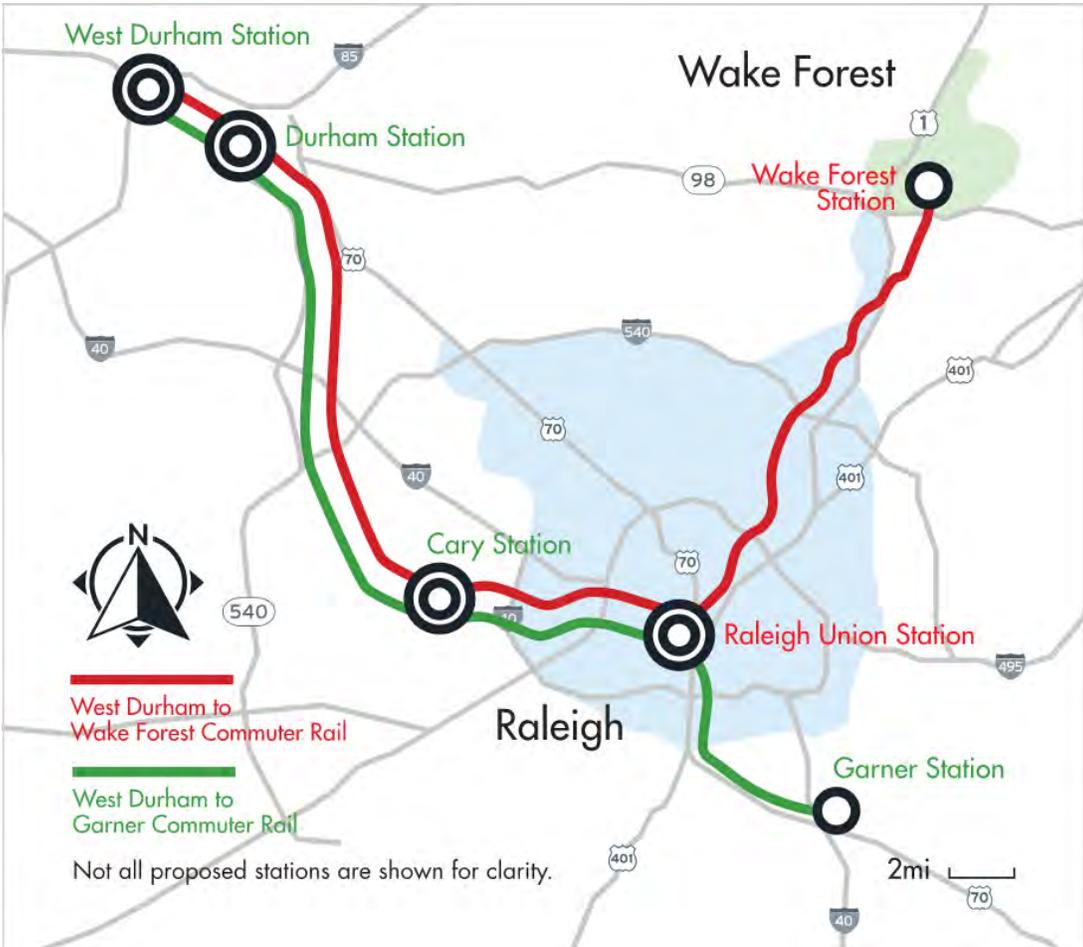
Trains operating to/from Wake Forest are assumed to utilize the Rail Operations and Maintenance Facility (ROMF) proposed for the West Durham to Garner service for layover and maintenance. The exact location of which has not been determined and is an aspect of other studies. Therefore, the NCDOT Capital Yard would not be utilized for these purposes and would not need to be enlarged. An additional layover yard at NC-98 Station is proposed to overnight the first 2 train sets that depart from Wake Forest in the morning.

The ten-daily roundtrip (4-1-4-1) service scenario assumes the implementation of a commuter rail service on the NCR Corridor between West Durham and Garner as envisioned in previous studies and the adopted Wake County Transit Plan. Prerequisite agreements and infrastructure

improvements on the NCR Corridor would also need to be completed prior to implementation of the 4-1-4-1 service scenario, including any track and signal improvements needed at Boylan to connect 'S' line and NCR Corridor commuter services.

At Raleigh Union Station, passengers could transfer from the 'S' line commuter platform through the station building to the existing platform on the NCR Corridor to access intercity passenger trains operating on the on the NCR Corridor.

Figure 7 – '4-1-4-1' Service Scenario Map



9. Commuter Train Run Time Calculation

A run time analysis was performed for northbound and southbound commuter trains to establish a baseline for developing train schedules assuming a maximum speed of 79 mph. The run time is the time it takes for a train to travel between the Downtown Wake Forest Station and Raleigh Union Station including decelerating to and accelerating from a stop at each station. The time spent stopped at each station is excluded from the run time calculation.

The analysis was conducted using a Microsoft Excel simulation developed by HNTB for this project that calculates train acceleration/deceleration and resulting velocity every 100'. The simulation utilizes industry standard formulas to adjust train performance to account for resistance associated with grades, curves, rolling resistance and wind resistance (Davis Equation). The typical deceleration rate was derived from Amtrak's CE-205 braking chart. Train performance was further adjusted to account for railroad signals that restrict train speed.

The analysis assumes that the train set utilized for this commuter rail service would consist of one F59 locomotive, two passenger cars and one 'cab car'. The results of the Excel simulation were then verified with a simple Rail Traffic Controller (RTC) model run to ensure that train performance matched that developed by the software program. See Appendices A and B for the train speed profiles. The run time analysis yielded the following results:

Table 9 – Southbound Commuter Train Run Time

Milepost	Station Name	Total Run Time (min:sec)	Interval (min:sec)
S-140.5	Downtown Wake Forest Station	-	-
S-141.5	NC-98 Station	02:34	02:34
S-144.2	Capital Blvd Station	06:02	03:28
S-147.4	Durant Rd Station	10:21	04:19
S-149.2	Northeast Regional Center (NERC)	13:05	02:44
S-153.8	Six Forks Station	19:10	06:05
S-156.5	Government Center Station	23:52	04:42
S-157.1	Raleigh Union Station	26:12	02:20

Table 10 – Northbound Commuter Train Run Time

Milepost	Station Name	Total Run Time (min:sec)	Interval (min:sec)
S-157.1	Raleigh Union Station	-	-
S-156.5	Government Center Station	02:31	02:31
S-153.8	Six Forks Station	07:45	05:14
S-149.2	Northeast Regional Center (NERC)	13:22	05:37
S-147.2	Durant Rd Station	16:15	02:53
S-144.2	Capital Blvd Station	20:14	03:59
S-141.5	NC-98 Station	24:02	03:48
S-140.5	Downtown Wake Forest Station	26:55	02:53

10. Proposed Commuter Train Schedules

Example weekday commuter train schedules were developed for both service scenarios to identify where infrastructure improvements would be needed to support the commuter rail services. No separate schedules were developed for weekend operations which may have a lower frequency than weekdays. The schedule uses the run time between each station, assumes 1 minute of dwell time at each station and adds additional schedule pad to enhance the reliability of the service.

As outlined in the FRA Technical Monograph⁴, additional schedule pad equal to 7% of the run time, is added to the schedule of every train to account for normal operating inefficiencies that can occur. This equates to 2 additional minutes for all trains. The FRA Technical Monograph also outlines additional schedule pad equal to 4.5% of run time for each time a train meets another going in the opposite direction. This equates to 1 additional minute of delay for each train meet. Additional schedule pad is added as necessary to facilitate trains meeting one another at passing sidings. This pad is generally added to the non-peak direction trains to increase the likelihood that the non-peak direction train would arrive at a passing siding first, allowing the peak-direction train to continue without delay. The amount of additional pad varies depending on the service scenario.

The resulting travel time between downtown Wake Forest and Raleigh Union Station is summarized as follows:

Table 11 – 8-2-8-2 Commuter Train Schedule

	Southbound	Northbound
Peak Direction	34 minutes	35 minutes
Off-Peak Direction	42 minutes	43 minutes

Table 12 – 4-1-4-1 Commuter Train Schedule

	Southbound	Northbound
Peak Direction	34 minutes	35 minutes
Off-Peak Direction	34 minutes	35 minutes

It is assumed that the commuter services would use ‘push-pull’ trains that need not be wyeed at each end station before returning in the opposite direction. However, to account for the time it takes for the train operator to configure the train to operate in the opposite direction, at least 13 minutes of turn-around time is provided at each end station.

Due to the headway and schedule pad in the northbound schedule, the first northbound train of the day doesn’t reach Wake Forest until the 3rd schedule southbound departure from Wake Forest for both the 8-2-8-2 and 4-1-4-1 service scenarios. Accordingly, two train sets are proposed to

⁴ Source: Technical Monograph: Transportation Planning for the Richmond-Charlotte Railroad Corridor, Volume II, Appendices, Appendix B. Federal Railroad Administration, United States Department of Transportation, January 2004.

remain overnight at a layover facility adjacent to the NC-98 Station and ‘deadhead’ to the Wake Forest Station prior to the scheduled departure time. At the end of the day, two train sets are positioned into the layover facility in preparation for the next day.

CSXT Freight Train Considerations

CSXT local freight train activities are assumed to remain unchanged from current operations. However, since the local freight train switches industries along the study corridor during the mid-day hours, the commuter train schedules did not need to be altered. Passenger train meets with the Raleigh to Youngsville local are accommodated with additional proposed track infrastructure. The approximate schedule for the Raleigh to Youngsville local shows the train switching all 4 industries which could be considered a worst-case scenario since the train would still be within the study limits when the afternoon peak time begins.

As noted in Section 6, the Raleigh to Hamlet local train occupies the ‘S’ Line main track at CSXT Raleigh Yard during the overnight and morning hours. Additional infrastructure is proposed to allow commuter trains to bypass the existing main track in this area during the morning peak. This has the added benefit of allowing CSXT to conduct any yard switching activities that are necessary without being impeded by commuter trains.

Amtrak Train Considerations

Deadheading Amtrak passenger trains moving between Raleigh Union Station and NCDOT Capital Yard are shown in the schedule to illustrate where those movements could occur. The arrival and departure times from Raleigh Union Station for these trains are derived from the NCDOT 5th Frequency Operating Plan dated January 10, 2012. Any conflicts between these movements and scheduled commuter trains were resolved by adjusting the deadheading train’s movement a few minutes earlier or later.

8-2-8-2 Service Scenario Schedule Summary

A total of 40 weekday commuter trains are scheduled with nominally 30-minute headways during the morning and afternoon peak hours. As discussed above, 2 minutes of schedule pad is added to each train’s schedule. For trains operating in the peak direction (southbound in the morning and northbound in the afternoon), no additional schedule pad is added. However, to facilitate train meets at passing sidings and account for subsequent delay, an additional 8 minutes of pad is added to off-peak direction trains. See Appendix C for the train schedule and Appendices D and E for the corresponding string charts.

4-1-4-1 Service Scenario Schedule Summary

A total of 20 weekday commuter trains are scheduled with nominally 1-hour headways during the morning and afternoon peak hours. The schedules for all trains are determined by the corresponding schedule ‘slot’ between Raleigh and Durham from the NSR/TTA/NCRR Commuter

Rail Study (August 2015). Thus, the arrival of southbound trains and departure of northbound trains from Raleigh Union Station corresponds with an arrival/departure time from that study.

In addition to 3 minutes of schedule pad, additional pad is added in a varying fashion to accommodate train meets at passing sidings where those meets occur. See Appendix G for the train schedule and Appendices H and I for the corresponding string charts.

11. Proposed Infrastructure Improvements

Both commuter rail service scenarios proposed under this study would require significant infrastructure improvements on the CSXT 'S' Line to operate reliably. Despite the difference in train frequency and number of trains between the two scenarios, the needed infrastructure is similar primarily due to requirements to maintain existing CSXT freight train operations.

The existing track infrastructure is proposed to be reconstructed in its entirety to support train speeds of 79 mph. For the purposes of this study, all existing timber tie mainline track that would be used by commuter trains would be replaced with new rail and concrete ties. This includes replacing existing timber tie turnouts with concrete tie turnouts. Any existing track that would remain in place and only used by freight trains would not be reconstructed.

Southeast Corridor Considerations

Within the Southeast Corridor EIS, infrastructure improvements along the CSXT 'S' Line are proposed and include adding additional main tracks, crossovers and grade separations to increase the reliability of future high speed train service. Many of these improvements would increase the reliability of commuter train service as well. Where additional main tracks and crossovers are needed to support commuter train operations, the alignment and location identified in the Southeast Corridor project is used to the extent possible. Conversely, where additional infrastructure is needed only to support commuter train service, the proposed infrastructure improvements have been configured as to not preclude the improvements identified for the Southeast Corridor.

Track – Downtown Wake Forest (MP S-140.5) to the Neuse River (MP S-146.2)

In this segment, the proposed track configuration consists of a double main track between the downtown Wake Forest Station and NC-98 Station, then a single main track from NC-98 Station to the Neuse River. Two passing sidings are provided at the Capital Boulevard Station to permit commuter trains to meet at the station.

Due to the proximity of the Wake Forest and NC-98 stations, the station tracks are connected to create a 1 mile stretch of double track. This provides a degree of operational flexibility if trains are not operating on time. The Wake Forest Station track ties back into the mainline north of the station. Although trains would rarely use the track north of the station, the connection back to the mainline is needed for signaling purposes.

At NC-98 Station, two passenger station tracks and a freight track are provided in the event a freight train needs to meet two commuter trains at the station. Two double ended tracks are also provided for a maintenance/layover facility located north of the NC-98 overhead roadway bridge.

Between NC-98 Station and Capital Boulevard Station, the existing track goes through several reverse curves. It was decided not to follow the Southeast Corridor alignment through this area which eliminates these curves but requires significant right-of-way acquisition. To reduce cost and impacts, a modest realignment is proposed through these curves to increase the maximum train speed up to 60 mph.

The Capital Boulevard Station is located on a Southeast Corridor proposed curve realignment. The existing main track is retained to function as a freight-only passing siding. A second station track is also provided because at least one commuter train meet occurs here in both service scenarios.

Track – Neuse River (MP S-146.2) to Control Point Edgeton (MP S-154.7)

In this segment, the proposed track configuration consists of a single main track and freight-only siding from the Neuse River to Durant Station and double main track from Durant Station to CP Edgeton. The limits of the double track correlate with what is proposed in Southeast Corridor. An additional freight passing track is located at the NERC station.

Between the Neuse River and Durant Station, the single main track is proposed to be located on the alignment proposed by Southeast Corridor, leaving a portion of the existing main track as the freight siding. Just south of Durant Station a No. 20 left-hand crossover allows passenger trains to access both tracks from this point southward.

At the NERC Station, a freight-only track is proposed adjacent to the double track mainline. This track allows freight trains to switch the 84 Lumber spur while commuter trains are meeting at the NERC Station. A No. 20 double crossover is proposed at the south end of the freight track to permit commuter trains more operational flexibility.

The proposed double track continues southward for 3 miles before the next signaled control point at MP S-152.8. At this location, a No. 20 double crossover is proposed to allow for operational flexibility and allow the CSXT local train to crossover and switch the Diamond Hill Plywood industrial spur. From this location to MP S-154.1 is a 1.3-mile section of double track where commuter trains can only operate on the western track due to the configuration of Six Forks Station.

Six Forks Station is located on the outside of the existing track curve and is configured such that when the 2nd main track is constructed for Southeast Corridor, the track serving the station is converted into a station track with No. 15 turnouts at both ends. The track speed is reduced to 30 mph since increased curvature is necessary to create a 'flat spot' of sufficient length to accommodate the station platform.

South of Six Forks Station, a No. 20 left hand crossover and turnout are proposed at MP S-154.1. This configuration allows commuter trains to access both tracks and for CSXT freight trains to access the existing main track, which is converted to a yard lead. The double track mainline would be used by commuter trains only from this point southward towards CP Edgeton.

Track – Control Point Edgeton (MP S-154.7) to Downtown Raleigh (MP S-156.8)

CP Edgeton, located at MP S-154.7 is where the NS 'NS' line crosses the CSXT 'S' line at-grade south of the Whitaker Mill at-grade crossing. Due to the proximity of NS Glenwood Yard, it is likely that switching activities at Glenwood Yard could block the CSXT 'S' line on a regular basis creating the potential to negatively impacting the reliability of a commuter train service. To eliminate conflicts at Edgeton, the study proposes to construct the double track grade separation to the west of the existing track as proposed by Southeast Corridor. The existing main track would be left in place to function as a lead track to CSXT Raleigh Yard and maintain access to the interchange tracks.

South of CP Edgeton, the alignment is proposed to follow the Southeast Corridor's alignments until approximately MP S-155.3. Here, where the north end of the NCDOT Capital Yard would connect to the Southeast corridor, the main track is proposed to run between NCDOT Capital Yard and CSXT Raleigh Yard. This concept allows commuter trains in the morning to operate around the Raleigh to Hamlet local train that typically occupies the existing main track at CSXT Raleigh Yard during this time.

Due to the tight confines between the two yards, a single main track is proposed south of MP S-155.3 for both service scenarios. To accommodate the additional main track, the existing CSXT TransFlo facility track would need to be shifted and extended to maintain the same amount of storage length. The south end of CSXT Raleigh Yard would also need to be reconfigured to accommodate the new main track(s).

The single commuter train main track continues southward, parallel to the existing CSXT main track over the Peace Street and Capital Boulevard bridges and through the Government Center Station location.

Track – Raleigh Union Station (MP S-156.8 to MP S-157.1)

Due to the curved track geometry of the CSXT 'S' line near the Raleigh Union Station building, it is not possible to locate a platform adjacent to the station for either commuter rail service scenario. Thus, the platform location proposed for this commuter rail study is the same platform location proposed by Southeast Corridor under the Hillsborough Street and Morgan Street overhead roadway bridges.

The track configuration proposed south of the Jones Street at-grade crossing matches the Southeast Corridor as well, allowing for access to the platform, a freight bypass track and providing NS the ability to cross over from the NS 'NS' (westernmost track) over to the freight bypass (easternmost track).

The 8-2-8-2 service scenario utilizes two stub ended station tracks, one on either side of the center-island platform. This configuration permits two trains to be in the station at the same time. Although the schedule does not require two trains to be in the station at the same time, the second track would allow the system to recover more quickly if a train incurs delay.

The 4-1-4-1 service scenario utilizes a single track through this area that wraps around the curve to Boylan Avenue on an alignment that matches what is proposed in Southeast Corridor. This allows commuter trains to continue along the CSXT 'S' line, gain access to the NCRR corridor and continue to West Durham. The one-hour headway between trains does not necessitate a second station track.

Industrial Spur Tracks

Proposed track infrastructure improvements maintain access to all industrial spur tracks that currently have a turnout in the main track whether they are active or not. These turnouts would be replaced with concrete tie turnouts and equipped with electric locks to interface with the new signal system.

Railroad Bridges

There are several locations where new railroad bridges would need to be constructed to accommodate proposed track infrastructure:

Table 13 – Proposed Railroad Bridges

Milepost	Name	Proposed Improvements	Approx. Length
S-140.5	Roosevelt Ave	None	50'
S-146.2	Neuse River	None	346'
S-147.9	Jeffrey's Branch #1	None	12'
S-148.9	Jeffrey's Branch #2	None	20'
S-149.2	Proposed Roadway @ NERC Station	New Double Track Ballast Deck Bridge (Main Tracks)	150'
S-149.2	Proposed Roadway @ NERC Station	New Single Track Ballast Deck Bridge (Freight Track)	150'
S-150.5	Spring Forest Rd	None	133'
S-150.9	Atlantic Ave	None	184'
S-153.8	Six Forks Rd	New Single Track Ballast Deck Bridge adjacent to Existing Bridge	150'
S-154.0	Crabtree Creek	Widen Existing Single Track Ballast Deck Bridge to Double Track	300'

S-154.7*	NS 'NS' Line & Capital Blvd.	New Double Track Ballast Deck Bridge	1485'
S-154.8	Closed Roadway	None	35'
S-154.8	Pigeon House Branch	None	14'
S-154.8	Pigeon House Branch	None	14'
S-155.0	Capital Blvd (US-1)	None	172'
S-156.3	Peace St	None	100'
S-156.5	Capital Blvd (US-1)	None	98'

*This bridge location and length is proposed in the Southeast Corridor project.

Overhead Roadway Bridges

There are several overhead roadway bridges that would need some modification to accommodate the proposed track infrastructure. Where the bridge span is not wide enough to allow 25' of horizontal clearance from the bridge piers to the centerline of any track, crashwalls are proposed. Crashwalls are used to strengthen bridge piers by connecting the individual columns together with a wall. This makes the bridge much more resilient to structural damage in the event of a train derailment.

Table 14 – Proposed Overhead Roadway Modifications

Milepost	Road Name	Description of Modifications
S-141.5	NC-98 Bypass	None – Span is wide enough for three tracks
S-144.8	Capital Blvd (US-1)	None – No additional track proposed
S-149.1	I-540	None – Span is wide enough for three tracks
S-150.2	Wake Forest Rd	Add Crashwalls
S-153.3	I-440	Add Crashwalls
S-156.9	Hillsborough St	Add Crashwalls
S-157.0	Morgan St	Add Crashwalls

Railroad-Roadway At-Grade Crossings

Each at-grade crossing with a public road within the study limits is already equipped with automated warning devices (lights and gates). The train detection circuits for each crossing would be lengthened to accommodate higher train speeds. Also, for cost estimating purposes, it is assumed that all existing grade crossing surfaces that do not consist of full width concrete panels would be upgraded to concrete panels. All new grade crossing surfaces are assumed to be concrete panels.

Signal and Communications System

As noted in Section 5, train movements on the existing CSXT 'S' Line require significant radio-based communication between train crews and dispatchers/yard masters. For a commuter rail system to operate efficiently and reliably, a modern Traffic Control System (TCS) with Positive Train Control (PTC) would need to be installed. The TCS system would include wayside signals for providing train movement authority by signal indication to the train crews. PTC is a GPS-based safety technology

capable of preventing train-to-train collisions, over-speed derailments, unauthorized incursions into work zones and train movements through switches left in the wrong position.⁵ The PTC system was mandated through the Rail Safety Improvement Act of 2008 for all lines that carry passenger trains.

Layover/Maintenance Facility at NC-98 Station

A layover and maintenance facility is proposed at the NC-98 Station to support the 8-2-8-2 scenario and, would serve as a location where trains would be staged, cleaned and maintained. Since the 4-1-4-1 scenario interfaces with the proposed West Durham to Garner commuter rail, trains would be maintained at the proposed facility along the NCRR/NS 'H' Line. The facility at NC-98 would then be of limited size and serve primarily as a location to overnight trains and stage them temporarily between the morning and afternoon peak times.

See Appendix F for the schematic showing the proposed infrastructure improvements for the 8-2-8-2 service scenario and Appendix I for the schematic showing the proposed infrastructure improvements for the 4-1-4-1 service scenario.

12. Right-of-Way and Property Acquisition

As mentioned in Section 5, the existing CSXT right-of-way is nominally 80' wide with many areas of variable width. As previously noted, GoTriangle owns the eastern side of the right-of-way from Wake Forest Road to Morgan Street. This study was developed assuming that the existing right-of-way owned by CSXT would remain under CSXT ownership and that a commuter rail service would utilize an operating agreement to operate within CSXT right-of-way. It is assumed that the GoTriangle-owned parcels are available for the construction of infrastructure improvements.

Where construction is anticipated outside of CSXT right-of-way and GoTriangle parcels, this study estimates the purchase of additional property. Due to the conceptual nature of the study, no cross sections or cut/fill lines are available to make determinations about construction limits. However, since most infrastructure improvements are consistent with the infrastructure proposed by the Southeast Corridor project, this study utilizes the same proposed right-of-way lines developed for Southeast Corridor where applicable.

At stations, additional property may be required to accommodate the footprint of park-and-ride lots, bus slips and ancillary infrastructure. Since ridership numbers are not currently available to size park-and-ride lots, property acquisition at stations with park-and-ride potential was assumed to encompass the entire parcel on which the station is located. Property acquisition costs were then derived from property values listed on the Wake County iMAPS online mapping application.

⁵ Source: <http://www.metrolinktrains.com/agency/page/title/ptc>

13. Vehicles

This commuter rail study assumes that trains would consist of one locomotive, two passenger cars and one 'cab car' (a passenger car that has operating controls at one end). This configuration permits the trains to operate in push-pull fashion without the need to turn around at each end station.

To operate the 8-2-8-2 schedule, 4 active train sets would be needed. In addition to the active train sets, 1 additional train set would be needed as a 'protect set' that can be used in the event one of the trains has an unexpected mechanical failure or is otherwise unable to operate. A total of 5 train sets would be needed to support the 8-2-8-2 service scenario.

To operate the 4-1-4-1 schedule, 3 active train sets dedicated to the West Durham to Wake Forest route would be needed. In addition to the active train sets, 1 additional train set would be needed as a 'protect set'. A total of 4 train sets would be needed to support the 4-1-4-1 service scenario. This does not include additional train sets that may be required to operate commuter service between West Durham and Garner. All train sets needed for the 4-1-4-1 schedule may be provided by the currently proposed commuter rail service in the adopted Wake County Transit Plan.

This study assumes that all locomotives and railcars would be purchased new. Additionally, no specific type of locomotive or rail car is identified for the service, but for cost estimating purposes, equipment similar to that operated by the SunRail commuter rail line in Orlando, FL is assumed.

Figure 8 – SunRail Commuter Trains



14. Probable Cost Estimate

An estimate of probable capital cost was developed for each service scenario based on the infrastructure improvements identified in Section 11 Proposed Infrastructure Improvements. The estimates use 2016 dollars with no escalation of unit costs.

Assumptions

It is important to note that preliminary engineering, construction, operating and other agreements between CSXT, NS, NCR and the operator of the commuter service would need to be in place before construction and operation of a commuter service on the CSXT 'S' Line. CSXT or the other railroads may require additional improvements in the agreements that are not accounted for in these cost estimates. It should also be noted that any commuter service proposed to extend beyond the S-line onto the NCR/NS corridor would require extensive coordination and agreements with those railroads as well for preliminary engineering, construction and operation.

The cost estimates assume the existing right-of-way remains under the ownership of CSXT. Right-of-way acquisition is assumed only where needed to contain construction limits. Additionally, the parcels owned by GoTriangle are assumed to be available for usage by the commuter service without additional acquisition costs.

Some trains in the 4-1-4-1 service scenario operate beyond the Wake Forest to Raleigh study limits. The cost estimate for the 4-1-4-1 service scenario only includes the costs associated with infrastructure improvements within the study limits. Costs associated with infrastructure improvements along the NCR between West Durham and Garner are not included.

Professional Services

Professional services such as environmental planning, engineering and construction management and administration are accounted for as 28% of the construction sub-total cost. The breakdown of professional services costs is as follows:

Project Management of Design and Construction	3%
NEPA Planning, Preliminary Design, Survey and Geotech	6%
Final Design	8%
Construction Administration and Management	8%
Construction Inspection	<u>3%</u>
	28%

Contingency

Due to the conceptual nature of this study, a 40% contingency factor is applied to all construction costs. This contingency covers the costs associated with engineering details that are not yet known as well as unexpected costs during construction. A 15% contingency is applied to vehicles and right-of-way costs.

Figure 9 – Probable Cost Estimate – 8-2-8-2 Service Scenario

Construction:

Item	Probable Cost
Grading and Drainage	\$12,590,000
Track	\$57,352,250
Structures	\$43,085,500
Stations	\$31,000,000
Roadway	\$810,000
Signals	\$21,010,800
Utility Construction	\$3,000,000
Facilities	\$25,000,000
Railroad Flagging	\$4,000,000
Sub-Total	\$197,807,550
Professional Services (28% of Sub-Total)	\$55,386,114
Contingency (40% of Sub-Total)	\$79,123,020
Construction Total	\$332,316,684

Vehicles & Right-of-Way:

Vehicles	\$89,850,000
R/W & Property Acquisition	\$12,600,000
Sub-Total	\$89,850,000
Contingency (15% of Sub-Total)	\$13,477,500
Vehicles & Right-of-Way Total	\$103,327,500

TOTAL PROJECT COST: \$435,644,184

SAY: \$435,700,000

Figure 10 – Probable Cost Estimate – 4-1-4-1 Service Scenario

Construction:

Item	Probable Cost
Grading and Drainage	\$12,590,000
Track	\$54,242,850
Structures	\$43,461,500
Stations	\$31,000,000
Roadway	\$810,000
Signals	\$21,264,900
Utility Construction	\$3,000,000
Facilities	\$1,000,000
Railroad Flagging	\$4,000,000
Sub-Total	\$171,369,250
Professional Services (28% of Sub-Total)	\$47,971,910
Contingency (40% of Sub-Total)	\$68,531,300
Construction Total	\$287,831,460

Vehicles & Right-of-Way:

Vehicles	\$61,800,000
R/W & Property Acquisition	\$12,600,000
Sub-Total	\$74,400,000
Contingency (15% of Sub-Total)	\$11,160,000
Vehicles & Right-of-Way Total	\$85,560,000

TOTAL PROJECT COST: \$373,391,460

SAY: \$373,400,000

15. Conclusions

Based on this study of operational scenarios and infrastructure needs, a commuter rail service between Wake Forest, NC and Raleigh, NC on the CSXT 'S' Line is in fact possible but would require a significant amount of new infrastructure to operate reliably. This is the case regardless of whether the service proposes to operate 20 trains or 40 trains a day due to the current operation of CSXT freight trains. Additionally, infrastructure for a commuter rail service can be constructed to incrementally implement infrastructure needed for the Southeast Corridor project.

As noted previously, driving times along US-1 between downtown Wake Forest and Raleigh Union Station are nominally 28-30 minutes and can exceed 50 minutes during peak hour travel times. Peak direction commuter trains on the CSXT 'S' Line could operate reliably with a 35-minute travel time. This could prove to be an attractive alternative for commuters living or working along the corridor.

The probable cost of the infrastructure improvements and trains identified for the two commuter service frequencies ranges from \$373.4M to \$435.7M.

16. Next Steps

Several areas of further study have been identified regarding the infrastructure proposed in this study:

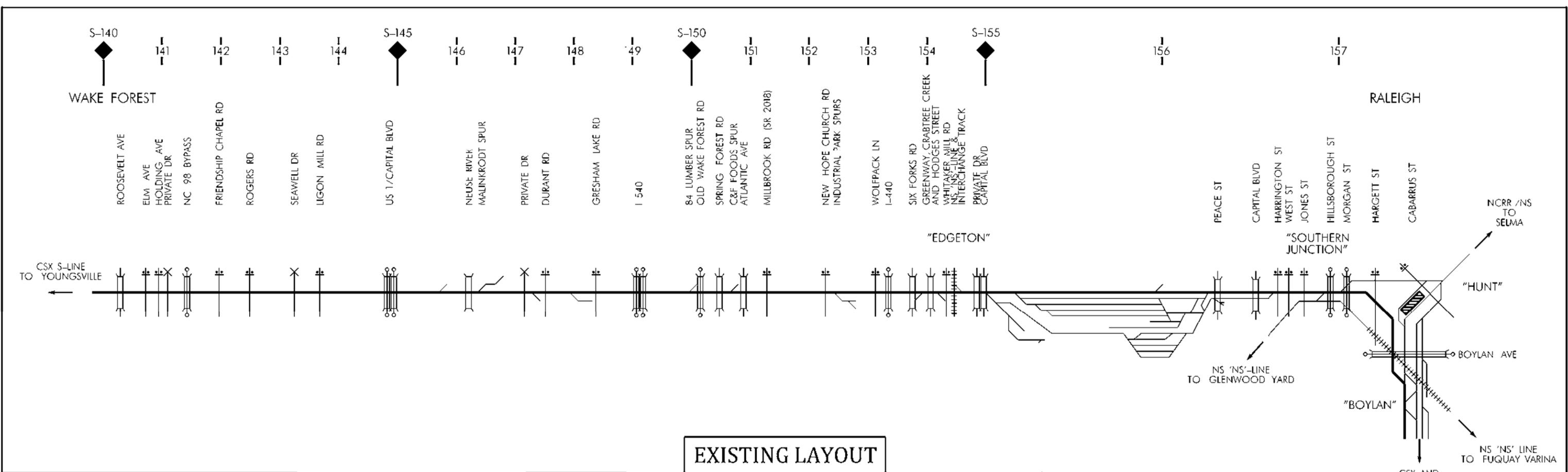
1. It is recommended that further evaluation include detailed coordination and the necessary agreements with the freight railroads to confirm feasibility, scope and cost of the service.
2. The location of potential stations should be refined based on a ridership/revenue study.
3. Preliminary engineering would be required to determine the actual impacts to the businesses along White St. in downtown Wake Forest.
4. The impacts to the existing TransFlo terminal and the CSXT Raleigh Yard would need to be carefully evaluated and coordinated with CSXT. Future expansion plans for this facility and NCDOT Capital Yard would also need to be reconciled with track infrastructure proposed for this commuter rail study.
5. In the event both this commuter service and the Richmond-Raleigh SEC project were completed, coordination with Amtrak would be necessary to determine the logistics of boarding commuter trains and SEC intercity passenger trains (operating on the 'S' line) on a single 'S' line platform at Raleigh Union Station given Amtrak's preferences regarding platform access control.

17. Definitions, Acronyms and Abbreviations

This section includes a summary of the definitions, acronyms, and abbreviations used throughout the report.

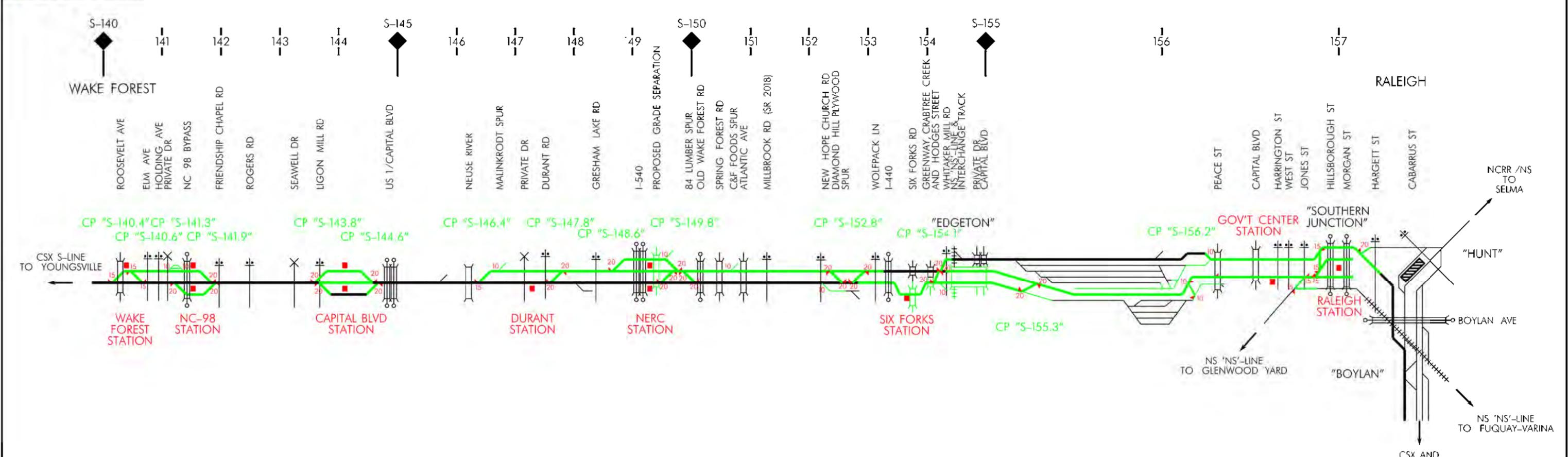
AA	Alternatives Analysis
AEI	Automatic Equipment Identification
Cab Car	A passenger railcar with operating controls at one end
CP	Control Point
CSXT	CSX Transportation
Deadheading	A passenger train moving between a station and maintenance yard with no passengers onboard
DTC	Direct Train Control
Dwell Time	The time a train spends at a scheduled stop without moving
EIS	Environmental Impact Statement
FRA	Federal Railroad Administration
Headway	A measurement of the distance or time between vehicles in a transit system
LRT	Light Rail Transit
NB	Northbound
MP	Milepost
NCDOT	North Carolina Department of Transportation Rail Division
NCRR	North Carolina Railroad
NERC	Northeast Regional Center
NS/NSR	Norfolk Southern Railway
PTC	Positive Train Control
ROD	Record of Decision
ROMF	Rail Operations and Maintenance Facility
RTC	Rail Traffic Controller
Run Time	The amount of time it takes for a vehicle to get from one stop to another
SB	Southbound
SEC	Southeast Corridor
STI	Strategic Transportation Investments
TCS	Traffic Control System
TTA	Triangle Transit Authority

Appendices



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F. 8-2-8-2 Infrastructure Improvements Schematic



G. 4-1-4-1 Train Schedules

SOUTHBOUND TRAINS										
STATION	Morning				Mid-Day	Afternoon				Evening
NC-98 Station (Non-Revenue)	4:42 AM	5:57 AM					3:37 PM			
Wake Forest Station (Non-Revenue)	4:45 AM	6:00 AM					3:40 PM			
Wake Forest Station (DP)	5:00 AM	6:15 AM	7:15 AM	8:15 AM	11:05 AM	2:50 PM	3:55 PM	5:05 PM	6:05 PM	7:37 PM
NC-98 Station	5:03 AM	6:18 AM	7:18 AM	8:18 AM	11:08 AM	2:56 PM	3:58 PM	5:11 PM	6:11 PM	7:43 PM
Capital Blvd Station	5:08 AM	6:23 AM	7:23 AM	8:23 AM	11:13 AM	3:01 PM	4:03 PM	5:16 PM	6:16 PM	7:51 PM
Durant Rd Station	5:13 AM	6:28 AM	7:28 AM	8:28 AM	11:18 AM	3:06 PM	4:08 PM	5:21 PM	6:21 PM	7:56 PM
Northeast Regional Center (NERC)	5:17 AM	6:32 AM	7:32 AM	8:32 AM	11:22 AM	3:10 PM	4:12 PM	5:25 PM	6:25 PM	8:00 PM
Six Forks Rd Station	5:24 AM	6:39 AM	7:39 AM	8:39 AM	11:29 AM	3:17 PM	4:19 PM	5:32 PM	6:32 PM	8:07 PM
Government Center Station	5:29 AM	6:44 AM	7:44 AM	8:44 AM	11:34 AM	3:22 PM	4:24 PM	5:37 PM	6:37 PM	8:12 PM
Raleigh Union Station	5:34 AM	6:49 AM	7:49 AM	8:49 AM	11:39 AM	3:24 PM	4:28 PM	5:39 PM	6:39 PM	8:14 PM
Cary Station	5:45 AM	7:00 AM	8:00 AM	9:00 AM	11:50 AM	3:35 PM	4:39 PM	5:50 PM	6:50 PM	8:25 PM
Durham Station	6:09 AM	7:24 AM	8:24 AM	9:24 AM	12:14 PM	3:59 PM	5:03 PM	6:14 PM	7:14 PM	8:49 PM
West Durham	6:13 AM	7:28 AM	8:28 AM	9:28 AM	12:18 PM	4:03 PM	5:07 PM	6:18 PM	7:18 PM	8:53 PM

(Note 5)

NORTHBOUND TRAINS										
STATION	Morning				Mid-Day	Afternoon				Evening
West Durham	5:20 AM	6:35 AM	7:35 AM	8:35 AM	11:15 AM	3:00 PM	4:15 PM	5:30 PM	6:30 PM	8:00 PM
Durham Station	5:24 AM	6:39 AM	7:39 AM	8:39 AM	11:19 AM	3:04 PM	4:19 PM	5:34 PM	6:34 PM	8:04 PM
Cary Station	5:47 AM	7:02 AM	8:02 AM	9:02 AM	11:42 AM	3:27 PM	4:42 PM	5:57 PM	6:57 PM	8:27 PM
Raleigh Union Station	5:58 AM	7:13 AM	8:13 AM	9:13 AM	11:53 AM	3:38 PM	4:53 PM	6:08 PM	7:08 PM	8:38 PM
Government Center Station	6:01 AM	7:16 AM	8:16 AM	9:16 AM	11:56 AM	3:41 PM	4:56 PM	6:11 PM	7:11 PM	8:41 PM
Six Forks Rd Station	6:08 AM	7:23 AM	8:23 AM	9:23 AM	12:03 PM	3:47 PM	5:02 PM	6:17 PM	7:17 PM	8:47 PM
Northeast Regional Center (NERC)	6:14 AM	7:29 AM	8:29 AM	9:29 AM	12:09 PM	3:53 PM	5:08 PM	6:23 PM	7:23 PM	8:53 PM
Durant Rd Station	6:18 AM	7:33 AM	8:33 AM	9:33 AM	12:13 PM	3:57 PM	5:12 PM	6:27 PM	7:27 PM	8:57 PM
Capital Blvd Station	6:23 AM	7:38 AM	8:38 AM	9:38 AM	12:18 PM	4:02 PM	5:17 PM	6:32 PM	7:32 PM	9:02 PM
NC-98 Station	6:28 AM	7:43 AM	8:43 AM	9:43 AM	12:23 PM	4:08 PM	5:23 PM	6:38 PM	7:43 PM	9:08 PM
Wake Forest Station	6:33 AM	7:48 AM	8:48 AM	9:48 AM	12:28 PM	4:13 PM	5:28 PM	6:43 PM	7:48 PM	9:13 PM
Wake Forest Station (Non-Revenue)			9:03 AM						8:03 PM	9:28 PM
NC-98 Station (Non-Revenue)			9:05 AM						8:05 PM	9:30 PM

(Note 5)

EASTBOUND GARNER TRAINS										
STATION	Morning				Mid-Day	Afternoon				Evening
West Durham	6:05 AM	7:05 AM	8:00 AM	9:20 AM	1:00 PM	3:45 PM	5:00 PM	6:00 PM	7:15 PM	9:30 PM
Durham Station	6:09 AM	7:09 AM	8:04 AM	9:24 AM	1:04 PM	3:49 PM	5:04 PM	6:04 PM	7:19 PM	9:34 PM
Cary Station	6:32 AM	7:32 AM	8:27 AM	9:47 AM	1:27 PM	4:12 PM	5:27 PM	6:27 PM	7:42 PM	9:57 PM
Raleigh Union Station	6:43 AM	7:43 AM	8:38 AM	9:58 AM	1:38 PM	4:23 PM	5:38 PM	6:38 PM	7:53 PM	10:08 PM
Greenfield Parkway (Garner)	6:58 AM	7:58 AM	8:53 AM	10:13 AM	1:53 PM	4:38 PM	5:53 PM	6:53 PM	8:08 PM	10:23 PM

(Note 5)

WESTBOUND GARNER TRAINS										
STATION	Morning				Mid-Day	Afternoon				Evening
Greenfield Parkway (Garner)	5:55 AM	7:05 AM	8:05 AM	9:25 AM	1:00 PM	3:45 PM	4:55 PM	5:55 PM	7:10 PM	9:30 PM
Raleigh Union Station	6:09 AM	7:19 AM	8:19 AM	9:39 AM	1:14 PM	3:59 PM	5:09 PM	6:09 PM	7:24 PM	9:44 PM
Cary Station	6:20 AM	7:30 AM	8:30 AM	9:50 AM	1:25 PM	4:10 PM	5:20 PM	6:20 PM	7:35 PM	9:55 PM
Durham Station	6:44 AM	7:54 AM	8:54 AM	10:14 AM	1:49 PM	4:34 PM	5:44 PM	6:44 PM	7:59 PM	10:19 PM
West Durham	6:48 AM	7:58 AM	8:58 AM	10:18 AM	1:53 PM	4:38 PM	5:48 PM	6:48 PM	8:03 PM	10:23 PM

(Note 5)

EASTBOUND PIEDMONTS / CAROLINIAN/SILVER STAR										
STATION	92	80	74	76	782	78				
Durham Station		9:37 AM	12:03 PM	5:03 PM	7:38 PM	10:13 PM				
Cary Station	8:15 AM	10:02 AM	12:28 PM	5:23 PM	8:03 PM	10:33 PM				
Raleigh Union Station (AR)	8:54 AM	10:17 AM	12:46 PM	5:41 PM	8:21 PM	10:51 PM				
Raleigh Union Station (Non-Revenue)			12:56 PM	5:51 PM	8:46 PM	11:01 PM				(Note 1)
NCDOT Yard (Non-Revenue)			1:06 PM	6:01 PM	8:56 PM	11:11 PM				(Note 2,6)

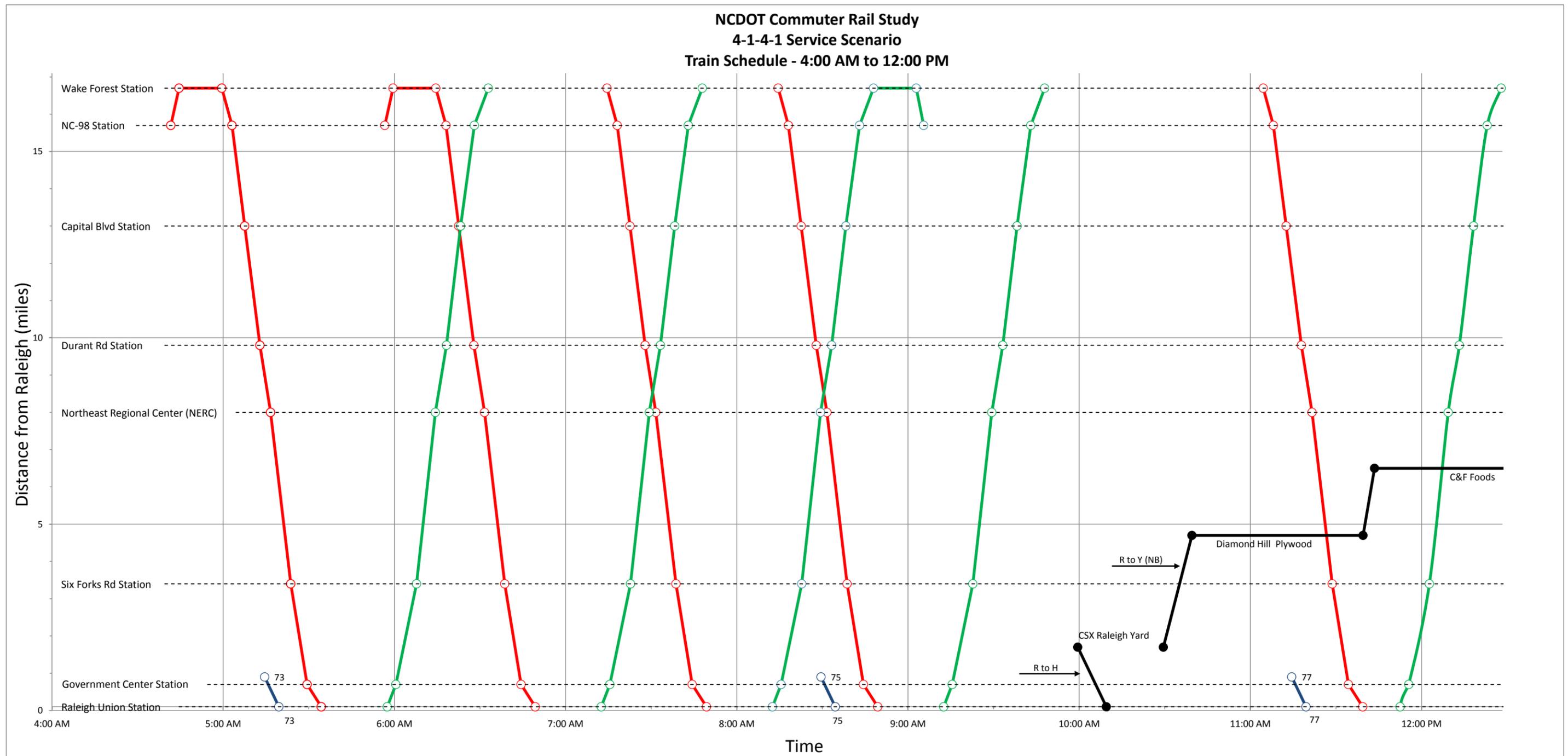
WESTBOUND PIEDMONTS / CAROLINIANS/SILVER STAR										
STATION	73	75	77	79	781	91				
NCDOT Yard (Non-Revenue)	5:15 AM	8:30 AM	11:15 AM		6:50 PM					(Note 4)
Raleigh Union Station (Non-Revenue)	5:20 AM	8:35 AM	11:20 AM		6:55 PM					
Raleigh Union Station (DP)	6:00 AM	9:15 AM	12:00 PM	4:50 PM	7:35 PM	9:13 PM				
Cary Station	6:12 AM	9:27 AM	12:12 PM	5:03 PM	7:47 PM	9:27 PM				
Durham Station	6:32 AM	9:47 AM	12:32 PM	5:29 PM	8:07 PM					

CSXT FREIGHT TRAINS										
STATION	R to Y (NB)	R to Y (SB)	R to H	H to R						
Cary Station			10:27 AM	3:33 PM						(Note 7, 8, 9)
Raleigh Union Station			10:10 AM	3:50 PM						
CSX Raleigh Yard	10:30 AM	9:00 PM	10:00 AM	4:00 PM						(Note 3)
Arrive Diamond Hill Plywood	10:40 AM	8:50 PM								
Depart Diamond Hill Plywood	11:40 AM	8:50 PM								
Arrive C&F Foods	11:44 AM	8:46 PM								
Depart C&F Foods	12:44 PM	8:46 PM								
Arrive 84 Lumber	12:47 PM	8:43 PM								
Depart 84 Lumber	1:47 PM	8:43 PM								
Arrive Mallinckrodt	1:55 PM	8:35 PM								
Depart Mallinckrodt	4:15 PM	8:35 PM								
Downtown Wake Forest	4:27 PM	8:23 PM								

Notes:

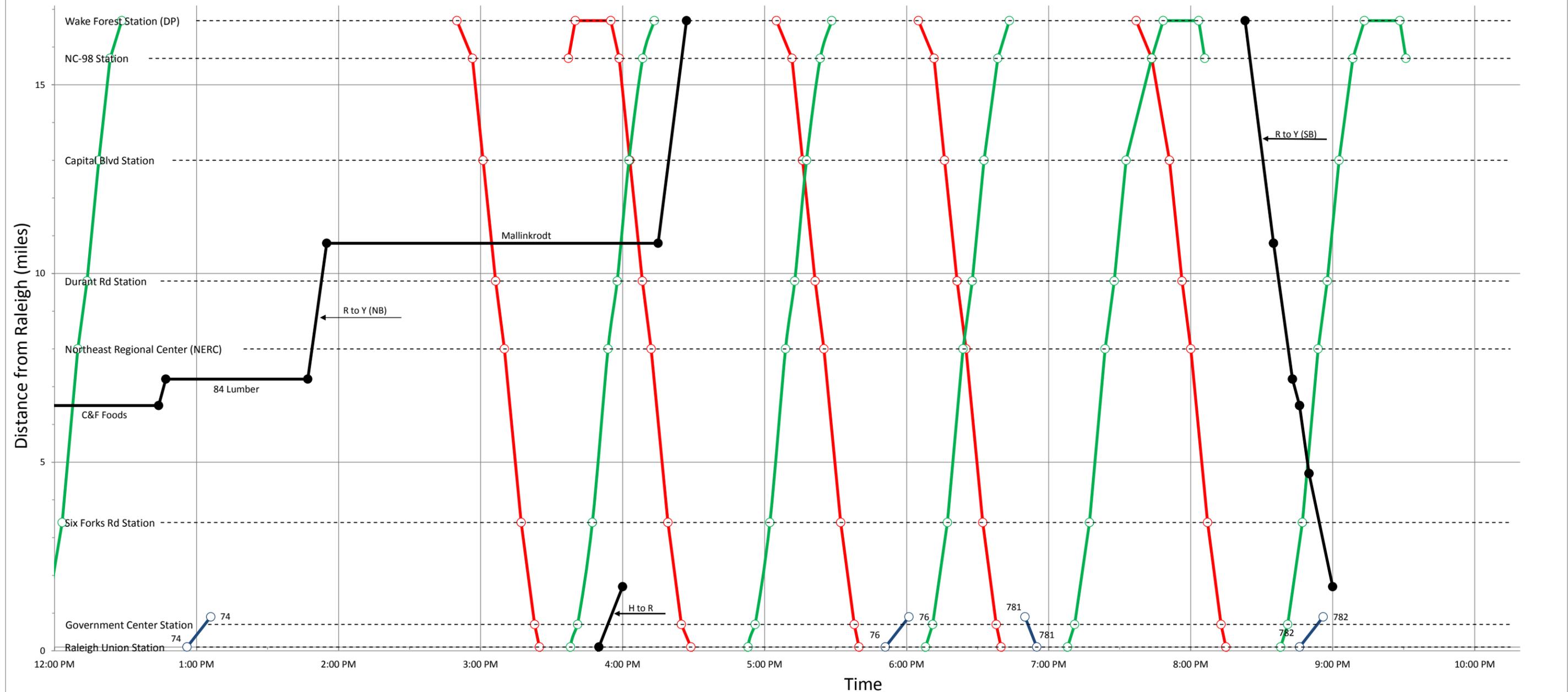
1. Trains 73,75,77,781 assume leave from NCDOT Yard 45 minutes ahead of scheduled departure from RUS
2. Trains 74,76,78 assume arrive at NCDOT Yard 20 minutes after scheduled arrival at RUS
3. Existing CSXT freight train schedules are based on field observations. R to Y (NB) typically leaves CSX Raleigh Yard at ~10:30 AM. R to Y (SB) returns to CSXT Raleigh Yard within +/- 1 hour from the listed schedule. H to R operates at night outside of the range of this schedule.
4. Piedmont/Carolinian/Silver Star train schedules between Raleigh Union Station and Durham Station are derived from the NCDOT proposed 5th Frequency Operating Plan dated 2012-01-10.
5. Commuter train schedules between Raleigh Union Station and West Durham Station are sourced from the GoTriangle West-Durham to Greenfield Commuter Rail Study dated August 2015.
6. Train 782 arrival into NCDOT Yard pushed 15 minutes later to avoid schedule conflict with commuter train.
7. R to Y represents Raleigh to Youngsville Local
8. R to H represents Raleigh to Hamlet Local
9. H to R represents Hamlet to Raleigh Local

H. 4-1-4-1 AM String Chart



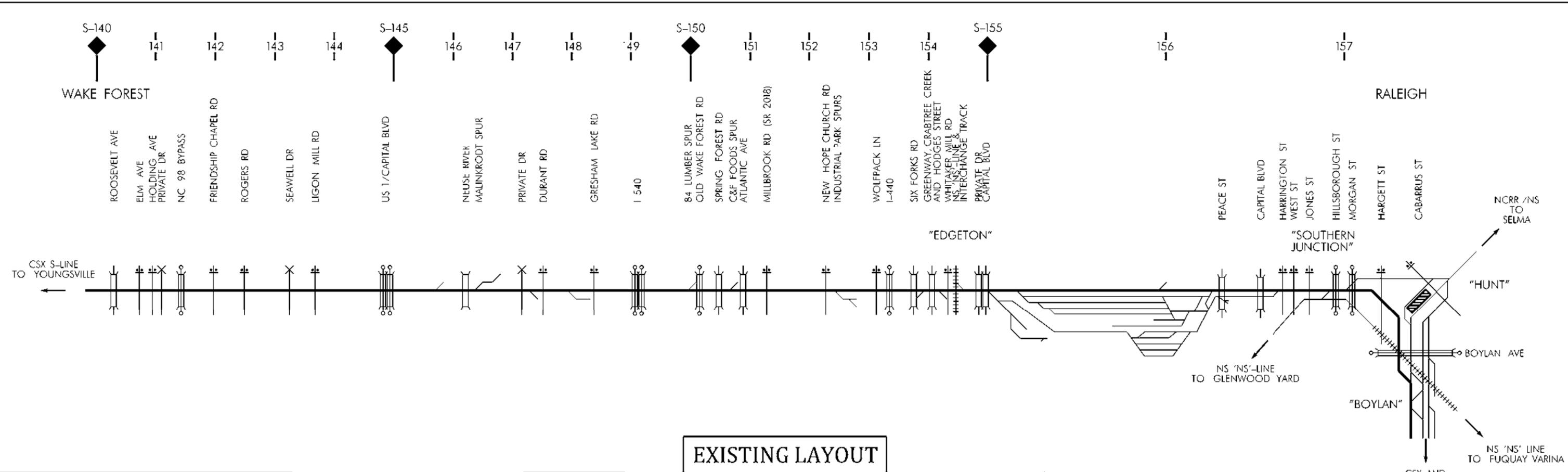
I. 4-1-4-1 PM String Chart

NCDOT Commuter Rail Study
 4-1-4-1 Service Scenario
 Train Schedule - 12:00 PM to 10:00 PM



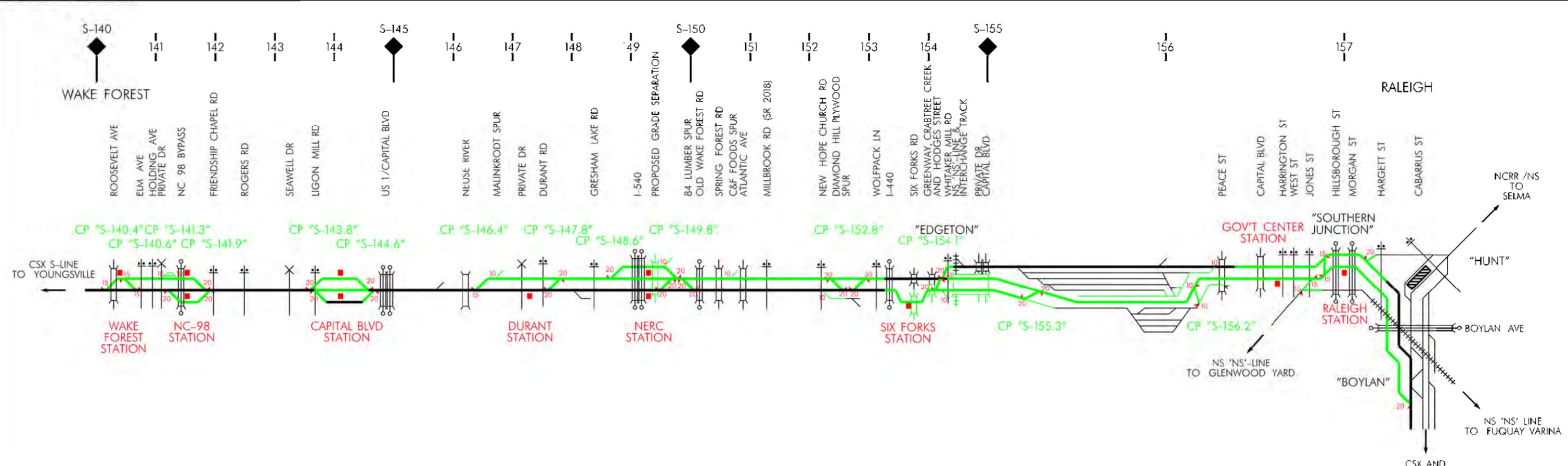
LEGEND

- Southbound Commuter Trains
- Northbound Commuter Trains
- Non-Revenue Amtrak Trains
- CSX Freight Trains



J. 4-1-4-1 Infrastructure Improvements Schematic

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PROPOSED LAYOUT

K. Detailed Probable Cost Estimate - '8-2-8-2' Service Scenario

PROBABLE COST
\$435,700,000

Description	Quantity	Unit	Price	Amount
Grading and Drainage				
Grading and Drainage	16.6	Mile	\$ 500,000.00	\$ 8,300,000.00
Erosion Control	16.6	Mile	\$ 15,000.00	\$ 249,000.00
Sub-Ballast	160,000	TN	\$ 25.00	\$ 4,000,000.00
Track				
Retire/Remove wood tie track	104,000	TF	\$ 20.00	\$ 2,080,000.00
Construct track, wood ties, 136RE new (includes ballast)	33,000	TF	\$ 150.00	\$ 4,950,000.00
Construct track, concrete ties, 136RE new (includes ballast)	147,000	TF	\$ 200.00	\$ 29,400,000.00
Remove Existing No. 8 Turnout	15	EA	\$ 4,000.00	\$ 60,000.00
Remove Existing No. 10 turnout	8	EA	\$ 5,000.00	\$ 40,000.00
Furnish and install No. 8 turnout (Timber Ties)	5	EA	\$ 100,000.00	\$ 500,000.00
Furnish and install No. 10 turnout (Concrete Ties)	11	EA	\$ 210,900.00	\$ 2,319,900.00
Furnish and install No. 10 turnout (Timber Ties)	5	EA	\$ 100,000.00	\$ 500,000.00
Furnish and install No. 15 turnout (Concrete Ties)	6	EA	\$ 305,250.00	\$ 1,831,500.00
Furnish and install No. 20 turnout (Concrete Ties)	12	EA	\$ 416,250.00	\$ 4,995,000.00
Furnish and install No. 10 crossover (Concrete Ties)	1	EA	\$ 494,000.00	\$ 494,000.00
Furnish and install No. 15 crossover (Concrete Ties)	2	EA	\$ 715,000.00	\$ 1,430,000.00
Furnish and Install No. 20 crossover (Concrete Ties)	7	EA	\$ 975,000.00	\$ 6,825,000.00
Furnish and install field welds	830	EA	\$ 510.00	\$ 423,300.00
Furnish and install insulated joint plug rails	130	EA	\$ 3,500.00	\$ 455,000.00
Furnish and install rail lubricators	3	EA	\$ 18,500.00	\$ 55,500.00
Furnish and install sliding block derail	7	EA	\$ 3,500.00	\$ 24,500.00
Concrete Grade Crossing Panels - E. Elm St.	90	TF	\$ 550.00	\$ 49,500.00
Concrete Grade Crossing Panels - E. Holding Ave	90	TF	\$ 550.00	\$ 49,500.00
Concrete Grade Crossing Panels - Friendship Chapel Road	36	TF	\$ 550.00	\$ 19,800.00
Concrete Grade Crossing Panels - Rogers Road	54	TF	\$ 550.00	\$ 29,700.00
Concrete Grade Crossing Panels - Seawell Dr	24	TF	\$ 550.00	\$ 13,200.00
Concrete Grade Crossing Panels - Ligon Mill Road	108	TF	\$ 550.00	\$ 59,400.00
Concrete Grade Crossing Panels - Durant Road	180	TF	\$ 550.00	\$ 99,000.00
Concrete Grade Crossing Panels - Gresham Lake Rd	90	TF	\$ 550.00	\$ 49,500.00
Concrete Grade Crossing Panels - E Millbrook Road	144	TF	\$ 550.00	\$ 79,200.00
Concrete Grade Crossing Panels - New Hope Church Road	162	TF	\$ 550.00	\$ 89,100.00
Concrete Grade Crossing Panels - Wolfpack Lane	126	TF	\$ 550.00	\$ 69,300.00
Concrete Grade Crossing Panels - E Whitaker Mill Road	189	TF	\$ 550.00	\$ 103,950.00
Concrete Grade Crossing Panels - TransFlo Access Road	72	TF	\$ 550.00	\$ 39,600.00
Concrete Grade Crossing Panels - N Harrington Street	126	TF	\$ 550.00	\$ 69,300.00
Concrete Grade Crossing Panels - N West Street	144	TF	\$ 550.00	\$ 79,200.00
Concrete Grade Crossing Panels - W Jones Street	126	TF	\$ 550.00	\$ 69,300.00
Structures				
Railroad Bridge over Proposed Roadway @ NERC Station (Mains)	4,725	SF	\$ 500.00	\$ 2,362,500.00
Railroad Bridge over Proposed Roadway @ NERC Station (Freight)	2,700	SF	\$ 500.00	\$ 1,350,000.00
Railroad Bridge Over Six Forks Road	3,700	SF	\$ 500.00	\$ 1,850,000.00
Railroad Bridge Over Greenway, Crabtree Creek, Hodges Street	7,000	SF	\$ 500.00	\$ 3,500,000.00
Railroad Bridge Over NS NS-Line, Private Drive, Capital Blvd	58,000	SF	\$ 500.00	\$ 29,000,000.00
Retaining Wall - RR North of NS NS-Line	6,800	SF	\$ 80.00	\$ 544,000.00
Retaining Walls - RR West of CSX Yard	13,700	SF	\$ 80.00	\$ 1,096,000.00
Retaining Walls - RR West of Raleigh Union Station	14,700	SF	\$ 80.00	\$ 1,176,000.00
Retaining Walls - RR East of Raleigh Union Station	5,900	SF	\$ 80.00	\$ 472,000.00
Crashwalls - Wake Forest Rd	60	LF	\$ 2,500.00	\$ 150,000.00
Crashwalls - I-440	330	LF	\$ 2,500.00	\$ 825,000.00
Crashwalls - Hillsborough	174	LF	\$ 2,500.00	\$ 435,000.00
Crashwalls- Morgan St	130	LF	\$ 2,500.00	\$ 325,000.00

Stations (Including Platform and Shelter)				
Downtown Wake Forest Station	1	LS	\$ 1,000,000.00	\$ 1,000,000.00
NC-98 Station (including parking lot, pedestrian tunnel)	1	LS	\$ 6,000,000.00	\$ 6,000,000.00
Capital Blvd Station (including parking lot, pedestrian tunnel)	1	LS	\$ 6,000,000.00	\$ 6,000,000.00
Durant Road Station (including parking lot)	1	LS	\$ 3,000,000.00	\$ 3,000,000.00
Northeast Regional Center Station (including parking lot, tunnel)	1	LS	\$ 6,000,000.00	\$ 6,000,000.00
Six Forks Station	1	LS	\$ 2,000,000.00	\$ 2,000,000.00
Government Center Station	1	LS	\$ 1,000,000.00	\$ 1,000,000.00
Raleigh Union Station (including ped bridge to RUS building)	1	LS	\$ 6,000,000.00	\$ 6,000,000.00
Roadway				
New Roadway at Northeast Regional Center Station	0.12	MI	\$ 3,000,000.00	\$ 360,000.00
Roadway Work at At-Grade Crossings	18	EA	\$ 25,000.00	\$ 450,000.00
Signals				
Relocate Gates and Flashers	6	EA	\$ 100,000.00	\$ 600,000.00
Relocate Gates and Flashers Cantilever	7	EA	\$ 30,000.00	\$ 210,000.00
Furnish and install Signal Power Access & Distribution	1	LS	\$23,400.00	\$23,400.00
Furnish and install Comms Equipment	1	LS	\$50,000.00	\$50,000.00
Furnish and install Traffic Control & Dispatching System	1	LS	\$20,000.00	\$20,000.00
Furnish and install Switch Heaters	54	EA	\$75,000.00	\$4,050,000.00
Furnish and Install Control Point	14	EA	\$554,100.00	\$7,757,400.00
Positive Train Control System	16.6	MI	\$500,000.00	\$8,300,000.00
Utility Construction				
Relocate Transmission Tower	1	LS	\$1,000,000.00	\$ 1,000,000.00
Utility Relocations	1	LS	\$2,000,000.00	\$2,000,000.00
Facilities				
Maintenance Facility	1	LS	\$ 25,000,000.00	\$ 25,000,000.00
Railroad Flagging	1	LS	\$ 4,000,000.00	\$4,000,000.00
Construction Sub-Total				\$ 197,807,550.00
Professional Services (28% of Construction Sub-Total)				\$ 55,386,114.00
Contingency (40% of Construction Sub-Total)				\$ 79,123,020.00
CONSTRUCTION TOTAL				\$ 332,316,684.00

Vehicles				
Locomotives	5	EA	\$ 6,500,000.00	\$ 32,500,000.00
Cab Cars	5	EA	\$ 3,150,000.00	\$ 15,750,000.00
Passenger Cars	10	EA	\$ 2,900,000.00	\$ 29,000,000.00
Right of Way				
Right-of-Way and Property Acquisition	1	LS	\$ 12,600,000.00	\$ 12,600,000.00
Vehicle and Right-of-Way Sub-Total				\$ 89,850,000.00
Contingency (15% of Sub-Total)				\$ 13,477,500.00
VEHICLE AND RIGHT-OF-WAY TOTAL				\$ 103,327,500.00

TOTAL PROJECT COST \$ 435,644,184.00

SAY \$ 435,700,000.00

L. Detailed Probable Cost Estimate - '4-1-4-1' Service Scenario

PROBABLE COST

\$373,400,000

Description	Quantity	Unit	Price	Amount
Grading and Drainage				
Grading and Drainage	16.6	Mile	\$ 500,000.00	\$ 8,300,000.00
Erosion Control	16.6	Mile	\$ 15,000.00	\$ 249,000.00
Sub-Ballast	160,000	TN	\$ 25.00	\$ 4,000,000.00
Track				
Retire/Remove wood tie track	104,000	TF	\$ 20.00	\$ 2,080,000.00
Construct track, wood ties, 136RE new (includes ballast)	35,000	TF	\$ 150.00	\$ 5,250,000.00
Construct track, concrete ties, 136RE new (includes ballast)	138,000	TF	\$ 200.00	\$ 27,600,000.00
Remove Existing No. 8 turnout	10	EA	\$ 4,000.00	\$ 40,000.00
Remove Existing No. 10 turnout	10	EA	\$ 5,000.00	\$ 50,000.00
Furnish and install No. 10 turnout (Concrete Ties)	7	EA	\$ 210,900.00	\$ 1,476,300.00
Furnish and install No. 10 turnout (Timber Ties)	7	EA	\$ 100,000.00	\$ 700,000.00
Furnish and install No. 15 turnout (Concrete Ties)	4	EA	\$ 305,250.00	\$ 1,221,000.00
Furnish and install No. 20 turnout (Concrete Ties)	12	EA	\$ 416,250.00	\$ 4,995,000.00
Furnish and install No. 10 crossover (Concrete Ties)	1	EA	\$ 494,000.00	\$ 494,000.00
Furnish and install No. 15 crossover (Concrete Ties)	2	EA	\$ 715,000.00	\$ 1,430,000.00
Furnish and install No. 20 crossover (Concrete Ties)	7	EA	\$ 975,000.00	\$ 6,825,000.00
Furnish and install field welds	800	EA	\$ 510.00	\$ 408,000.00
Furnish and install insulated joint plug rails	150	EA	\$ 3,500.00	\$ 525,000.00
Furnish and install rail lubricators	3	EA	\$ 18,500.00	\$ 55,500.00
Furnish and install sliding block derail	7	EA	\$ 3,500.00	\$ 24,500.00
Furnish and install railroad diamond	1	EA	\$ 100,000.00	\$ 100,000.00
Concrete Grade Crossing Panels - E. Elm St.	90	TF	\$ 550.00	\$ 49,500.00
Concrete Grade Crossing Panels - E. Holding Ave	90	TF	\$ 550.00	\$ 49,500.00
Concrete Grade Crossing Panels - Friendship Chapel Road	36	TF	\$ 550.00	\$ 19,800.00
Concrete Grade Crossing Panels - Rogers Road	54	TF	\$ 550.00	\$ 29,700.00
Concrete Grade Crossing Panels - Seawell Dr	24	TF	\$ 550.00	\$ 13,200.00
Concrete Grade Crossing Panels - Ligon Mill Road	108	TF	\$ 550.00	\$ 59,400.00
Concrete Grade Crossing Panels - Durant Road	180	TF	\$ 550.00	\$ 99,000.00
Concrete Grade Crossing Panels - Gresham Lake Rd	90	TF	\$ 550.00	\$ 49,500.00
Concrete Grade Crossing Panels - E Millbrook Road	144	TF	\$ 550.00	\$ 79,200.00
Concrete Grade Crossing Panels - New Hope Church Road	162	TF	\$ 550.00	\$ 89,100.00
Concrete Grade Crossing Panels - Wolfpack Lane	126	TF	\$ 550.00	\$ 69,300.00
Concrete Grade Crossing Panels - E Whitaker Mill Road	189	TF	\$ 550.00	\$ 103,950.00
Concrete Grade Crossing Panels - TransFlo Access Road	72	TF	\$ 550.00	\$ 39,600.00
Concrete Grade Crossing Panels - N Harrington Street	126	TF	\$ 550.00	\$ 69,300.00
Concrete Grade Crossing Panels - N West Street	144	TF	\$ 550.00	\$ 79,200.00
Concrete Grade Crossing Panels - W Jones Street	126	TF	\$ 550.00	\$ 69,300.00
Structures				
Railroad Bridge over Proposed Roadway @ NERC Station (Mains)	4,725	SF	\$ 500.00	\$ 2,362,500.00
Railroad Bridge over Proposed Roadway @ NERC Station (Freight)	2,700	SF	\$ 500.00	\$ 1,350,000.00
Railroad Bridge Over Six Forks Road	3,700	SF	\$ 500.00	\$ 1,850,000.00
Railroad Bridge Over Greenway, Crabtree Creek, Hodges Street	7,000	SF	\$ 500.00	\$ 3,500,000.00
Railroad Bridge Over NS NS-Line, Private Drive, Capital Blvd	58,000	SF	\$ 500.00	\$ 29,000,000.00
Retaining Wall - RR North of NS NS-Line	6,800	SF	\$ 80.00	\$ 544,000.00
Retaining Walls - RR West of CSX Yard	13,700	SF	\$ 80.00	\$ 1,096,000.00
Retaining Walls - RR West of Raleigh Union Station	14,700	SF	\$ 80.00	\$ 1,176,000.00
Retaining Walls - RR East of Raleigh Union Station	5,900	SF	\$ 80.00	\$ 472,000.00
Retaining Wall - RR West of Wye	4,700	SF	\$ 80.00	\$ 376,000.00
Crashwalls - Wake Forest Rd	60	LF	\$ 2,500.00	\$ 150,000.00
Crashwalls - I-440	330	LF	\$ 2,500.00	\$ 825,000.00
Crashwalls - Hillsborough	174	LF	\$ 2,500.00	\$ 435,000.00
Crashwalls- Morgan St	130	LF	\$ 2,500.00	\$ 325,000.00

Stations (Including Platform and Shelter)					
Downtown Wake Forest Station	1	LS	\$	1,000,000.00	\$ 1,000,000.00
NC-98 Station (including parking lot, pedestrian tunnel)	1	LS	\$	6,000,000.00	\$ 6,000,000.00
Capital Blvd Station (including parking lot, pedestrian tunnel)	1	LS	\$	6,000,000.00	\$ 6,000,000.00
Durant Road Station (including parking lot)	1	LS	\$	3,000,000.00	\$ 3,000,000.00
Northeast Regional Center Station (including parking lot, tunnel)	1	LS	\$	6,000,000.00	\$ 6,000,000.00
Six Forks Station	1	LS	\$	2,000,000.00	\$ 2,000,000.00
Government Center Station	1	LS	\$	1,000,000.00	\$ 1,000,000.00
Raleigh Union Station (including ped bridge to RUS building)	1	LS	\$	6,000,000.00	\$ 6,000,000.00
Roadway					
New Roadway at Northeast Regional Center Station	0.12	MI	\$	3,000,000.00	\$ 360,000.00
Roadway Work at At-Grade Crossings	18	EA	\$	25,000.00	\$ 450,000.00
Signals					
Relocate Gates and Flashers	6	EA	\$	100,000.00	\$ 600,000.00
Relocate Gates and Flashers Cantilever	7	EA	\$	30,000.00	\$ 210,000.00
Furnish and install Signal Power Access & Distribution	1	LS		\$23,400.00	\$23,400.00
Furnish and install Comms Equipment	1	LS		\$50,000.00	\$50,000.00
Furnish and install Traffic Control & Dispatching System	1	LS		\$20,000.00	\$20,000.00
Furnish and install Switch Heaters	50	EA		\$75,000.00	\$3,750,000.00
Furnish and Install Control Point	15	EA		\$554,100.00	\$8,311,500.00
Positive Train Control System	16.6	MI		\$500,000.00	\$8,300,000.00
Utility Construction					
Relocate Transmission Tower	1	LS		\$1,000,000.00	\$1,000,000.00
Utility Relocations	1	LS		\$2,000,000.00	\$2,000,000.00
Facilities					
Layover Facility	1	LS	\$	1,000,000.00	\$ 1,000,000.00
Railroad Flagging	1	LS	\$	4,000,000.00	\$4,000,000.00
Construction Sub-Total					\$ 171,328,250.00
Professional Services (28% of Construction Sub-Total)					\$ 47,971,910.00
Contingency (40% of Construction Sub-Total)					\$ 68,531,300.00
CONSTRUCTION TOTAL					\$ 287,831,460.00

Vehicles					
Locomotives	4	EA	\$	6,500,000.00	\$ 26,000,000.00
Cab Cars	4	EA	\$	3,150,000.00	\$ 12,600,000.00
Passenger Cars	8	EA	\$	2,900,000.00	\$ 23,200,000.00
Right of Way					
Right-of-Way and Property Acquisition	1	LS	\$	12,600,000.00	\$ 12,600,000.00
Vehicle and Right-of-Way Sub-Total					\$ 74,400,000.00
Contingency (15% of Sub-Total)					\$ 11,160,000.00
VEHICLE AND RIGHT-OF-WAY TOTAL					\$ 85,560,000.00

TOTAL PROJECT COST \$ 373,391,460.00

SAY \$ 373,400,000.00

Appendix M: List of Preparers

Organization	Name	Primary Role
NCDOT Rail Division	Paul Worley, CPM	Executive Leadership
	James Bridges, PE	NCDOT Project Manager
	Jason Orthner, PE	Technical Oversight
	Matthew Simmons, PE	Technical Oversight
GoTriangle	Jeff Mann, PE	Executive Leadership
	Darcy Downs	Technical Oversight
HNTB North Carolina, P.C.	Corey Vernier, PE	Report Preparation

Appendix N:

Formal Railroad Responses



May 23, 2017

VIA EMAIL

Mr. Jason Orthner, PE
Manager of Design and Construction
NCDOT Rail Division
1553 Mail Service Center
Raleigh, NC 27699

Re: Wake Forest to Raleigh Commuter Rail Conceptual Infrastructure Analysis,
Draft Final Summary Report, March 2017

Dear Mr. Orthner,

North Carolina Railroad Company appreciates the opportunity to review and provide comments regarding the *Wake Forest to Raleigh Commuter Rail Infrastructure Analysis* report. The focus of the report is on two proposed commuter rail scenarios operating on CSX's S Line between the Raleigh Union Station and the Town of Wake Forest. As this rail line is off of NCRR's corridor, we have no comments on aspects of the report pertaining solely to the CSX S Line and the Norfolk Southern NS Line north of Raleigh Union Station.

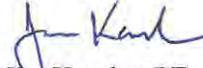
However, one of the proposed operating scenarios contained in the report, the 4-1-4-1 commuter rail service, is proposed to operate between Wake Forest and West Durham. Under this proposed scenario, the commuter trains would operate on the NCRR corridor between Raleigh and West Durham. This scenario assumes that the 8-2-8-2 commuter rail service evaluated in the *2015 NSR/TTA/NCRR Commuter Rail Service Study* would split at Raleigh with half of the trains (4-1-4-1) originating/terminating at Wake Forest on the CSX S Line and half of the trains (4-1-4-1) originating/terminating at Garner on the NCRR H Line.

The report does not go into any detail regarding infrastructure requirements for the NCRR corridor resulting from the proposed 4-1-4-1 scenario. NCRR therefore cannot provide comments regarding the proposed 4-1-4-1 commuter rail scenario other than noting that prior to any further consideration of this scenario detailed coordination with NCRR, Norfolk Southern and CSX is required. No assumptions can be made at this time that the railroads are in agreement with the proposed scenario.

Additionally, we note that the Raleigh Union Station currently under construction was designed and is being constructed by the project sponsors as an intercity passenger rail station. We understand there are no specific provisions for commuter rail as the station is currently designed. Modification and/or expansion of the Raleigh Union Station will be required to accommodate any proposed commuter rail service.

Although our comments at this time are limited due to the limited information provided with regard to the NCRH Line, we are available to discuss our comments if desired. I may be contacted at 919.546-8997 or jimkessler@ncrr.com.

Sincerely,

A handwritten signature in blue ink, appearing to read "Jim Kessler".

Jim Kessler, PE
Vice President – Engineering

Cc: John Edwards, Norfolk Southern



Marco Turra – Director
CSX Transportation
500 Water Street, J315
Jacksonville, FL 32202
Office (904) 359-1099
Marco_Turra@csx.com

May 4, 2017

James Bridges, P.E.
Rail Project Development Engineer
North Carolina Department of Transportation

VIA EMAIL

Re: Wake Forest To Raleigh Commuter Rail Conceptual Infrastructure Analysis

Dear Mr. Bridges:

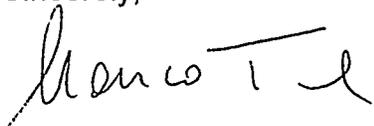
Thank you for the opportunity to review and provide comments to the "Wake Forest to Raleigh Commuter Rail Conceptual Infrastructure Analysis". As presented, the planned service would require about 16.6 miles of CSX's right-of-way and tracks on the "S Line". CSX offers the following items for consideration by the study team:

1. CSX's core business is freight and the project will require CSX's infrastructure and resources to accommodate the proposed commuter service. CSX has no plans to build, operate, maintain and dispatch a new passenger service on our property between Raleigh and Wake Forest. In the recent past, CSX has successfully worked on the implementation of similar projects by selling rail corridors, at fair market value, to a public or state agency. The agency can then plan and build, at no cost to CSX, the necessary infrastructure to operate the passenger service while CSX retains a permanent and exclusive freight easement.
2. The study recognizes that CSX operations may be impacted, especially in the vicinity of Capital Yard in Raleigh. CSX has a significant market presence in the area and we are committed to provide reliable and consistent service to our freight customers. The corridor might also host the Southeast High Speed Rail (SEHSR) intercity passenger service. Additional rail infrastructure, relocation of freight facilities and appropriate freight windows will need to be studied to make sure that freight service is not negatively impacted.

In closing, we are including the CSX Passenger Access Principles that can provide you with additional guidance in the planning of the new service.

Thank you for the opportunity to provide comments to the study and please let us know if you have any questions as you progress this important initiative.

Sincerely,



Marco Turra

Cc: John Dillard, CSXT Resident VP

CSX Passenger Train Access Principles

America's freight railroads are critical to the nation's economy, providing safe, efficient, economical and environmentally beneficial freight service that is so vital to our communities, our businesses and industries and our way of life.

CSX recognizes the important benefits that passenger rail service can provide to the public, including reducing traffic congestion and avoiding expensive highway construction. At the same time, CSX has a responsibility to all of its stakeholders, including rail freight shippers, to preserve and protect the substantial public benefits it delivers through freight rail transportation.

The rail industry has been investing billions of dollars every year in privately-owned freight rail infrastructure. These investments resulted in significant improvements in service for the nation's shippers and considerable benefits to the overall US economy. As a result the industry has entered a "rail renaissance" characterized by new demand from shippers and public policy interest in moving more goods by rail.

Future agreements for passenger access to freight rail lines must therefore balance the nation's desire for additional rail passenger services with railroads' critical role in carrying freight that otherwise would be diverted onto an already crowded and often underfunded highway network.

Based on this expectation, CSX established the following protocols for working with public agencies interested in conducting feasibility studies and implementing passenger rail:

Studies

- CSX will consider reasonable proposals for new or expanded passenger rail service that are viable financially and operationally and do not adversely impact freight operations.
- Studies will be conducted by CSX, or consultants approved by CSX, and will be paid for by the requesting planning agency. A primary goal of the studies will be to preserve freight rail capacity while striving to accommodate any new proposed passenger service.

Feasible separation of freight and passenger operation

- Many freight corridors are already at capacity and require expansions to handle future freight growth. CSX cannot consider proposals for shared use of such corridors, or sell property along such corridors that would compromise CSX's ability to serve current or future customer needs. We will encourage planning agencies to consider a separate right of way for new or expanded services in such corridors.
- One way to achieve such separation is to move the majority of freight trains out of urban corridors. CSX will consider publicly funded relocations of freight operations if they preserve CSX's customer service, competitive position, and access to current and future freight customers.

Where separation or relocation is not feasible but freight operations can be protected, passenger trains may, in some cases, share CSX's tracks, provided certain principles for shared use operations are properly addressed:

Safety

- Adding passenger service must not compromise safety. Planning Agencies must meet and fund any required safety infrastructure.

Capacity

- Any addition or expansion of passenger rail service on the freight rail network must ensure that the capacity utilized for the new service is fully replaced at no cost to CSX. This capacity must allow CSX to safely and efficiently handle all current and future freight demand, not just enough to address current conditions or to cover a few years
- CSX's ability to locate new freight customers along the right of way must also be preserved. Service to freight customers must be protected and should not be compromised or limited by new passenger rail service.
- CSX will not participate in so-called Service Outcome Agreements.

Compensation

- CSX must be fully compensated for its costs in planning and hosting passenger rail service. The compensation should be sufficient to support future reinvestments in infrastructure to continue providing safe, efficient and environmentally-friendly freight service. CSX and its freight rail customers should not be asked to subsidize passenger service.

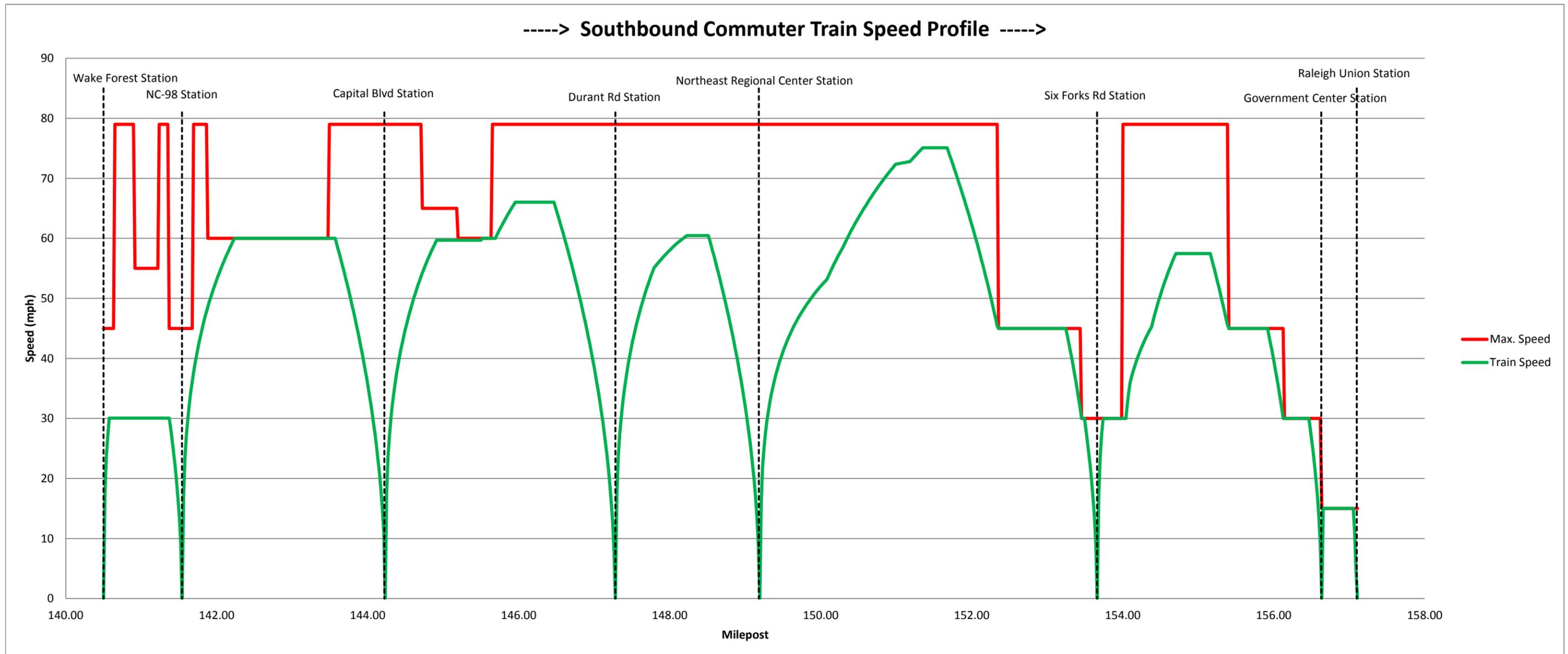
Liability

- CSX must be fully protected from any liability arising from the presence of passenger rail service on its freight lines. Any additional service introduces an element of risk and liability that is not related to CSX's core business as a freight rail carrier, and CSX should not be asked to assume such risk.
- Planning agencies should be prepared to carry and provide evidence of insurance covering liability exposure of at least \$295 million or the current limit of liability under federal law for passenger rail claims.

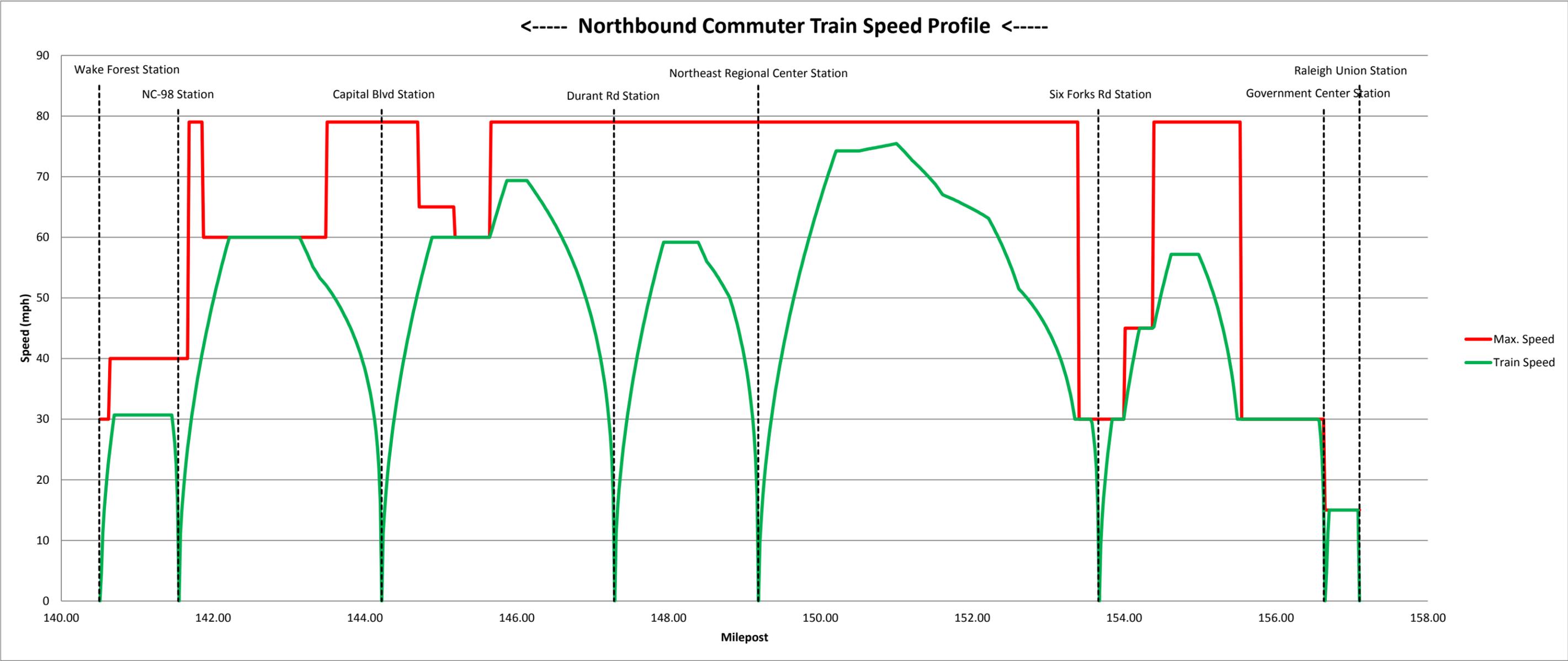
Higher Speed Rail and High Speed Rail

- Higher Speed Rail refers to trains traveling at maximum speeds higher than 79 MPH. CSX requires that any passenger train operating at speeds above 90MPH, including High Speed Rail (defined as trains traveling at speeds higher than 125MPH) be on its own dedicated tracks and right of way, separated by at least 30 ft. from freight rail service . These standards are subject to change as new information and research becomes available consistent with CSX's core value to provide safe rail services to the communities where trains operate.

A. Southbound Commuter Train Speed Profile



B. Northbound Commuter Speed Profile



C. 8-2-8-2 Train Schedules

SOUTHBOUND TRAINS																					
STATION	MORNING								Mid-Day				Afternoon						Evening		
NC-98 Station (Non-Revenue)	5:06 AM	5:36 AM																3:55 PM			
Wake Forest Station (Non-Revenue)	5:09 AM	5:39 AM																3:58 PM			
Wake Forest Station (DP)	5:24 AM	5:54 AM	6:24 AM	6:54 AM	7:24 AM	7:54 AM	8:24 AM	8:54 AM	10:45 AM	12:45 PM	2:43 PM	3:43 PM	4:13 PM	4:43 PM	5:13 PM	5:43 PM	6:13 PM	6:43 PM	7:43 PM	9:13 PM	
NC-98 Station	5:27 AM	5:57 AM	6:27 AM	6:57 AM	7:27 AM	7:57 AM	8:27 AM	8:57 AM	10:48 AM	12:48 PM	2:46 PM	3:46 PM	4:16 PM	4:46 PM	5:16 PM	5:46 PM	6:16 PM	6:46 PM	7:46 PM	9:16 PM	
Capital Blvd Station	5:32 AM	6:02 AM	6:32 AM	7:02 AM	7:32 AM	8:02 AM	8:32 AM	9:02 AM	10:53 AM	12:53 PM	2:51 PM	3:51 PM	4:21 PM	4:51 PM	5:21 PM	5:51 PM	6:21 PM	6:51 PM	7:51 PM	9:21 PM	
Durant Rd Station	5:37 AM	6:07 AM	6:37 AM	7:07 AM	7:37 AM	8:07 AM	8:37 AM	9:07 AM	10:58 AM	12:58 PM	2:56 PM	3:56 PM	4:26 PM	4:56 PM	5:26 PM	5:56 PM	6:26 PM	6:56 PM	7:56 PM	9:26 PM	
Northeast Regional Center (NERC)	5:41 AM	6:11 AM	6:41 AM	7:11 AM	7:41 AM	8:11 AM	8:41 AM	9:11 AM	11:02 AM	1:02 PM	3:00 PM	4:00 PM	4:30 PM	5:00 PM	5:30 PM	6:00 PM	6:30 PM	7:00 PM	8:00 PM	9:30 PM	
Six Forks Rd Station	5:48 AM	6:18 AM	6:48 AM	7:18 AM	7:48 AM	8:18 AM	8:48 AM	9:18 AM	11:09 AM	1:13 PM	3:11 PM	4:11 PM	4:41 PM	5:11 PM	5:41 PM	6:11 PM	6:41 PM	7:11 PM	8:11 PM	9:41 PM	
Government Center Station	5:55 AM	6:25 AM	6:55 AM	7:25 AM	7:55 AM	8:25 AM	8:55 AM	9:25 AM	11:16 AM	1:24 PM	3:22 PM	4:22 PM	4:52 PM	5:22 PM	5:52 PM	6:22 PM	6:52 PM	7:22 PM	8:22 PM	9:52 PM	
Raleigh Union Station (AR)	5:58 AM	6:28 AM	6:58 AM	7:28 AM	7:58 AM	8:28 AM	8:58 AM	9:28 AM	11:19 AM	1:27 PM	3:25 PM	4:25 PM	4:55 PM	5:25 PM	5:55 PM	6:25 PM	6:55 PM	7:25 PM	8:25 PM	9:55 PM	
Raleigh Union Station (Non-Revenue)									9:13 AM										7:10 PM	10:10 PM	
NCDOT Yard (Non-Revenue)									9:18 AM										7:15 PM	10:15 PM	

NORTHBOUND TRAINS																					
STATION	MORNING								Mid-Day				Afternoon						Evening		
NCDOT Yard (Non-Revenue)	4:57 AM	5:27 AM																	3:55 PM		
Raleigh Union Station (Non-Revenue)	5:02 AM	5:32 AM																	4:00 PM		
Raleigh Union Station (AR)	5:17 AM	5:47 AM	6:17 AM	6:47 AM	7:17 AM	7:47 AM	8:17 AM	8:47 AM	10:45 AM	12:45 PM	2:45 PM	3:45 PM	4:15 PM	4:45 PM	5:15 PM	5:45 PM	6:15 PM	6:45 PM	7:45 PM	9:15 PM	
Government Center Station	5:20 AM	5:50 AM	6:20 AM	6:50 AM	7:20 AM	7:50 AM	8:20 AM	8:50 AM	10:48 AM	12:48 PM	2:48 PM	3:48 PM	4:18 PM	4:48 PM	5:18 PM	5:48 PM	6:18 PM	6:48 PM	7:48 PM	9:18 PM	
Six Forks Rd Station	5:26 AM	5:56 AM	6:26 AM	6:56 AM	7:26 AM	7:56 AM	8:26 AM	8:56 AM	10:54 AM	12:54 PM	2:54 PM	3:54 PM	4:24 PM	4:54 PM	5:24 PM	5:54 PM	6:24 PM	6:54 PM	7:54 PM	9:24 PM	
Northeast Regional Center (NERC)	5:38 AM	6:08 AM	6:38 AM	7:08 AM	7:38 AM	8:08 AM	8:38 AM	9:08 AM	11:06 AM	1:01 PM	3:01 PM	4:01 PM	4:31 PM	5:01 PM	5:31 PM	6:01 PM	6:31 PM	7:01 PM	8:01 PM	9:31 PM	
Durant Rd Station	5:42 AM	6:12 AM	6:42 AM	7:12 AM	7:42 AM	8:12 AM	8:42 AM	9:12 AM	11:10 AM	1:05 PM	3:05 PM	4:05 PM	4:35 PM	5:05 PM	5:35 PM	6:05 PM	6:35 PM	7:05 PM	8:05 PM	9:35 PM	
Capital Blvd Station	5:47 AM	6:17 AM	6:47 AM	7:17 AM	7:47 AM	8:17 AM	8:47 AM	9:17 AM	11:15 AM	1:10 PM	3:10 PM	4:10 PM	4:40 PM	5:10 PM	5:40 PM	6:10 PM	6:40 PM	7:10 PM	8:10 PM	9:40 PM	
NC-98 Station (DP)	5:57 AM	6:27 AM	6:57 AM	7:27 AM	7:57 AM	8:27 AM	8:57 AM	9:27 AM	11:25 AM	1:17 PM	3:17 PM	4:17 PM	4:47 PM	5:17 PM	5:47 PM	6:17 PM	6:47 PM	7:17 PM	8:17 PM	9:47 PM	
Wake Forest Station (AR)	6:00 AM	6:30 AM	7:00 AM	7:30 AM	8:00 AM	8:30 AM	9:00 AM	9:30 AM	11:28 AM	1:20 PM	3:20 PM	4:20 PM	4:50 PM	5:20 PM	5:50 PM	6:20 PM	6:50 PM	7:20 PM	8:20 PM	9:50 PM	
Wake Forest Station (Non-Revenue)									9:15 AM										7:05 PM	10:05 PM	
NC-98 Station (Non-Revenue)									9:18 AM										7:08 PM	10:08 PM	

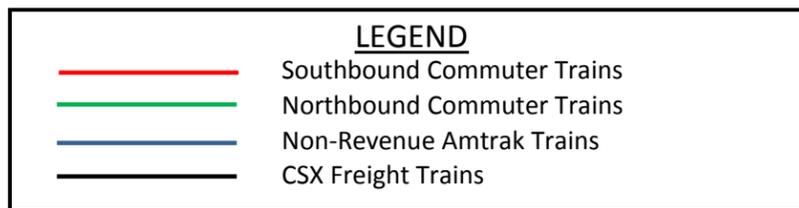
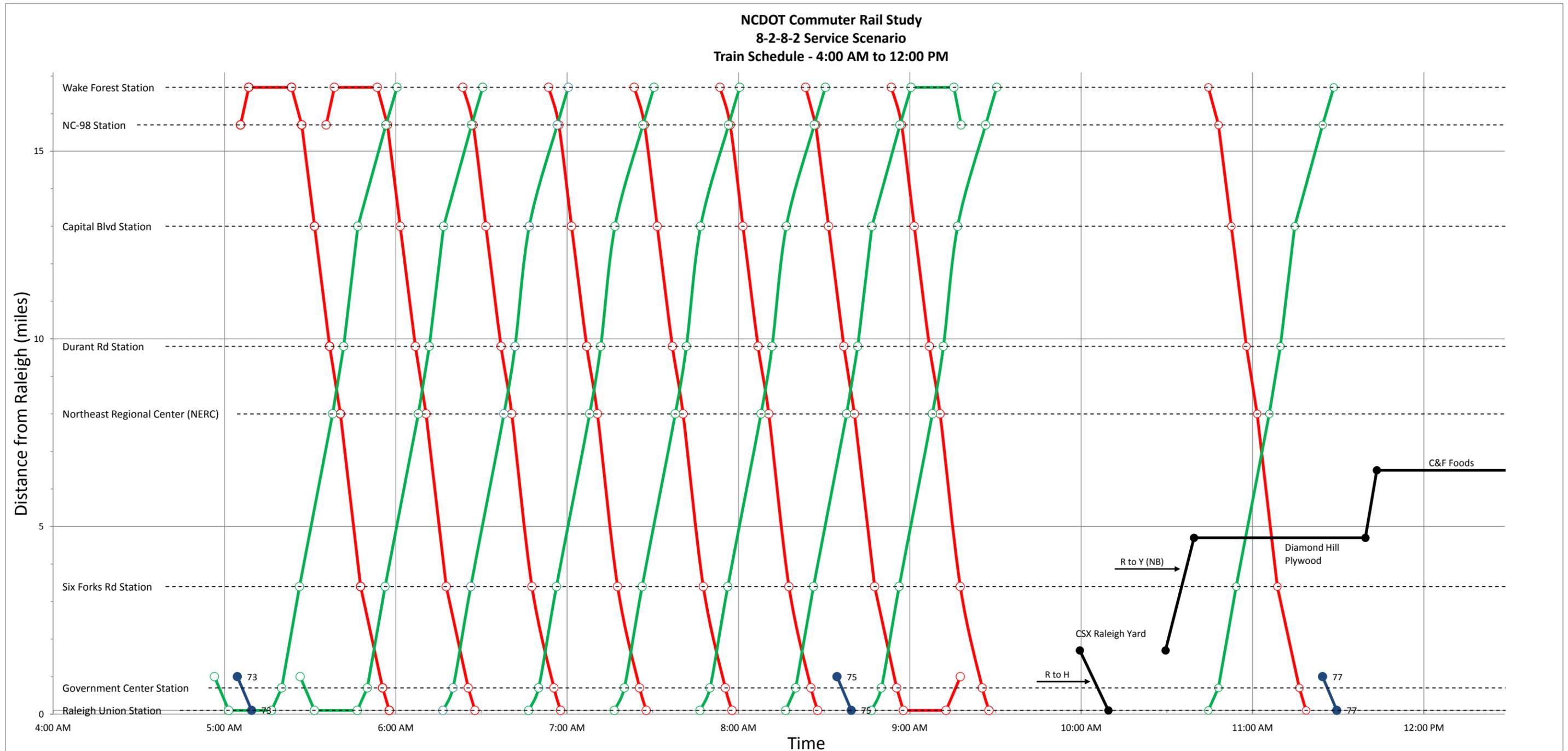
PIEDMONT NON-REVENUE MOVES																				
STATION	73	75	77	781	74	76	782	78												
NCDOT Yard	5:05 AM	8:35 AM	11:25 AM	7:00 PM	1:06 PM	6:01 PM	8:41 PM	11:11 PM												(Note 1,5,6)
Boylan Wye	5:10 AM	8:40 AM	11:30 AM	7:05 PM	1:01 PM	5:56 PM	8:36 PM	11:06 PM												(Note 2)
Raleigh Union Station	6:00 AM	9:15 AM	12:00 PM	7:35 PM	12:46 PM	5:41 PM	8:21 PM	10:51 PM												(Note 3)

CSXT FREIGHT TRAINS																				
STATION	R to Y (NB)	R to Y (SB)	R to H	H to R																
Raleigh Union Station			10:10 AM	3:50 PM																(Note 7, 8, 9)
CSX Raleigh Yard	10:30 AM	8:05 PM	10:00 AM	4:00 PM																(Note 4)
Arrive Diamond Hill Plywood	10:40 AM	7:55 PM																		
Depart Diamond Hill Plywood	11:40 AM	7:55 PM																		
Arrive C&F Foods	11:44 AM	7:51 PM																		
Depart C&F Foods	12:44 PM	7:51 PM																		
Arrive 84 Lumber	12:47 PM	7:48 PM																		
Depart 84 Lumber	1:47 PM	7:48 PM																		
Arrive Mallinckrodt	1:55 PM	7:40 PM																		
Depart Mallinckrodt	4:26 PM	7:40 PM																		
Downtown Wake Forest	4:38 PM	7:28 PM																		

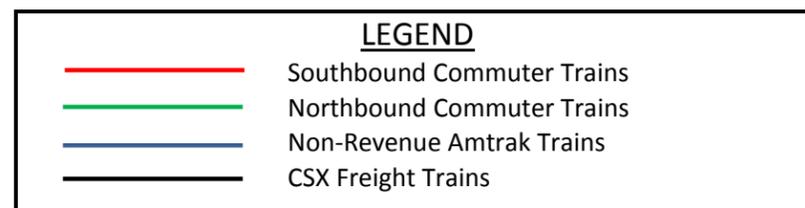
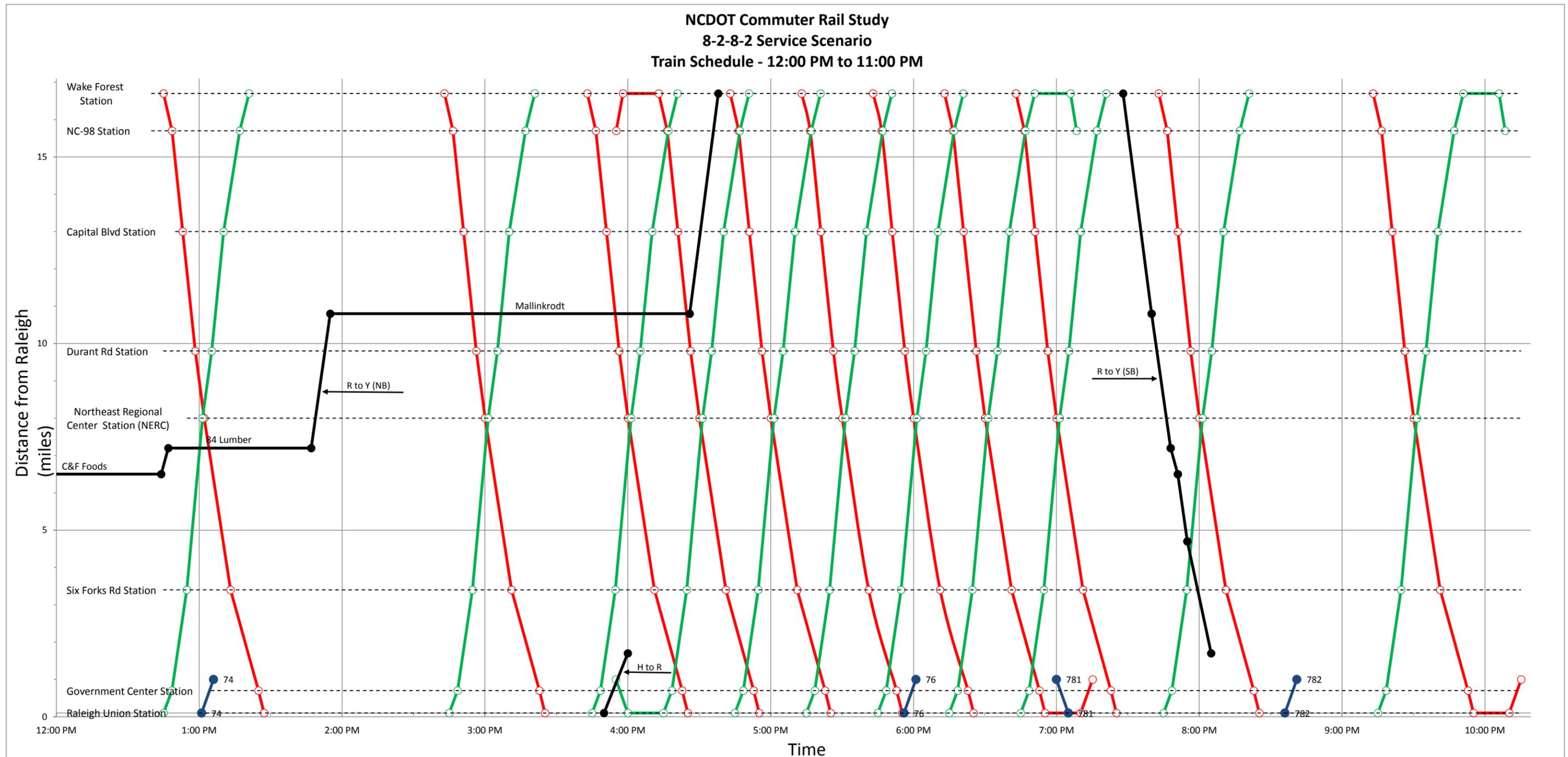
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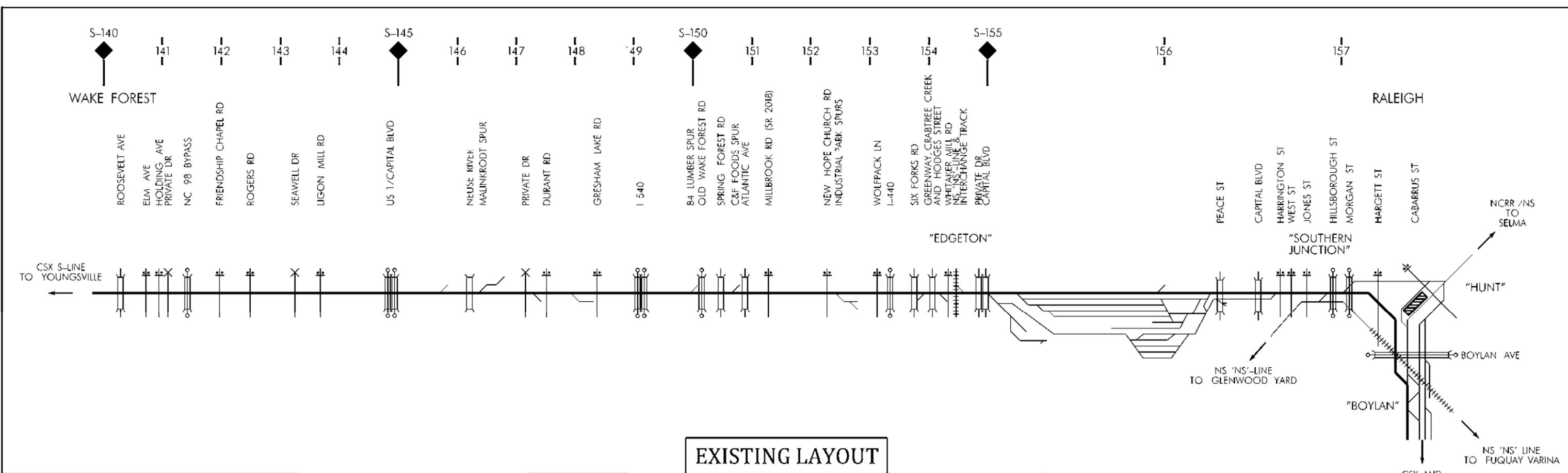
1. Trains 77,781 assume departure from NCDOT Yard 35 minutes ahead of scheduled departure from Raleigh Union Station - based on field observations.
2. 74,76,78,782 assume arrive at NCDOT Yard 20 minutes after scheduled arrival at RUS - based on field observations.
3. Piedmont train arrival and departure times from Raleigh Union Station are derived from the NCDOT proposed 5th Frequency Operating Plan dated 2012-01-10.
4. Existing CSXT freight train schedules are based on field observations. R to Y (NB) typically leaves CSX Raleigh Yard at ~10:30 AM. R to Y (SB) returns to CSXT Raleigh Yard within +/- 1 hour from the listed schedule. H to R operates at night outside of the range of this schedule.
5. Train 73 departure from NCDOT Yard moved 20 minutes earlier to avoid commuter train conflicts.
6. Train 75 departure from NCDOT yard moved 5 minutes earlier to avoid commuter train conflicts.
7. R to Y represents Raleigh to Youngsville Local
8. R to H represents Raleigh to Hamlet Local

D. 8-2-8-2 AM String Chart



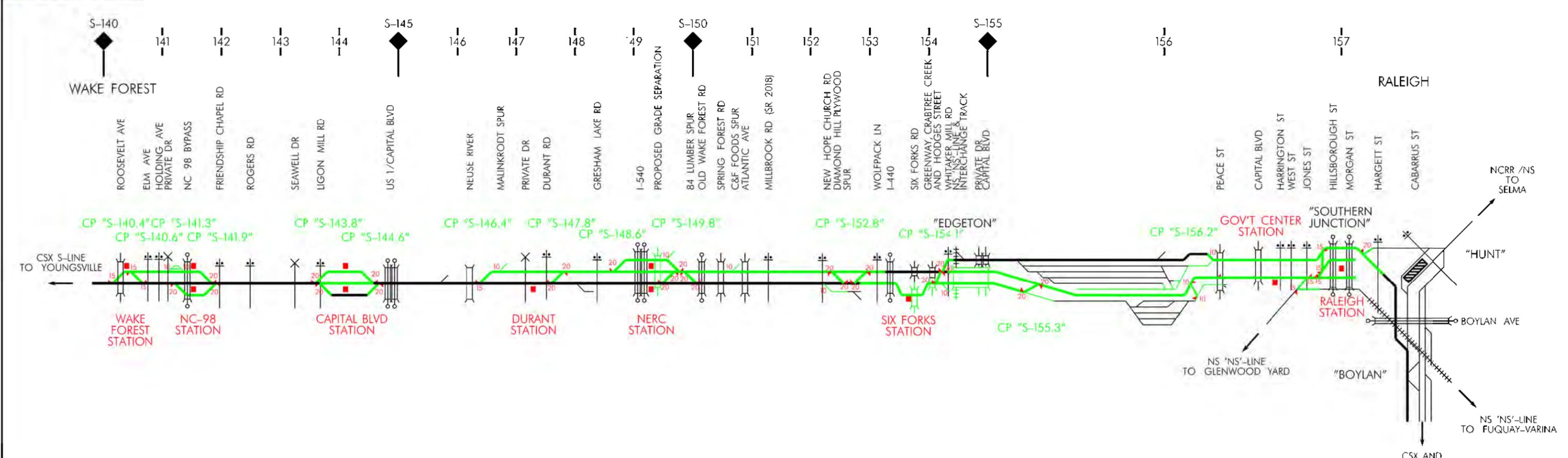
E. 8-2-8-2 PM String Chart





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 343 E. Six Forks Road, Suite 200
 Raleigh, North Carolina 27609
 NC License No: C-1554

F. 8-2-8-2 Infrastructure Improvements Schematic



G. 4-1-4-1 Train Schedules

SOUTHBOUND TRAINS										
STATION	Morning				Mid-Day	Afternoon				Evening
NC-98 Station (Non-Revenue)	4:42 AM	5:57 AM					3:37 PM			
Wake Forest Station (Non-Revenue)	4:45 AM	6:00 AM					3:40 PM			
Wake Forest Station (DP)	5:00 AM	6:15 AM	7:15 AM	8:15 AM	11:05 AM	2:50 PM	3:55 PM	5:05 PM	6:05 PM	7:37 PM
NC-98 Station	5:03 AM	6:18 AM	7:18 AM	8:18 AM	11:08 AM	2:56 PM	3:58 PM	5:11 PM	6:11 PM	7:43 PM
Capital Blvd Station	5:08 AM	6:23 AM	7:23 AM	8:23 AM	11:13 AM	3:01 PM	4:03 PM	5:16 PM	6:16 PM	7:51 PM
Durant Rd Station	5:13 AM	6:28 AM	7:28 AM	8:28 AM	11:18 AM	3:06 PM	4:08 PM	5:21 PM	6:21 PM	7:56 PM
Northeast Regional Center (NERC)	5:17 AM	6:32 AM	7:32 AM	8:32 AM	11:22 AM	3:10 PM	4:12 PM	5:25 PM	6:25 PM	8:00 PM
Six Forks Rd Station	5:24 AM	6:39 AM	7:39 AM	8:39 AM	11:29 AM	3:17 PM	4:19 PM	5:32 PM	6:32 PM	8:07 PM
Government Center Station	5:29 AM	6:44 AM	7:44 AM	8:44 AM	11:34 AM	3:22 PM	4:24 PM	5:37 PM	6:37 PM	8:12 PM
Raleigh Union Station	5:34 AM	6:49 AM	7:49 AM	8:49 AM	11:39 AM	3:24 PM	4:28 PM	5:39 PM	6:39 PM	8:14 PM
Cary Station	5:45 AM	7:00 AM	8:00 AM	9:00 AM	11:50 AM	3:35 PM	4:39 PM	5:50 PM	6:50 PM	8:25 PM
Durham Station	6:09 AM	7:24 AM	8:24 AM	9:24 AM	12:14 PM	3:59 PM	5:03 PM	6:14 PM	7:14 PM	8:49 PM
West Durham	6:13 AM	7:28 AM	8:28 AM	9:28 AM	12:18 PM	4:03 PM	5:07 PM	6:18 PM	7:18 PM	8:53 PM

(Note 5)

NORTHBOUND TRAINS										
STATION	Morning				Mid-Day	Afternoon				Evening
West Durham	5:20 AM	6:35 AM	7:35 AM	8:35 AM	11:15 AM	3:00 PM	4:15 PM	5:30 PM	6:30 PM	8:00 PM
Durham Station	5:24 AM	6:39 AM	7:39 AM	8:39 AM	11:19 AM	3:04 PM	4:19 PM	5:34 PM	6:34 PM	8:04 PM
Cary Station	5:47 AM	7:02 AM	8:02 AM	9:02 AM	11:42 AM	3:27 PM	4:42 PM	5:57 PM	6:57 PM	8:27 PM
Raleigh Union Station	5:58 AM	7:13 AM	8:13 AM	9:13 AM	11:53 AM	3:38 PM	4:53 PM	6:08 PM	7:08 PM	8:38 PM
Government Center Station	6:01 AM	7:16 AM	8:16 AM	9:16 AM	11:56 AM	3:41 PM	4:56 PM	6:11 PM	7:11 PM	8:41 PM
Six Forks Rd Station	6:08 AM	7:23 AM	8:23 AM	9:23 AM	12:03 PM	3:47 PM	5:02 PM	6:17 PM	7:17 PM	8:47 PM
Northeast Regional Center (NERC)	6:14 AM	7:29 AM	8:29 AM	9:29 AM	12:09 PM	3:53 PM	5:08 PM	6:23 PM	7:23 PM	8:53 PM
Durant Rd Station	6:18 AM	7:33 AM	8:33 AM	9:33 AM	12:13 PM	3:57 PM	5:12 PM	6:27 PM	7:27 PM	8:57 PM
Capital Blvd Station	6:23 AM	7:38 AM	8:38 AM	9:38 AM	12:18 PM	4:02 PM	5:17 PM	6:32 PM	7:32 PM	9:02 PM
NC-98 Station	6:28 AM	7:43 AM	8:43 AM	9:43 AM	12:23 PM	4:08 PM	5:23 PM	6:38 PM	7:43 PM	9:08 PM
Wake Forest Station	6:33 AM	7:48 AM	8:48 AM	9:48 AM	12:28 PM	4:13 PM	5:28 PM	6:43 PM	7:48 PM	9:13 PM
Wake Forest Station (Non-Revenue)			9:03 AM						8:03 PM	9:28 PM
NC-98 Station (Non-Revenue)			9:05 AM						8:05 PM	9:30 PM

(Note 5)

EASTBOUND GARNER TRAINS										
STATION	Morning				Mid-Day	Afternoon				Evening
West Durham	6:05 AM	7:05 AM	8:00 AM	9:20 AM	1:00 PM	3:45 PM	5:00 PM	6:00 PM	7:15 PM	9:30 PM
Durham Station	6:09 AM	7:09 AM	8:04 AM	9:24 AM	1:04 PM	3:49 PM	5:04 PM	6:04 PM	7:19 PM	9:34 PM
Cary Station	6:32 AM	7:32 AM	8:27 AM	9:47 AM	1:27 PM	4:12 PM	5:27 PM	6:27 PM	7:42 PM	9:57 PM
Raleigh Union Station	6:43 AM	7:43 AM	8:38 AM	9:58 AM	1:38 PM	4:23 PM	5:38 PM	6:38 PM	7:53 PM	10:08 PM
Greenfield Parkway (Garner)	6:58 AM	7:58 AM	8:53 AM	10:13 AM	1:53 PM	4:38 PM	5:53 PM	6:53 PM	8:08 PM	10:23 PM

(Note 5)

WESTBOUND GARNER TRAINS										
STATION	Morning				Mid-Day	Afternoon				Evening
Greenfield Parkway (Garner)	5:55 AM	7:05 AM	8:05 AM	9:25 AM	1:00 PM	3:45 PM	4:55 PM	5:55 PM	7:10 PM	9:30 PM
Raleigh Union Station	6:09 AM	7:19 AM	8:19 AM	9:39 AM	1:14 PM	3:59 PM	5:09 PM	6:09 PM	7:24 PM	9:44 PM
Cary Station	6:20 AM	7:30 AM	8:30 AM	9:50 AM	1:25 PM	4:10 PM	5:20 PM	6:20 PM	7:35 PM	9:55 PM
Durham Station	6:44 AM	7:54 AM	8:54 AM	10:14 AM	1:49 PM	4:34 PM	5:44 PM	6:44 PM	7:59 PM	10:19 PM
West Durham	6:48 AM	7:58 AM	8:58 AM	10:18 AM	1:53 PM	4:38 PM	5:48 PM	6:48 PM	8:03 PM	10:23 PM

(Note 5)

EASTBOUND PIEDMONTS / CAROLINIAN/SILVER STAR										
STATION	92	80	74	76	782	78				
Durham Station		9:37 AM	12:03 PM	5:03 PM	7:38 PM	10:13 PM				
Cary Station	8:15 AM	10:02 AM	12:28 PM	5:23 PM	8:03 PM	10:33 PM				
Raleigh Union Station (AR)	8:54 AM	10:17 AM	12:46 PM	5:41 PM	8:21 PM	10:51 PM				
Raleigh Union Station (Non-Revenue)			12:56 PM	5:51 PM	8:46 PM	11:01 PM				(Note 1)
NCDOT Yard (Non-Revenue)			1:06 PM	6:01 PM	8:56 PM	11:11 PM				(Note 2,6)

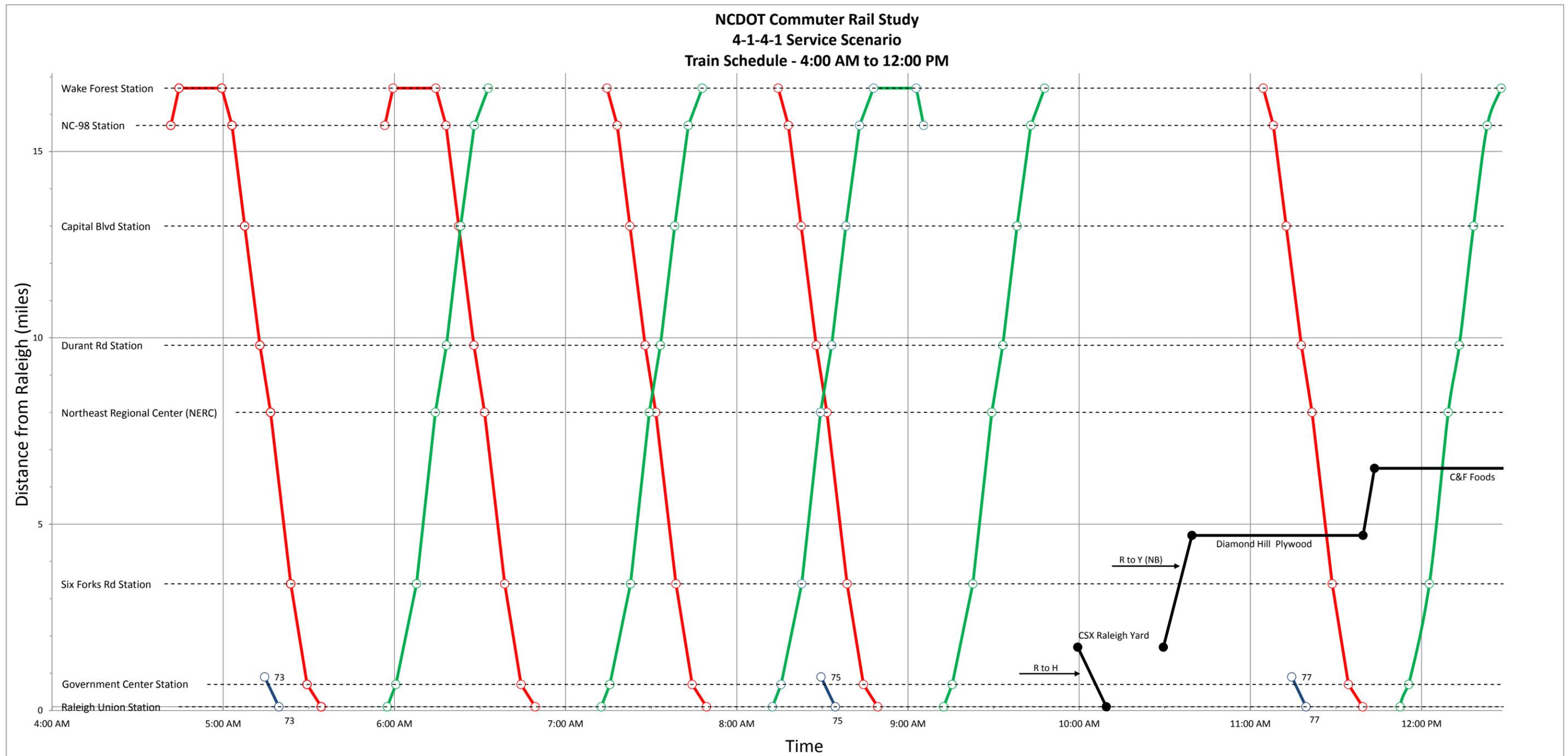
WESTBOUND PIEDMONTS / CAROLINIANS/SILVER STAR										
STATION	73	75	77	79	781	91				
NCDOT Yard (Non-Revenue)	5:15 AM	8:30 AM	11:15 AM		6:50 PM					(Note 4)
Raleigh Union Station (Non-Revenue)	5:20 AM	8:35 AM	11:20 AM		6:55 PM					
Raleigh Union Station (DP)	6:00 AM	9:15 AM	12:00 PM	4:50 PM	7:35 PM	9:13 PM				
Cary Station	6:12 AM	9:27 AM	12:12 PM	5:03 PM	7:47 PM	9:27 PM				
Durham Station	6:32 AM	9:47 AM	12:32 PM	5:29 PM	8:07 PM					

CSXT FREIGHT TRAINS										
STATION	R to Y (NB)	R to Y (SB)	R to H	H to R						
Cary Station			10:27 AM	3:33 PM						(Note 7, 8, 9)
Raleigh Union Station			10:10 AM	3:50 PM						
CSX Raleigh Yard	10:30 AM	9:00 PM	10:00 AM	4:00 PM						(Note 3)
Arrive Diamond Hill Plywood	10:40 AM	8:50 PM								
Depart Diamond Hill Plywood	11:40 AM	8:50 PM								
Arrive C&F Foods	11:44 AM	8:46 PM								
Depart C&F Foods	12:44 PM	8:46 PM								
Arrive 84 Lumber	12:47 PM	8:43 PM								
Depart 84 Lumber	1:47 PM	8:43 PM								
Arrive Mallinckrodt	1:55 PM	8:35 PM								
Depart Mallinckrodt	4:15 PM	8:35 PM								
Downtown Wake Forest	4:27 PM	8:23 PM								

Notes:

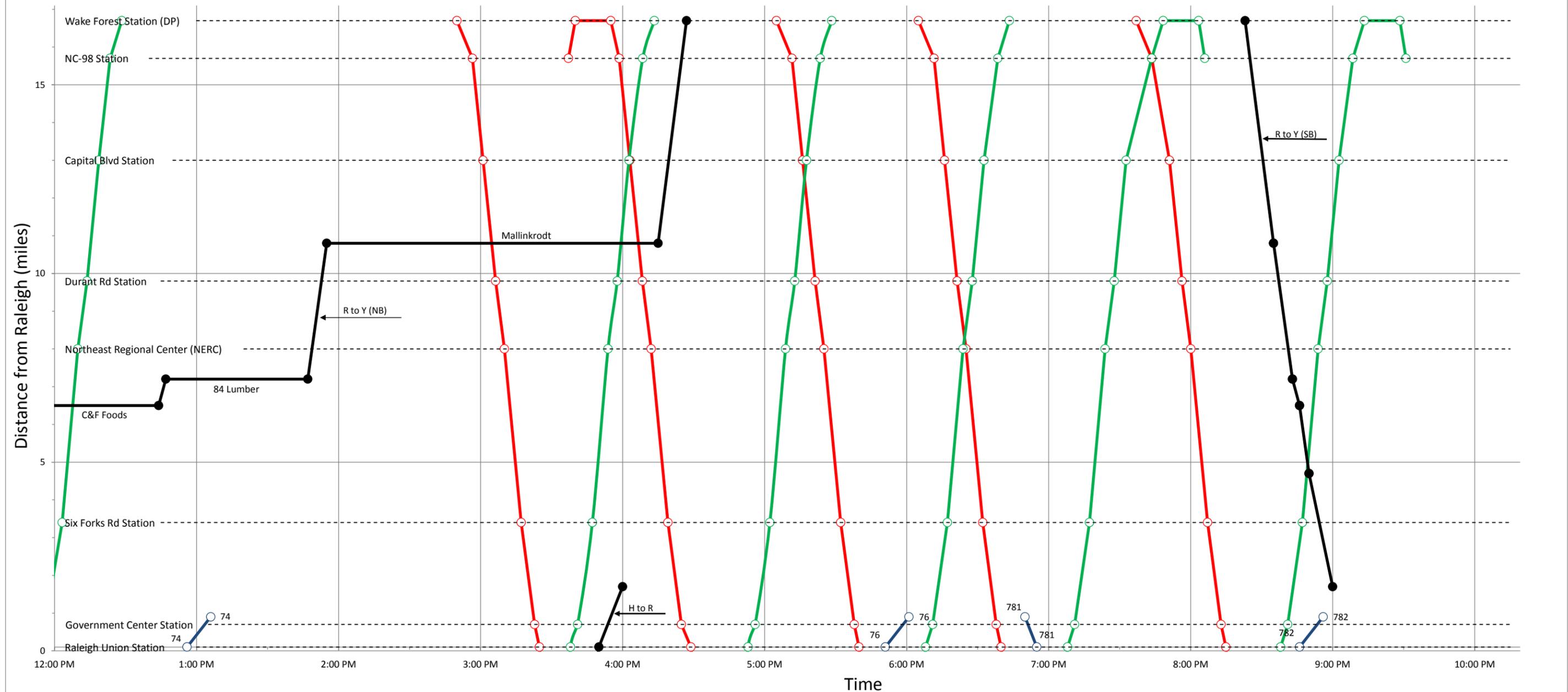
1. Trains 73,75,77,781 assume leave from NCDOT Yard 45 minutes ahead of scheduled departure from RUS
2. Trains 74,76,78 assume arrive at NCDOT Yard 20 minutes after scheduled arrival at RUS
3. Existing CSXT freight train schedules are based on field observations. R to Y (NB) typically leaves CSX Raleigh Yard at ~10:30 AM. R to Y (SB) returns to CSXT Raleigh Yard within +/- 1 hour from the listed schedule. H to R operates at night outside of the range of this schedule.
4. Piedmont/Carolinian/Silver Star train schedules between Raleigh Union Station and Durham Station are derived from the NCDOT proposed 5th Frequency Operating Plan dated 2012-01-10.
5. Commuter train schedules between Raleigh Union Station and West Durham Station are sourced from the GoTriangle West-Durham to Greenfield Commuter Rail Study dated August 2015.
6. Train 782 arrival into NCDOT Yard pushed 15 minutes later to avoid schedule conflict with commuter train.
7. R to Y represents Raleigh to Youngsville Local
8. R to H represents Raleigh to Hamlet Local
9. H to R represents Hamlet to Raleigh Local

H. 4-1-4-1 AM String Chart



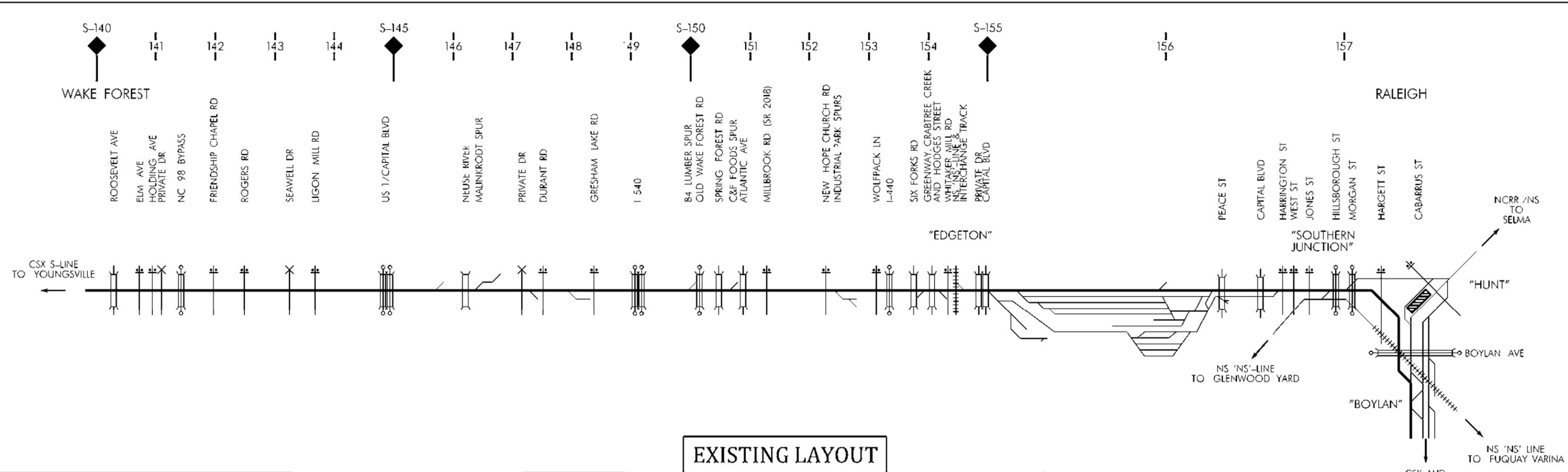
I. 4-1-4-1 PM String Chart

NCDOT Commuter Rail Study
 4-1-4-1 Service Scenario
 Train Schedule - 12:00 PM to 10:00 PM



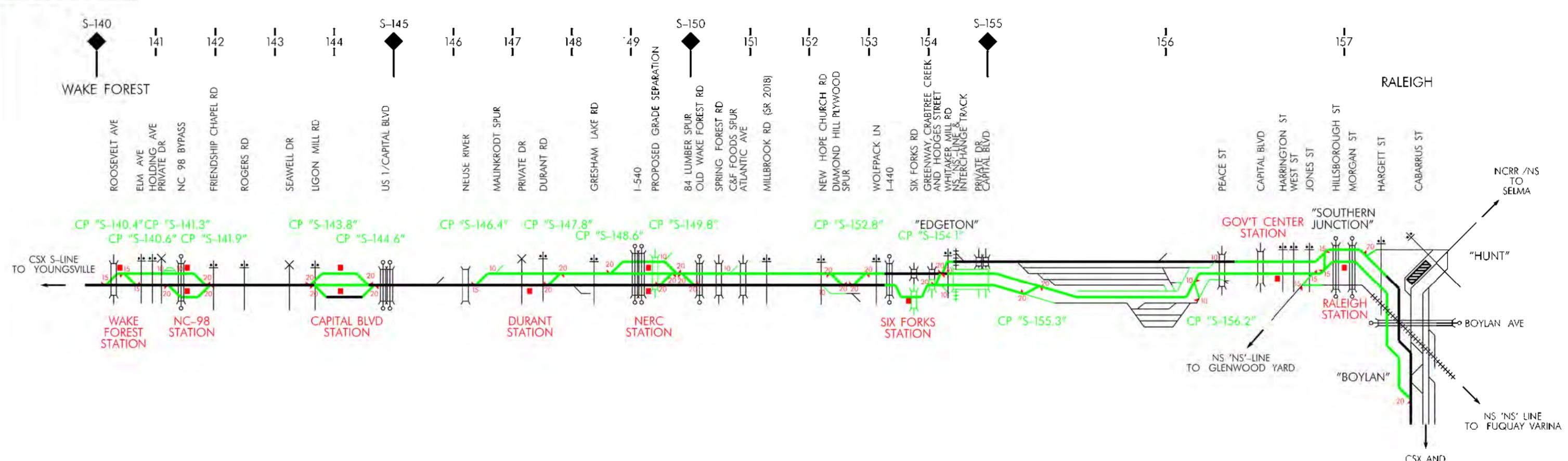
LEGEND

- Southbound Commuter Trains
- Northbound Commuter Trains
- Non-Revenue Amtrak Trains
- CSX Freight Trains



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 Raleigh, North Carolina 27609
 NC License No: C-1554

J. 4-1-4-1 Infrastructure Improvements Schematic



K. Detailed Probable Cost Estimate - '8-2-8-2' Service Scenario

PROBABLE COST
\$435,700,000

Description	Quantity	Unit	Price	Amount
Grading and Drainage				
Grading and Drainage	16.6	Mile	\$ 500,000.00	\$ 8,300,000.00
Erosion Control	16.6	Mile	\$ 15,000.00	\$ 249,000.00
Sub-Ballast	160,000	TN	\$ 25.00	\$ 4,000,000.00
Track				
Retire/Remove wood tie track	104,000	TF	\$ 20.00	\$ 2,080,000.00
Construct track, wood ties, 136RE new (includes ballast)	33,000	TF	\$ 150.00	\$ 4,950,000.00
Construct track, concrete ties, 136RE new (includes ballast)	147,000	TF	\$ 200.00	\$ 29,400,000.00
Remove Existing No. 8 Turnout	15	EA	\$ 4,000.00	\$ 60,000.00
Remove Existing No. 10 turnout	8	EA	\$ 5,000.00	\$ 40,000.00
Furnish and install No. 8 turnout (Timber Ties)	5	EA	\$ 100,000.00	\$ 500,000.00
Furnish and install No. 10 turnout (Concrete Ties)	11	EA	\$ 210,900.00	\$ 2,319,900.00
Furnish and install No. 10 turnout (Timber Ties)	5	EA	\$ 100,000.00	\$ 500,000.00
Furnish and install No. 15 turnout (Concrete Ties)	6	EA	\$ 305,250.00	\$ 1,831,500.00
Furnish and install No. 20 turnout (Concrete Ties)	12	EA	\$ 416,250.00	\$ 4,995,000.00
Furnish and install No. 10 crossover (Concrete Ties)	1	EA	\$ 494,000.00	\$ 494,000.00
Furnish and install No. 15 crossover (Concrete Ties)	2	EA	\$ 715,000.00	\$ 1,430,000.00
Furnish and Install No. 20 crossover (Concrete Ties)	7	EA	\$ 975,000.00	\$ 6,825,000.00
Furnish and install field welds	830	EA	\$ 510.00	\$ 423,300.00
Furnish and install insulated joint plug rails	130	EA	\$ 3,500.00	\$ 455,000.00
Furnish and install rail lubricators	3	EA	\$ 18,500.00	\$ 55,500.00
Furnish and install sliding block derail	7	EA	\$ 3,500.00	\$ 24,500.00
Concrete Grade Crossing Panels - E. Elm St.	90	TF	\$ 550.00	\$ 49,500.00
Concrete Grade Crossing Panels - E. Holding Ave	90	TF	\$ 550.00	\$ 49,500.00
Concrete Grade Crossing Panels - Friendship Chapel Road	36	TF	\$ 550.00	\$ 19,800.00
Concrete Grade Crossing Panels - Rogers Road	54	TF	\$ 550.00	\$ 29,700.00
Concrete Grade Crossing Panels - Seawell Dr	24	TF	\$ 550.00	\$ 13,200.00
Concrete Grade Crossing Panels - Ligon Mill Road	108	TF	\$ 550.00	\$ 59,400.00
Concrete Grade Crossing Panels - Durant Road	180	TF	\$ 550.00	\$ 99,000.00
Concrete Grade Crossing Panels - Gresham Lake Rd	90	TF	\$ 550.00	\$ 49,500.00
Concrete Grade Crossing Panels - E Millbrook Road	144	TF	\$ 550.00	\$ 79,200.00
Concrete Grade Crossing Panels - New Hope Church Road	162	TF	\$ 550.00	\$ 89,100.00
Concrete Grade Crossing Panels - Wolfpack Lane	126	TF	\$ 550.00	\$ 69,300.00
Concrete Grade Crossing Panels - E Whitaker Mill Road	189	TF	\$ 550.00	\$ 103,950.00
Concrete Grade Crossing Panels - TransFlo Access Road	72	TF	\$ 550.00	\$ 39,600.00
Concrete Grade Crossing Panels - N Harrington Street	126	TF	\$ 550.00	\$ 69,300.00
Concrete Grade Crossing Panels - N West Street	144	TF	\$ 550.00	\$ 79,200.00
Concrete Grade Crossing Panels - W Jones Street	126	TF	\$ 550.00	\$ 69,300.00
Structures				
Railroad Bridge over Proposed Roadway @ NERC Station (Mains)	4,725	SF	\$ 500.00	\$ 2,362,500.00
Railroad Bridge over Proposed Roadway @ NERC Station (Freight)	2,700	SF	\$ 500.00	\$ 1,350,000.00
Railroad Bridge Over Six Forks Road	3,700	SF	\$ 500.00	\$ 1,850,000.00
Railroad Bridge Over Greenway, Crabtree Creek, Hodges Street	7,000	SF	\$ 500.00	\$ 3,500,000.00
Railroad Bridge Over NS NS-Line, Private Drive, Capital Blvd	58,000	SF	\$ 500.00	\$ 29,000,000.00
Retaining Wall - RR North of NS NS-Line	6,800	SF	\$ 80.00	\$ 544,000.00
Retaining Walls - RR West of CSX Yard	13,700	SF	\$ 80.00	\$ 1,096,000.00
Retaining Walls - RR West of Raleigh Union Station	14,700	SF	\$ 80.00	\$ 1,176,000.00
Retaining Walls - RR East of Raleigh Union Station	5,900	SF	\$ 80.00	\$ 472,000.00
Crashwalls - Wake Forest Rd	60	LF	\$ 2,500.00	\$ 150,000.00
Crashwalls - I-440	330	LF	\$ 2,500.00	\$ 825,000.00
Crashwalls - Hillsborough	174	LF	\$ 2,500.00	\$ 435,000.00
Crashwalls- Morgan St	130	LF	\$ 2,500.00	\$ 325,000.00

Stations (Including Platform and Shelter)				
Downtown Wake Forest Station	1	LS	\$ 1,000,000.00	\$ 1,000,000.00
NC-98 Station (including parking lot, pedestrian tunnel)	1	LS	\$ 6,000,000.00	\$ 6,000,000.00
Capital Blvd Station (including parking lot, pedestrian tunnel)	1	LS	\$ 6,000,000.00	\$ 6,000,000.00
Durant Road Station (including parking lot)	1	LS	\$ 3,000,000.00	\$ 3,000,000.00
Northeast Regional Center Station (including parking lot, tunnel)	1	LS	\$ 6,000,000.00	\$ 6,000,000.00
Six Forks Station	1	LS	\$ 2,000,000.00	\$ 2,000,000.00
Government Center Station	1	LS	\$ 1,000,000.00	\$ 1,000,000.00
Raleigh Union Station (including ped bridge to RUS building)	1	LS	\$ 6,000,000.00	\$ 6,000,000.00
Roadway				
New Roadway at Northeast Regional Center Station	0.12	MI	\$ 3,000,000.00	\$ 360,000.00
Roadway Work at At-Grade Crossings	18	EA	\$ 25,000.00	\$ 450,000.00
Signals				
Relocate Gates and Flashers	6	EA	\$ 100,000.00	\$ 600,000.00
Relocate Gates and Flashers Cantilever	7	EA	\$ 30,000.00	\$ 210,000.00
Furnish and install Signal Power Access & Distribution	1	LS	\$23,400.00	\$23,400.00
Furnish and install Comms Equipment	1	LS	\$50,000.00	\$50,000.00
Furnish and install Traffic Control & Dispatching System	1	LS	\$20,000.00	\$20,000.00
Furnish and install Switch Heaters	54	EA	\$75,000.00	\$4,050,000.00
Furnish and Install Control Point	14	EA	\$554,100.00	\$7,757,400.00
Positive Train Control System	16.6	MI	\$500,000.00	\$8,300,000.00
Utility Construction				
Relocate Transmission Tower	1	LS	\$1,000,000.00	\$ 1,000,000.00
Utility Relocations	1	LS	\$2,000,000.00	\$2,000,000.00
Facilities				
Maintenance Facility	1	LS	\$ 25,000,000.00	\$ 25,000,000.00
Railroad Flagging	1	LS	\$ 4,000,000.00	\$4,000,000.00
Construction Sub-Total				\$ 197,807,550.00
Professional Services (28% of Construction Sub-Total)				\$ 55,386,114.00
Contingency (40% of Construction Sub-Total)				\$ 79,123,020.00
CONSTRUCTION TOTAL				\$ 332,316,684.00

Vehicles				
Locomotives	5	EA	\$ 6,500,000.00	\$ 32,500,000.00
Cab Cars	5	EA	\$ 3,150,000.00	\$ 15,750,000.00
Passenger Cars	10	EA	\$ 2,900,000.00	\$ 29,000,000.00
Right of Way				
Right-of-Way and Property Acquisition	1	LS	\$ 12,600,000.00	\$ 12,600,000.00
Vehicle and Right-of-Way Sub-Total				\$ 89,850,000.00
Contingency (15% of Sub-Total)				\$ 13,477,500.00
VEHICLE AND RIGHT-OF-WAY TOTAL				\$ 103,327,500.00

TOTAL PROJECT COST \$ 435,644,184.00

SAY \$ 435,700,000.00

L. Detailed Probable Cost Estimate - '4-1-4-1' Service Scenario

PROBABLE COST

\$373,400,000

Description	Quantity	Unit	Price	Amount
Grading and Drainage				
Grading and Drainage	16.6	Mile	\$ 500,000.00	\$ 8,300,000.00
Erosion Control	16.6	Mile	\$ 15,000.00	\$ 249,000.00
Sub-Ballast	160,000	TN	\$ 25.00	\$ 4,000,000.00
Track				
Retire/Remove wood tie track	104,000	TF	\$ 20.00	\$ 2,080,000.00
Construct track, wood ties, 136RE new (includes ballast)	35,000	TF	\$ 150.00	\$ 5,250,000.00
Construct track, concrete ties, 136RE new (includes ballast)	138,000	TF	\$ 200.00	\$ 27,600,000.00
Remove Existing No. 8 turnout	10	EA	\$ 4,000.00	\$ 40,000.00
Remove Existing No. 10 turnout	10	EA	\$ 5,000.00	\$ 50,000.00
Furnish and install No. 10 turnout (Concrete Ties)	7	EA	\$ 210,900.00	\$ 1,476,300.00
Furnish and install No. 10 turnout (Timber Ties)	7	EA	\$ 100,000.00	\$ 700,000.00
Furnish and install No. 15 turnout (Concrete Ties)	4	EA	\$ 305,250.00	\$ 1,221,000.00
Furnish and install No. 20 turnout (Concrete Ties)	12	EA	\$ 416,250.00	\$ 4,995,000.00
Furnish and install No. 10 crossover (Concrete Ties)	1	EA	\$ 494,000.00	\$ 494,000.00
Furnish and install No. 15 crossover (Concrete Ties)	2	EA	\$ 715,000.00	\$ 1,430,000.00
Furnish and install No. 20 crossover (Concrete Ties)	7	EA	\$ 975,000.00	\$ 6,825,000.00
Furnish and install field welds	800	EA	\$ 510.00	\$ 408,000.00
Furnish and install insulated joint plug rails	150	EA	\$ 3,500.00	\$ 525,000.00
Furnish and install rail lubricators	3	EA	\$ 18,500.00	\$ 55,500.00
Furnish and install sliding block derail	7	EA	\$ 3,500.00	\$ 24,500.00
Furnish and install railroad diamond	1	EA	\$ 100,000.00	\$ 100,000.00
Concrete Grade Crossing Panels - E. Elm St.	90	TF	\$ 550.00	\$ 49,500.00
Concrete Grade Crossing Panels - E. Holding Ave	90	TF	\$ 550.00	\$ 49,500.00
Concrete Grade Crossing Panels - Friendship Chapel Road	36	TF	\$ 550.00	\$ 19,800.00
Concrete Grade Crossing Panels - Rogers Road	54	TF	\$ 550.00	\$ 29,700.00
Concrete Grade Crossing Panels - Seawell Dr	24	TF	\$ 550.00	\$ 13,200.00
Concrete Grade Crossing Panels - Ligon Mill Road	108	TF	\$ 550.00	\$ 59,400.00
Concrete Grade Crossing Panels - Durant Road	180	TF	\$ 550.00	\$ 99,000.00
Concrete Grade Crossing Panels - Gresham Lake Rd	90	TF	\$ 550.00	\$ 49,500.00
Concrete Grade Crossing Panels - E Millbrook Road	144	TF	\$ 550.00	\$ 79,200.00
Concrete Grade Crossing Panels - New Hope Church Road	162	TF	\$ 550.00	\$ 89,100.00
Concrete Grade Crossing Panels - Wolfpack Lane	126	TF	\$ 550.00	\$ 69,300.00
Concrete Grade Crossing Panels - E Whitaker Mill Road	189	TF	\$ 550.00	\$ 103,950.00
Concrete Grade Crossing Panels - TransFlo Access Road	72	TF	\$ 550.00	\$ 39,600.00
Concrete Grade Crossing Panels - N Harrington Street	126	TF	\$ 550.00	\$ 69,300.00
Concrete Grade Crossing Panels - N West Street	144	TF	\$ 550.00	\$ 79,200.00
Concrete Grade Crossing Panels - W Jones Street	126	TF	\$ 550.00	\$ 69,300.00
Structures				
Railroad Bridge over Proposed Roadway @ NERC Station (Mains)	4,725	SF	\$ 500.00	\$ 2,362,500.00
Railroad Bridge over Proposed Roadway @ NERC Station (Freight)	2,700	SF	\$ 500.00	\$ 1,350,000.00
Railroad Bridge Over Six Forks Road	3,700	SF	\$ 500.00	\$ 1,850,000.00
Railroad Bridge Over Greenway, Crabtree Creek, Hodges Street	7,000	SF	\$ 500.00	\$ 3,500,000.00
Railroad Bridge Over NS NS-Line, Private Drive, Capital Blvd	58,000	SF	\$ 500.00	\$ 29,000,000.00
Retaining Wall - RR North of NS NS-Line	6,800	SF	\$ 80.00	\$ 544,000.00
Retaining Walls - RR West of CSX Yard	13,700	SF	\$ 80.00	\$ 1,096,000.00
Retaining Walls - RR West of Raleigh Union Station	14,700	SF	\$ 80.00	\$ 1,176,000.00
Retaining Walls - RR East of Raleigh Union Station	5,900	SF	\$ 80.00	\$ 472,000.00
Retaining Wall - RR West of Wye	4,700	SF	\$ 80.00	\$ 376,000.00
Crashwalls - Wake Forest Rd	60	LF	\$ 2,500.00	\$ 150,000.00
Crashwalls - I-440	330	LF	\$ 2,500.00	\$ 825,000.00
Crashwalls - Hillsborough	174	LF	\$ 2,500.00	\$ 435,000.00
Crashwalls- Morgan St	130	LF	\$ 2,500.00	\$ 325,000.00

Stations (Including Platform and Shelter)					
Downtown Wake Forest Station	1	LS	\$	1,000,000.00	\$ 1,000,000.00
NC-98 Station (including parking lot, pedestrian tunnel)	1	LS	\$	6,000,000.00	\$ 6,000,000.00
Capital Blvd Station (including parking lot, pedestrian tunnel)	1	LS	\$	6,000,000.00	\$ 6,000,000.00
Durant Road Station (including parking lot)	1	LS	\$	3,000,000.00	\$ 3,000,000.00
Northeast Regional Center Station (including parking lot, tunnel)	1	LS	\$	6,000,000.00	\$ 6,000,000.00
Six Forks Station	1	LS	\$	2,000,000.00	\$ 2,000,000.00
Government Center Station	1	LS	\$	1,000,000.00	\$ 1,000,000.00
Raleigh Union Station (including ped bridge to RUS building)	1	LS	\$	6,000,000.00	\$ 6,000,000.00
Roadway					
New Roadway at Northeast Regional Center Station	0.12	MI	\$	3,000,000.00	\$ 360,000.00
Roadway Work at At-Grade Crossings	18	EA	\$	25,000.00	\$ 450,000.00
Signals					
Relocate Gates and Flashers	6	EA	\$	100,000.00	\$ 600,000.00
Relocate Gates and Flashers Cantilever	7	EA	\$	30,000.00	\$ 210,000.00
Furnish and install Signal Power Access & Distribution	1	LS		\$23,400.00	\$23,400.00
Furnish and install Comms Equipment	1	LS		\$50,000.00	\$50,000.00
Furnish and install Traffic Control & Dispatching System	1	LS		\$20,000.00	\$20,000.00
Furnish and install Switch Heaters	50	EA		\$75,000.00	\$3,750,000.00
Furnish and Install Control Point	15	EA		\$554,100.00	\$8,311,500.00
Positive Train Control System	16.6	MI		\$500,000.00	\$8,300,000.00
Utility Construction					
Relocate Transmission Tower	1	LS		\$1,000,000.00	\$1,000,000.00
Utility Relocations	1	LS		\$2,000,000.00	\$2,000,000.00
Facilities					
Layover Facility	1	LS	\$	1,000,000.00	\$ 1,000,000.00
Railroad Flagging	1	LS	\$	4,000,000.00	\$4,000,000.00
Construction Sub-Total					\$ 171,328,250.00
Professional Services (28% of Construction Sub-Total)					\$ 47,971,910.00
Contingency (40% of Construction Sub-Total)					\$ 68,531,300.00
CONSTRUCTION TOTAL					\$ 287,831,460.00

Vehicles					
Locomotives	4	EA	\$	6,500,000.00	\$ 26,000,000.00
Cab Cars	4	EA	\$	3,150,000.00	\$ 12,600,000.00
Passenger Cars	8	EA	\$	2,900,000.00	\$ 23,200,000.00
Right of Way					
Right-of-Way and Property Acquisition	1	LS	\$	12,600,000.00	\$ 12,600,000.00
Vehicle and Right-of-Way Sub-Total					\$ 74,400,000.00
Contingency (15% of Sub-Total)					\$ 11,160,000.00
VEHICLE AND RIGHT-OF-WAY TOTAL					\$ 85,560,000.00

TOTAL PROJECT COST \$ 373,391,460.00

SAY \$ 373,400,000.00