Greater Triangle Commuter Rail (GTCR) Phase II Feasibility Study

Client: GoTriangle

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Rolling Stock and Accessibility Technical Memorandum

FINAL

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Contents

ABBREVIATIONS / ACRONYMS

ADA – Americans with Disabilities Act
ATR – Above Top of Rail
CEM – Crash Energy Management
CFR – Code of Federal Regulations
CSX – CSX Transportation
DMU – Diesel Multiple Unit
EMU – Electric Multiple Unit
FRA – Federal Railroad Administration
GTCR – Greater Triangle Commuter Rail
NCRR – North Carolina Railroad
NS – Norfolk Southern Railroad
NTD – National Transit Database
ROW – Right-of-Way

Revision History

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V0.0	3/31/21	Draft for Internal Review	M. Barrow
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1. Introduction

1.1. Project Background

The Greater Triangle Commuter Rail (GTCR) study aims to develop a feasible plan for implementing commuter rail service on the NCRR H-Line corridor between West Durham and Auburn, NC with a potential extension to Clayton, NC. One of the the goals of early project development in Phase 2 of the GTCR study is to further refine and achieve consensus on the project concept, including focus on areas where design and constructability challenges are relevant to project cost and schedule risk.

Phase 1 of the GTCR study focused on developing alternative operating plans and infrastructure capacity improvements necessary to implement commuter rail in the corridor. To focus the analysis on the comparative performance of the various operating and infrastructure alternatives, the Phase 1 study made a simplifying assumption that the GTCR project would utilize a standard modern commuter rail approach to rolling stock and station accessibility.

1.2. Phase 1 Rolling Stock and Accessibility Assumptions

Most modern commuter rail projects in the US implemented recently utilize locomotive-hauled bi-level passenger coaches, that provide level or assisted accesible boarding from low-level station platforms. (See discussion in Section 3 below.) The GTCR Phase 1 study, for purposes of preliminary analysis, assumed that all alternatives would have train consists made up of a diesel-electric locomotive and four bi-level passenger coaches.

Figure 1: Typical Modern Commuter Rail Train, Sunrail

Photo: https://www.orlandocitysc.com

1.3. Phase 2 Effort

The Phase 2 GCTR study includes a closer analysis of passenger accessibility and the interaction between rolling stock and station platforms. While the details of rolling stock procurement and station platform design will take place in future project phases, these items are being studied at this time as the requirements codified in federal regulations have design implications on station, track, and vehicle design. These elements need to be considered now in Phase 2 to refine the project concept, including the operating plan, physical scope, and cost of the project.

This document presents the results of that analysis, including:

- Definitions of accessibility in passenger rail and relevant federal regulations and host railroad desgin standards;
- Peer review of modern commuter rail systems and approaches to accessibility;
- Analysis of the accessibility options available to GTCR on a project-wide and station-by-station basis, including physical scope, cost, and operational implications; and,
- Comparison of rolling stock technology options avialable to the project.

2. Accessibility in Rail Transit

2.1. What is Accessibility?

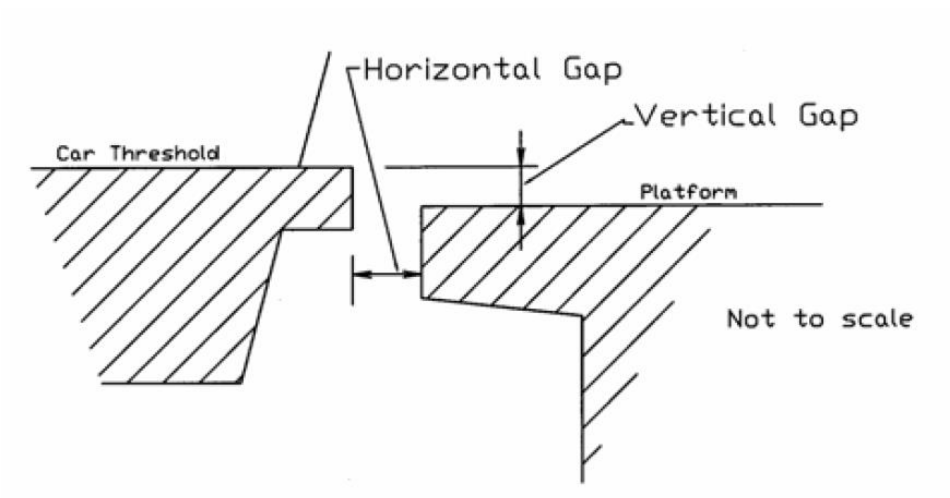
Accessibility in rail transit refers to the principle that transit services and vehicles should be accessible to and usable by individuals with disabilities. While this priniciple was codified in Federal law by the Americans with Disabilities Act (ADA) of 1990, and specific regualtions for the application of the ADA to rail transportation were developed shortly after and have been refined over the last 30 years, it is important to note that the creation of a truly accesible rail transportation system represents best practice nationally and internationally for providing high quality transit service to all people.

An accessible transit system will have benefits for all people, not just for individuals with disabilities. Individuals who use mobility assitance devices, the elderly, children, people with luggage, strollers, or other equipment – all of these groups will benefit from the physical infrastructure and other interventions that allow for accessible boarding. Accessibility features generally speed up the boarding and alighting process and make the overall travel experience more comfortbale for everyone.

Accesibility interventions cover a range of potential items in a rail transportation system, including: level boarding; on-board facilities for individuals with disabilities; accessible signage and travel information (both audio & visual for hearing-impared and sight-impared individuals); station design and wayfinding features; accessible parking and kiss-and-ride facilities. Our focus in this task is on the provision of accessibility to passengers during the boarding process and the interface between the rolling stock (i.e. vehicles) and the station platform. These items are being studied more closely at this time, as part of the Phase 2 efforts to refine the project concept. Many of the other interventions mentioned above are architectural in nature and have well established design standards that can be addressed during station design as the project advances; it is important to note that these architectural features are not less important and should not be forgotten in the later design process.

Throughout the discussions below of the boarding interface, the two important elements of accessibility critical to this analysis are the horizontal gap and the vertical gap. These interface gaps are stipulated in the federal regulations and also represent the simplest explanation of the challenges faced by passengers boarding trains. The horizontal gap is the distance between the platform edge and the edge of the train door; the vertical gap is the distance bewteen the top of the platform and the train floor. These gaps, resulting from the design of the station platform and the vehicle, are the distances that must be covered by any accessibility interventions.

Figure 2: Schematic showing example Vertical Gap and Horizontal Gap



Source: "Customer Behavior Relative to Gap Between Platform and Train", NCDOT 2009

Figure 3:Example Vertical Gap (left) and Horizontal Gap (right)

Photos: Left photo by Elvert Barnes, accessed on ggwash.org. Right photo Newsday/Audrey C. Tiernan.

2.2. Commuter Rail / Shared Use Corridor Accessibility

Accessibility for passengers boarding and alighting trains on rail transit systems is generally provided by designing vehicles and station platforms to align such that the vertical and horizontal gaps are minimized. For mass transit systems (i.e. heavy rail/subway and light rail) the service typically operates on fully dedicated infrastructure where the vehicles and station platforms can be designed in concert to align exactly and minimize the gaps. In commuter rail environments, however, there are particular challenges related to the mixing of various types of services and vehicles that make it difficult to minimize the horizontal and vertical gaps.

Commuter rail service can operate in two types of environments: a dedicated railroad corridor where only passenger trains operate, or a shared-use corridor where a mix of passenger and freight trains operate. In dedicated passenger rail corridors, stations can be designed to reduce the gaps between train and platform, but the mix of operators and fleets with variable sizes sometimes requires additional interventions to bridge the gap.

In shared-use corridors, however, passengers and freight trains with very different sizes and clearance requirements share the same tracks and the larger sizes and clearance requirements must be accommodated. The NCRR H-Line where the GTCR project would operate is a shared-use corridor today with Amtrak intercity passenger services operating on the same tracks and NS and CSX freight trains. The addition of commuter rail passenger trains to this corridor would not change this designation, as the conceptual infrastructure plans developed thus far would see passenger and freight trains operating on the same tracks.

The requirements of a shared-use corridor impact accessibility for passenger trains in terms of both the horizontal gaps and vertical gaps discussed previously:

- Horizontal clearance requirements: Freight trains are typically wider than passenger trains. Station platforms must be constructed with edge far enough from the track to allow freight trains to pass on shared tracks, which often results in a large horizontal gaps between the station platform and the passenger trains.

Figure 4: Large horizontal gap on Amtrak Downeaster in Maine

Photo: https://subwaynut.com

- Vertical gap between vehicle floor and platform: Commuter rail vehicles can be designed with a range of potential floor heights, but platforms cannot always be constructed at precisely the same level. The top of the platform must remain lower than potential edge of freight train, outside the clearance envelope. The photos below present a few common commuter rail vehicle designs and floor heights.

Figure 5: High floor train (48") with low level platform (8") resulting in long vertical gap, Piedmont service in NC

Photo: https://americastransportationawards.org/

Figure 6: Low floor train (25") with low level platform (8") resulting in moderate vertical gap, Sounder in Seattle

Photo: https://seattletransitblog.com

Figure 7: Low floor train (22") with low level platform (22") resulting in small/no vertical gap, TexRail in Fort Worth

Photo: https://www.tripadvisor.com/

2.3. Federal Law

As discussed earlier in Section 2.1, federal regulations stipulate how the requirements of the ADA are to be implemented in passenger rail projects. For purposes of a project like GTCR, which would operate in a shared use corridor, the Federal Railroad Administration (FRA) establishes the relevant federal requirements. These requirements, shown below, are located in 49 CFR 37.

- *49 CFR 37.42*
    - *(a) …an operator of a commuter, intercity, or high-speed rail system must ensure…that the following performance standard is met: individuals with disabilities, including individuals who use wheelchairs, must have **<u>access to all accessible cars available to passengers without disabilities</u>** in each train using the station.*
    - *(b) For new or altered stations serving commuter, intercity, or high-speed rail lines or systems, in which **<u>no track passing through the station and adjacent to platforms is shared with existing freight rail operations</u>**, the performance*

standard of paragraph (a) of this section must be met by ***providing level-entry boarding to all accessible cars*** *in each train that serves the station.*

- *(c) For new or altered stations serving commuter, intercity, or high-speed rail lines or systems, in which track passing through the station and adjacent to platforms is* ***shared with existing freight rail operations****, the railroad operator may comply with the performance standard of paragraph (a)* ***by use of one or more of the following means****:*
  - *(1) Level-entry boarding;*
  - *(2) Car-borne lifts;*
  - *(3) Bridge plates, ramps or other appropriate devices;*
  - *(4) Mini-high platforms, with multiple mini-high platforms or multiple train stops, as needed, to permit access to all accessible cars available at that station; or*
  - *(5) Station-based lifts*

Subsection (a) above stipulates that passengers with disabilities must be provided with access to every car in a train. Earlier versions of this requirement allowed for access to be provided to a single car only. Circumstances around the country where this condition still exists were approved under the older regulations.

Subsection (b) above describes the preferred approach for accessibility in passenger rail projects: the provision of true level boarding between train and platform. Level boarding means a design where the station platform and vehicle floor are aligned to minimize the horizontal and vertical gaps; horizontal gaps cannot exceed 3 inches and vertical gaps cannot exceed 5/8 inch. These requirements apply to any station platform where the adjacent track is used by passenger trains only and not shared with freight traffic.

Subsection (c) above describes a set of exceptions that apply to shared-use corridors where the track adjacent to the station platform is used by both passenger and freight trains. In these circumstances, access to passengers with disabilities can be provided through one or more alternate means:

- Level-entry boarding
- Car-borne lifts
- Bridge plates, ramps, etc
- Mini-high platforms
- Station-based lifts

These alternate approaches to accessibility will be defined in more detail in the following sections.

2.3.1. Level boarding

The preferred approach to accessible boarding, both in terms of federal regulation and industry best practice around the county and world, is to provide level boarding. This reflects a system design where the platform edge and the vehicle floor and closely aligned with minimal gaps to allow for easy boarding into the vehicle. Per federal regulation, level boarding must maintain the resulting gaps within certain thresholds: less than 3 inches of horizontal gap and less than 5/8 inch or vertical gap. Circumstances where the gaps exceed these values, even by a small amount, must be remedied through one of the alternate approaches indicated in 49 CFR 37.42(c). As an example in brief, small gaps are often addressed with automatic ramps or manual bridge plates, while larger gaps require more substantial interventions.

Figure 8: Level boarding with Bi-level coach on UTA Frontrunner

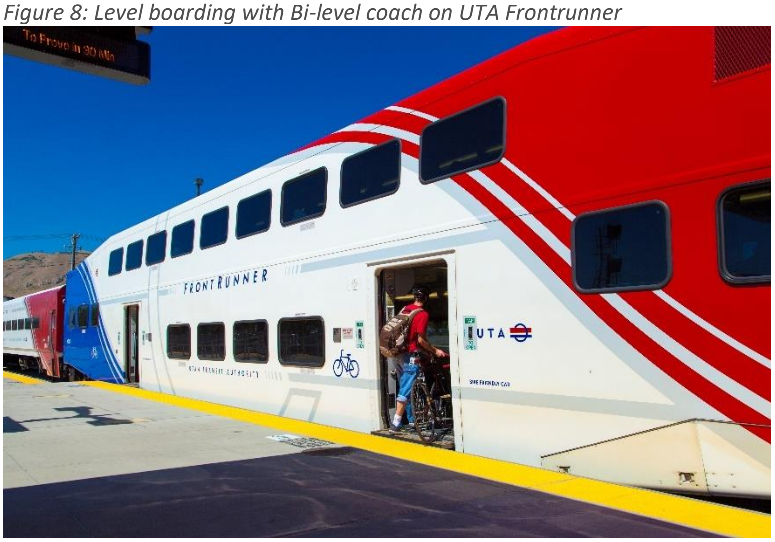


Photo: https://wikimedia.org

Level boarding provides the quickest and easiest environment for boarding to all passengers, and passengers with disabilities or using a mobility device are able to board without assistance.

The Federal regulations draw a distinction between dedicated passenger tracks in subsection (b) and shared passenger/freight tracks in subsection (c), because freight trains often require wider horizontal clearances to nearby obstructions than passenger trains. This creates a situation where passenger trains would be unable to meet the horiztonal gap requirements described above. (Specific details regarding freight clearance requirements for NS railroads are described in Section 2.4 below.)

To achieve level boarding on a shared use corridor with both freight and passenger traffic, several options can be considered, including:

- Dedicated station tracks
- Gauntlet tracks
- Folding platform edges

Dedicated station tracks

The most straightforward approach to providing level-boarding in a shared-use corridor is to construct dedicated tracks for passenger trains at each station location. A configuration like this would allow for station platforms to be constructed meeting all necessary horizontal and vertical gap requirements, as freight trains would never be present on the dedicated tracks, in keeping with 49 CFR 37.42(b).

In the corridor today, Raleigh Union Station features level boarding with dedicated station tracks for Amtrak trains separate from the mainline freight track.

Gauntlet tracks

An alternate approach to dedicated station tracks utilized in some circumstances is gauntlet tracks. Gauntlet tracks are a second set of rails constructed within the station area, offset slightly from the main tracks. This configuration allows passenger trains to stop close to the platform edge, reducing or eliminating the horizontal gap, while allowing freight trains to pass by farther from the platform edge with sufficient clearance. Gauntlet tracks are not common on Class I railroads and not present anywhere on the Norfolk Southern network; in preliminary discussions with NS, the railroad indicated that gauntlet tracks are highly discouraged on their network.

Figure 9: Gauntlet tracks on WES in Portland

Photo: https://trainpages.blogspot.com/

Folding platform edges

A final alternate approach to the provision of level boarding in shared-use corridors is the folding platform edge. This is a physical device attached to the edge of a platform that can be extended to reduce the horizontal gap between platform and train. Platform edge devices are typically short in length (around 12 inches) which limits their use to minor clearance issues, and they are typically manually operations limiting their use to corridors with occasional wide freight loads.

Figure 10: Mini-high platform with folding edge on MBTA

Photo: https://csengineermag.com/

2.3.2. Mini high platforms and bridge plates

The second group of alternative approaches to providing accessible boarding are bridge plates or ramps and mini-high platforms. Although these are listed as two separate bullets in the federal guidelines, they are often applied together: bridge plates cover horizontal gaps while mini-high platforms help overcome vertical gaps.

Bridge plates or ramps are mechanical or manual devices that cover the horizontal gap between train and platform. For longer gaps, a manual bridge plate placed by the train conductor is typically used. For shorter gaps, it is possible to utilize an automatic ramp that deploys from the train. Bridge plates or ramps can provide some coverage of a small vertical gap, provided that the resulting slope of the ramp is within federal standards.

For larger vertical gaps where the length of the ramp would be excessive or simply impossible, mini-high platforms can be used to create a short area of high or higher platform at the same level as the train floor. Theoretically, a mini-high could be constructed that is perfectly flush with the edge of the train, but generally speaking there will remain a horizontal gap that requires a bridgeplate.

Mini-high platforms are discouraged by Norfolk Southern but allowed with certain dimensional requirements. (See Section 2.4).

Figure 11: Passenger using a bridgeplate on NM Railrunner

Photo: https://www.riometro.org/

2.3.3. Car-borne lifts

The third alternative approach to accessible boarding is car-borne lifts. These are mechanical lifts contained within the passenger coach itself that can be used bring passengers in wheelchairs or who otherwise need assistance into the vehicle. They are typically only used for wheelchairs or mobility devices, so they do not offer the more general benefits to other passengers that level boarding or bridgeplates do.

Figure 12: Car-borne lift in use on VRE

Photo: https://www.vre.org

NCDOT plans to purchase a new fleet of coaches for Piedmont service that will feature car-borne lifts to provide accessible boarding at stations with low-level platforms such as Durham and Cary, replacing the platform lifts described in Section 2.3.4 below.

2.3.4. Platform lifts

The final alternative approach to accessible boarding included in the federal regulation are station-based or platform lifts. These are mechanical lifts on mobile units that must be rolled over to the train by a conductor or station attendant. They are very slow to operate (requiring upwards of 5 minutes of boarding time) and are typically only used for wheelchairs or mobility devices, so they do not offer the general benefits to other passengers that level boarding or bridgeplates do.

They are used by Amtrak/Piedmont trains in the corridor today, but there no examples of commuter rail systems using platform lifts. Finally, the US Access Board and its Rail Vehicles Access Advisory Committee (RVAAC) are considering a revision of federal regulations related to accessibility on rail passenger systems ; their recommendations include the phase out of platform lifts.

Figure 13: Amtrak platform-based lift

Photo https://newsela.com

2.4. Freight Railroad Requirements

In addition to the federal requirements for providing accessible boarding on passenger rail, any project in a shared-use corridor like GTCR must also take into account the design requirements of the host railroad. In the case of GTCR, the host/owner railroad of the H-Line corridor is NCRR;

for purposes of infrastructure design in the corridor, NCRR defers to the design requirements of the operating freight railroads, NS and CSX.

Freight railroads typically establish requirements for the placement and design of passenger station platforms in shared use corridors. Generally speaking, these requirements will usually consist of the following:

- No high platforms are allowed adjacent to tracks where freight operates.
- Mini-high platforms are allowed, when set back a certain distance from the track to provide clearance between platform and train.
- Low platforms are allowed and preferred, with platform heights typically in a range of 8-16 inches above top of rail[1].

For this corridor, NS has established station design requirements in the document “General Principles Guiding Norfolk Southern’s Evaluation of Passenger Station Proposals” from 2018; see Appendix A. These requirements are similar to, if somewhat stricter than, typical requirements seen at other freight operators:

- No high platforms are allowed adjacent to tracks where freight operates.
- Mini-high platforms are discouraged, but allowed if set back 8 feet 6 inches from the track centerline.
- Low platforms are allowed and preferred, with a platform height no greater than 8 inches and the platform edge 5 feet 4 inches from the track centerline.

[1] Both platform height and vehicle floor height are typically defined as the vertical distance above the top of the rail (above top of rail, or ATR). Any discussion of platform of vehicle floor height in this report is presented in inches ATR, if not otherwise indicated.

Figure 14: Illustration of NS Station Design Requirements for Shared Track

Original Photo: https://caltrain-hsr.blogspot.com

2.5. Implications for the GTCR Corridor

Considering the federal regulations alongside the NS design standards, we see a few implications for the design and configuration of the GTCR project:

1) Station platforms will be limited to a height of 8 inches on shared tracks.
2) Any vehicle with floor height above 8 inches (i.e. all available passenger rail vehicles) cannot achieve level boarding on a shared freight / passenger track.
3) Therefore, the project will need to either consider the Federal alternate approaches to accessibility or construct dedicated passenger tracks or other special infrastructure in station areas, for any chosen vehicle type.

With these implications in mind, the team set forth on examining the accessibility approaches taken by peer commuter rail systems around the country and evaluated the potential options available to the GTCR project.

3. Peer Review of US Commuter Rail

3.1. Peer Systems

To better understand the range of options available to the GTCR project for providing accessible boarding, the consultant team conducted a comprehensive review of every operating commuter rail system in the United States – 33 systems in all[2] – to determine how each system provides accessibility between their vehicles and station platforms. This peer review considered three groups of systems:

1) "Modern" commuter rail systems: 14 systems constructed most recently (post-1990 and post-ADA) in shared-use railroad corridors. These are the primary peer systems for the GTCR project.

2) "Legacy" commuter rail systems: 9 systems constructed before the ADA. These were not considered to be peer systems.

3) "Hybrid Rail" commuter rail systems: 10 systems operating or planned to operate with diesel multiple unit (DMU) trains. These systems operate in different types of corridors than the modern commuter rail systems, but they were included in the peer analysis as described below.

The following sections: describe the peer systems examined, both the modern commuter rail examples, as well as legacy commuter railroads and newer, hybrid diesel multiple unit (DMU) system; and catalog the accessibility approaches used across the peer systems.

3.1.1. Modern Commuter Rail

Of the 33 commuter rail systems identified, the consultant team designated 14 of these systems as modern commuter rail system that represent a peer comparison for the proposed GTCR project. "Modern" in this context is taken to mean commuter rails systems that were constructed in the last 30 years or so, following the advent of the ADA in 1990. Thus, the peer systems could be expected to have been designed with accessibility, and accessible boarding in particular, in mind.

[2] The 33 systems were identified according to their NTD (National Transit Database) designations: either as commuter rail (modern and legacy systems) or hybrid rail (DMU commuter rail systems).

Figure 15: Sunrail, Modern commuter rail

Photo: https://en.wikipedia.org

These modern systems are typically operated in shared-use railroad corridors, either mixing with freight traffic in operation or sharing the same tracks with some form of temporal separation. As shared-use projects, these systems are regulated by the FRA, their fleets are subject to FRA crashworthiness requirements (codified in 49 CFR 238). Further, their stations are generally subject to the constraints around design and placement (with the resulting horizontal and vertical gaps) that were discussed earlier in Section 2.2. As such, these systems typically require some application of the alternate approaches to accessible boarding stipulated in the federal regulations.

Modern commuter rail projects are typically low cost, or relatively low cost compared to other major rail projects. Stations are constructed minimalistically, reducing size and scope while still meeting federal accessibility regulations. Vehicle fleets typically consist of locomotive-hauled coaches, sometimes procured new and other times purchased from the older fleets of more established systems.

The 14 systems identified as modern commuter rail are listed below. The survey results of their approaches to accessible boarding are presented in Section 3.2 below.

- Sounder (Seattle, WA)
- Tri-Rail (Miami, FL)
- Texas Railway Express (TRE) (Dallas-Fort Worth, TX)
- RailRunner (Santa Fe/Albuquerque, NM)
- Coaster (San Diego, CA)
- Caltrain (San Francisco, CA)
- Metrolink (Los Angeles, CA)
- Altamont Corridor Express (San Jose, CA)
- SunRail (Orlando, FL)
- Northstar (Minneapolis, MN)
- Music City Star (Nashville, TN)
- Virginia Railway Express (DC / NoVA)
- Frontrunner (Salt Lake City, UT)
- RTD A/B/G Lines (Denver, CO)

3.1.2. Legacy Systems

In contrast to the modern commuter rail systems identified above, another 9 systems were grouped as "legacy" commuter rail. These systems represent the long-standing commuter rail lines or networks in cities in the northeastern and midwestern US. In some cases, passenger rail has been operating on these lines for over 100 years. These systems consist of a mix of very old track and station infrastructure with modern upgrades, and typically large, mixed fleets that have grown and been replaced gradually over time.

These systems typically operate on either dedicated passenger tracks, or on shared-used corridors where there is very light freight traffic. In these latter cases, the passenger railroad agency typically controls and dispatches the corridor. Given this different environment from the modern system, legacy commuter railroads typically are able to provide level boarding at major stations where investments have been made. Smaller, outlying stations may have alternate approaches in place (e.g. mini-high platforms) or in many cases may be inaccessible, with the insufficient state of the station allowable until major capital investments are made.

Figure 16: NJ Transit, Legacy commuter rail

Photo: https://twitter.com/njtransit/

Many of these legacy systems are electrified, operating with EMU (electric multiple unit) trainset or electric locomotives hauling passenger coaches. Un-electrified systems typically use diesel-power locomotives hauling passenger coaches. The vehicle fleets for the legacy commuter railaroads are subject to FRA regulation and the FRA crashworthiness standards.

Given the unique nature of these very old systems, they were determined to not represent good peer comparisons for the GTCR project.

3.1.3. Hybrid Rail systems

The 23 systems described in the previous two sections represent the typical set of "commuter rail" systems in the US. In addition these, there is a growing group of systems that represent a middle ground between commuter rail and light rail; these 10 systems[3] are identified as "hybrid rail" systems by the National Transit Database (NTD) and represent systems that operate with lighter, more "transit-like" vehicles at service levels more frequent than typical commuter rail lines but not as frequently as light rail or other similar transit modes.

These systems employ an alternate fleet type known as a DMU, or a diesel multiple unit, train. Rather than being made of a locomotive and coaches, a DMU train consists of several self-powered cars, with the diesel engines on-board the vehicle. These vehicles are typically smaller and lighter than standard passenger coaches with lower floor heights, giving them an appearance more like a light rail vehicle. DMUs are common in Europe, but have only been implemented in limited circumstances in the US.

The DMU has been growing in prominence as a potential vehicle type for commuter rail, with several projects under development recently and changes to FRA regulation targeting more widespread adoption. (See detailed discussion in Section 5.2 below). There is much interest in this vehicle type, as the look of the vehicle sometimes appears more modern than standard commuter equipment, and as the lower floor heights have allowed for an easier provision of accessible boarding for systems with exclusive tracks or near-exclusive tracks with low freight traffic.

Figure 17: TexRail, Diesel Multiple Unit (DMU) system

Photo: https://www.railpictures.net/photo/664597/

[3] These include 8 systems currently operating, and 2 systems under construction (DART Silver Line and San Bernardino Arrow).

Despite these new regulations and projects, DMU systems are still few and far between. Thus far, DMU projects are generally limited to corridors with low levels of freight traffic and/or corridors controlled by the passenger rail agency. There are no examples of a DMU operating for substantial distances over the territory of a major Class I railroad (e.g. NS and CSX).

Finally, while low-floor DMUs do typically have a lower floor height than low-floor bi-level passenger coaches (DMU: 22 inches; Bi-level: 25 inches), these vehicles would still not be low enough to provide level boarding in compliance with the NS station requirements discussed above. (NS requires 8 inch high platforms.) Thus, DMUs could be implemented on the GTCR project, but they would be subject to the same station design constraints as a fleet of locomotive-hauled bi-level coaches, would require the same set of alternate approaches to accessible boarding, and therefore would not represent a clear benefit over standard coaches in terms of accessibility.

Figure 18: Illustration of Bi-level Coach vs DMU Floor Heights

Original Photo: https://www.santafenewmexican.com

3.2. Summary of Common Accessibility Approaches

The table below presents a summary of the results of the peer review, with a focus on the modern commuter rail systems that represent the best comparison to the GTCR project.

Twelve systems, all modern commuter rail systems, have assisted boarding. These systems typcially operate in shared use corridors, operating alongside Class I railroads in corridors with high levels of freight traffic. These corridors are most similar to the GTCR corridor.

- The most common approach to providing accessible boarding at these systems is the use of mini-high platforms in combination with a fleet of bi-level passenger coaches: 10 of 14 modern systems. These passengers coaches are all either Bombardier bi-level coaches or coaches designed to match the Bombardier vehicle's 25 inch floor height.
- In at least two of the 10 modern commuter rail systems with mini-high platforms (Sunrail and Northstar), the bi-level coaches are also equipped with on-board vehicle lifts. This combination allows for a single mini-high platform to be constructed at each station as the main means of accessible boarding, while providing car-borne lifts to provide access to the other cars on the train in accordance with federal regulations.[4]
- Two modern commuter rail systems utilize high-floor passenger coaches (roughly 48 inch floor height). One system (Nashville) uses mini-high platforms and the other (VRE) uses car-borne lifts.

Twelve systems have level boarding. These systems typically operate in exclusive or shared corridors with low levels of freight traffic. These corridors are often controlled by the operating transit agency.

- Two modern commute rail systems provide true level boarding:
  - RTD in Denver was constructed as a dedicated passenger system with no tracks shared with freight, high floor vehicles, and high platforms, similar to the design of some legacy systems.
  - Frontrunner in Utah also operates largely on nearly-exclusive dedicated passenger tracks, and provides level boarding from a 25 inch high platform to a bi-level passenger coach.
- All 10 of the current or upcoming hybrid rail systems feature level boarding.
  - The 2 hybrid rail systems with high platforms utilize gauntlet tracks to provide the level boarding solution.
  - The 8 systems with low platforms provide level boarding to a roughly 22 inch high platform.

[4] The systems using mini-high platforms only, either provide access to the train via multiple mini-high platforms, or only provide access to a single car; the latter configuration is grandfathered in for systems of a certain age.

Table 1: Peer Comparison of Commuter Rail Accessibility Solutions

Peer System	Location	Corridor (Freight Traffic)[5]	Level Boarding	Mini-Highs	Car-borne Lifts
Modern Commuter Rail					
Sounder	Seattle	Shared (Class I RR)		Low Platform	
Tri-Rail	Miami	Shared (Class I RR)		Low Platform	
TRE	Dallas-Forth Worth	Shared (Class I RR)		Low Platform	
RailRunner	New Mexico	Shared (Class I RR)		Low Platform	
Coaster	San Diego	Shared (Class I RR)		Low Platform	
Caltrain	SF Bay Area	Shared (Class I RR)		Low Platform	
Metrolink	Los Angeles	Shared (Class I RR)		Low Platform	
ACE	SF Bay Area	Shared (Class I RR)		Low Platform	
SunRail	Orlando	Shared (Class I RR)		Low Platform	Low Platform
Northstar	Minneapolis	Shared (Class I RR)		Low Platform	Low Platform
Music City Star	Nashville	Shared (Class I RR)		High Platform	
VRE	Virginia	Shared (Class I RR)			High Platform
Frontrunner	Salt Lake City	Near-Exclusive (Class I RR)	Low Platform		
RTD A Line	Denver	Exclusive (None)	High Platform		
Hybrid Rail DMU					
SMART	SF Bay Area	Shared (Short Line)	High Platform		
WES	Portland	Shared (Short Line)	High Platform		
RiverLine	Southern NJ	Shared (Short Line)	Low Platform		
Capital Metro	Austin	Shared (Short Line)	Low Platform		
A-Train	Dallas–Fort Worth	Shared (Short Line)	Low Platform		
eBart	SF Bay Area	Exclusive (None)	Low Platform		
Sprinter	San Diego	Shared (Class I RR)	Low Platform		
TEXRail	Dallas–Fort Worth	Shared (Short Line)	Low Platform		
Silver Line*	Dallas–Fort Worth	Shared (Short Line)	Low Platform		
Arrow*	San Bernardino	Shared (Class I RR)	Low Platform		

**Under Construction*

A full summary of the accessibility solutions employed at the peer commuter rail systems is presented in Appendix B.

[5] Corridors are identified as either: Shared (with freight), Exclusive (commuter only), or Near-Exclusive (very limited freight traffic). Freight Traffic on shared corridors is identified as either: Class I Railroad (one of the four major national carriers) or Short Line Railroad (small local carriers). Class I Railroads will typically have higher traffic and more stringent clearance requirements.

4. Review of Accessibility Options for GTCR

Based on the review of federal regulations, freight design standards, and peer projects presented above, the following sections provide an assessment of the approaches to providing passenger accesibility for the GTCR project. In general, there are two potential options available:

1) Providing assisted accessible boarding at station platforms located on shared tracks

2) Providing level boarding at station platforms located on dedicated tracks

These two concepts are evaluated in the following sections, both in terms of the system as a whole and in terms of application to individual stations. As the FRA will ultimately consider the question of accessibility on a station-by-station basis, the project must consider now whether certain stations will lend themselves to, or even require, level boarding. For example, Raleigh Union Station and the terminal stations are all likely to be constructed on dedicated station tracks, requiring level boarding between train and station platform.

4.1. Assisted Boarding Concept

For an assisted boarding configuration on shared track, station platforms would be constructed at the NS-specified height of 8 inches. Access from these low level platforms to the commuter rail vehicles would be provided via one of the alternate methods of accessibility, mini-high platforms or car-borne lifts.

Car-borne lifts installed within the vehicles would allow for passengers using mobility devices to board the trains. These would be installed in every car of the train to ensure that the Federal access requirements are supported. Car-borne lifts are reported to require 2-3 minutes of boarding time (or more in some cases) which can add significant time to a station stop.

Mini-high platforms constructed on the low-level station platforms could allow for accessible boarding for passengers with mobility devices, as well as providing an easier entry for passengers with heavy equipment (e.g. luggage, strollers, bicycles, etc.) It is possible, but not common, for car-borne lifts to be deployed for these types of non-ADA needs. Boarding times at stations with mini-high platforms are estimated at 60-90 seconds per station. As conductors (and passengers) become more familiar with boarding locations and procedures, the process of deploying a bridge plate to a mini-high platform can become very quick.

The mini-high platform approach would require careful design to ensure that (1) all NS requirements regarding horizontal clearance are respected and that the configuration is accepted by NS; and (2) that pedestrian circulation can be maintained around the elevated sections.

For the latter reason, one approach applied at some commuter rail systems is the use of both mini-high platforms (for the first car of the train) and car-borne lifts (to provide access to the remaining cars). Operations staff from Sunrail reported that the mini-high platform is the preferred method of boarding, as it is much faster, but they offer both methods to fulfill their obligation to provide access to every car under federal regulations.

The commuter rail vehicle could be procured in any type and with any standard floor height. Car-borne lifts have been installed on passenger coaches both high floor (~48 inch) and low floor (~25 inch) vehicles. While car-borne lifts are not currently used on any DMU system in the US, they could feasibly be installed on any vehicle. As mini-high platforms can and have been constructed to any height, they offer no restrictions on the type or configuration of vehicles procured.

4.2. Level Boarding Concept

For a level boarding configuration served by dedicated tracks or other additional infrastructure, station platforms would be constructed to be level with the floor height of the selected commuter rail vehicle. As such, no special accessibility approaches are required. Small manual or automatic bridge plates may be employed for situations where the federal minimum standards for horizontal and vertical gaps (less than 3 inches of horizontal gap and less than 5/8 inch or vertical gap) cannot be achieved.

For a level boarding configuration, vehicles could be procured in any type and with any standard floor height. Passenger coaches and DMU trains exist in both high floor (~48 inches) and low-floor (~22-25 inches) configurations. While both floor heights are commonly procured for passenger coaches, most DMU systems in the US use low-floor (22 inch) vehicles.

If level boarding is provided at a high-floor level (~48 inches), the shared stations could offer level boarding to intercity trains as well. If level boarding is provided at a low-floor level (~22-25 inches), then intercity trains at shared locations would need to utilize an alternate method for accessible boarding as they do today. The new passenger coaches being procured for the Piedmont service are planned to include car-borne lifts, which could be applied in such a situation; coordination would be required to ensure that the bottom step on the Piedmont coaches align properly with the chosen platform height (22-25 inches) for the commuter rail system.

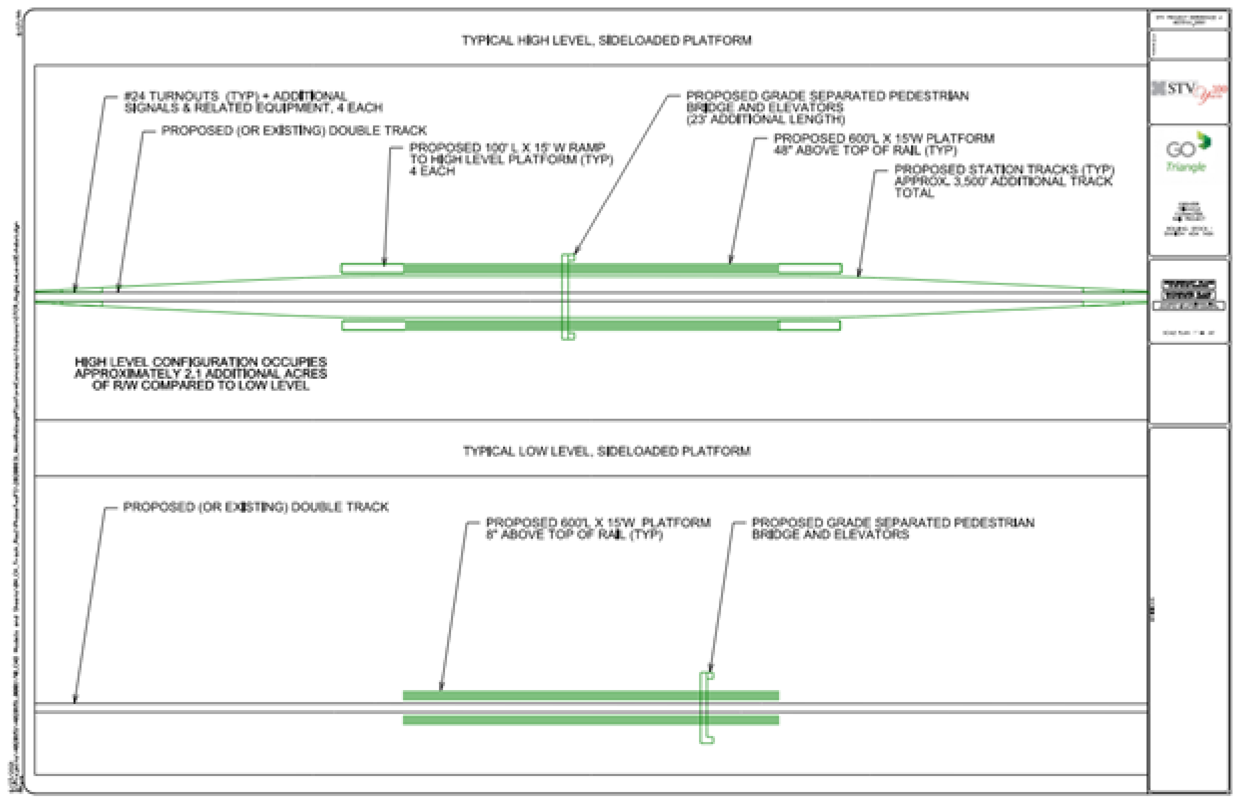
4.3. Station and Track Infrastructure

4.3.1. Assisted Boarding on Shared Tracks

For an assisted boarding configuration, no special station or track infrastructure will be required. A typical station will consist of two mainline tracks, shared by passenger and freight trains, with two side platforms constructed at the NS-specified height of 8 inches.

Figure 19 below presents the typical configuration for a shared track station.

Figure 19: Typical Station Configurations



This configuration could be applied to most station locations on the corridor, with the except of Raleigh Union Station and the proposed terminal stations in West Durham and Auburn/Clayton. At Raleigh, the station already includes dedicated passenger tracks and the new commuter rail platform would serve these dedicated tracks. For the terminal stations, the proposed project configuration calls for dedicated station tracks off the mainline, to allow freight and intercity trains to operate freely past commuter trains laying over at the terminal. At all three of these locations, level boarding would need to be pursued.

4.3.2. Level Boarding on Dedicated Tracks

For a level boarding configuration, dedicated station tracks would need to be constructed at each station location providing level boarding. As discussed, level boarding will be required at Raleigh Union Station and the two terminal stations, as these facilities are planned to be constructed with dedicated station tracks.

The project team has developed feasible concepts for dedicated station tracks at every station on the line. The typical configuration (shown in Figure 19 above) provides two center mainline tracks for freight and intercity trips, and two side station tracks for passenger service only. Side platforms would be constructed at the same height as the proposed commuter rail vehicle type. Intercity trains would access the station tracks at shared station locations (e.g. Durham and Cary).

At certain locations, a more complex configuration would be pursued, including the option to provide both station tracks offset to the north or south of the corridor serving a center island level platform. This type of configuration is applied in locations where available right-of-way does not exist on both sides of the corridor.

All configurations for dedicated station tracks include special trackwork with a minimum turnout size of #20, to ensure that passenger trains can enter and exit the station area at a reasonable speed (i.e. maximum of 40 miles per hour).

4.3.3. Gauntlet Tracks on Shared Tracks

In addition to the primary method of providing level boarding via dedicated station tracks, it is physically feasible to provide the same level boarding via gauntlet tracks. As discussed previously, gauntlet tracks allow for a level boarding platform to be located far enough from a freight track to maintain the necessary clearances.

Under a gauntlet track scenario, the station would be constructed similarly to the assisted boarding scenario, with two shared tracks and two side platforms. The station platforms would be constructed far enough from the freight track to maintain clearances, and the gauntlet tracks would bring passenger trains adjacent to the platform. See Figure below.

While a gauntlet track configuration may offer benefits in areas with severe right-of-way constraints, there are several risks to consider. Today, there are no active gauntlet tracks on NS territory, and it has been advised by NCRR that NS strongly discourages the use of gauntlet tracks. Further, NS horizontal clearances are more restrictive than some freight railroads, as discussed in Section 2.4 above, the design of the gauntlet tracks would need to provide a greater horizontal offset than is typically designed.

4.4. Station-by-Station Assessments

The following table presents a station by station assessment of the implementation of each method of accessibility. The table includes draft capital costs for each station, inclusive of station platforms, track and signals, right-of-way, and civil/roadway costs. A detailed assessment of capital costs is included in the “High-Level Versus Low-Level Platform Cost Comparison” technical memo.

It should be noted that if <u>every</u> station is planned to provide level boarding, then a modest cost savings could be realized by removing mini-high platforms and car-borne lifts from the project plan. These costs are expected to be minimal, however - less than $10 million each systemwide.

Table 2: Individual Station Configuration Assessments

Station	Average Daily Boardings (2040)	Assisted Boarding / LLP		Level Boarding / HLP		Additional Design Considerations
		Configuration	Cost (2020$)	Configuration	Cost (2020$)	
West Durham	High (>1,000)	*N/A - Dedicated Tracks*		Two track terminal, Center platform, with tail tracks	$31.9 M	Terminal station constructed on dedicated tracks
Downtown Durham	High (>1,000)	2 tracks, 2 side platforms	$15.5 M	Side platforms with center bypass	$34.9 M[6]	Significant constraints on available ROW for station, especially for HLP options. Consider gauntlet track configuration, but note that gauntlet track highly discouraged by NS.
East Durham	Low (< 600)	2 tracks, 2 side platforms	$15.5 M	Center platform with station tracks south of corridor	$41.9 M	Significant constraints on available ROW for station. Impacts to adjacent CSX yard and pedestrian access on public grade crossings. Consider gauntlet track configuration, but note that gauntlet track highly discouraged by NS.
Ellis Road	Low (< 600)	2 tracks, 2 side platforms	$15.5 M	Side platforms with center bypass	$36.7 M	
RTP	Medium (600-1,000)	2 tracks, 2 side platforms	$15.5 M	Side platforms with center bypass	$63.6 M	Major bridge work required for HLP station
Morrisville	Low (< 600)	2 tracks, 2 side platforms	$15.5 M	Side platforms with center bypass	$28.8 M	
Downtown Cary	Medium (600-1,000)	2 tracks, 2 side platforms	$15.5 M	Side platforms with center bypass	$32.5 M	
Corp Center Dr	Low (< 600)	2 tracks, 2 side platforms	$15.5 M	Side platforms with center bypass	$28.8 M	
Blue Ridge Road	Medium (600-1,000)	2 tracks, 2 side platforms	$15.5 M	Side platforms with center bypass	$30.1 M	
NCSU	High (>1,000)	2 tracks, 2 side platforms	$15.5 M	Side platforms with center bypass	$28.8 M	
Raleigh	High (>1,000)	*N/A - Dedicated Tracks*		New platform and track added north of existing RUS Station entry tracks reconfigured	$45.6 M	RUS parallel entry configuration, including reconstruction of Boylan bridge
Hammond	Low (< 600)	2 tracks, 2 side platforms	$15.5 M	Side platforms with center bypass	$40.0 M	
Garner	Low (< 600)	2 tracks, 2 side platforms	$15.5 M	Center platform with station tracks north of corridor	$36.6 M	Significant constraints on available ROW for station, especially for HLP options. Consider gauntlet track configuration, but note that gauntlet track highly discouraged by NS.
Auburn	Medium (600-1,000)	2 tracks, 2 side platforms	$15.5 M	Side platforms with center bypass	$28.8 M	
Downtown Clayton	Low (< 600)[7]	2 tracks, 2 side platforms	$15.5 M	Side platforms with center bypass	$29.5 M	
East Clayton	Low (< 600)[6]	*N/A - Dedicated Tracks*		Two track terminal, Center platform	$28.8 M	Terminal station constructed on dedicated tracks

[6] Durham costs are intended to reflect the premium for HLP over LLP and do not include mainline costs such as raising the tracks to include vertical clearances to roadways under track bridges.
[7] Clayton Station was modeled at NC-42 in the Phase 1 ridership forecasts.

4.5. Configuration Scenarios for GTCR

From the assessments above, the team has developed three potential scenarios for the GTCR project:

- All Assisted Boarding Configuration
- All Level Boarding Configuration
- Hybrid Configuration

4.5.1. Assisted Boarding Configuration

Under the Assisted Boarding Configuration, the GTCR system would mirror many of the recently opened modern commuter rail systems, with low-level platforms (8 inches) located on tracks shared between freight and passenger traffic.

At most locations, passengers needing assistance would board using a combination of mini-high platforms (where physically feasible) and car-borne lifts installed within the vehicle fleet. Vehicles could have either a low level floor height (22 to 25 inches) or a high level floor height (48 inches). Passengers not requiring assistance would board the train via stairs; high floor trains would have a longer distance to climb than low floor trains.

At the three dedicated track stations on the corridor (West Durham terminal, Auburn or Clayton terminal, and Raleigh Union Station) the commuter rail platform would be constructed to be level with the selected vehicle fleet (22 to 25, or 48 inches). At these locations, passengers would be able to access the trains via level boarding. At the stations shared with intercity traffic (Durham, Cary, and Raleigh) intercity passengers would continue to board as they do today: assisted at Durham and Cary, level at Raleigh with minimal assistance.

This configuration has an estimated capital cost for stations of $308.4 million (2020$).[8]

Station	Configuration
West Durham	Level Boarding
Downtown Durham	Assisted Boarding
East Durham	Assisted Boarding
Ellis Road	Assisted Boarding
RTP	Assisted Boarding
Morrisville	Assisted Boarding
Downtown Cary	Assisted Boarding
Corp Center Dr	Assisted Boarding

Station	Configuration
Blue Ridge Road	Assisted Boarding
NCSU	Assisted Boarding
Raleigh	Level Boarding
Hammond	Assisted Boarding
Garner	Assisted Boarding
Auburn	Assisted Boarding
Downtown Clayton	Assisted Boarding
East Clayton	Level Boarding

[8] The Phase 1 capital cost estimate for stations was $246 million (2020$). That estimate assumed an assisted boarding configuration at every station.

4.5.2. Level Boarding Configuration

Under the Level Boarding Configuration, the GTCR system would provide an accessible passenger boarding environment requiring minimal or no assistance mirroring certain modern and legacy commuter rail systems and the hybrid rail DMU systems. This configuration would feature level boarding platforms (22 to 25 inches, or 48 inches) located on tracks dedicated for passenger service.

At all locations, passengers would board the train from a platform constructed at the same height as the chosen vehicle. Vehicles could have either a low level floor height (22 to 25 inches) or a high level floor height (48 inches).

If station platforms at the stations shared with intercity traffic (Durham, Cary, and Raleigh) are constructed at the high floor level (48 inches), intercity passengers would also be able to access the train via level boarding. If station platforms at these locations are not built to the high floor level, assisted boarding methods would still be required for the intercity trains; details for such a configuration would need to be coordinated with NCDOT and their new Piedmont fleet.

This configuration has an estimated capital cost of $567.3 million (2020$), an increment of $258.9 million over the assisted boarding configuration. This configuration would also have a higher annual operations and maintenance (O&M) cost than the assisted boarding configuration, accounting for the cost of maintaining additional track and signal infrastructure.

Station	Configuration
West Durham	Level Boarding
Downtown Durham	Level Boarding
East Durham	Level Boarding
Ellis Road	Level Boarding
RTP	Level Boarding
Morrisville	Level Boarding
Downtown Cary	Level Boarding
Corp Center Dr	Level Boarding

Station	Configuration
Blue Ridge Road	Level Boarding
NCSU	Level Boarding
Raleigh	Level Boarding
Hammond	Level Boarding
Garner	Level Boarding
Auburn	Level Boarding
Downtown Clayton	Level Boarding
East Clayton	Level Boarding

4.5.3. Hybrid Configuration

A third potential configuration option exists for the GTCR project: a Hybrid Configuration providing a mixed operating environment, targeting the investments for level boarding at the highest priority stations.

At most locations, low-level platforms (8 inches) would be located on tracks shared between freight, with passengers needing assistance boarding using a combination of mini-high platforms (where physically feasible) and car-borne lifts installed within the vehicle fleet. Vehicles could have either a low level floor height (22 to 25 inches) or a high level floor height (48 inches).

Passengers not requiring assistance would board the train via stairs; high floor trains would have a longer distance to climb than low floor trains.

At several stations, dedicated tracks would be constructed and the commuter rail platform would be constructed to be level with the selected vehicle fleet (22 to 25, or 48 inches). At these locations, passengers would be able to access the trains via level boarding.

Determinations of the priority stations for level boarding infrastructure could be made along several possible dimensions. Some options, for consideration, include:

- Terminal Stations (West Durham and Auburn or East Clayton) – These locations would almost certainly be constructed with dedicated infrastructure.
- Intercity Stations (Durham, Cary, and Raleigh) – These locations would provide benefits to intercity rail passengers as well as commuter rail passengers.
- Other stations as identified by local stakeholders

NCRR, as the corridor owner, has indicated a general preference for low platforms due to lower complexity and physical footprint. Dedicated tracks with high platforms at locations other than the terminal stations and RUS would require NCRR and NS approval.

4.6. Operational Performance

In addition to the conceptual design and capital cost estimation efforts around the station accessibility configuration options presented above, the project team conducted operations modeling of the two general scenarios to assess the relative operational performance of each.

Project team member Gannett Fleming developed a Rail Traffic Controller (RTC) operations model of the proposed GTCR project with two station configuration scenarios: the "low level platform" scenario with assisted boarding and the "high level platform" scenario with level boarding.

The "low level platform" scenario reflects the initial proposed configuration of the GTCR system: a shared-use corridor with station platforms located on the mainline tracks shared between passenger and freight trains. Accessibility between platform and vehicles would be provided via one of the alternative accessibility methods described previously.

The "high level platform" scenario reflects a proposed configuration with dedicated station tracks at all locations with level boarding. In addition to the proposed dedicated passenger tracks at stations, the modeling team assumed that the future signal system design could incorporate shorter braking distances on station tracks utilized by passenger trains only, while maintaining longer braking distances on routes used by freight traffic. This would allow for better operational performance of passenger trains through station areas, including closer train spacing. This configuration will need to be designed in detail in subsequent project phases.

The table below summarizes the delay and on-time performance (OTP) results for the base case (no GTCR) and two GTCR scenarios. These statistics are the key values that the freight railroads and other stakeholders will use to evaluate the performance of the corridor.

Table 3: Summary of RTC Modeling Results

Operator/ Service	Base Case Results				Low-Level Platform Future Case Results				High-Level Platform Future Case Results			
	Train Count	Avg. Speed (mph)	Delay (min/100 train-mi)	OTP (5m)	Train Count	Avg. Speed (mph)	Delay (min/100 train-mi)	OTP (5m)	Train Count	Avg. Speed (mph)	Delay (min/100 train-mi)	OTP (5m)
GT Commuter	-	-	-	-	54*	21.3	4.0	97.4%	54*	22.5	0.9	100%
Amtrak Intercity**	14	40.2	0	100%	14	38.1	7.6	97.5%	14	39.1	3.7	97.5%
CSX	5	19.6	0	-	5	22.3	22.6	-	5	23.0	13.3	-
NS***	19	20.5	33.5	-	20	19.4	65.6	-	20	20.6	36.3	-
Overall	**38**	**26.8**	**15.7**	**100%**	**93**	**22.7**	**18.8**	**97.4%**	**93**	**23.9**	**9.4**	**99.8%**

*Includes 14 non-revenue equipment positioning movements (scheduled and unscheduled) that are included in train delay analysis but are not included in OTP calculations.
**Reflects 6-Frequency *Piedmont* Operating Plan.
***The delta of one additional NS freight train in the Future Case represents organic freight traffic growth.

Both GTCR scenarios show a minor impact to Amtrak intercity operational performance, with OTP of around 97%. This is a minor impact that can likely be mitigated through adjustments to the commuter rail timetable and resolution of the freight impacts.

Both scenarios also show impacts to NS and CSX freight operations in the corridor, with modestly lesser impacts attributed to the high-level scenario. Delays to CSX trains in the model are minor; despite the increase in delay minutes, CSX trains actually experience an improvement in average operating speed, associated with the improved track infrastructure between Cary (CP Fetner) and Raleigh (CP Boylan). NS trains experience more significant delays, which are primarily associated with NS trains 350 and 351 that traverse the corridor in the AM Peak period and spend long periods of time service the NS Yard in East Durham between the GTCR East Durham and Ellis Road stations. Recommendations for addressing these delays, including modifications to the commuter rail timetable and a physical expansion of the yard tracks in East Durham, apply in both the low-level and high-level scenarios.

The improvement in the delay statistics in the high-level scenario is primarily attributable to the proposed additional track infrastructure and the assumed improvements to the signal system configuration for passenger trains. It is important to note again that these signal system improvements have not yet been designed and the benefits would need to be confirmed in future phases of work.

The project team also considered the impact of the high-level platform scenario on dwell times and the commuter rail timetable. The modeling team maintained an assumed 60 second dwell time for all stations (90 seconds at Raleigh) in both scenarios. The high-level platform configuration may allow for shorter dwell times given the improved level boarding configuration; peer railroad experience indicates a station dwell of 35 to 45 seconds may be feasible, for a time savings of 15 to 25 seconds per station. However, the high-level configuration also requires many diverging and merging trains moves to access the station platforms, which will tend to increase the running time; the modeling results estimated this time increase at 10 seconds per station.

With these impacts offsetting, the overall time savings per station is estimated at 5 to 15 seconds per station. While these benefits are real, such a modest decrease in travel time is not reflected in the scheduled timetable at this time. Other potential benefits of the high-level scenario, including reductions in the variability of station dwell times and increases in overall corridor capacity beyond the modeled timetable scenarios, have not been quantified at this time.

5. Rolling Stock Technology Options

As discussed in Section 4 above, the choice of approach in providing accessible boarding at stations across the system will not dictate the vehicle type chosen. Both locomotive-hauled passenger coaches and DMU trains exist at multiple floor heights and can be implemented with any accessible boarding approach. This section, therefore, offers a more comprehensive comparison of the vehicle types.

5.1. Locomotive-hauled coaches

A standard passenger train used in commuter rail operations consists of locomotive and multiple passenger coaches. The locomotive provides the motive power for the train, typically with either diesel power or electric power fed by overhead catenary. While hybrid- and battery-electric locomotives are under development, there are no service-provide models available today.

Passenger coaches come in a variety of sizes and configurations; the most typical configurations in commuter railroad use are high-floor coaches with a floor height of ~48 inches, and bi-level coaches with a low-level floor height of ~25 inches.

All locomotives and passenger coaches used in the US are fully-compliant with FRA standards for crashworthiness and can therefore be operated in shared use corridors with no additional approvals.

5.2. DMU vehicles

A DMU train consists of several self-powered cars, with the diesel engines on-board the vehicle. Alternative propulsion technologies are under varying degrees of development, including hydrogen fuel cell and battery-electric engines. These vehicles are typically smaller and lighter than standard passenger coaches, which gives them an appearance more like a light rail vehicle.

DMU trains have been developed at various floor heights similar to passenger coaches, including high-floor (~48 inch) and low-floor (~22 inch) floor heights. Recent projects in the US have largely been developed with the low-floor configuration, with most systems procuring the vehicles from the same single vendor.

For a long time, many low-floor DMUs did not meet FRA crashworthiness standards, given their lighter weight and smaller size. To maintain safety, FRA required that these vehicles only be operated in dedicated passenger corridors, or in some cases, granted shared use waivers that allow operation in shared-use corridors where it could be ensured that DMUs and mainline freight trains never operated at the same time.

Recent changes[9], however, have increased the opportunities for these vehicles. FRA has modified the process for achieving Alternate Compliance with the crashworthiness standards established in 49 CFR 238. Crash Energy Management (CEM) techniques that provide safety in the event of a crash are now acceptable in lieu of meeting certain vehicle weight and strength requirements for Tier I (standard speed) rail equipment; previously, CEM was only applied in Tier II and Tier III (high speed) rail equipment. The wider acceptance of CEM allows the lighter DMU vehicles to be used on shared-use corridors. Additionally, a DMU vehicle design approved for one corridor can now automatically be approved for other corridors, provided that it is the exact same design as the first system. These new changes have accelerated the roll-out of DMU projects in Texas and California, with the recently opened TexRail and the under construction DART Silver Line and San Bernardino Arrow; however, it is important to note that the requirement for pre-approval is tied to the same design being provided by the same single vendor.

5.3. Emissions & Sustainability

An additional important consideration for the selection of a vehicle type is the potential for the integration of new propulsion technologies aimed at reducing emissions and improving sustainability. Green technologies in vehicle propulsion are advancing rapidly, so GoTriangle must consider the state of technologies both today, over the next several years of project development, and at project implementation.

Both vehicle types discussed above – locomotives and DMUs – are currently configured at properties around the country with diesel engines. While modern diesel engines with Tier 4 emissions stanards may have lower emissions than in previous generations, these engines are still fueled by non-renewable sources.

DMUs are generally thought of as having lower emissions than diesel locomotives. This is because typically, locomotives have one very large diesel-electric engine, while DMU trains have 2-4 smaller diesel-electric engines. While the smaller DMU engines are specifically sized to the length of the train and the operational needs of the system, a diesel locomotive has the capability to pull many passenger coaches. While the GTCR project is considering trains with the equivalent of 2 to 4 passenger coaches, a representative diesel engine has the capability to pull 10 or more coaches. This potentially results in a locomotive train that has both a higher level of diesel emissions on a per-train basis, and a higher horsepower and resulting train performance on a per-train basis, than a DMU train with an equivalent passenger capacity.

Sustainable technologies are currently being researched and developed for both vehicle types. These developments include pilot projects with battery or hydrogen fuel cell multiple unit trains, as well as development of battery locomotives for industrial and freight uses. While these

[9] "Passenger Equipment Safety Standards; Standards for Alternative Compliance and High-Speed Trainsets", Federal Railroad Administration, November 2018

technologies are advancing rapidl, they should be considered to be “bleeding edge” developments for both train types.

As technology advances over the next decade, GoTriangle will have the opportunity to incorporate these technologies into procurement plans, or at the very least, to make plans to upgrade train propulsion types after project opening. A locomotive and coach solution may allow for the eventual replacement of the initial fleet of diesel locomotives without any change to the coach fleet. In the same way, DMU manufacturers also market that the power units of their trains can be designed to be swappable for different technologies.

5.4. Comparison of Rolling Stock Types

The following table presents a representative comparison between the two train types: locomotive-hauled coaches and DMUs. The representative train consists shown have similar passenger capacities, to make a fair comparison of potential trains that could be utilized on the GTCR project.

Certain other points are comparison are difficult to gauge, as they are dependent on the design details of a specific vehicle type and the specific configuration being evaluated. For example, questions around train operational performance and engine emissions are dependent on the size and configurations of the engines in a specific train type, as discussed above.

Table 4: Comparison of Locomotive-hauled Coaches and DMUs

		Standard Locomotive-hauled Train Consist		**Diesel Multiple Unit (DMU) Consist**	
Train Consist Makeup		1 Locomotive & 2 Bi-level Coaches		Diesel Multiple Unit trainset	
Train Length		~245 feet		~266 feet	
Train Capacity		436 passengers (300 seated / 136 standing)		450 passengers (224 seated / 226 standing)	
Representative Train Type		Siemens Charger locomotive Bombardier Bi-Level coaches		Stadler FLIRT	
Capital Cost (per trainset)		$14 - 17 M per trainset		$15 - 18 M per trainset	
O&M Cost (per trainset)		Typically lower 1 large engine		Typically higher 4 small engines	
FRA Compliance		Fully FRA Compliant		Alternative Compliance or FRA Waiver required	
Current Systems In-Service		***Low Floor***	***High Floor***	***Low Floor***	***High Floor***
Modern Commuter / Hybrid Systems		10 Modern	4 Modern	8 Hybrid	2 Hybrid
Floor Height		25 inches	48 inches	22 inches	48 inches
Accessibility Approaches	Level Boarding	Yes In-service	Yes In-service	Yes In-service	Yes In-service
	Car-borne lifts	Yes In-service	Yes In-service	Feasible Not in Service	Feasible Not in Service
	Mini-high platforms	Yes In-service	Yes In-service	Feasible Not in Service	Feasible Not in Service

6. Conclusions

This technical memorandum summarizes the analyses completed to date examining options for the provision of accessible boarding on the GTCR project and the implications for track, station, and vehicle design flowing from that decision. In summary:

1) Under Federal law, level boarding is the preferred approach to providing an ADA-compliant boarding environment for passengers. However, there are ADA-compliant approaches to assisted boarding that are common in shared-use corridors, and FRA will ultimately make determinations on a station-by-station basis.

2) Providing level boarding in the GTCR corridor would require the construction of dedicated passenger tracks at stations to comply with freight railroad design standards. Implementing level boarding at every station will have an incremental capital cost of $263 million.

3) The proposed track and signal configuration for level boarding at every station performed modestly better than the assisted boarding configuration in operational modeling, with fewer negative impacts to freight traffic. However, that configuration does not substitute for other required capacity improvements. The track and signal confiration offers only modest quantifiable operational benefits to passenger trains using the station tracks, but the primary benefit is simply the provision of unassisted level boarding. Both configurations appear feasible but would require interventions (schedule modifications or additional infrastructure) to achieve no impacts to freight traffic.

4) Both the assisted boarding and level boarding scenarios offer flexibility in rolling stock choices, as vehicles can be procured at a wide range of desirable vehicle floor heights and/or with assisted boarding equipment installed.

APPENDIX A – General Principles Guiding Norfolk Southern's Evaluation of Passenger Station Proposals

GENERAL PRINCIPLES GUIDING
NORFOLK SOUTHERN'S EVALUATION OF
PASSENGER STATION PROPOSALS

The following principles are a guide for planners of passenger station proposals when working with Norfolk Southern. Of course, each proposal necessarily is unique, and NS' application of the principles to particular proposals will often be context-specific as well. These principles should be read together with the latest General Principles Guiding NS's Evaluation of Intercity and Commuter Passenger Rail Proposals, when relevant. Early discussions with NS concerning any Passenger Station Proposal is highly recommended.

I. Important General Considerations.

A. Safety is our paramount concern. Design, maintenance practices, and operating patterns will always emphasize safety.

- When NS refers to safety in the context of proposed passenger projects, we refer to the safety of all touched by the proposal.
  - We refer to the residents of the communities through which we operate.
  - We refer to the safety of the passengers who will use the proposed passenger project, as well as invitees and others who will be visiting the rail corridor to pick up, drop off, or provide services to passengers.
  - And we refer to the safety of railroad employees – those who operate trains and maintain our right of way.
- Ultimately, the safety of passengers, invitees, and even trespassers, will be the responsibility of the passenger rail operator and the station owner, and safety must be their paramount concern as well.

B. Existing stations should not be considered to be precedent for station standards.

- Planners should not consider a particular feature or standard acceptable just because that feature or standard appears at an existing station.
- A great deal of regulatory, corporate, operations, technical, equipment and best practice history has gone into creating the current rail infrastructure, and what might have applied in the past may no longer be relevant.

C. Modifications to existing stations should be guided by these principles.

- Any substantial modification or rehabilitation of an existing passenger station should be guided by these principles, at least to the extent of the modification.

- Consultation with NS is necessary to determine whether efforts at compliance beyond the planned modification or rehabilitation are advisable in any particular proposal.

D. All potential impacts of a proposal must be evaluated as part of the planning process.

- As described in the General Principles Guiding Norfolk Southern's Evaluation of Intercity and Commuter Passenger Rail Proposals, any proposed or modified passenger operation must achieve "transparency" in the affected rail system. Transparency is the capacity for passenger trains and freight trains to operate without delay, however minimal, to each other, while still allowing for route maintenance.

- As applied to any modification of an existing station that would potentially affect rail operations, any proposed modification or rehabilitation must be evaluated by NS to determine that no operating restrictions of any kind are being introduced and that there will be the same level of system fluidity following the project as before the project, if not more.

    - For example, if a passenger station proposal is to convert an existing low-level platform station to a high-level platform station, some combination of newly constructed additional track(s) and relocation of existing track(s) would be necessary to provide required clearances for freight operations.

    - If a passenger station proposal is to create a new parking facility at an existing station, a full review of passenger safety infrastructure would be necessary.

- As applied to the introduction of a new station, a proposed project must be evaluated assuming full utilization of the proposed station – not only in terms of proposed passenger service that is currently covered by the immediate proposal but also other passenger service that could reasonably be foreseeable as utilizing the proposed new station.

- NS will coordinate the operational feasibility study. The cost of the study (including NS' time) is the responsibility of the sponsoring public agency. For planning purposes, NS can estimate study costs in advance. Studies are detailed and specific and take a year, and often longer, to complete.

II. Separate Dedicated Passenger Station Tracks.

A. Separate dedicated passenger station tracks will be required whenever a planned station dwell is other than brief.

- Whenever a station is to be the site for maintenance, layover, crew change, equipment change, refueling, or extended boarding and debarking activities, that station's platform track(s) and ancillary track(s) must be separate, dedicated passenger station track(s) in order to release the mainline for through operations.

- Accommodating these station related track(s), while preserving future locations for railroad facilities (e.g., track alignment(s), signal and communications installations) for freight operations, can be costly. Any necessary property purchase would be the responsibility of the project sponsor.

B. Separate, dedicated, passenger station tracks will be required whenever there is a high-level platform or other clearance obstruction involved that does not comply with NS's standard clearance requirements.

- Separate, dedicated, passenger station tracks should be double ended, connecting with the main line track on each end with dispatcher controlled, power turnouts. The turnout should be sufficient to provide reasonable passenger ride quality and reduced maintenance – in railroad terms not less than a "No. 15 turnout".

III. High-Level vs Low-Level Platforms.

A. High-level platforms are acceptable on separate dedicated passenger station tracks only.

- Because high-level platforms preclude the movement of extra-dimensional shipments and greatly restrict the movement of standard shipments, high-level platforms are reserved for locations with separate dedicated station tracks. Design of station tracks must preserve the ability of NS to expand its own freight railroad facilities and operations, including modifications and additions to the existing track corridor and signal and communications installations.

- Extra attention should be paid to safeguards at locations with high-level platforms to ensure the safety of passengers, railway workers and trespassers who (intentionally or not) happen to be located on the ground and in the "well" between two high-level platforms or between a high-level platform and any fencing or other barrier.

- High level platforms must provide a horizontal clearance of at least 5 feet – 7 inches measured from the centerline of the nearest track to the edge of platform, and have an elevation not higher than 4 feet – 0 inches above the top of the rail.

- High-level platforms should be designed to be located completely along tangent track. Construction of a high-level platform along a curve is highly discouraged.

    - If a high-level platform cannot be constructed along tangent track, then adjacent curves may not be sharper than 1 degree 40 minutes.

    - Constructing a high-level platform along a curve introduces the need to modify the horizontal clearance to correct for the introduced curvature.

    - Constructing a high-level platform along a curve further introduces modifications to the gap that will exist between passenger rail cars and the high-level platform. The project sponsor must take into consideration any resulting modifications to the gap anticipated by the construction of a high-level platform along a curve.

    - Clearance information must be submitted to NS for review.

B. <u>Low-level platforms are required where the passenger station platform is on shared freight/passenger trackage</u>.

- Low-level platforms must provide a horizontal clearance of at least 5 feet - 4 inches measured from the centerline of the nearest track to the edge of platform, and rise to a level no higher than 8 inches above the top of the rail.

- Low-level platforms must not be located on or within 90 feet of a curve.

C. <u>Mini-high-level platforms are discouraged</u>.

- If permitted, mini-high-level platforms must be constructed with the platform edge no closer than 8 feet - 6 inches from the centerline of the nearest freight track.

- Passenger car vestibule/platform edge gap reduction methods may not result in clearance less than the 8 feet - 6 inches requirement.

IV. Station Track Separation.

- Station track vicinities must be designed to permit maintenance of the freight tracks either: (1) by separation from the nearest freight track by a minimum of 26 feet measured between the track centerlines of the freight and nearest station track with the separation being minimally held between the measured ends of the nearest platform, or (2) accommodating additional track or right of way separation to permit maintenance on the side away from the affected station track(s).

- Station tracks must be separated from the nearest freight track by a barrier fence installed not closer than 15 feet from the centerline of the nearest freight track and being not less than 6 feet in height. For potential maintenance purposes, barrier fence will consist of sections, including the above ground posts, which can be temporarily removed and restored by hand without further disassembly, damage or the need for machine assistance.

V. Pedestrian and Rubber Wheeled Vehicle Safety.

A. Particular attention should be focused on ensuring the safety of all pedestrians in the greater passenger station area.

- Passenger stations must be designed to ensure the safety of persons on foot whether those people are following established entry/exit routes, trespassing in order to reach the station or parking facilities, or attempting to exit the area in the event of an emergency.

- Passenger station facilities must be designed to create easy and safe established entry/exit routes to facilitate compliance with those routes.

    - Overhead bridges or under grade tunnels are required for any station parking facilities located across the tracks from the station platform.

    - Emergency exit routes should be developed to facilitate the movement of passengers from the platform area in the event of an emergency that precludes the use of established entry/exit routes.

- Passenger station facilities should be designed and located to discourage trespassing and unauthorized entry/exit routes.

    - Fencing will be required to discourage efforts to enter or exit the platform, or to move from one platform to another, over active rail lines.

- Passenger stations must be located away from highway-rail grade crossing locations so as to discourage the use of the roadway as a means for pedestrians crossing the tracks.

- Split platforms (platforms bisected by an active roadway) are not permitted.

VI. Single vs Dual Track Access; Center Island vs Outside Platforms.

A. Stations located along a double-track segment should have platforms adjacent to each outside main line.

- Any station located along a single-track segment must be designed in such a way as to easily be converted to a double-track configuration in the event that a second track is constructed. All costs association with a single-track to double track conversion will be the responsibility of the station owner.

B. A center island platform may be permitted only in the event that outside platforms prove unworkable.

- A center island platform should be low-level and provide emergency, alternate, footpath exit routes which do not cross any track at grade but lead to safe zones when grade separated routes are not feasible.

- Platforms must have controlled access to prevent passengers from accessing the platform prior to the arrival of a passenger train.

- Gauntlet tracks are not permitted.

- Passenger access to a center island platform must be by undertrack tunnel or overhead walkway bridge.

VII. Canopies and other features.

A. Canopies are permitted subject to design, clearance and maintenance considerations.

- Only gutter-less canopies are permitted.

- Gutter-less canopies must slope away from the tracks to focus rain runoff away from the rail right of way.

- The side clearance for gutter-less canopies must be at least 9 feet on tangent track.

- The side clearance for gutter-less canopies must be increased 1 and 1/2 inch per degree of curvature in curved track.

- In addition, the side clearance for gutter-less canopies must be increased 4 and 1/2 inch per inch of super elevation, measured at a height of 16 feet - 2 inches above top of rail, where the cars lean into the canopy.

- If the project sponsor desires for the canopy to extend over the track, it must provide at least 23 feet of vertical clearance measured from the top of rail or the top of the high rail (if track is super-elevated).

B. <u>Any railing or other feature that occupies the space above the top of the platform surface must meet the same clearance requirements of this section.</u>

<u>VIII. Future Modifications to Stations and Discontinuance of Use</u>.

A. <u>Should regulatory mandates require modifications to stations, the station owner will incur all modification costs.</u>

- Such modification must be performed in a manner that does not adversely affect safety, freight operations, freight capacity, and maintenance of the track and station infrastructure.

B. If the use of a station facility is or is expected to be discontinued for a period exceeding three (3) years, the platform and other features affecting drainage and impeding track maintenance must be removed and any modified track geometry restored to the satisfaction of NS.

a. Such modifications shall be performed at no cost to NS.

<u>IX. Costs Associated with Passenger Station Projects</u>.

A. <u>All costs associated with the study, implementation and maintenance of a passenger station project will be covered by parties other than NS</u>.

- The cost of a passenger station project includes fair compensation for use of NS's transportation corridors.

- NS's transportation corridors consist of track and right-of-way that might, or might not, be fully utilized at any given time. As rail traffic flows change over time, this capacity, and the flexibility and potential it represents, is a key NS asset.

- In determining a fair price for use of assets, NS will factor in any new equipment (including Positive Train Control) and costs, as well as additional property and other taxes that would not be incurred absent passenger service project.

- It is possible that public funding may be taxable to NS. Any public funding provided in support of a passenger station project must be grossed up to offset identified tax liabilities incurred by NS.

B. New and expanded passenger projects require adequate liability protection.

- Passenger station operators must indemnify NS for additional risk created by the passenger station projects, and any such indemnification needs to be backed up by an adequate level of insurance. This includes coverage for risks that may not be covered by the current passenger rail operator, if any.

- Liability issues can create major hurdles. Often, sovereign immunity issues must be overcome. The cost to the passenger carrier for insurance and indemnification is substantial, as borne out by our experience with commuter authorities.

C. Any new or substantially modified passenger station or related facility must be owned by parties other than NS.

- The project sponsor or another party must be designated for ownership and ongoing responsibility of any new or substantially modified facilities.

Additional Station Planning Guidelines.

There are several aspects of the station planning process that NS will be subject to regulations or guidelines set forth by others. Those should be consulted.

NS cannot provide regulatory compliance advice, but does recommend that planners consult and comply with applicable regulations imposed by the Federal Transit Administration and the Federal Railroad Administration.

Also, in its Station Program and Planning Guide, Amtrak sets for guidelines on platform length, width and live loading. Passenger station planners should refer to these guidelines in designing the proposed station, keeping in mind and accommodating the principles set forth by NS. The Amtrak Station Program and Planning Guide is available at: http://www.greatamericanstations.com/planning-development/station-planning-guidelines.

APPENDIX B – Summary of Modern Commuter Rail and Hybrid DMU Systems

Peer System	Location	Operator	Corridor Type	ROW Owner	Owner Type	*ROW Notes*	Freight Traffic	Passenger Traffic	Passenger Service	Train Floor Height	Method of Accessibility		
											Level Boarding	Mini-Highs	Car-borne Lifts
Modern Commuter Rail Systems													
Sounder	Seattle	BNSF	Shared	BNSF	Class I RR		BNSF	North: 2 roundtrips South: 9 roundtrips	Peak Focused	Low, 25"		X	
Tri-Rail	Miami	Herzog	Shared	SFRTA / FLDOT	Agency	*RR sold ROW*	CSX	25 roundtrips	Peak Focused	Low, 25"		X	
TRE	Dallas-Forth Worth	Herzog	Shared	DART/TRE	Agency	*RR sold ROW*	BNSF, UP, short lines	35 roundtrips	30 Peak/60 Off	Low, 25"		X	
RailRunner	New Mexico	Herzog	Shared	NMDOT	Agency	*RR sold ROW*	BNSF, short line	12 roundtrips	Peak Focused	Low, 25"		X	
Coaster	San Diego	Bombardier	Shared	NCTD	Agency	*RR sold ROW*	BNSF	12 roundtrips	Peak Focused	Low, 25"		X	
Caltrain	SF Bay Area	Transit America Services Inc (TASI)	Shared	Caltrain	Agency	*Could be Legacy*	UP	35 roundtrips	30 Day/60 Night	Low, 25"		X	
Metrolink	Los Angeles	Amtrak	Shared	BNSF/UP; Metrolink	Class I RR / Agency	*Could be Legacy*	BNSF / UP	Nearly 100 roundtrips Multiple lines	30/60 variable	Low, 25"		X	
ACE	SF Bay Area	Herzog	Shared	UP / Caltrain	Class I RR / Agency		UP	4 roundtrips	Peak Focused	Low, 25"		X	
SunRail	Orlando	Bombardier	Shared	CFCRC / FLDOT	Agency	*RR sold ROW*	CSX (night)	20 roundtrips	30 Peak/90 Off	Low, 25"		X	X
Northstar	Minneapolis	BNSF	Shared	BNSF	Class I RR		BNSF	4 roundtrips	Peak Focused	Low, 25"		X	X
Music City Star	Nashville	Transit Solutions Group	Shared	Nashville & Eastern RR	Short Line RR		Short Line RR	4 roundtrips	Peak Focused	High, 48"		X	
VRE	Virginia	Keolis	Shared	Amtrak/CSX/NS	Class I RR		CSX / NS	16 roundtrips (2 lines)	Peak Focused	High, 48"			X
Frontrunner	Salt Lake City	UTA - Agency	Exclusive	UTA	Agency	*RR sold ROW*	UP (night)	25 roundtrips	30 Peak/60 Off	Low, 25"	X		
RTD A Line	Denver	RTD-Agency (N) Denver Transit Partners (A,B,G)	Exclusive	RTD	Agency		N/A	A: 72 roundtrips B: 18 roundtrips G: 40 roundtrips N: 36 roundtrips	A: 15-min N: 60-min G: 30-min N: 30 min	High, 48"	X		
Hybrid Rail (DMU) Systems													
SMART	SF Bay Area	Agency	Shared	Northwestern Pacific RR / SMART	Short Line RR / Agency	*RR sold ROW*	Short Line RR	20 roundtrips	60-min	High, 48"	X		
Westside Express Service	Portland	P&W RR	Shared	Tri-Met / Portland & Western RR	Short Line RR / Agency		P&W RR	16 roundtrips	Peak Focused	High, 48"	X		
RiverLine	Southern NJ	Bombardier	Shared	NJ Transit	Agency	*RR sold ROW*	Conrail	44 roundtrips	15 Peak / 30 Off	Low, 23"	X		
Capital Metro	Austin	Herzog	Shared	Capital Metro	Agency	*RR sold ROW*	Short Line RR	25 roundtrips	30 Peak/60 Off	Low, 23"	X		
A-Train	Dallas Forth Worth	First Transit	Shared	DCTA	Agency	*RR sold ROW*	Short Line RR	22 roundtrips	30 Peak/60 Off	Low, 23"	X		
eBART	SF Bay Area	BART - Agency	Exclusive	BART	Agency	*New ROW*	N/A	46 roundtrips	15 Peak / 30 Off	Low, 23"	X		
Oceanside Sprinter	San Diego	Bombardier	Shared	NCTD	Agency	*RR sold ROW*	BNSF	40 roundtrips	30-min all day	Low, 23"	X		
TEXRail	Dallas Forth Worth	Trinity Metro - Agency	Shared	UP / Trinity Metro	Class I RR / Short Line RR / Agency		UP, Short Line RRs	36 roundtrips	30 Peak/60 Off	Low, 22"	X		
DART Silver Line	Dallas Forth Worth	DART - Agency	Shared	DART	Agency	*RR sold ROW*	BNSF, Short Line RRs	~25 roundtrips	30 Peak/60 Off	Low, 22"	X		
Future:													
Arrow Commuter Rail	*San Bernadino*	*SCRRA*	*Shared*	*BNSF / Metrolink*	*Agency*		*BNSF*	*~25 roundtrips*	*30 Peak/60 Off*	*Low, 22"*	*X*		