Report to Congress **VOLUME I**

Potential Improvements to the Washington—Richmond Railroad Corridor

National Railroad Passenger Corporation

May 1999

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Amtrak

May 26, 1999

Honorable Richard C. Shelby
Chairman
Subcommittee on Transportation
United States Senate
Washington, DC 20510

Dear Chairman Shelby :

The Omnibus Consolidated Emergency Supplemental Appropriations Act for Fiscal Year 1999 directed Amtrak to identify the improvements and estimated costs necessary to support higher-speed passenger service between Washington, DC, and Richmond, Virginia. This report, which was prepared by Amtrak in conjunction with the Federal Railroad Administration (FRA), outlines a transportation plan for this corridor and specifies, on a preliminary basis, the infrastructure improvements necessary to accommodate higher-speed rail passenger service, an increased level of commuter services and additional freight service along this track.

Amtrak and the State of Virginia view the Washington-to-Richmond corridor as a logical extension of the Northeast Corridor and as a key area for market growth. Currently, this corridor handles several Washington to Richmond and Newport News Amtrak intercity trains, in addition to long-distance service between New York and Miami. The Virginia Rail Express (VRE) commuter service, operated by Amtrak, also uses a portion of this corridor between Washington and Richmond. Beyond the passenger rail uses, CSX Transportation Company (CSX) -- the owner of this track -- operates a significant amount of freight traffic linking southern and northern markets. The report attempts to lay out a framework for development of this corridor over the next 15 years.

Since its initial construction prior to and after the Civil War, this corridor has been a major connecting line for all north/south rail service -- both passenger and freight. While most of the corridor is double tracked and signaled for speeds in excess of 79 mph passenger traffic, additional passenger and freight growth will require significant upgrades to the infrastructure, and in some areas, particularly northern Virginia, the construction of a third track. The signaling system dates back to the 1920s. While safe for existing speeds and current utilization, this system will need significant upgrades to support higher speeds and additional traffic. In addition, the corridor has numerous highway rail grade crossings, an issue which also needs to be addressed.

For several years now, Amtrak, in conjunction with the FRA, the Virginia Department of Transportation (VDOT), and CSX have discussed what it would take to improve the existing infrastructure to support additional traffic including higher-speed rail passenger service. The growing congestion along Interstate 95, which parallels much of this route, makes this corridor an attractive candidate for higher utilization of passenger rail. This report details current utilization and condition of the corridor, planning methodologies, goals to support service levels envisioned by the Year 2015, and the investment requirements needed to achieve these goals. The second part of the report provides an in-depth analysis of the infrastructure needs to support the planning requirements by the Year 2015. All in all, both volumes provide an in-depth analysis and estimated costs to achieve the goals assumed in the Year 2015. Amtrak, FRA, VRE, VDOT, and CSX realize the importance of this corridor not just to the respective users, but to the entire region.

It is our hope that this report will act as a catalyst for further discussion and development of this corridor to support higher levels of rail utilization. We look forward to working with you to formulate a plan that will realize the goals of this report.

Sincerely,

George D. Warrington
President and Chief Executive Officer

National Railroad Passenger Corporation, 60 Massachusetts Avenue, N.E., Washington, DC 20002 Telephone (202) 906-3000

Amtrak

May 26, 1999

Honorable Frank R. Wolf
Chairman
Subcommittee on Transportation
U.S. House of Representatives
Washington, DC 20515

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Report to Congress

Potential Improvements to the Washington—Richmond Railroad Corridor

May 1999
EXECUTIVE SUMMARY

INTRODUCTION

Congressional Mandate

This report on possible improvements to the Washington–Richmond railroad corridor responds to explicit Congressional mandates in the context of analytical requirements and the evolving needs of the freight railroad industry, commuter authorities, Amtrak, and the Southeast Corridor states—most prominently, Virginia and North Carolina.[1] In the Omnibus Consolidated Emergency Supplemental Appropriations Act for Fiscal Year 1999,[2] Congress directed that Amtrak identify, by March 1, 1999, improvements (and estimated costs) necessary on track between Washington, D.C. and Richmond, Virginia so that passenger trains could operate at higher speeds. Meanwhile, in carrying out a prior Congressional directive to develop a transportation plan for the southerly half of the Northeast Corridor, Amtrak and the Federal Railroad Administration (FRA) had jointly identified operational linkages at Union Station, Washington, between the New York-Washington and Washington–Richmond routes. So intertwined were operating schedules, practices, and performance for rail services north and south of Washington that Amtrak and the FRA decided to fulfill both an obvious planning need and the intent of Congress by extending their ongoing collaborative analyses south to Richmond. This effort is all the more timely because of the pending restructuring of Northeastern rail freight service, expected growth in commuter travel in the Washington area, and the opportunity—fostered by Amtrak, FRA, and the farsighted Southeast Corridor states—for through, high-speed train service between Northeast and Southeast Corridor points.

The study scope was confined to fixed facility improvements that would safely support intended train schedules, frequencies, and service reliability through the year 2015. "Service reliability"—that is, on-time performance for passenger and scheduled freight services, and the consistent, expeditious, and economic movement of other freight trains—is of utmost importance because without it, higher passenger train speeds and frequencies, and restructured, modernized freight operations, cannot penetrate their intended markets.

Other types of improvements, including some which would be prerequisite to the desired service and safety levels, did not undergo analysis: for example, provision of locomotives and cars, grade crossing hazard reduction, and development of station parking and amenities. These categories of improvement will require careful attention in the more detailed planning and design that must precede any significant investment in the Corridor.

[1] Subsequent to completion of this analysis, the Southeast Corridor was extended to include South Carolina, Georgia, and Florida.
[2] Public Law 105-277.

Conceptual Framework

Report Purpose

This report aims at specifying, on a preliminary basis, the infrastructure improvements that would enable the Washington–Richmond Corridor to accommodate reliably the mix and volume of higher speed intercity passenger, commuter, and freight services that the line's operators and public partners foresee for the year 2015.

Approach

The Washington Richmond Corridor already experiences capacity shortfalls; its many services face dependability challenges even at year 1999 service levels. To establish the investment needs for **reliable** services, this study has adopted a fifteen-year planning horizon, which would allow sufficient time for high-speed and other improvements to be constructed and implemented in a logical sequence.

In view of the multiple uses of the Washington-Richmond Corridor, proper performance of the study necessitated a team effort by Amtrak, FRA, the Commonwealth of Virginia, Virginia Railway Express (as the commuter authority most immediately concerned with the line), and the freight railroad right-of-way owners: CSX Transportation, Inc. (CSX) and Norfolk Southern (NS).

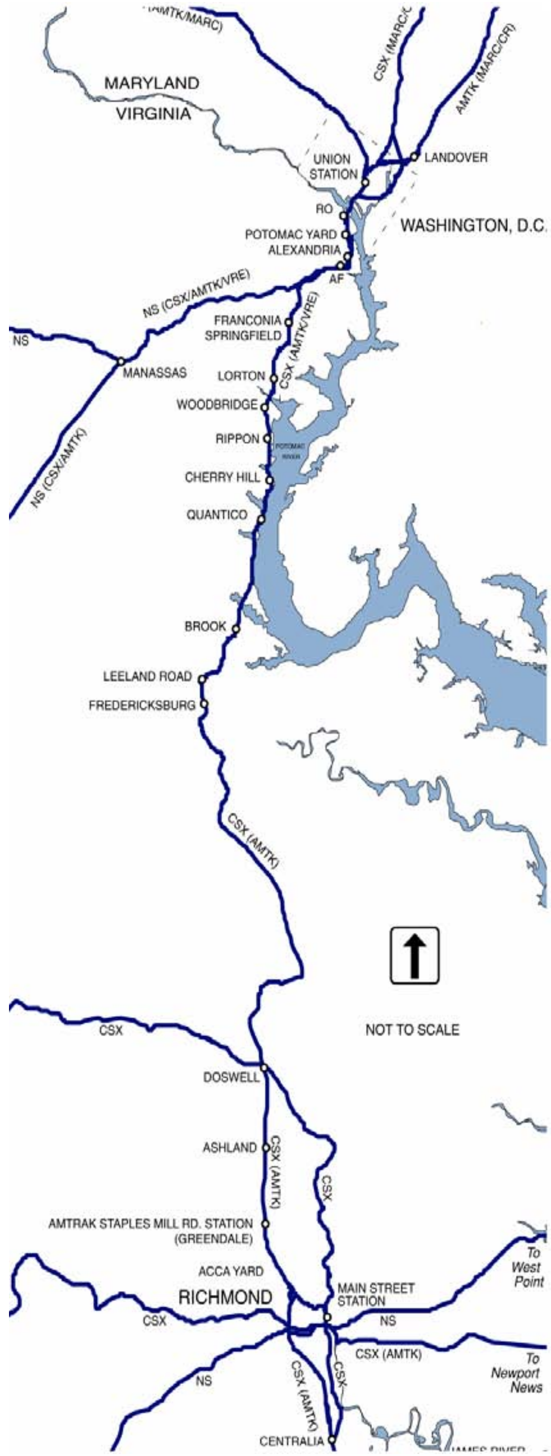
The study is based on the following comprehensive analytical approach:

- Assess current facilities, services and operating conditions on the route;
- Characterize service needs for the planning year 2015;
- Conduct operational analyses simulating the performance of future (year 2015) services over various configurations of infrastructure; and
- Identify the infrastructure investments that would allow the Corridor's operators to achieve their intended 2015 service quality and train volumes with satisfactory reliability.

The following sections address each of these tasks in summary; the Main Report provides further details for every task.

THE CORRIDOR TODAY

Figure 1: Washington–Richmond Corridor

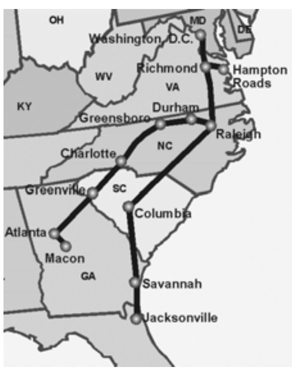


Fixed Plant

Location

The Washington–Richmond Corridor (Figure 1) is a segment of the Southeast Corridor, which the Secretary of Transportation formally designated as an emerging high-speed rail line under the Intermodal Surface Transportation Efficiency Act of 1991. Depicted in Figure 2, the Southeast Corridor reaches from Washington south to Richmond, Raleigh, Greensboro, Charlotte, Atlanta, and Macon; also from Richmond to Hampton Roads, and from Raleigh south to Columbia, Savannah, and Jacksonville. For convenience, the present report refers to the Southeast Corridor segment between Washington and Richmond as the **Washington–Richmond Corridor.**

Figure 2
Southeast Corridor



Length and ownership

The Washington–Richmond Corridor extends for 118 miles between Union Station, Washington and Main Street Station, Richmond.[3] The primary owner of the Corridor is CSX. Approximately two miles between Arlington and "Control Point (CP) Virginia" now[4] belong to

[3] This is not now an operational station but will be reopened under pending plans.
[4] As of February 1999. The ownership transfer will occur when the Conrail acquisition by CSX and NS is completed later in 1999.

Conrail and will soon shift to CSX ownership. Amtrak owns one mile of trackage at the southern approach to Washington Union Station.

Trackage and Track Conditions

The line has two tracks except for a single-track bridge over Quantico Creek, and three short stretches of third track in Alexandria, Possum Point (north of Quantico Creek), and Fredericksburg. The owner railroads have maintained the line in a condition satisfactory for the current designated operating speed class.

Alignment

Over 100 curves—many exceeding two degrees of curvature, with minimal spirals—help to limit the line's current maximum allowable operating speed to 70 mph, thus constraining passenger train performance.

Signaling

Dating back to the 1920s, the automatic block signaling system on the Corridor—although safe for existing speed levels—has outlived its economic and physical life. Because the original design of the system was highly advanced, with continuous cab signaling and automatic train control features similar to those of the Northeast Corridor north of Washington, the upgrading necessary for high-speed rail service is relatively modest.

CSX has recently completed a program to make the system fully compatible with the system found on the Northeast Corridor and major Conrail routes, by converting the cab signal frequency from 60 to 100 hz in anticipation of the planned restructuring of freight operations.

Highway-Railroad Grade Crossings

Like most proposed high-speed corridors, Washington–Richmond contains numerous highway-rail grade crossings: 52 on public roads and 13 for access to private property. Almost all the public crossings have, at a minimum, crossbucks, flashing lights, gates, and ringing bells. The private crossings have no such protective devices in most cases. Every effort should be made to close, or grade-separate, as many crossings as possible.

Stations

Passenger service is currently offered at 13 stations, of which 6 are for Virginia Railway Express (VRE) commuter service only, 5 serve VRE and Amtrak, and 2 accommodate Amtrak only.[5] The VRE stations have platforms only on one side of the tracks, thereby limiting operating flexibility and contributing to existing capacity constraints. In the Richmond area, Amtrak trains stop at Staples Mill Road only; the City of Richmond is restoring, in three phases, the centrally-located Main Street Station as an intermodal facility, to include the operation of intercity trains.

Users and Services

Like the Northeast Corridor, the Washington–Richmond Corridor fulfills multiple, equally important transportation purposes: Amtrak intercity service, VRE commuter operations, and freight service of the CSX and NS railroads.

Amtrak

Amtrak provides three distinct lines of business on this corridor:

- Corridor-type services—daylight trains geared to short-haul trips in the 100-500 mile range. Currently, all such daily services operate as extensions of Northeast Corridor trains[6];
- Long-distance services—overnight trains serving long-haul and leisure travel; and
- Auto Train—a specialized service carrying passengers and their motor vehicles to and from Florida.

VRE Commuter Service

VRE currently operates (by means of Amtrak, its contractor) six weekday commuter round trips between Washington and Fredericksburg. Another seven VRE round trips, operating to Manassas, make use of the Washington-Alexandria portion of the Washington–Richmond Corridor.

Freight

CSX, the primary user, operates freight trains over the entire corridor from Richmond to Washington, and serves local shippers as well; NS, by contrast, traverses only the segment between Washington and Alexandria, where its main line diverges to the southwest, toward Manassas and Charlottesville. In total, about 20 freight trains per day typically operate on the busiest segment (Alexandria-Washington). Most freight trains

[5] In addition, Amtrak has a special-purpose terminal at Lorton for Auto Train customers.

provide general merchandise and intermodal service. Unit coal trains, operating without intermediate switching between origin mines and the utility plant, serve a principal destination—the Virginia Electric Power Company plant at Possum Point, on Quantico Creek.

Freight operations are much more variable than passenger services in terms of arrival and departure times, train size, train performance, and frequency in a given period of time. Freight trains vary significantly in their performance capabilities and compatibility with passenger operations: for example, unit trains of coal and grain generally have a lower horsepower-to-tonnage ratio than more time-sensitive operations. Thus, a general merchandise or intermodal train ordinarily takes less time to clear a given route segment than a unit coal train.

Because almost all intercity passenger and commuter trains on the Washington–Richmond Corridor operate during daylight hours, the line would, in theory, offer more flexibility to freight operations late at night. In practice, however, the for-profit freight carriers have far-flung operations of which the Washington–Richmond Corridor constitutes but one segment. Customer demands, scheduling requirements, and operating constraints elsewhere on their extremely large and complex networks have led the freight railroads to cluster their trains between Washington and Richmond in the 11:00 a.m. to 6:00 p.m. period. Conflicts between freight, intercity passenger, and commuter operations have ensued, particularly during the evening rush hour. **Therefore, the need to provide service reliability for intercity passenger, commuter, and freight trains alike during the evening peak has governed the design and evaluation of the improvements contemplated in this report.**

As explained below, the need to efficiently manage peak traffic will become even more critical in the future: not only will rail passenger travel increase, but CSX and NS have also projected higher levels of freight traffic as a result of their acquisition of Conrail. In fact, the "I-95" Corridor, which parallels the Northeast and Washington- Richmond Corridors, has been identified as one of the key growth lanes for the two freight companies.

Current service levels for all operators appear in Table 1. The table is divided at Alexandria because the junction with the NS is immediately south of the station.

Existing Service Quality

With today's fixed plant, operating capabilities, and traffic volumes, delays are already affecting intercity passenger, commuter, and freight trains on the Washington–Richmond Corridor, particularly in the segment between Washington and Alexandria, at the six-mile-

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[6] The Fall/Winter 1998-99 schedule includes one weekend train operating from Newport News to Washington.

long Franconia Hill, and at the Amtrak Auto Train facility in Lorton. Paralleling a long-term decline in total train operations, the line's throughput has waned since the 1950s; yet the concentration of passenger operations has increased during the rush hours, thus compromising service quality. For example, the lower level of Washington Union Station (accommodating through service to and from the South) now handles four times as many rush hour train movements as it did in 1930, with fewer tracks and passenger platforms now available.[7] South of Union Station, a number of daily freight train operations during the same peak hours further reduce the reliability of all services. It is not uncommon to see four freight trains "on hold" in Alexandria (waiting for passenger trains to clear the tracks) during the evening peak.

Table 1: Existing Railroad Services on the Washington–Richmond Corridor

Service	Route	Number of Daily Train Movements (Round-Trips)	
		Washington to Alexandria	**Alexandria to Richmond**
	AMTRAK		
Corridor-type services	Newport News—Northeast Corridor	2	2
	Richmond—Northeast Corridor	2	2
	North Carolina—Northeast Corridor	1	1
Total, Corridor-type services		*5*	*5*
Long-distance services	Florida—Northeast Corridor	3	3
	New Orleans—Northeast Corridor	1	
	Chicago—Cincinnati— Northeast Corridor	1	
Total, Long-distance services		*5*	*3*
Auto Train	Lorton, Virginia—Sanford, Florida		1
Total Amtrak		***10***	***9***
	VIRGINIA RAILWAY EXPRESS (VRE)		
Commuter service	Washington—Manassas	7	
	Washington—Fredericksburg	6	6
Total VRE		***13***	***6***
	FREIGHT		
All freight services *(CSX and Norfolk Southern)*[8]		***13***	***12***
GRAND TOTAL WASHINGTON—RICHMOND CORRIDOR		***36***	***27***

Recent incidents have drawn public attention to the line's current lack of operating flexibility. During the Summer of 1997, routine track maintenance work between Quantico and Fredericksburg resulted in numerous substantial daily delays to Amtrak and VRE trains.

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[7] Cf. the main report for further details.
[8] Because of the variability and directional imbalance of freight traffic, the numbers shown here (expressed as daily round trips for comparability with the other services) are rough approximations.

On average, Amtrak and VRE trains were running an hour late because a 20-mile segment of track was closed daily for maintenance. Only a single track was available to run multiple trains in both directions. While expressing an understanding of the situation, many commuters cited the need to get to work reliably and adopted other means of transport. VRE ridership suffered significantly. A derailment at RO Interlocking[9] during August 1997 further worsened system performance, to the point that VRE canceled half of its daily schedule, reasoning that it was better for some trains to run on time than for all trains to operate late.

In light of these service quality trends, the line's capacity and future would merit close scrutiny even in the absence of plans for high-speed passenger service, and underpins the need for, and the timeliness of, this report, that contemplates a future for the Corridor with high-speed passenger service.

Areas of Special Complexity

The mix of facilities, services, and surrounding land uses in the Washington-Richmond Corridor poses special challenges in the following three locations in the District of Columbia and Virginia:

- **Washington** requires especially careful consideration because of such factors as the following (see Figure 4, page 18):
    - **Washington Union Station** suffers from track capacity limitations in handling resurgent intercity travel on Amtrak's Northeast Corridor as well as heavy commuter volumes (of both VRE and the Maryland MARC commuter system) for which the station's infrastructure was not originally designed.
    - **VRE** has added a completely new service to the already congested area between Alexandria and Washington Union Station. Its commuter stations have platforms on one track only, thus hindering operating flexibility. For example, the L'Enfant Plaza station—VRE's busiest—was the subject of a separate study because of its impacts on all railroad operations in Southwest D.C.
    - A proposed change in commuter service—allowing selected MARC services to access L'Enfant Plaza and possibly other VRE stations—would have noticeable impacts on other Washington-area rail operations.

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[9] At the south end of the Potomac River bridge. See Figure 4.

- The **Virginia Avenue Tunnel**, which feeds all freight traffic to and from the Washington-Richmond Corridor, is a single-track facility with a 10 mph speed limit. This highly constrained trackage exacerbates the bottleneck affecting all rail services in Southwest D.C.

- The **Long Bridge**, carrying the Washington-Richmond Corridor across the Potomac River, passes through protected Federal parkland; any additions to the bridge's capacity would likely be subject to intensive environmental reviews, such as a 4(f) statement.

- In **Ashland,** the rail line traverses the heart of the city, punctuated by seven road and 12 pedestrian crossings. Existing speed restrictions at Ashland could be difficult to remove in an economical way that accords with local planning considerations.

- **Richmond.** The suburban location of Amtrak's Richmond station—at Staples Mill Road, eight miles north of the centrally-sited but currently unused Main Street Station—impedes rail's ability to compete with other modes, particularly for business travel in the 118-mile Washington—Richmond city pair market. The City of Richmond, in cooperation with CSX, the Virginia Department of Rail and Public Transportation, Amtrak, FRA, and others, has planned for its reactivation and has completed designs for the station. However, over the past quarter-century, the rail passenger infrastructure has deteriorated in metropolitan Richmond, where heavily used grade crossings abound and freight service requirements pose capacity challenges for current and future passenger operations. Acca Yard, for example, has in recent years absorbed some of the functions of the former Potomac Yard in Alexandria, and frequently becomes congested, a condition worsened by the need to provide operating windows for passenger trains. (See Figure 5, page 20.)

The Main Report presents further details on these and other areas of special complexity.

SERVICE GOALS

All operators and sponsors—intercity passenger, commuter, and freight—intend the services on the Washington-Richmond Corridor in the target planning year, 2015, to be more reliable than those operating on the Corridor at present. The envisioned mix of services is presented in Table 2 and described below.

Table 2: Railroad Services Envisioned for 2015 on the Washington–Richmond Corridor

Service	Route	Number of Daily Train Movements (Round-Trips)	
		Washington to Alexandria	**Alexandria to Richmond**
	AMTRAK		
Corridor-type services	Newport News—Northeast Corridor	3	3
	Richmond—Northeast Corridor	3	3
	North Carolina—Northeast Corridor	4	4
	Bristol-Washington	*2*	
Total, Corridor-type services		*12*	*10*
Long-distance services	Florida—Northeast *Corridor*	4	4
	New Orleans—Northeast Corridor	2	
	Chicago—Cincinnati— Northeast Corridor	1	
Total, Long-distance services		*7*	*4*
Auto Train	Lorton, Virginia—Sanford, Florida		1
Total Amtrak		***19***	***15***
	VIRGINIA RAILWAY EXPRESS (VRE)		
Commuter service	Washington—Manassas	22	
	Washington—Fredericksburg	22	22
Total VRE		***44***	***22***
	FREIGHT		
All freight services *(CSX and Norfolk Southern)* [10]		***17***	***16***
GRAND TOTAL WASHINGTON—RICHMOND CORRIDOR		***80***	***53***

[10] Because of the variability and directional imbalance of freight traffic, the numbers shown here (expressed as daily round trips for comparability with the other services) are rough approximations.

Intercity Passenger

Corridor-Type Services

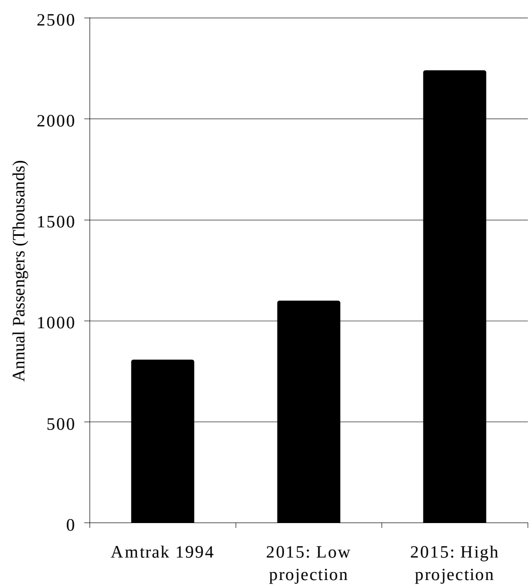
A strong demand would exist for corridor-type high-speed intercity train service between Washington and Richmond if such service were to be provided. This is the message of studies prepared for the Commonwealth of Virginia, which project a significant increase in intercity rail travel demand on the Washington–Richmond Corridor by the year 2015, as shown in Figure 3. Confirming the Virginia projections, FRA's commercial feasibility study, *High-Speed Ground Transportation for America* (September 1997), projects an even more marked growth in intercity rail travel demand for the Washington—Richmond Corridor.

To satisfy this latent demand, most of which would relieve overburdened highways of intercity travelers, **Virginia envisions train service** reliably linking Washington, D. C. (Union Station) and Richmond (Main Street Station) **in less than two hours** by 2015, with two intermediate stops.

The 2015 service would include ten daily trains, with one-hour headways during peak periods and two-hour headways off -peak, as follows:

- Richmond - New York trains (three round trips),
- Newport News - New York trains (three round trips); and
- Charlotte - New York trains (four round trips)

Figure 3: Demand for Intercity Corridor Train Services, Washington–Richmond[11]



[11] Source: Report for the Commonwealth of Virginia: URS, *Washington, D.C. to Richmond Rail Corridor*, 1996.

These plans are evolving. For instance, Virginia is now considering the possibility of rail passenger service between Bristol, Lynchburg, Washington, and Richmond.[12] Also, the U.S. Secretary of Transportation recently extended the Southeast Corridor from Charlotte, North Carolina south to Macon and Atlanta, and from Richmond south to Columbia, Savannah, and Jacksonville (see Figure 1). These extensions could ultimately result in additional train frequencies, which the fixed plant contemplated in this report for 2015 would readily accommodate to the extent they make use of the Washington-Richmond Corridor outside the evening rush hours.

Long-Distance Trains

By 2015, Amtrak envisions four daily Florida overnight trains in each direction, an increase of one over current schedules. Amtrak is also considering the addition of a second daily long-distance train between Washington and Atlanta.[13] Other long-distance services would remain at current levels. To the extent possible given their equipment, length, weight, and mail-and-express payload, these overnight trains would take advantage of the trip-time benefits afforded to corridor-type trains. However, the prime advantage of Washington–Richmond Corridor development to Amtrak's long-distance trains would be reliability enhancement.

Auto Train

Amtrak foresees a continuation of the single daily Auto Train round trip during the planning period, with the northern terminus remaining at Lorton, Virginia.

Commuter

VRE projects that increasing commuter travel demand by 2015 will necessitate commuter train volumes three to four times higher than at present, as shown in Table 2. Although the percentage increases are large, they are from a low-frequency base—the existing startup service. The contemplated future train volumes would replicate those found in mature commuter services elsewhere in the United States.

Freight

On the busiest segment of the Corridor (Alexandria—Washington), this study projects that typical freight operations would increase from roughly 13 daily trains today in each direction, to approximately 17 by the year 2015.

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[12] The analysis for this report provided, in its simulations, for two daily connecting round trips between Lynchburg and Richmond, which are not shown in the table because they operate on the corridor for only one-half mile, at Main St. Station.

[13] Via Alexandria, Lynchburg and the former Southern Railway route of NS; not via the Southeast Corridor.

METHODOLOGIES

Sources for this study included reports prepared by the FRA, the VRE, and the Virginia Department of Rail and Public Transportation, filings before the Surface Transportation Board, track diagrams, maps, equipment specifications, and other engineering and ownership documentation. Limited field investigations took place to verify existing conditions. Also, the study team met with appropriate State, local, CSX, NS, and VRE officials to assess the status of their respective plans, and to assemble a consensus list of possible projects that would assist all operators to meet their service goals.

The analysis compared the services as presently envisioned by the operators for 2015, with the fixed plant as configured today and as upgraded with various carefully-ordered combinations of improvements. The analysis focused on two questions:

- Can individual trains meet their trip-time goals, irrespective of other traffic? and
- Can all the services operate in combination at intended speeds and schedules over the Corridor, while still meeting their reliability imperatives?

To answer the first question, the study team used a computer model known as a train performance calculator (TPC) to model the operation of a single train, with defined performance characteristics, over a traffic-free railroad with profile, alignment, and maximum speeds as specified for each segment. The train performance calculator was applied to prototypical freight, intercity passenger, and commuter trains, to assess their optimal performance over the Corridor under different sets of conditions. However, it must be remembered that the mere physical possibility of operating a given train over a given right-of-way at a given trip time offers no assurance that a combination of services can reliably operate on the Corridor.

To answer the second question, the study team applied detailed simulations—modeling sophisticated, random variations in operating conditions and performance—to the full spectrum of freight, intercity passenger, and commuter services on the Washington–Richmond Corridor. These simulations assessed the impacts of changes in both schedules and fixed plant capabilities on all services operating simultaneously over a hypothetical seven-day test period.

Taken together, the TPC runs and the detailed operating simulations permitted the analysts to compare intended schedules, optimal running times, and expected performance for all services. The effects of alternative schedules and fixed plant capabilities were evaluated through numerous model runs. By these means the study team developed a preliminary list of potential projects and priorities that would meet the trip time and reliability goals of the study. This report synthesizes the results of investigations to date and defines a plan that can serve as a basis for further design, environmental work, and partnership and financial development for the Washington—Richmond Corridor.

INVESTMENT REQUIREMENTS

The analysis yielded a preliminary list of projects that would provide the service envisioned by Congress, the Corridor operators, and the States. This list of projects assumes that the freight railroads, as owners of the fixed plant, will continue to maintain it in the state of good repair that characterizes the main line portions today, from Washington to the Staples Mill Road/Acca Yard area north of Richmond. For that segment, therefore, the investment requirements contained in this report **do not** include replacement in kind of key existing track components (ties, rail, and the like)—in railroad parlance, "program maintenance."

On the other hand, for the segment between Staples Mill Road/Acca Yard through Richmond to Centralia, this report provides for a significant upgrade, with replacement of rails, ties, and other track components to assure safe, expeditious passenger and freight service.

Project Groups

In response to funding limitations, the need to protect ongoing operations, and time requirements for further study, planning, design, and necessary environmental work, Amtrak and FRA have grouped the projects together by priority. These groupings describe a staging concept that subsequent analysts may use as a guide in considering improvements to this complex corridor. The priority project groups follow in Table 3.

Table 3: Description of Project Groups

Project Group	Service Goals	Projected time frame
A	Improved capacity and reliability at today's trip times, including: – More dependable current Amtrak timings between Staples Mill Road and Union Station (two hours, five minutes); and – More flexibility at the junction in Alexandria between the Manassas line and the Washington—Richmond Corridor, thus allowing more frequent VRE Manassas service..	Short term
B	Slight increases in intercity train frequency and up to a few minutes' trip time reduction; limited service to Main Street[14]; further improved reliability	2005
C	Less than 2 hour Amtrak travel times, Main Street to Union Station; add Southeast Corridor services and additional VRE frequencies, as well as increased freight activity	2015

[14] For Newport News trains only.

Description of Improvements

Table 4 offers a preliminary list of projects that would fulfill the service goals of each project group. Cost estimates are included for those infrastructure items covered in the study scope.

Table 4: Preliminary Listing of Projects for Washington–Richmond Corridor
NOTE: Project types excluded from the analysis are indicated as "to be determined (tbd)"

Project	**Estimated Cost[15]**
PROJECT GROUP A:	
Bridges: Rebuild Lorton Road Bridge and Rebuild Auto Train™ Siding (Under construction)	6
Grade Crossings: hazard reduction	tbd
Route realignment/ augmentation: Install third track Fredericksburg to Hamilton (3.1 miles)	11
Signaling and train control: Upgrade signal system to accommodate other improvements in Group A	2
Stations: Extend northbound platform at Alexandria	1
Track component upgrades: New and reconfigured interlockings	14
TOTAL, PROJECT GROUP A—exclusive of items to be determined	*34*
PROJECT GROUP B:	
Bridges: Construct Double-track Bridge – Quantico Creek	25
Route realignment/ augmentation: Install third tracks and other capacity additions	25
Signaling and train control: Upgrade signal system to accommodate other improvements in Group B	15
Stations: Improve Crystal City VRE station	6
Stations: Implement Phase I and II Main Street Station improvements (Operational portions only)	13
Stations: Upgrade Amtrak Auto Train Facility, Lorton	4
Track component upgrades: Improve rail/rail crossings, install new interlockings	4
Tunnel work: Repair Virginia Avenue tunnel, D.C.; lengthen additional track north of tunnel	20
Vehicles: Trainsets for high-speed rail service	tbd
TOTAL, PROJECT GROUP B—exclusive of items to be determined	*112*
Omnibus improvement: MARC And VRE Run-through Train Operations	23
Route realignment/ augmentation: Realign curves and spirals for higher speeds	21
Route realignment/ augmentation: Reconfigure tracks, upgrade speed in D.C.	2
Route realignment/ augmentation: Add 4th Track, Potomac River ("RO") to Alexandria ("AF")	12
Route realignment/ augmentation: Install 6.7 miles of third track between "RW" (Milepost 96.7) and Colchester (Milepost 90.0)	34
Route realignment/ augmentation: Install 12 miles of third track between Powells (Milepost 83) and Aquia (Milepost 71)	42
Route realignment/ augmentation: Construct inner zone turn-back track at Quantico Station	6
Route realignment/ augmentation: Install 8.7 miles of third track between South Aquia (Milepost 69.8) and Dahlgren Junction (Milepost 61.1)	40
Route realignment/ augmentation: Install sections of third track, new and modified interlockings, and turnback track between "FB" (Milepost 58.8) and North Ashland (Milepost 15.5)	44
Route realignment/ augmentation: Reconfigure tracks in Southwest D.C. and install center-island platform at VRE L'Enfant Station	52
Signaling and train control: Upgrade signal system to accommodate other improvements in Group C	*26*
(Table 4 continued on following page)	

[15] Fully loaded 1999 dollars, in millions – includes design, construction management and contingency.

Project	Estimated Cost[15]
Stations: Add second commuter platform at VRE stations	23
Stations: Complete Richmond Main Street Station (Operational portions only)	19
Stations: ADA access at key stations	tbd
Stations: Intercity and commuter parking	tbd
Stations: Amtrak station improvements	Tbd
Support facilities: Build service facility and storage yard in Richmond	11
Track component upgrades: Rehabilitate Main Street to Centralia for access to and from Southeast Corridor	10
Vehicles: Trainsets for high-speed rail service	Tbd
TOTAL, PROJECT GROUP C—exclusive of items to be determined	*409*
GRAND TOTAL—*exclusive of items to be determined*	555

Table 5 categorizes the above projects by type and describes, in general terms, what each category includes.

Table 5: Potential Improvements by Category
(NOTE: Project types excluded from the analysis are indicated as "to be determined (tbd)")

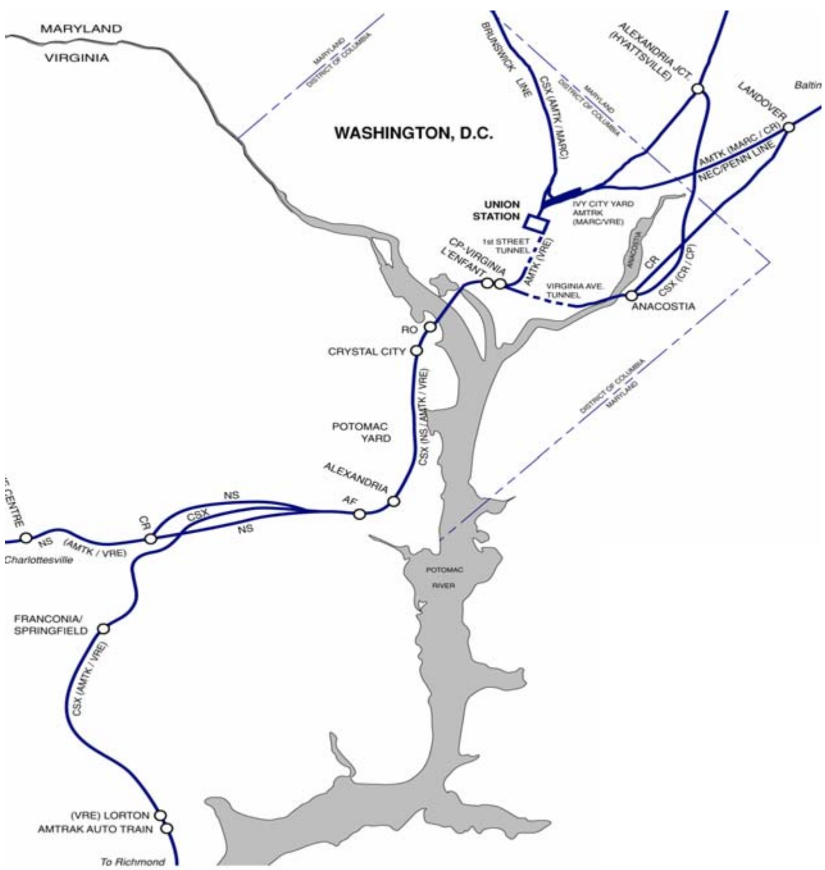
Category	Description	Total Contemplated Investment ($ Millions)	Appears in Project Groups:
Bridges	All capacity-related bridge improvements, such as construction of a double-track bridge at Quantico Creek, and the rebuild (now under construction) of the Lorton Road bridge and the associated Auto Train siding	$31	A, B
Grade Crossings	All grade crossing hazard elimination projects. While critical to safety, these were not part of the project scope.	tbd	A
Route realignment/ augmentation	All curve realignments, and additions of third or fourth track.	$333	Mostly C
Signaling and train control	Installation of signaling system improvements for at least 90 mph operation; this impacts both capacity and speed.	$43	A, B, C
Stations	Includes track work, platform reconfigurations, and building construction. The Alexandria platform extension, provision of VRE platforms on two tracks, track-related portions of Main Street Station and other station improvements fall under this rubric.	$66	A, B, C
Support Facilities	Richmond servicing facility and storage yard	$11	C
Track component upgrades	New and redesigned interlockings; upgraded rail/rail crossings; track upgrading between Staples Mill Road and Main Street Stations.	$28	A, B, C
Tunnel work	Essential work in and near Washington's Virginia Avenue Tunnel to relieve congestion from freight service	20	B
Vehicles	High-speed rail locomotives and cars; not addressed in this analysis	tbd	B, C
Omnibus improvements	All track capacity and related improvements needed to facilitate thru operation of Maryland Diesel commuter trains to L'Enfant Plaza and Alexandria	23	C
Grand total—All categories included in scope	Excludes items to be determined	$555	A. B, C

Improvements include the construction of third or fourth tracks and commuter pocket tracks, and the reconfiguration of switching stations (interlockings) to optimize operating flexibility and provide the capability of making simultaneous train crossover movements (parallel moves). This expanded capacity reduces the impact of the projected intercity and commuter passenger service increases, and maintains the quality of freight service on the line, thereby making the increased passenger service attractive to CSX, the owner/operator.

Washington, D.C. and Vicinity

The Washington area is the most critical section of the entire corridor. Capacity improvements must occur here if the goals—particularly the reliability goals—of all service providers are to be met.

Figure 4: Selected Rail Lines in Washington D.C. Area



Coordination of intercity passenger service south of Washington with Northeast Corridor train service would help reduce negative effects of planned increases in rail service using the lower level of Washington Union Station. This internal Amtrak schedule coordination will help the operators overcome the numerous constraints in the Union Station vicinity—the First Street Tunnel and the location of the station and other structures relative to the station tracks and platforms—all of which prevent wholesale changes.

Electrification of the Washington-Richmond Corridor would significantly improve operations at Washington Union Station, but its high cost (estimated at $300-400 million), and the difficulty in finding a location to exchange locomotives at Richmond, would place it at the bottom of the priority list in any case. (Main Street Station's elevated structures would severely limit the ability to make the extra movements required.) Therefore, it is not being recommended at this time.

The construction of additional tracks, the revision of several interlockings, and the construction of a new L'Enfant station would improve the passenger/freight interfaces in the segment between Washington Union Station and Alexandria and increase the reliability of the proposed Amtrak and VRE service improvements while minimizing interference with NS and CSX freight service. In particular, the listed projects would reduce congestion and operating problems between Arlington and Washington.

Alexandria—Richmond (Staples Mill Road Station)

Between Alexandria and Staples Mill Road Station, Richmond, the reliability, travel time and capacity goals could be met with construction of selected third track sections.

Alexandria—Fredericksburg

In the commuter territory between Alexandria and Fredericksburg, almost 33 miles of third-track (out of a possible 46 route-miles), with appropriate interlocking modifications, would need to be constructed. The changes in track configuration would ease congestion; ensure dependability of the train schedules; offset capacity constraints, particularly in the peak (rush hour) periods; and accommodate the increased level of intercity, commuter, and freight trains.

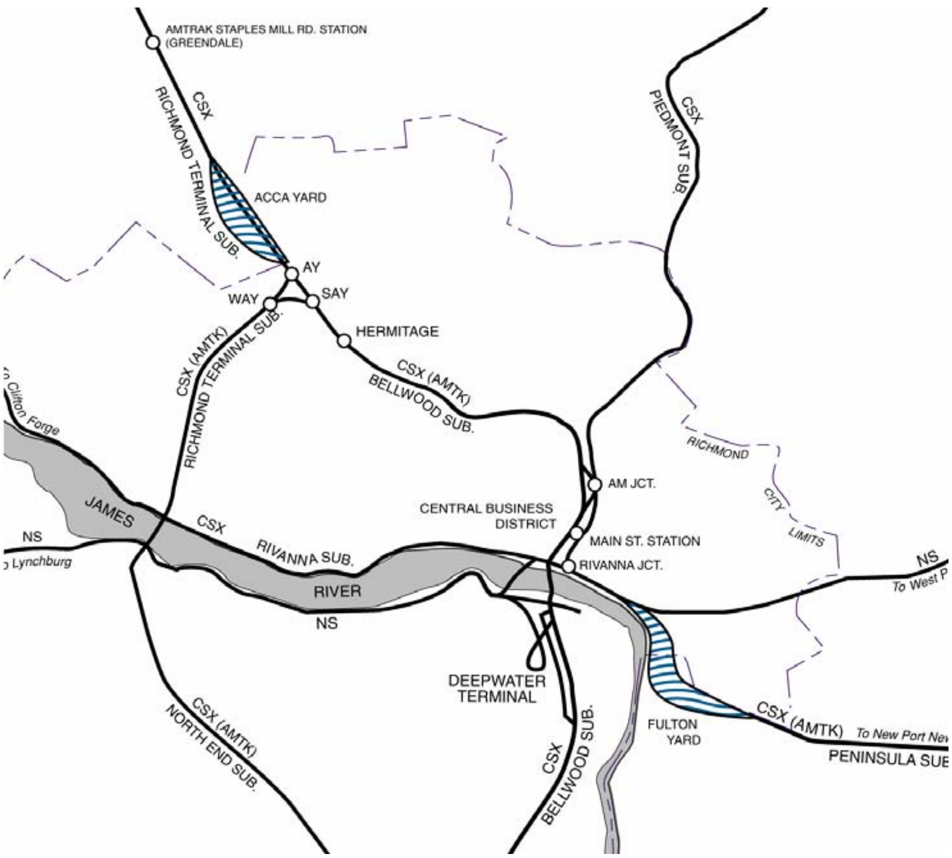
In particular, present corridor congestion caused by the 6-mile long Franconia Hill section between Alexandria and Franconia would be alleviated by reinstallation of the previously removed third track. The revised configuration would provide for future levels of traffic by allowing overtakes of slower freight trains by the faster intercity and commuter trains in the segment.

Fredericksburg—Staples Mill Road

Between Fredericksburg and Staples Mill Road, the construction of 8 miles of third-track and 3 miles of fourth-track (out of a possible 54 route-miles), with appropriate interlocking modifications, would provide capacity for both freight and high-speed intercity trains. Two new sections of third-track (and a fourth-track south of Fredericksburg) would allow a freight train to be overtaken by a faster train that left Richmond or Washington at a later time. Simulations have shown that both train services would perform reliably in this segment of the Corridor, with these improvements.

Richmond Vicinity

Figure 5: Selected Rail Lines in Richmond



New track construction and revisions to existing track configuration and train operations would increase track speeds and reduce freight-passenger train interfaces in the segment between Staples Mill Road Station and Main Street Station, in Richmond (Figure 5). This congestion relief would prevent operations from becoming more restricted in the vicinity of Acca Yard. The improvements also would allow re-institution of intercity train service into Main Street Station and enable the number of daily trains to Newport News to increase. Coordination of the proposed track improvements with on-going design work by the City of Richmond for Main Street Station is essential. Plans by the North Carolina DOT to introduce through, high-speed rail service from Charlotte and Raleigh to New York City also would be accommodated,[16] as would the Commonwealth of Virginia's proposed origination of three New York-bound trains at Main Street Station, and the proposed Lynchburg/Bristol service. The proposed track modifications would minimize the potential for conflicts between intercity and freight trains.

CONCLUSIONS

This analysis of current and projected railroad operations and facilities on the Washington–Richmond Corridor has led to the following conclusions:

- **Protection of all freight and passenger services:** Numerous computerized simulations of the operations of all users of this Corridor (freight, commuter, and Amtrak) have identified a number of specific infrastructure changes that would provide the capacity to reliably handle all existing and projected services. Even with these changes, close scheduling and dispatching coordination among operators—extending to the Northeast Corridor and other contiguous routes—would be necessary to optimize the use of the improved facility and preserve the dependability and marketability of all passenger and freight operations.
- **Need for further engineering:** Detailed engineering construction plans need to be prepared for the various improvements. Work should begin promptly on the extensive, detailed design efforts that would be required for two particularly challenging areas: the changes required in the vicinity of L'Enfant Station in Washington, and the track and station changes required between Staples Mill Road Station and Main Street Station in Richmond.
- **Amtrak's and FRA's commitments:** Amtrak and FRA endorse the development concept, described in this report, for the Washington–Richmond Corridor and commit to:

[16] The improvements would likewise help facilitate any additional service resulting from Southeast Corridor extensions to South Carolina, Georgia, and Florida.

- — Work with the Commonwealth of Virginia, VRE, NCDOT, the City of Richmond, the freight railroads, and other affected parties to obtain funding for the recommended improvements, to progress the necessary engineering work on a timely basis, and to arrange for any needed environmental/historic documentation; and
  - — Work with CSX and officials of the Commonwealth of Virginia and local governments to close or upgrade as many highway-rail grade crossings as possible on this route.

- **Feasibility of high-speed service:** Reliable high-speed passenger train service between Washington and Richmond is a feasible goal **provided** that requisite infrastructure improvements are constructed.

On the basis of this report's recommendations, and with the partnership of the interested government agencies, railroads, shippers, and members of the traveling public, Amtrak and FRA look forward to the day when the Washington–Richmond Corridor will achieve its full potential for fast, reliable, convenient, market-driven railroad services of all types—intercity, commuter, and freight.

Report to Congress

Potential Improvements to the Washington—Richmond Railroad Corridor

May 1999

MAIN REPORT

Chapter 1
INTRODUCTION

Congressional Mandate

This report on possible improvements to the Washington–Richmond railroad corridor responds to explicit Congressional mandates in the context of the analytical requirements and the evolving needs of the freight railroad industry, commuter authorities, Amtrak, and the Southeast Corridor states—most prominently, Virginia and North Carolina.[17]

In the Omnibus Consolidated Emergency Supplemental Appropriations Act for Fiscal Year 1999,[18] Congress required Amtrak "to identify improvements necessary on track between Washington, D.C. and Richmond, Virginia so that passenger trains could operate at higher speeds. Amtrak is directed to report its findings and estimated costs to do this work to the House and Senate Committees on Appropriations by March 1, 1999."

The report issued in 1996 and 1997 by the Federal Railroad Administration (FRA), *High-Speed Ground Transportation for America,* had identified the Southeast Corridor (of which the Washington–Richmond Corridor forms a part) as showing marked potential for the development of high-speed rail service through private/public partnerships. This pronounced "partnership potential" largely resulted from the assumption that revenue increases on Amtrak's Northeast Corridor (NEC) resulting from through high-speed rail traffic to and from Southeast Corridor points, could be credited to the Southeast Corridor.[19] While leaving the details of any such partnership arrangements to the States, Amtrak, and other concerned parties, the FRA report heightened public awareness of the opportunities presented by rail passenger service south of Washington.

Meanwhile, Amtrak and the FRA had jointly identified operational linkages at Union Station, Washington, between the New York–Washington and Washington–Richmond routes. As planning work on the potential reconfiguration of Washington Union Station progressed as part of the development of the Washington to New York City Corridor Transportation Plan (CTP), it became apparent that the projected 2015 train operations at the lower level of Washington Union Station[20] could be handled only with significant reconfiguration of track, platforms, and several interlockings. Although Virginia Railway Express (VRE) commuter service would continue to originate or terminate at Washington, virtually all the intercity service to or from points south of Washington would be projected

[17] Subsequent to completion of this analysis, the Southeast Corridor was extended to include South Carolina, Georgia, and Florida.
[18] Public Law 105-277.
[19] See Chapter 8 of FRA, *High-Speed Ground Transportation for America,* Main Report, September 1997.

to operate over the NEC to New York City or points north. In view of the projected levels of NEC high-speed, conventional, and commuter trains, the intercity trains to and from the South must fit in certain operating windows at a number of "choke points" between New York and Washington, which would basically dictate their arrival and departure times at Washington. Therefore, the need for integrated planning of the NEC and service south of Washington was identified as a necessity.

The planning for Washington Union Station also identified several issues related to the feasibility of operating the projected number of—

- VRE commuter trains;
- Virginia-sponsored intercity trains to Richmond, Newport News, and Bristol;
- North Carolina-sponsored trains to Raleigh and Charlotte; and
- Amtrak service to Florida and Atlanta/New Orleans

—all of which would be intermixed with a relatively dense freight service operated by CSX Transportation. Inc. (CSX) and the Norfolk Southern Corporation (NS)[21] on the existing, mainly two-track railroad from Washington to Richmond.

Observations by individuals involved with the New York-Washington CTP indicated that substantial delays were being incurred by freight and passenger trains between Washington and Alexandria, Virginia on nearly a daily basis at 1997 traffic levels. Additional problems appeared to be generated by the 6-mile long Franconia Hill and the Amtrak Auto Train facility at Lorton.

Amtrak and FRA therefore jointly decided, even prior to the Congressional directive, that a preliminary analysis should be made of the Washington–Richmond rail Corridor to assess its existing capacity and determine its capability to reliably operate the levels of intercity passenger, commuter, and freight rail service projected for the year 2015.

This effort is all the more timely because of the pending restructuring of Northeastern rail freight service, expected growth in commuter travel in the Washington area, and the opportunity—fostered by Amtrak, FRA, and the farsighted Southeast Corridor states—for through, high-speed train service between Northeast and Southeast Corridor points.

The study scope was confined to fixed facility improvements that would safely support intended train schedules, frequencies, and service reliability through the year 2015.

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[20] The lower level provides service to and from points south of Washington, D.C., including VRE commuter trains and Amtrak intercity trains.
[21] NS operations are between Washington and Alexandria only.

“Service reliability”—that is, on-time performance for passenger and scheduled freight services, and the consistent, expeditious, and economic movement of other freight trains—is of utmost importance because without it, higher passenger train speeds and frequencies, and restructured, modernized freight operations cannot penetrate their intended markets.

Although this study addresses the Washington–Richmond Corridor, it should be noted that the adjacent few miles of connecting routes at Washington (CSX freight line to Alexandria Junction in Maryland’s Prince George’s County), Alexandria (NS to Charlottesville), Doswell (CSX to Charlottesville), Richmond (Acca Yard), and Richmond (Main Street Station connections) were reviewed to ensure that the proposed junction configurations would work as intended. The New York–Washington CTP effort previously had used information developed by a MARC[22]/CSX study of the Camden and Brunswick lines to develop appropriate junction configurations for Washington Union Station.

Other types of improvements, including some which would be prerequisite to the desired service and safety levels, did not undergo analysis: for example, provision of locomotives and cars, grade crossing hazard reduction, and development of station parking and amenities. These categories of improvement would require careful attention in the more detailed planning and design that must precede any significant investment in the Corridor.

Conceptual Framework

Report Purpose

This report aims at specifying, on a preliminary basis, the infrastructure improvements that would enable the Washington–Richmond Corridor to accommodate reliably the mix and volume of intercity passenger, commuter, and freight services that the line’s operators and public partners foresee for the year 2015.

Approach

The Washington–Richmond Corridor already experiences capacity shortfalls; its many services face dependability challenges even at year 1999 service levels. To establish the investment needs for **reliable** services, this study has adopted a fifteen-year planning horizon, which would allow sufficient time for high-speed and other improvements to be constructed and implemented in a logical sequence.

In view of the multiple uses of the Washington-Richmond Corridor, proper performance of the study necessitated a team effort, in which Amtrak, FRA, the Commonwealth of Virginia, VRE (as the commuter authority most immediately concerned with the line), and the freight railroad right-of-way owners (CSX and NS) participated.

The study is based on the following comprehensive analytical approach:

- Assess current facilities, services and operating conditions on the route;
- Characterize service needs for the planning year 2015;
- Conduct operational analyses simulating the performance of future (year 2015) services over various configurations of infrastructure; and
- Identify the infrastructure investments that would allow the Corridor's operators to achieve their intended 2015 service quality and train volumes with satisfactory reliability.

The following chapters address each of these tasks in turn.

[22] MARC is the State of Maryland's acronym for its commuter rail service in the Washington and Baltimore metropolitan regions.

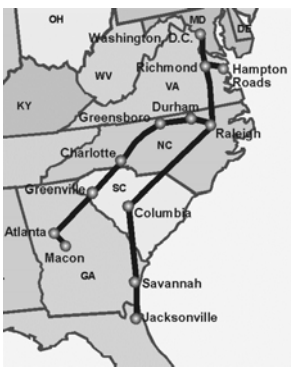
Chapter 2
THE CORRIDOR TODAY

Fixed Plant

Location

The Washington–Richmond Corridor (Figure 2-1) is a segment of the Southeast Corridor, which the U.S. Secretary of Transportation formally designated as an emerging high-speed rail line under the Intermodal Surface Transportation Efficiency Act of 1991. Depicted in Figure 2-2, the Southeast Corridor reaches from Washington south to Richmond, Raleigh, Greensboro, Charlotte, Atlanta, and Macon; also from Richmond to Hampton Roads, and from Raleigh south to Columbia, Savannah, and Jacksonville. For convenience, the present report refers to the Southeast Corridor segment between Washington and Richmond as the **Washington–Richmond Corridor.**

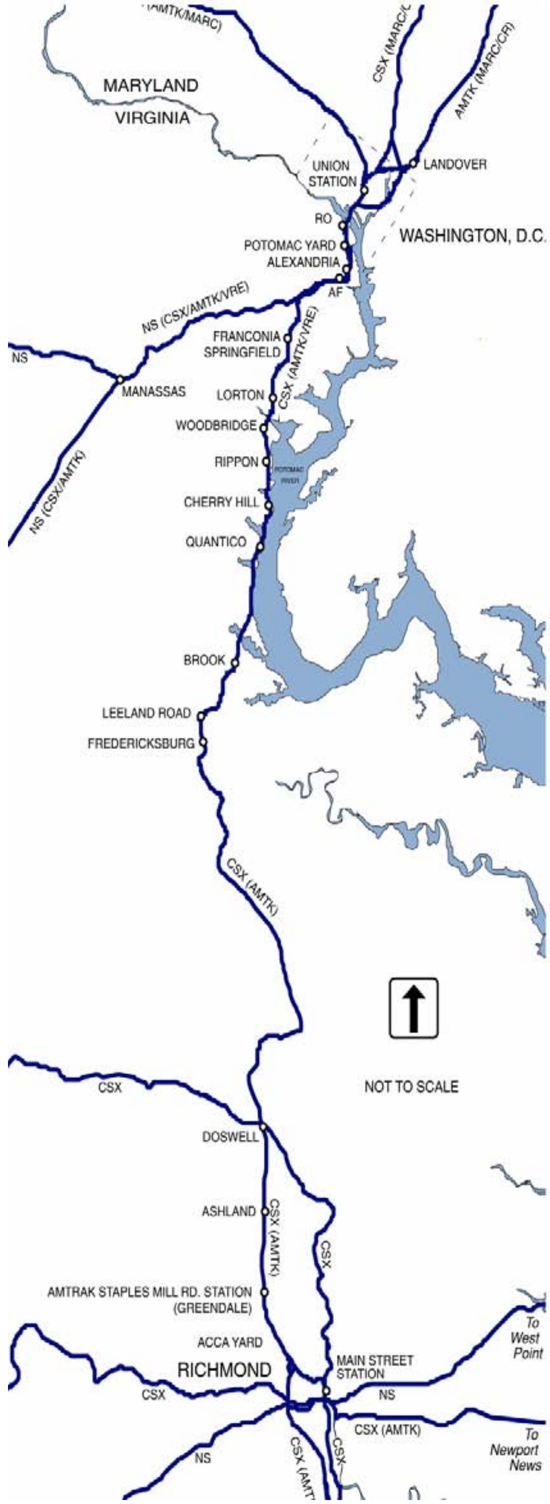
Figure 2-2
Southeast Corridor



Background

The Richmond, Fredericksburg and Potomac Railroad Company (RF&P) was chartered by an act of the General Assembly of Virginia on February 25, 1834. It constructed its own line from Richmond to Quantico, ultimately connecting with two smaller railroad lines north of Quantico in 1872. This

Figure 2-1
Washington–Richmond Corridor



formed a continuous line between Richmond and Washington.

In 1901, the RF&P assumed operation of the connecting lines to form a single through route, utilizing trackage rights over the Pennsylvania Railroad to the Pennsylvania's passenger station, then located on the Mall in Washington. In the same year, the Washington Terminal Company was chartered to construct and operate Union Station, which opened in 1907. The RF&P was one of its tenant railroad companies. Access to Union Station from the south is via a 4,908-foot, double-track tunnel beneath First Street. Freight trains bypass Union Station on an alignment through the Virginia Avenue Tunnel in southeast D.C., but share the route across the Potomac River bridge with passenger trains to and from points south. Control Point (CP)-Virginia interlocking, in southwest D.C., is the junction of the two routes.

In November 1991, the RF&P's operating assets were acquired by CSX. In addition to the RF&P, CSX's predecessor railroad companies include the Chesapeake & Ohio Railway (C&O), Baltimore & Ohio, Seaboard Air Line Railroad (SAL), Atlantic Coast Line, and Louisville & Nashville.

Length and Ownership

The Washington–Richmond Corridor extends for 118 miles between Union Station, Washington and Main Street Station, Richmond.[23] The primary owner of the Corridor is the CSX Transportation Company (CSX). CSX also owns the Bellwood Subdivision from central Richmond south to Centralia (see Figure 2-1).

Approximately two miles between Arlington and CP-Virginia now[24] belong to Conrail. In June 1997, CSX filed a joint application with NS at the U.S. Surface Transportation Board (STB) for control and operating lease of Conrail, Inc. and its operating subsidiary, Consolidated Rail Corporation. STB has approved this transaction. Upon its full implementation later in 1999, CSX ownership and operating control will be extended to the segment between the Potomac River bridge and the Washington Terminal Company (Amtrak) connection at CP-Virginia. CSX ownership will continue north along the freight-only alignment through the Virginia Avenue Tunnel and include both the former Conrail line to the NEC at Landover, and the CSX line to Alexandria Junction in Prince George's County, Maryland. NS will also retain certain freight operating rights on the Washington–Richmond Corridor under the Conrail transaction.

Amtrak owns one mile of trackage at the southern approach to Washington Union Station.

[23] Main Street is not now an operational station but would be reopened under pending plans.
[24] As of February 1999. The ownership transfer will occur when the Conrail acquisition by CSX and NS is completed.

Table 2-1 presents a summary of current track ownership.

Table 2-1
Track Ownership and Operating Control[25]

Milepost	Route-Miles	Locations	Owner and Operator	Dispatched From
135.2 - 136.4	1.2	Union Station - CP-Virginia	Amtrak	"K" Tower, Washington Union Station
136.7 - 138.9	2.2	CP-Virginia - RO	Conrail	Mt. Laurel, NJ
110.1 - 1.0	109.1	RO - Acca Yard	CSX	Jacksonville, FL
4.0 - 0.0	4.0	Acca Yard - Main Street Station	CSX	Jacksonville, FL
Total	116.5			

Operating Control

Also presented in Table 2-1 is the operating control of the various segments of the Washington–Richmond Corridor. Operating control currently matches ownership.

Trackage and Track Conditions

The line has two tracks except for a single-track bridge over Quantico Creek, and three short stretches of third-track in Alexandria, Possum Point (north of Quantico Creek), and Fredericksburg.

CSX and Conrail, the owner/operators of approximately 99 percent of the Corridor, have maintained the Corridor in a condition satisfactory for the current designated operating speed class. Current maximum operating speed in the Corridor is 70 mph for passenger trains. Slow orders, requiring trains to operate at slower than the specified maximum speeds, if and when they are necessary, are efficiently removed to facilitate train operations. CSX believes that the Corridor is a valuable asset, and its acquisition of Conrail includes plans to utilize the route to compete for a larger percentage of the north-south I-95 truck traffic.

Reviews of work previously performed for the Virginia Department of Rail and Public Transportation (VDRPT), supplemented by limited field investigations performed early in 1997, confirm that the Corridor has been maintained to a reasonable level of good repair. There is no evidence to indicate that CSX, as the majority owner of the Corridor, intends to reduce annual maintenance programs. CSX recently constructed a third-track (with provision for the ultimate expansion to a four-track configuration) between Alexandria and Crystal City. Train handling and facility improvements also have been implemented

[25] As of February 1999. See above regarding Conrail transaction.

south of Staples Mill Road Station. VRE, as a principal user of the line north of Fredericksburg, has invested in facility improvements to promote the reliable operation of its trains. These improvements also have benefited CSX train operations.

Alignment

Train speed is fundamentally limited by the horizontal curvature present in the alignment, regardless of the power rating, method of propulsion, and speed capability of the trains on the line. The line between Washington and Richmond includes more than 100 curves. Many of these curves exceed two degrees of curvature that, with a maximum of three inches of unbalanced superelevation, are presently restricted to a maximum speed of 70 miles per hour or less. Additional curves have been identified as not satisfying strict passenger ride comfort criteria used by the FRA when evaluating a line's high-speed rail potential. While safe and adequate for present operations, the track curvature and present 70 mph maximum authorized speed (MAS) for passenger trains are two conditions that severely constrain commuter and intercity train trip times. The MAS for freight trains is 60 mph.

Signaling

Dating back to the 1920s, the automatic block signaling system on the Corridor—although safe for existing speed levels—has outlived its economic and physical life. Because the original design of the system was highly advanced for its time, with continuous cab signaling and automatic train control features similar to those of the NEC north of Washington, the upgrading necessary for high-speed rail service is relatively modest and, indeed, has already begun under the auspices of CSX.[26] Such an upgrading would need to include state-of-the-art equipment to accommodate higher speeds (potentially up to 110 miles per hour), increased train operations, and closer spacing of trains. The system should be capable of allowing trains to be operated at MAS in either direction on either track under contingency conditions.

Highway-Railroad Grade Crossings

Increasing speeds and the frequency of trains raises concern for safety at the numerous at-grade highway crossings on the Richmond Line. Every effort should be made to close, or grade-separate, as many crossings as possible.

[26] CSX is converting the system from 60 to 100 cycles for compatibility with Conrail operations, in anticipation of the restructuring of freight operations on the East Coast.

Crossing Inventory

In total, there are 65 crossings between Washington and Main Street Station: 52 of these are for public use, and 13 allow access to private property. All the public crossings are protected, at a minimum, by crossbucks, flashing lights, gates, and ringing bells, with one exception (Brown Street in Richmond).

There are no public grade crossings and one unnamed private grade crossing in the first 25 miles south of Washington. Within the territory of VRE Fredericksburg Line operation, there are seven public, and two private grade crossings.

There are 12 public and ten private crossings in the span of 36 miles from Fredericksburg to Doswell, an average of one every 1.6 miles. Many of these are very lightly traveled, but are difficult to justify closing, because, in most cases, there is no alternative access to the homes and families they serve. Where alternate routes are available, many crossings already have been closed.

The frequency of crossings (27 public and two private) between Doswell and Staples Mill Road Station, a distance of 14 miles, is even greater—an average of one every 0.5 miles. Nineteen of these are concentrated in the city of Ashland, including 12 for pedestrians.

There are six crossings between Staples Mill Road Station and Main Street Station, all of which are located south of Acca Yard. Three of these, Hermitage Road, Brook Road and Hospital Street, are heavily used. The other three, James Street, Valley Road, and Brown Street, are not. Brown Street no longer serves any purpose except access to the railroad for maintenance.

Crossing Safety Initiatives

The VDRPT has an ongoing program to identify crossings that can either be:

- Eliminated, through closure;
- Separated, through construction of a bridge or underpass; or
- Improved, through the installation of more extensive and more highly visible protection devices.

Safety is a primary concern when increasing speeds and train frequency on the Richmond line. Higher speeds would require, as just one example, that the actuating circuits be lengthened to initiate warnings sufficiently in advance of the arrival of the train. Faster trains take less time to traverse the length of the circuit, and they reach the crossing sooner than slower trains.

Effect of Increased Speed on Crossings in the Staples Mill Road Station–Main Street Station Segment

Speed is a significant concern regarding the crossings on the segment between Staples Mill Road Station and Main Street Station over which passenger service would be significantly increased. The most heavily used crossings, Hermitage Road, Brook Road and Hospital Street, are located on curves. To attain the moderate increase in speed planned over these crossings, an increase in superelevation would be necessary.

Raising the outside rail on each track on the curve would result in a series of inclines, one between the rails of each track, and a dip from the slope of one track to the next, to be crossed by vehicles. There is also likely to be a slope upward to the tracks on each side, the one on the outside of the curve being significantly greater than the one on the inside of the curve. This is not practical on a heavily traveled road and may require that these crossings be closed or grade-separated.

Crossings—Conclusion

With the introduction of more trains, many of which would be traveling at higher speeds, an effort needs to be continued to eliminate as many crossings as possible and to increase protection on those that remain. The Section 1103(c) program under the recent TEA 21 legislation[27] contains provisions for special Federal assistance for the upgrading of safety on highway-railroad crossings in emerging high-speed corridors, and it is anticipated that the Commonwealth of Virginia will continue to avail itself of that program (as well as other Federal-aid highway grade crossing funds and State, local, and other funding sources) to address crossing issues on this Corridor.

The present study did not include a detailed review of the crossings on the Washington–Richmond Corridor, and this report accordingly expresses no opinion on, and includes no cost estimates for, the grade crossing safety improvements that may be required to allow for the installation of higher-speed service on this route.

Stations

Amtrak and VRE, as the passenger service providers in the Corridor, are responsible for the condition and level of service provided at the Corridor's stations. The conditions of individual stations and the availability of parking to support 2015 operations were not investigated as part of this study. Consequently, other than recommendations relative to the construction of additional platforms at VRE stations, programs to upgrade station facilities to meet 2015 needs are not contained in this report.

[27] The successor to the Section 1010 program under ISTEA.

An effort to re-institute rail passenger service into Main Street Station is ongoing. As part of this program, the station would become part of the Richmond Multi-modal Transportation Center (RMTC). Washington Union Station will be upgraded as part of Amtrak's introduction of improved high-speed rail service utilizing the ***Acela*** trainsets.

An inventory of station ownership appears in Table 2-2.

Table 2-2
Station Ownership and Use[28]

			Owner		
Milepost	**Location**	**User**	**Land**	**Station**	**Parking**
136 (WTCO[29])	Washington Union Station	Amtrak/VRE/MARC[30]	US Govt	US Govt	US Govt
137 (Conrail[31])	L'Enfant	VRE	Conrail	VRE	None
109 (CSX)	Crystal City	VRE	CSX	VRE	None
105	Alexandria	Amtrak/VRE	CAP	CAP[32]	CAP
98	Franconia/Springfield	VRE	CSX	VRE	WMATA
93	Lorton	VRE	CSX	VRE	Fairfax County
93	Auto Train (Lorton)	Amtrak	Amtrak	Amtrak	Amtrak
89	Woodbridge	VRE/Amtrak	CSX	VRE	Prince William County
79	Quantico	Amtrak/VRE	CSX	CSX	Various
68	Brooke	VRE	CSX	VRE	Stafford County
63	Leeland Road	VRE	CSX	VRE	Stafford County
59	Fredericksburg	Amtrak/VRE	CSX	CSX	City of Fredericksburg
15	Ashland	Amtrak	Town of Ashland	Town of Ashland	N/A
(Table 2-2 continued on following page)					

[28] As of February 1999. See page 6 regarding the pending completion of the Conrail transaction and its effects on ownership of the Washington-Richmond corridor.
[29]Washington Terminal Company.
[30]Does not presently operate south of Washington.
[31]Consolidated Rail Corporation, Conrail.
[32]Commonwealth Atlantic Properties.

Milepost	Location	User	Owner		
			Land	Station	Parking
4	Richmond - Staples Mill Road	Amtrak	Amtrak	Amtrak	Amtrak
0	Richmond - Main Street Station (future)	Amtrak	State of Virginia	State of Virginia	State of Virginia
Planned Stations					
83	Cherry Hill (future)	VRE	N/A	N/A	N/A
74	Widewater (future)	VRE	N/A	N/A	N/A

Users And Services

As in the Washington–New York City segment of the NEC, the Washington-Richmond Corridor has several sponsors of service:

- VRE: Local commuter service from Fredericksburg and Manassas to Washington;
- Amtrak: Washington - Richmond intercity service;
- VDRPT: Newport News - Richmond - Washington intercity service; and
- North Carolina Department of Transportation (NCDOT): Charlotte - Richmond - Washington intercity service.

All passenger trains are operated by Amtrak, either on its own account or through a contractual relationship with other sponsors. The relationships of the operator and sponsors to the track owners are established in operating agreements. The pertinent agreements are summarized in Appendix E.

Amtrak

The volume of passenger train operations steadily declined in the decades following World War II, as improvements to other transportation alternatives, including the interstate highway system, dramatically reduced the demand for rail passenger service. As a measure of this decline, in January of 1930 there were 43 arrivals and departures at Union Station each day by the RF&P, compared to Amtrak's current 14 daily trains.

Amtrak has managed to reverse the passenger volume decline in the Washington–Richmond rail Corridor. The total number of Amtrak passengers traveling on this Corridor was about 708,000 in 1994. Ridership has significantly increased in the past ten years.

According to Amtrak about 40 percent of these passengers entrained or detrained at Richmond. Of the Richmond passenger volume, about 83 percent were passengers traveling to and from NEC points north of Washington.

VRE Commuter Service

VRE began to operate local commuter service from Fredericksburg and Manassas to Washington in 1992. Presently, VRE operates six weekday round trips between Fredericksburg and Washington and seven weekday round trips between Manassas and Washington. The Manassas trains operate on the Richmond Line between Alexandria and Washington. The highest-patronage stations are L'Enfant, in Southwest D.C., and Crystal City, in Arlington, Virginia. VRE is constrained from adding additional trains by its agreement with CSX, which requires VRE to fund specified capacity expansions to handle additional traffic.

The VRE system experienced about a 12 percent decrease in ridership between 1996 and 1997 for a variety of reasons, such as the extension of high-occupancy vehicle lanes by the Virginia Department of Transportation and the travel time from outlying stations to Washington under present operating schedules. During 1998 poor schedule performance resulting from track maintenance and derailments also affected ridership. On the assumption that on-time performance will stabilize, the long-term outlook remains promising, and ridership had substantially recovered toward the end of 1998.

VRE contracts with Amtrak to provide train and engine crews and other support services for the operation of VRE's two commuter routes to Washington on the 55-mile Fredericksburg Line over CSX tracks (the Washington–Richmond Corridor), and the 33-mile Manassas Line, over NS trackage. VRE operates six round trips on weekdays on the Fredericksburg Line and seven round trips on the Manassas Line. Stations served by both lines include Union Station, L'Enfant, Crystal City, and Alexandria. South of Alexandria, the Fredericksburg Line has eight stations, with two more planned. The Manassas Line has six stations, with one planned for the future. The Manassas Line connects with the Washington–Richmond route at AF Interlocking, about one mile south of Alexandria Station. AF is the junction of NS and CSX, and all trains to or from points on the NS line use CSX and Conrail trackage rights north of this point.

Freight

Presently, approximately 13 freight trains per day operate in each direction on the busiest freight segment north of AF, including NS freight trains. CSX, the primary user, operates freight trains over the entire Corridor from Richmond to Washington, and serves local shippers as well; NS, by contrast, traverses only the segment between Washington and Alexandria, where its main line diverges to the southwest, toward Manassas and Charlottesville. Most freight trains provide general merchandise and intermodal service.

Most freight trains operate over the entire route between Washington (CP-Virginia) and CSX's Acca Yard in Richmond.

Since the cessation of operations at Potomac Yard, in Alexandria, in 1990, Acca Yard has acquired additional functions. At times, Acca Yard is congested, a condition exacerbated by the need to provide operating windows for passenger trains at South Acca and elsewhere.

The principal intermediate freight origin/destination is the Virginia Electric Power Company at Possum Point, on Quantico Creek, Milepost (M.P.) 80. This facility is served by unit coal trains, operating without intermediate switching between origin mines and the utility plant.

Freight operations are much more variable than passenger services in terms of arrival and departure times, train size, train performance, and frequency in a given period of time. Freight trains vary significantly in their performance capabilities and compatibility with passenger operations: for example, unit trains of coal and grain generally have a lower horsepower-to-tonnage ratio than more time-sensitive operations. Thus, a general merchandise or intermodal train ordinarily takes less time to clear a given route segment than a unit coal train. Most freight trains operated on the Washington–Richmond route are general merchandise and intermodal trains.

Because almost all intercity passenger and commuter trains on the Washington–Richmond Corridor operate during daylight hours, the line would, in theory, offer more flexibility to freight operations late at night. In practice, however, the for-profit freight carriers have far-flung operations of which the Washington–Richmond Corridor constitutes but one segment. Customer demands, scheduling requirements, and operating constraints elsewhere on their extremely large and complex networks have led the freight railroads to cluster their trains between Washington and Richmond in the 11:00 a.m. to 6:00 p.m. period. Conflicts between freight, intercity passenger, and commuter operations have ensued, particularly during the evening peak period.[33] **Therefore, the need to provide service reliability for intercity passenger, commuter, and freight trains alike during the evening peak has governed the design and evaluation of the improvements contemplated in this report.**

As explained below, the need to efficiently manage peak traffic will become even more critical in the future: not only will rail passenger travel increase, but CSX and NS have also projected higher levels of freight traffic as a result of their acquisition of Conrail. In fact, the I-95 corridor, which parallels the Northeast and Washington–Richmond Corridors, has been identified as one of the key growth lanes for the two freight companies. Current service levels appear in Table 1. The table is divided at Alexandria because the junction with the NS is immediately south of the station

[33] Defined, for this report, as the four-hour period from 3:30 p.m. to 7:30 p.m.

Table 2-3: Existing Railroad Services on the Washington–Richmond Corridor

Service	Route	Number of Daily Train Movements (Round-Trips)	
		Washington to Alexandria	**Alexandria to Richmond**
Amtrak			
Corridor-type services	Newport News—Northeast Corridor	2	2
	Richmond—Northeast Corridor	2	2
	North Carolina—Northeast Corridor	1	1
Total, Corridor-type services		*5*	*5*
Long-distance services	Florida—Northeast Corridor	3	3
	New Orleans—Northeast Corridor	1	
	Chicago—Cincinnati— NEC	1	
Total, Long-distance services		*5*	*3*
Auto Train	Lorton, Virginia—Sanford, Florida		1
Total Amtrak		***10***	***9***
Virginia Railway Express (VRE)			
Commuter service	Washington—Manassas	7	
	Washington—Fredericksburg	6	6
Total VRE		***13***	***6***
Freight			
All freight services *(CSX and Norfolk Southern)*[34]		***13***	***12***
GRAND TOTAL WASHINGTON—RICHMOND CORRIDOR		***36***	***27***

Amtrak provides three distinct lines of business on this Corridor:

- Corridor-type services—daylight trains geared to short-haul trips in the 100-500 mile range. Currently, all such daily services operate as extensions of NEC trains[35];
- Long-distance services—overnight trains serving long-haul and leisure travel; and
- Auto Train—a specialized service carrying passengers and their motor vehicles to and from Florida.

[34] Because of the variability and directional imbalance of freight traffic, the numbers shown here (expressed as daily round trips for comparability with the other services) are rough approximations.
[35] The Fall/Winter 1998-99 schedule includes one weekend train operating from Newport News to Washington.

As detailed in Table 2-4, these lines of business address approximately six major geographic markets. Only two trains originate/terminate at Richmond.

Table 2-4
Amtrak Train Service in the Washington–Richmond Corridor

Market Served	Train	Line of Business	Terminus	Days of Operation	Enter/Leave Corridor at—
Newport News	Twilight Shoreliner	Corridor	Boston	Daily	Main Street Sta.[36]
	Old Dominion - Gotham Ltd	Corridor	Boston - New York	Su-Fr and Sa	Main Street Sta.
	Tidewater	Corridor	New York	Su	Main Street Sta.
	James River	Corridor	Washington	Su	Main Street Sta.
Richmond	Virginian	Corridor	Boston	Mo-Sa[37]	Staples Mill Sta.
	Charter Oak	Corridor	Springfield, MA	Daily	Staples Mill Sta.
Florida	Silver Palm	Long-distance	Boston	Daily	Acca Yard
	Silver Star	Long-distance	Boston	Daily	Acca Yard
	Silver Meteor	Long-distance	Boston	Daily	Acca Yard
	Auto Train	Auto-train	Lorton, VA	Daily	Acca Yard
North Carolina	Piedmont	Corridor	Boston	Daily	Acca Yard
	Carolinian	Corridor	Boston	Daily	Acca Yard
New Orleans	Crescent	Long-distance	New York	Daily	Alexandria
Chicago	Cardinal	Long-distance	Washington	We, Fr, Su	Alexandria

Existing Service Quality

At the outset of this study, it became evident that all services were incurring substantial delays on a regular basis. The following paragraphs explore the reasons for, and effects of, these service perturbations. The next section analyzes, on a site-specific basis, the most prominent bottlenecks on the Corridor.

A critical operational difference in the Richmond Corridor between the past and the present is the spacing of train schedules throughout the day. In 1930, for example, most trains were long distance intercity trains, and schedules were spread evenly over each day, with some prominent trains from New York to the South serving the Nation's Capital in the middle of night. In contrast, the present train schedules concentrate trains, in particular between Washington and Fredericksburg, during the daylight peak periods, primarily to serve commuters. The latest Corridor-oriented departure from Washington is 8:15 p.m., the

[36]At present, trains do not stop at Main Street Station.
[37]Extends to Newport News on Friday and Sunday.

Charter Oak to Richmond. The Silver Meteor departs at 10:59 p.m., but runs non-stop to Staples Mill Road Station.

Thus, the lower level of Washington Union Station (accommodating through service to and from the South) now handles four times as many peak period train movements as it did in 1930, with fewer tracks and passenger platforms now available. South of Union Station, normal daily freight train operations during the same peak hours further reduce the reliability of all services: it is not uncommon to see four freight trains "on hold" in Alexandria (waiting for passenger trains to clear the tracks) during the evening peak. This concentration of intercity, commuter, and freight traffic serves to intensify the operational conflicts that were analyzed as part of this study.

Indeed, recent events have given rise to concerns about the capacity of the railroad as it is presently configured to support existing services. During the Summer of 1997, routine track maintenance work between Quantico and Fredericksburg resulted in numerous substantial daily delays to Amtrak and VRE trains. On the average, Amtrak and VRE trains were running about an hour late as a result of a daily closing of a 20-mile segment of track to perform maintenance. Only a single track was available to run multiple trains in both directions. Intercity passengers and commuters will not tolerate such delays, and generally tend to seek alternatives. Commuters expressed an understanding of the situation, but found alternate means of transportation, citing the need to get to work reliably. VRE ridership suffered significantly. A derailment at RO Interlocking during August, 1997 further exacerbated system performance, to the point that VRE canceled half of its daily schedule, reasoning that some trains running on time were better than all trains operating late.

In light of these service quality trends, the line’s capacity and future would merit close scrutiny even in the absence of plans for high-speed passenger service, and underpins the need for, and the timeliness of, this report, that contemplates a future for the Corridor with high-speed passenger service.

Areas Of Special Complexity

The mix of facilities, services, and surrounding land uses poses special challenges in the following three locations in the District of Columbia and Virginia:

Washington

This section describes only one of the many challenging locations in the Washington area: Union Station. Other bottlenecks in the Washington–Richmond Corridor are described in Appendix C.

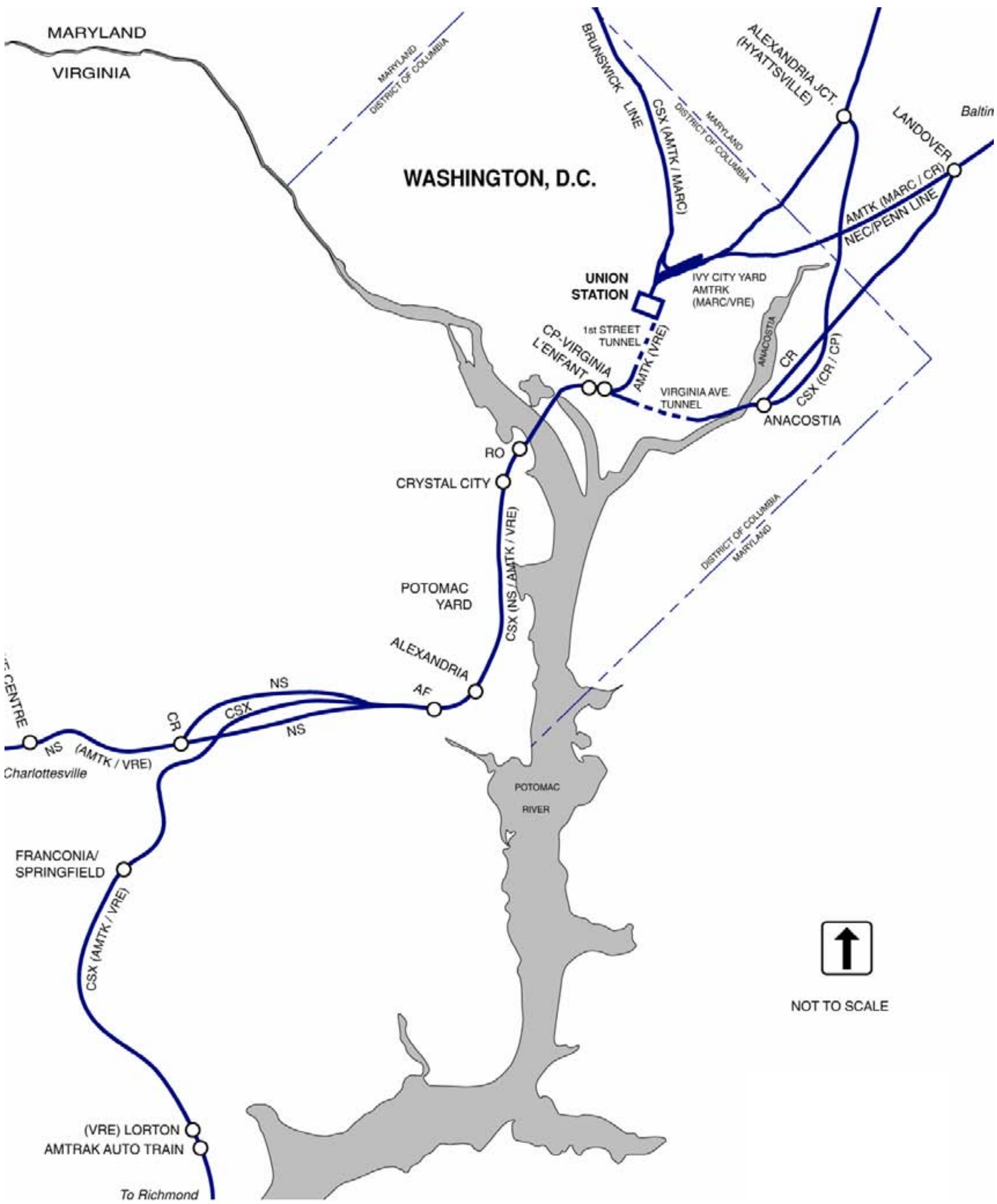
A generalized map of railroad routes in the Washington Metropolitan area is shown in Figure 2-3. Principally as the result of significant increases in VRE and MARC commuter train operation at Washington Union Station in the last ten years, particularly during the morning and evening peak periods, there is an increasing need for the station to be able to originate and terminate more trains, and provide additional storage. Because all trains to and from points in the South must arrive and depart on the lower level of Union Station, these six tracks must be used more efficiently to prevent passenger train delays, particularly when a train arrives late and out of the normal sequence for track occupancy. Additionally, the eight longest Amtrak trains must use lower-level Tracks 25 and 26 because they are adjacent to the longest platforms, further reducing flexibility for track assignments. All trains that operate through to/from the NEC also must change locomotives (to electric to operate on the NEC and to Diesel to operate to Richmond). These locomotive changes add to the level of activity and operating problems. In particular, changing southbound locomotives requires use of the two tracks within the First Street Tunnel, further reducing train capacity. Mail cars also are removed or added from the through intercity trains. With the increased Amtrak emphasis on mail and express service as a revenue source, increased car handling is expected to further add to operating problems on the lower level.

By way of historical comparison, in January 1930 the lower level, which then had additional track capacity, had 75 arrivals and departures each day by the RF&P, Southern Railway and Chesapeake & Ohio Railway. However, 19 of those trains were present between midnight and 6:00 a.m., being overnight trains en route to or from the South. Presently, only one train, en route from Florida, uses the lower level between midnight and 6:00 a.m. Today there are 43 daily trains, including VRE, using the lower level. Thus the train volume over the course of a day is about equal to the train volume in 1930, with less actual track capacity.

Since long-term (2015) plans anticipate significant increases in the daily number of Amtrak and VRE trains on the lower level, optimizing capacity is essential. Fortunately, some capacity can be restored at modest cost by providing passenger access to two out-of-service platforms and the restoration of a shortened Track 21. This track would provide adequate length for a VRE train. The very short distance within which all lower level tracks merge to two tracks through the First Street tunnel constitutes another intractable constraint. The double track, extending to RO interlocking across the Potomac River, also is shared with freight trains, beginning at CP-Virginia, about one mile from Union Station.

Other noteworthy points in Figure 2-3 include the freight-only Virginia Avenue Tunnel; the L'Enfant commuter station, consisting of a single, one-track platform in the midst of the constricted region between CP-Virginia and Alexandria; and AF Interlocking, where NS and CSX freight trains (and Amtrak trains over those lines) diverge.

Figure 2-3
Railroads in the Washington Metropolitan Area



Ashland, Virginia

Ashland is an area of special complexity because the rail line is located in the heart of this historic town, and there are many rail-highway or rail-pedestrian grade crossings. The seven public road crossings in Ashland are protected by crossbucks, gates, lights and bells. (There are no private crossings in Ashland.) The twelve pedestrian crossings have no protection, although the track is straight and visibility is excellent. These many crossings in Ashland have resulted in a permanent speed restriction; upgrading the speed through Ashland has been considered in the past and rejected. Significant modification to present restrictions is not included in the present program; any future attempts to deal with this situation would need to address the significant town planning issues surrounding these grade crossings.

Richmond, Virginia

This section highlights two particularly complex areas in the Richmond vicinity: Main Street Station and the routing of trains from Richmond to the South.

A generalized map of the railroad routes in Richmond area is shown in Figure 2-4. The key north-south and east-west routes are shown as well as the principal yards, stations, and junctions.

Main Street Station

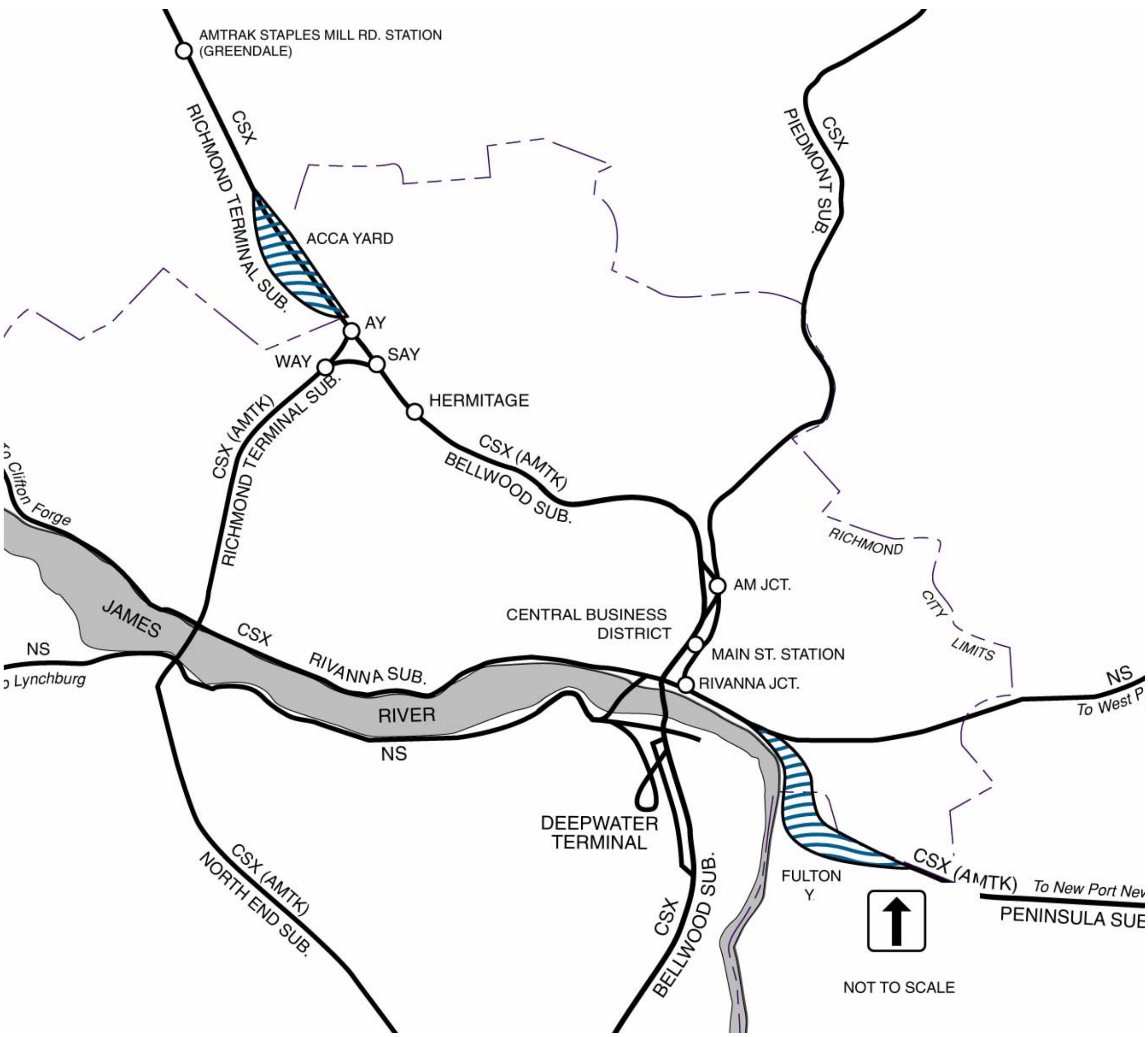
By 1975, Amtrak, then in its fifth year of existence, had withdrawn from Broad Street Station and Main Street Station. In an attempt to control station operating expenses in Richmond, Amtrak opened a new, far more modest structure along Staples Mill Road, located between the Dumbarton and Greendale communities, north of the city. The station is adjacent to GN interlocking, at M.P. 4.8 on the former RF&P mainline. The station is about a mile north of Acca Yard and eight miles north of Main Street Station. The principal disadvantages of Staples Mill Road Station are its distance from the commercial center of the city—a distinct marketing drawback in a relatively short corridor like Washington–Richmond—and its relative lack of access to major local and interstate roads. These factors have assumed greater weight as corridor-type service between Richmond, Washington, and NEC points has grown in importance and promise; when opened, the station principally served the long-distance Florida trains, which did not provide a particularly convenient, reliable schedule to and from Washington, Philadelphia, and New York City for Richmond passengers.

Since 1975, Amtrak has initiated additional service that focused on the Richmond and Tidewater markets and has been successful in building ridership, which also adds to the NEC patronage. Presently, there are 14 trains per day operating to, from and through Richmond, including four trains that originate/terminate there. In addition, four trains serve

Richmond to and from Newport News, Virginia, passing, but not stopping at, Main Street Station in downtown Richmond.

The City of Richmond and the Commonwealth of Virginia, through its Secretary of Transportation and the VDRPT, have conducted several studies concluding that a combination of increased service and reduced travel times, along with the restoration of service to Main Street Station, would achieve a number of objectives. These include reducing congestion on I-95, improving air quality, and providing a cost-effective alternative to additional highway construction. The architecturally-distinguished Main Street Station would become the central focus of the RMTC. The RMTC also would provide facilities for intercity buses, transit, and airport limousines, as well as parking and retail amenities.

Figure 2-4
Railroads in the Richmond Area



Although all passenger trains except the Amtrak Auto Train would serve Main Street Station, the vast majority of trains would be through trains not requiring layover facilities. Several trains, however, do require layover and turnaround facilities to efficiently use equipment. Because no passenger trains at Main Street Station have required layover facilities for inspection and storage for several decades, the infrastructure for such uses has been dismantled and some of the property sold.

Options to minimize the potential for conflict with freight train operations in the Richmond area include segregating, to the extent possible, passenger and freight services between Amtrak's present station and Main Street Station. This segregation is necessary to achieve reliable on-time performance, which is necessary to attract and retain viable ridership levels.

Train Operations South of Richmond

Passenger trains en route to or from south of Richmond currently use the former Atlantic Coast Line Railroad (now the CSX "A" or west line) route from Acca Yard, crossing the James River to the west of downtown Richmond. Four trains that originate/terminate in Richmond use the wye track on the "A" line at South Acca, about four miles south of the Staples Mill Road station, to turn. All passenger trains use the "Passenger Main" track on the west side of Acca Yard. At the south end of the yard, the North Carolina and Florida trains access the "A" line and head to Centralia (without passing through Main Street Station), while the Newport News trains continue southeast and use the tracks on the east side of Main Street Station (without stopping) to proceed to Newport News. The connection to the southeast, located at the south end of Acca Yard, is less than ideal because of speed restrictions and opposing freight train movements from and within Acca Yard.

Trains to and from Newport News use the Bellwood Subdivision for about three miles to the connection to the Piedmont Subdivision, about one mile north of Main Street Station. The Bellwood Subdivision, which has an MAS of 30 mph, with two additional restrictions of 20 mph, previously was the mainline of the SAL. Until 1958, SAL used Main Street Station for its 12 passenger trains to and from the Carolinas, Georgia, and Florida. SAL shared this station with the C&O, which operated eight daily trains. SAL trains, operating a north-south service, used the west side of Main Street Station, while C&O trains, operating from Newport News to Charlottesville and the west, used the east side of the station. Both alignments are elevated on viaducts.

The Bellwood Subdivision (or "S" line) currently extends nine miles south of Main Street Station, where it rejoins the CSX mainline, or "A" line, at Centralia. Restoration of passenger service on the line would require some rehabilitation since it has not been a core system freight or passenger route for several decades. The "S" line is, however, assuming an increased role for CSX freight operations in the Richmond area, as a route for the westward movement of empty coal trains from electric utilities in the Carolinas to the Piedmont Subdivision connection, about one mile north of Main Street Station.

The Piedmont Subdivision, from Clifton Forge and Charlottesville, connects to the Rivanna Subdivision, from Clifton Forge via the James River line, at Rivanna Junction, located about 1000 feet east of Main Street Station. Freight train volume between Rivanna Junction and Newport News on the Peninsula Subdivision principally consists of about ten long, slow coal trains per day. Thus Rivanna Junction is, and will remain, a daily, constant factor affecting the efficient movement of passenger trains on the east side of Main Street Station. Rivanna Junction will become more significant in the future because CSX plans to operate an increased number of coal and grain trains on the James River line eastbound through Rivanna Junction, as well as more westbound empty coal trains on both the Bellwood and Piedmont Subdivisions. Thus, passenger trains presently could encounter significant conflicts on the 8-mile segment from Amtrak's Staples Mill Road Station through Acca Yard to Main Street Station, particularly at the connection to the Piedmont Subdivision. The viaduct track structure presents an additional constraint to modifying the track configuration.

Chapter 3
SERVICE GOALS

All operators and sponsors—intercity passenger, commuter, and freight—intend the services on the Washington-Richmond Corridor in the planning year, 2015, to be more reliable than those operating on the Corridor at present. The envisioned mix of services is presented in Table 3-1 and described below.

Table 3-1: Railroad Services Envisioned for 2015 on the Washington–Richmond Corridor

Service	Route	Number of Daily Train Movements (Round-Trips)	
		Washington to Alexandria	**Alexandria to Richmond**
	AMTRAK		
Corridor-type services	Newport News—Northeast Corridor	3	3
	Richmond—Northeast Corridor	3	3
	North Carolina—Northeast Corridor	4	4
	Bristol—Washington	*2*	
Total, Corridor-type services		*12*	*10*
Long-distance services	Florida—Northeast Corridor	4	4
	New Orleans—Northeast Corridor	2	
	Chicago—Cincinnati— NEC	1	
Total, Long-distance services		*7*	*4*
Auto Train	Lorton, Virginia—Sanford, Florida		1
Total Amtrak		***19***	***15***
	VIRGINIA RAILWAY EXPRESS (VRE)		
Commuter service	Washington—Manassas	22	
	Washington—Fredericksburg	22	22
Total VRE		***44***	***22***
	FREIGHT		
All freight services *(CSX and Norfolk Southern)* [38]		***17***	***16***
GRAND TOTAL WASHINGTON—RICHMOND CORRIDOR		***80***	***53***

Covering a typical 24-hour period, the numbers of daily trains envisioned in Table 3-1 do not adequately depict the congestion potential on the Corridor. To assess that

[38] Because of the variability and directional imbalance of freight traffic, the numbers shown here (expressed as daily round trips for comparability with the other services) are rough approximations.

potential requires contemplation of the **evening peak period** movements in each direction through the Washington–Alexandria bottleneck, as shown in Table 3-2. In view of the varying performance profiles and station stop requirements of the three services, as well as the needs for diverging, combining, and conflicting moves at AF and CP-Virginia, the average intervals underline the need for such capacity additions as this report suggests.

Table 3-2
Projected Train Movements by Direction between Washington and Alexandria between 3:30 p.m. and 7:30 p.m., Year 2015

Service	Southbound Moves	Northbound Moves
Amtrak (all services)	7	4
VRE	22	9
Freight (CSX and NS)	3	2
Total movements	32	15
Average interval (in minutes) between movements	7½ min.	16 min.

Intercity Passenger

Corridor-Type Services

A strong demand would exist for corridor-type high-speed intercity train service between Washington and Richmond if such service were to be provided. This is the message of studies prepared for the Commonwealth of Virginia, which project a significant increase in intercity rail travel demand on the Washington–Richmond Corridor by the year 2015, as shown in Figure 3-1. Confirming the Virginia projections, FRA's commercial feasibility study, *High-Speed Ground Transportation for America* (September 1997), projects an even more marked growth in intercity rail travel demand for the Washington–Richmond Corridor.

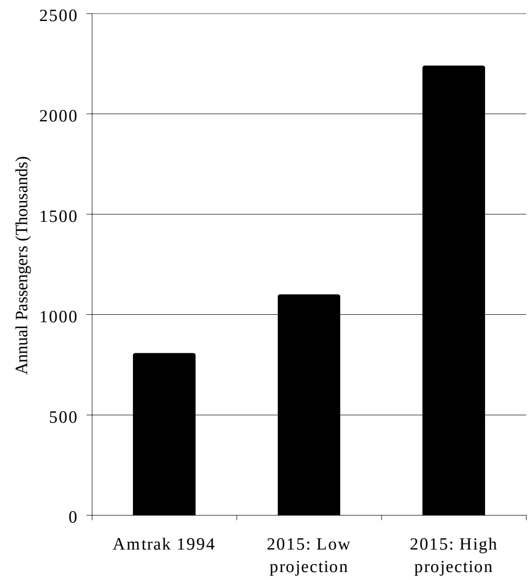
To satisfy this latent demand, most of which would relieve overburdened highways of intercity travelers, Virginia envisions train service reliably linking Washington, D. C. (Union Station) and Richmond (Main Street Station) in less than two hours by 2015, with two intermediate stops.[39]

[39] Service between the existing Staples Mill Road Station and Union Station, Washington would take approximately 100 minutes.

The 2015 service would include ten daily trains, with one-hour headways during peak periods and two-hour headways off -peak, as follows:

- Richmond–New York trains (three round trips),
- Newport News–New York trains (three round trips); and
- Charlotte–New York trains (four round trips)

Figure 3-1
Demand for Intercity Corridor Train Services, Washington–Richmond[40]



NCDOT high-speed rail planners assume that service over the former SAL railroad route (the "S" Line) between Raleigh and Richmond (Main Street Station) will be resumed, with an MAS of 110 mph. Assuming that a trip time of less than two hours is attained for the Washington-Richmond route, travel time from Charlotte to New York would be about nine hours, while travel times between Raleigh and New York would be slightly more than six hours.

All these plans are evolving. For instance, Virginia is now considering the possibility of rail passenger service between Bristol, Lynchburg, Washington, and Richmond.[41] Also, the U.S. Secretary of Transportation recently extended the Southeast Corridor from Charlotte, North Carolina south to Macon and Atlanta, and from Richmond south to Columbia, Savannah, and Jacksonville (see Figure 2-2). These extensions could ultimately result in additional train frequencies, which the fixed plant contemplated in this report for 2015 would readily accommodate to the extent they make use of the Washington–Richmond Corridor outside the evening peak period.

Long-Distance Trains

By 2015, Amtrak envisions four daily Florida overnight trains in each direction, an increase of one over current schedules. Amtrak is also considering the addition of a second

[40] URS Consultants for the Commonwealth of Virginia, *Washington, D.C. to Richmond Rail Corridor*, 1996.
[41] The analysis for this report provided, in its simulations, for two daily round trips between Lynchburg and Richmond, which are not shown in the table because they operate on the corridor for only one-half mile, at Main St. Station.

daily long-distance train between Washington and Atlanta.[42] Other long-distance services would remain at current levels. To the extent possible given their equipment, length, weight, and mail-and-express payload, these overnight trains would take advantage of the trip-time benefits afforded to corridor-type trains. However, the prime advantage of Washington–Richmond Corridor development to Amtrak's long-distance trains would be reliability enhancement.

Auto Train

Amtrak foresees a continuation of the single daily Auto Train round trip during the planning period, with the northern terminus remaining at Lorton, Virginia.

Commuter

VRE projects that increasing commuter travel demand by 2015 will necessitate commuter train volumes three to four times higher than at present, as shown in Table 3-1. Although the percentage increases are large, they are from a low-frequency base—the existing startup service. The contemplated future train volumes would replicate those found in mature commuter services elsewhere in the United States.

New commuter services are also possible by 2015. A study of the potential for improved commuter rail operations in the Washington-Baltimore metropolitan area was recently completed. The study evaluated options for the run-through operation of VRE and MARC trains onto each other's lines and recommended a two-phase service initiation program. The first phase would include a limited number of MARC trains operating through to Alexandria, where a small yard would be constructed to store trains between the morning and evening peak periods. The second phase, based on 2015 schedules, would include extensive operation of MARC and VRE trains to terminals on each others' lines. This report includes allowances for the fixed facilities needed for such coordinated service, but assumes that the joint operation would be so planned as to not materially increase train frequencies over the Washington–Richmond Corridor during peak periods.

Freight

This study used existing levels of freight service, augmented by changes projected by CSX and NS as a result of the joint application to STB, in June 1997, for the Conrail Acquisition. The Operating Plan contained in the application served as an additional source of information to validate the freight service assumptions. In addition, CSX provided information on planned revisions to its operations in the Richmond area, on the Bellwood,

[42] Via Alexandria, Lynchburg and the former Southern Railway route of the NS; not via the Southeast Corridor.

Piedmont, Rivanna and Peninsula Subdivisions, in the vicinity of Main Street Station. CSX does not attribute significant changes in freight traffic on these subdivisions to the Conrail Acquisition, but the subdivisions nevertheless will experience increased levels of freight train activity.

On the segment with the highest level of train movements, between CP-Virginia and AF (Washington to Alexandria), ten freight train movements (total for both directions[43]) were simulated during the hours of primary passenger train activity, with five of these moves occurring during the highly sensitive evening peak.[44] This segment contains three passenger stations, and is double tracked between CP-Virginia and RO, a distance of 2.2 miles. Much of the increase in freight service train movements is expected to be provided by intermodal trains, which are characterized by higher horsepower-per-ton and operating speeds that closely approximate the MAS for a given segment of the route.

In total, for a typical day on the Washington to Alexandria segment, this study assumes that typical freight movements would increase from roughly 26 daily trains today (total for both directions), to approximately 34 by the year 2015.

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[43] I.e., southbound plus northbound movements. This is a realistic way of depicting freight activity, since it recognizes that directional imbalances are typical of freight movements.

[44] See Table 3-2.

Chapter 4
METHODOLOGIES

Sources for this study included reports prepared by the FRA, the VRE, and the VDRPT, filings before the STB, track diagrams, maps, equipment specifications, and other engineering and ownership documentation. Limited field investigations took place to verify existing conditions. Also, the study team consulted with appropriate VDRPT, local, CSX, NS, and VRE officials to assess the status of their respective plans, and to assemble a consensus list of possible projects that would assist all operators to meet their service goals. Extensive inputs, review, and comments were solicited from the these agencies and railroads, and numerous meetings were held, jointly and separately, to discuss the effort and resolve differences. The work process is described in subsequent subsections.

Work Performed By The Commonwealth Of Virginia

In 1993, the General Assembly of the Commonwealth of Virginia directed the State Secretary of Transportation, in conjunction with the VDRPT, to perform a study of the rail freight and passenger demands for the Corridor between Washington and Richmond. The study was to include an assessment of the existing conditions, capacities, and improvements needed. Technical Reports and a Final Report[45] were prepared and were extensively used in the performance of the analyses documented in this report.

Data Collection And Organization

Development of this Washington–Richmond study included a limited review of the current (1997) condition of the rail Corridor and its ability to safely and efficiently handle the existing levels of rail services operated by Amtrak, VRE, and CSX/NS. The review included, but was not limited to, track conditions and configurations, roadbed and under-grade bridge conditions, signal and traffic control systems, passenger stations, and maintenance facilities.

In the interest of efficiency, and to reduce the number of requests for data from concerned government agencies and organizations, the data collection processes for the state of the rail Corridor analysis, and this report, were combined whenever possible. Consultations were held with the appropriate staff of Amtrak, VRE, CSX, NS, Conrail, and VDRPT who were involved with rail operations in the Corridor. The objective was to obtain

[45] URS Consultants for the Commonwealth of Virginia, op. cit.

data on existing and projected 2015 train operations and to obtain information on presently planned improvements to the Corridor.

The latest track chart, curve information, real time outputs from the Amtrak track geometry car that operates over the Corridor twice a year, and track maintenance program information were obtained from CSX, Conrail, and Amtrak, to serve as an input to the subsequent analyses.

Available maps and documents were collected and reviewed, and on-site inspections were made. Current information on existing usage and any current plans for upgrading the Corridor were obtained and reviewed. The results of investigations of current conditions in the Corridor were reviewed with, and comments were obtained from, Amtrak and state and local transportation agencies so that their concerns and needs were known and resolved prior to the preparation of this report.

A summary level description of the condition of the existing Washington–Richmond Corridor rail plant was developed (see Chapter 2). The description was based on the results of reviews of documentation previously prepared, augmented, as needed, by the results of field inspections. Summary descriptions of current and 2015 service levels for commuter, intercity, and freight operations also were prepared and are presented in Chapters 2 and 3.

A summary of track and station ownership, lease, operating and occupancy rights to the land, equipment and fixtures was prepared. It included an outline of the various operating agreements that pertain to both freight and passenger rail service between Washington and Richmond (Appendix E).

Entities having possible ownership or operating interest in Corridor right-of-way, stations, and air rights were contacted for this information. Pertinent maps, drawings, agreements (trackage rights, maintenance, operating, etc.), franchises, government permits, title documents, and other data relating to ownership and use of the right-of-way (inclusive of all fixed and moveable-span bridges), and stations were reviewed.

Initial Development Of Improvements

Draft documentation detailing the program of improvements in the Washington–Richmond Corridor was prepared and submitted to participating agencies for review and comment. The documentation included recommendations for enhancements and modifications thought to be necessary for upgrading the Washington–Richmond facilities so they could handle the projected levels of intercity, commuter, and freight service safely and efficiently in 2015.

A list of planned, proposed and desired Corridor improvement projects was compiled to establish a "control list" of projects as well as the elements to be included in the preliminary program of projects to be recommended. The list was developed by reviewing prior reports, documents, and improvement programs; consultation with the owners and operators of the railroads; Federal, state, and local government agencies; and field investigations to verify existing conditions. The projected operating schedules of all Corridor users over the next 20 years also were obtained and a determination was made as to whether the planned improvements were adequate to handle the projected traffic levels.

Specific projects that needed further analysis or conceptual development were identified, and additional information was gathered to enable recommendations to be developed. Projects that were reviewed included proposals to:

- Upgrade the track structure;
- Install new signaling and traffic control systems;
- Realign selected curves to increase operating speeds and reduce trip time;
- Reconfigure, eliminate, or install interlockings to improve operating flexibility;
- Install trackage to accommodate increased traffic levels; and
- Initiate station improvements.

Reports, plans, drawings, schematics, schedules, results of operational analyses, and budgets were reviewed to identify areas requiring follow-on investigations. Photographs and video also were used in the analytical process.

As each planned, proposed, or potential project that might affect rail operations was identified, a project data sheet was initiated. The data sheet information included, wherever possible: a description, location on the Corridor, and the rationale for the improvement.

After the proposed projects were identified, evaluated and documented, summary geographical presentations illustrating existing and proposed spatial interrelationships were developed. These are included in Appendix D.

The preparation of the preliminary list of projects to meet program goals was a limited iterative process. The process resulted in a list of projects that would—

- meet intercity rail service goals based on reduced running times and higher frequency of service;
- enable other services to coexist at their present levels without degradation; and
- accommodate projected or future growth or changing conditions, such as increased commuter rail operations in the Corridor.

Scenarios to achieve the best integration of intercity, commuter, and freight rail services were prepared, based on operational constraints identified from analyses of the projected 2015 intercity, commuter, and freight volumes.

As necessary, alternative projects, beyond those initially proposed, that would enable attainment of the stated goals were developed, analyzed, and included.

Analysis Of Operations

This section summarizes the essential lines of the analysis, and then provides selected details.

Overview of the Analysis

The analysis compared the services as presently envisioned by the operators for 2015, with the fixed plant as configured today and as upgraded with various carefully-ordered combinations of improvements. The analysis focused on two questions:

- Can individual trains meet their trip-time goals, irrespective of other traffic? and
- Can all the services operate in combination at intended speeds and schedules over the Corridor, while still meeting their reliability imperatives?

To answer the first question, the study team used a computer model known as a train performance calculator (TPC) to model the operation of a single train, with defined performance characteristics, over a traffic-free railroad with profile, alignment, and maximum speeds as specified for each segment. The TPC was applied to prototypical freight, intercity passenger, and commuter trains, to assess their optimal performance over the Corridor under different sets of conditions. However, it must be remembered that the mere physical possibility of operating a given train over a given right-of-way at a given trip time offers no assurance that a combination of services can reliably operate on the Corridor.

To answer the second question, the study team applied detailed simulations—modeling sophisticated, random variations in operating conditions and performance—to the full spectrum of freight, intercity passenger, and commuter services on the Washington–Richmond Corridor. These simulations assessed the impacts of changes in both schedules and fixed plant capabilities on all services operating simultaneously over a hypothetical seven-day test period.

Taken together, the TPC runs and the detailed operating simulations permitted the analysts to compare intended schedules, optimal running times, and expected performance for all services. The effects of alternative schedules and fixed plant capabilities were evaluated through numerous model runs. By these means the study team developed a preliminary list of potential projects and priorities that would meet the trip time and reliability goals of the study. This report synthesizes the results of investigations to date and defines a plan that can serve as a basis for further design, environmental work, and partnership and financial development for the Washington–Richmond Corridor.

Simulation Techniques

Manual and computerized operational simulation techniques were used to analyze the reliability of the projected intercity, commuter, and freight services operating on the same trackage between Washington and Richmond. The sophisticated computerized simulations were performed using the same Monte Carlo™ model used for the New York to Washington NEC spine. Details of the simulations performed are contained in Appendix C.

The "delays" generated by the computerized simulation are derived from the theoretically perfect trip time between the origin and destination of a particular train, rather than from the scheduled trip time. The difference between the theoretically perfect trip time and the scheduled trip time is known as “pad,” a term further defined in Appendix B. The following times for CSX Intermodal Train 192 between Alexandria and Acca Yard (Richmond) illustrate the variation in these times:

- TPC time (theoretically perfect trip time) - 2 hours, 17 minutes;
- Scheduled operating time - three hours 20 minutes; and
- Average simulated operating times - two hours 26 minutes.

Consequently, although Train 192 on average operated nine minutes slower than its optimal TPC time, its average performance was 54 minutes better than scheduled. The nine minutes of "delay" is acceptable, and to be expected when optimized TPC times are used as the basis against which "delay" is measured. Until Intermodal Train 192's total "delay" exceeds 63 minutes it is considered to have "on-time performance." Train 192 had an exceptionally satisfactory performance during the simulations performed.

No economical railroad operation is free of “delays.” This is illustrated by the existing “delays” that occur when two freight trains meet at the single track Virginia Avenue Tunnel and one has to wait for the other to clear the tunnel. Likewise, a late-running Amtrak Florida train may be further delayed south of Washington by having to follow a local commuter train. If it had not missed its assigned operating window, the conflict would have been avoided. The "delays" discussed in this study, while undesirable, must be viewed from the context of optimized TPC times, existing “delay” histories, and the potential “delays” that would occur if nothing is changed.

TPC model simulations of train operations were used to assess the overall quality and effectiveness of the proposed projects. The analyses of the projects deemed necessary to achieve the trip time and reliability goals were made to represent the completed projects taken together, rather than each project separately.

The TPCs also were necessary to show that reliable trip times for intercity and commuter trains were possible without degrading other current or future services.

Cost Estimates

Conceptual, order-of-magnitude estimates for each project identified as necessary were developed in 1999 dollars. Appropriate levels of contingency, reflecting the level of project development, were included.

Project Categories

Each proposed improvement was assigned to one of two major categories defining the basic purpose of the work: Trip Time-Related Projects and Capacity-Related Projects. While this categorization is useful analytically, the categories can overlap: some trip time-related projects would help to improve capacity, and some capacity-related projects would help to reduce trip times.

Trip Time-Related Projects

Projects generally contributing directly to lower trip times or permitting higher operating speeds, were included in this category:

- curve and spiral modifications,
- interlocking reconfigurations,
- signal modifications for higher speeds, and
- use of high performance trains.

Capacity-Related Projects

Projects providing additional railroad capacity to preserve attainment of the trip time, while accommodating higher train frequencies were included in this category:

- installation of passing tracks,
- installation of second platforms at VRE stations,
- higher speed turnouts and crossovers, and
- additional signal speed commands.

Preliminary Project Phasing

A detailed project schedule for constructing these projects was not developed. Instead, a preliminary phasing analysis was performed to identify project priorities and the relative interface of projects. The phasing of projects was determined once an agreed priority for projects and individual construction work items was established. This approach included an analysis of constraints associated with projects that would depend on track availability for construction. Phasing generally took into consideration logistics and procurement of materials and equipment, availability of resources, environmental approvals, real estate acquisitions, track availability, and funding availability.

Assessment Of Projects

The benefits associated with individual projects were identified based on the operational analyses. Detailed environmental analysis was not performed; however, experience gained from prior projects was reviewed to ensure that recommended projects could reasonably be assumed to be implemented with a minimum of environmental disruption. Further, work to identify the potential changes in intercity ridership, revenues, and costs as the result of implementing the program of projects, and the proposed 2015 intercity rail service schedules, was not performed.

Key Assumption: Condition Of The Underlying Railroad

As noted on page 7, the Corridor, as a principal north-south freight route, has been maintained to facilitate safe and expeditious freight movements. Therefore, this study assumes that the freight railroads, as owners of the fixed plant, will continue to maintain it in the state of good repair that characterizes the main line portions today, from Washington to the Staples Mill Road/Acca Yard area north of Richmond. For that segment, the investment requirements contained in this report do not include replacement in kind of key existing track components (ties, rail, and the like)—in railroad parlance, "program maintenance."

On the other hand, for the segment between Staples Mill Road/Acca Yard through Richmond to Centralia, this report provides for a significant upgrade, with replacement of rails, ties, and other track components to assure safe, expeditious passenger and freight service.

Chapter 5
INVESTMENT REQUIREMENTS

The analysis yielded a preliminary list of projects that would provide the service envisioned by Congress, the Corridor operators, and the States. This chapter generally describes the types of improvements contemplated, provides background and details regarding the projects on a site-specific basis focusing on the areas of special complexity, and summarizes the improvements in a tabular format. Appendix G provides an extensive narrative on the specific projects throughout the Corridor.

Overview Of The Improvements

The Washington–Richmond line is a multiple-use Corridor, in which freight, commuter, and intercity services perform equally vital functions.

In that context, providing intercity rail passenger service in less than two hours between the city centers of Washington and Richmond on a frequent, reliable schedule would require that more than 25 minutes be eliminated from the current schedule of the fastest train. The existing rail line would have to be upgraded so that trains can run at higher maximum and average speeds to produce lower trip times. Achieving the trip time on a reliable, consistent basis—while preserving and enhancing the dependability of the important and growing freight and commuter services sharing the line with intercity passenger trains—would require that the capacity of the rail line also be increased. Reduced trip times and improved capacity would enable the high-speed service to be operated reliably without adversely affecting or being delayed by the large number of frequently stopping commuter trains and the long freight trains.

Based on the operational and maintenance analyses performed, including a review of work performed by others over the last several years, facility modifications and improvements between Washington and Richmond are suggested. Facility improvements between Richmond and Centralia, to facilitate the operation of Amtrak Florida and North Carolina trains via Main Street Station, also are described.

Station improvements, which serve multiple purposes, are discussed in a separate section below.

Trip Time-Related Projects

The speed, or trip time-related, projects required to achieve center-to-center service between Washington and Richmond in less than two hours were identified by repeatedly simulating the operation of the service, assuming that varying sets of improvements had been implemented. Beginning with an understanding of VDRPT's recommended program, and after dozens of simulations, it was concluded that such service between Washington and Richmond could be achieved if improvements briefly described below were implemented.

Curve Realignments

The Richmond Line was built in the mid-19th century, when railroad technology was in its infancy. Although a few line relocations have been made over the years, it remains a railroad with a significant number of curves. At many locations the community around it has developed to the point where relocation of the alignment is unrealistic. Environmental concerns make relocation difficult elsewhere. Nevertheless, several types of fixed-plant improvements to reduce the speed constraints associated with curves in the Washington–Richmond Corridor could be implemented:

- Increasing superelevation to the maximum allowable for a particular track alignment;
- Increasing the amount of unbalanced superelevation used to calculate speeds through curves, in order to minimize the need to shift trackage; and
- Modifying spirals (the length of track that provides a smooth transition from tangent track to curved track to provide a smoother ride). Such adjustments can involve moving the track by a small amount, up to about four feet (see Appendix A).

The alternative of changing the degree of curvature on existing curves, either within the existing right-of-way, or by acquiring land outside the existing right-of-way, was considered but generally deemed not necessary to meet the trip time goal of less than two hours between the two cities.

Though listed here as a single project, the improvements would actually consist of a large number of separate "sub-projects" at individual curves or groups of curves. The initial analysis represents a "best case". It is likely that detailed study would reveal local constraints that would limit the feasibility or practicality of implementing some specific sub-projects. The recommended alignment changes would allow higher speeds that can be sustained for meaningful periods of time.

The curve realignment program would contribute significantly to the improvement in travel times in the Corridor, thereby justifying the time and expense required to implement the program.

Signal System Upgrade

The signal system would be upgraded to efficiently handle increased train traffic on the Corridor and permit improved intercity passenger service with greater safety, while enabling commuter and freight service to successfully operate on the same tracks. New block layout and signal aspects would accommodate speeds up to 90 miles per hour. The signal system would use microprocessor-based track circuits and control/indication equipment. Block spacing would anticipate increased train speeds. Reverse signaling would be installed universally. Interlockings would be remotely controlled from Jacksonville, Florida.

The new signal system would improve the reliability of train operations for all services and reduce maintenance expenses, in addition to supporting higher speed train operations.

High-Performance Intercity Trainsets

The train consists that would be operated in the Richmond Corridor to provide improved high-speed rail service have not been identified. Their capital and operating costs, their compatibility with the NEC for through service, and their marketability (in terms of generating passenger volumes and maximizing net revenues) would exemplify the factors that would enter into the selection of train equipment.

Confirmation of Trip-Time Improvements

TPC simulation was performed to assess whether the proposed capital improvements would permit less than 2-hour trip times. The TPC assessed the performance of one train operating over a hypothetical route with no other trains present. Alternative track configurations, speed restrictions, locomotive models, and train consists were considered. Details of these analyses are provided in Appendix B.

The TPC runs confirmed that operating a high-speed train between Washington and Richmond (Main Street Station) within less than two hours (120 minutes), would be appropriate and achievable, provided that:

- At least five inches of unbalanced superelevation on curves is permitted;
- Superelevation on curves is increased to the recommended superelevation that would maximize speed and comfort (discussed in Appendix A);
- Curve spiral lengths are increased to the recommended length that would maximize speed and comfort, while satisfying CSX design and maintenance criteria;
- Signal improvements to allow trains to run fast enough to benefit from the recommended speed improvements are implemented;
- Other specific trip time-related projects are implemented;
- 90 mph top speed is permitted in those sections where speed is not constrained by curvature;

- Capacity-related improvements to promote reliable train operations are implemented; and
- Express trains are limited to two stops.

To ensure reliability, a schedule pad of seven percent has been added to the TPC times. Pad is defined as the difference between a published schedule time and the best achievable time between two terminals. Pad provides an allowance for variables that occur in the real world.

When analyzing the results of TPC runs, pad also provides allowance for two additional factors:

- the possibility that some of the configuration and alignment improvements incorporated into the model would prove physically infeasible and not be implemented; and
- the realization that the model assumes that the train is operated in accordance with all changes in speed, in a consistent and precise manner, at all times.

These assumptions may be too optimistic, and the pad functions as an allowance to evaluate whether the trains simulated would be able to perform reliably on a day-to-day basis. The amount of pad built into a schedule allows trains to incur small increments of delay en route and still maintain a high probability of on-time performance.

Capacity-Related Improvements

This section briefly describes the rationale for and nature of the capacity improvements suggested by this study. It also summarizes the results of the simulations confirming the feasibility of the year 2015 service levels over a railroad improved in accordance with this report.

Rationale

High-speed rail service between Union Station, Washington and Main Street Station, Richmond on a schedule of less than two hours can be achieved with the trip time-related projects identified in the previous section. To operate that service reliably, at an average 59 mph,[46] without adversely affecting the slower freight trains (40 to 42 mph average for intermodal freights; 35 to 38 mph for conventional freights) and commuter trains (35 to 37 mph average), would require that capacity be added to the rail line to allow the various trains to coexist while operating at different speeds, with increased train frequencies.

[46] This assumes performance equivalent to that of two Diesel locomotives per train, and includes intermediate stops.

Without any significant capital improvements, it would be nearly impossible to operate improved intercity service between Washington and Richmond. If the planned growth in all services provided on the Washington–Richmond Corridor occurs under current operating conditions, intercity trains would operate in a physically constrained and congested environment. As a consequence, even the current intercity rail service might be less attractive to potential customers than competing modes of travel. The congestion also would also affect commuter operations; VRE would be hard pressed to provide reliable peak period operations.

These problems can be addressed by a combination of capital improvements and operating strategies. Some of these improvements are currently being progressed as part of VDRPT's proposed high-speed program. Cooperation among the Corridor operators also is key to successfully tackling the problems faced by all of the groups.

Recent investigations of the Richmond Line, and an evaluation of existing and proposed train operations, have identified facility and operating improvements proposed to be implemented by 2015.

Nature of the Capacity Improvements

The types of capacity improvements suggested for implementation are site-specific, and are discussed further below and in Appendix G. In general, they include the construction of third or fourth tracks and commuter pocket tracks; the reconfiguration of switching stations (interlockings) to optimize operating flexibility and provide the capability of making simultaneous train crossover movements (parallel moves); and accompanying changes in the signaling/train control system. This expanded capacity would reduce the impact of the projected intercity and commuter passenger service increases, and would maintain the quality of freight service on the line, thereby making the increased passenger service attractive to CSX, the owner/operator.

Confirmation of the Capacity Improvements

As described in Chapter 4, the interaction of the various services was simulated to identify necessary improvements to meet the goal of less than two-hour service without adversely affecting future freight or commuter rail services. If only trip time-related improvements were implemented, it was concluded that the service goal could be met only if the other services were adversely affected: commuter and freight trains would often be held on sidings and branch line tracks to permit the high-speed trains to take advantage of the improvements. With the increased number of trains, the existing number of main tracks and sidings would be insufficient.

After several iterations of simulations, a set of cost-effective improvements was identified that would permit the intercity service goal to be achieved while preserving the reliability of future commuter rail and freight services. **Thus, the simulations confirmed the feasibility of reliably operating all the projected services in the year 2015, provided that the suggested trip time <u>and capacity</u> enhancements are installed.**

With regard to freight, for example, the simulation results indicate that the configuration ultimately modeled has sufficient facilities, appropriately placed, so that the projected 2015 freight trains can be operated reliably. If sufficient facilities had not been provided in the simulation, the freight transit times would have fluctuated widely, which they did not do. The average running times for each class of trains are the same north and southbound.

Actual versus scheduled freight train performance for the seven-day train simulation performed for the Washington–Richmond Corridor was compared. Delay statistics for groups of trains of a similar type were developed and analyzed. Lateness was measured with respect to scheduled transit time once a train entered the Corridor. Delays that may have occurred prior to a train entering the Corridor were not measured. These delays are generated randomly in the Monte Carlo™ model and are intended to reflect normal operations. Scheduled times are for trains operating between Acca and Potomac yards.

Four trains (two northbound, and two southbound) accounted for all the delays. Recent data indicates that one northbound train has been rescheduled and operates at another time with a revised schedule. Using this schedule would eliminate four of the five northbound delays in the simulation, leaving a single one-minute delay on day seven, a reduction of 53 minutes. One southbound train's schedule also has been lengthened. This would have eliminated one of the southbound delays and reduced the total delay by 30 minutes. The single delay to the other southbound train could have been avoided with a minor change in dispatching logic. Otherwise the running times were uniform and less than scheduled, with one train operating 53 percent faster than scheduled. While on average intermodal trains performed better than in both directions, General Merchandise trains performed, on average, 57 minutes better than scheduled northbound and 112 minutes better than scheduled southbound.

A review of the simulation model and the freight and passenger schedules used indicates that—outside the critical evening peak period (see Table 3-2)—numerous slots and sufficient track capacity would be available in 2015 to accommodate the operation of additional freight service, and extra trains that were not modeled.

Station Improvements

Station improvements—whether to tracks, platforms, buildings, parking, or access facilities—can serve multiple purposes. By easing passengers' interface with the rail system, such improvements can actually reduce door-to-door trip times and upgrade the marketing posture of the rail mode, both intercity and commuter. Such improvements can also improve rail line capacity and reduce line-haul schedule timings.

While thus recognizing the broader benefits of a station improvement program, this study focuses on station-related work that would enhance rail line capacity and facilitate shorter trip times. Two examples follow; additional station projects are included in the site-specific discussions further below.

VRE Commuter Platforms

VRE commuter operations presently utilize platforms installed on only one side of the right-of-way (on the Track 3 side north of Alexandria and the Track 2 side south of Alexandria). Therefore, northbound VRE trains must cross over at AF to access the present platforms between Alexandria and Washington, resulting in operational conflicts. The density of commuter and intercity train operations projected for 2015 would require that VRE install platforms on both sides of the right-of-way, at all stations. By providing second platforms at all locations between Washington and Fredericksburg where only one currently exists, either track can be used by commuter trains, thus providing significant additional operating flexibility in this high-density area.

Alexandria Platform Extension

Another station priority is the lengthening of the northbound platform at Alexandria. This would expedite the movement of Amtrak Florida trains, which typically are longer than this platform. When they stop, many of the cars do not have access to the platform. It is not safe to let passengers off except on a platform, and it is a slow, tedious process to "walk them up" through the intermediate cars, particularly because long- distance travelers tend to carry more and bulkier luggage than short-distance travelers. The alternative is to make two or more stops, to give all cars an opportunity to be positioned at the platform. This can be very time consuming, particularly given the need to move very slowly and carefully, because of the detraining passengers who will be standing with their unsecured luggage staged at the doors. The excessive amount of time taken for this process encroaches on the time allotted to other trains, and the resulting delays quickly cascade to them. Thus, the Alexandria platform extension would have important capacity implications.

Site-Specific Discussion

The following sections discuss the operational considerations and suggested improvements on a site-specific basis, starting in the Washington region and working south to the Richmond area.[47]

Operations Overview: Washington–Fredericksburg

The running time of an intercity passenger train is about 30 minutes faster than a freight train between Washington and Fredericksburg, and 20 minutes faster than a commuter train making all stops.

While a commuter train is slower, the proposed 2015 schedule was crafted so as to minimize scheduled overtakes of a commuter train by an intercity train. When hourly Richmond service is being operated during the evening peak, a commuter train is always scheduled to leave Washington immediately following the intercity train. With normal operations, the commuter train will arrive in Fredericksburg, or Quantico, and be off the main line prior to the scheduled arrival of the next intercity train.

An intercity train running late will either delay the commuter train or will follow the commuter train all the way to Fredericksburg, if no overtaking facilities exist. The intercity train will be delayed once it has caught up with the commuter train, because it is forced to operate at the commuter train's average speed. With overtaking capability, every effort would be made to operate the trains on parallel tracks so that neither is delayed. The existing track layout does not generally provide this flexibility.

A subsequent recommendation would be the installation of a second platform at each commuter station, to improve the operating flexibility of the line and provide alternative routings for commuter trains. This is especially beneficial in the evening, when, at most stops, commuters would be alighting, and the location of the platform would not matter.

Based on current on-time performance, about 25 percent of the evening peak intercity trains would leave Washington late enough to be behind a commuter train and become at least 30 minutes late by Fredericksburg. This is unsatisfactory. Additionally, three southbound freight trains are normally scheduled to operate during the same evening peak. Few, if any, of these freights can leave Washington and reach Fredericksburg without an intercity train overtaking them. The addition of commuter trains to the mix of trains, with their numerous stops, further complicates train operating problems during the evening peak period. Currently, on-time performance during this period quite often is unsatisfactory: one, or all, of the three train services can be delayed.

[47] The reader is referred to Figure 2-1 (Washington–Richmond Corridor), Figure 2-3 (Washington area), and Figure 2-4 (Richmond area) for assistance in locating the points mentioned.

With the scheduled mix of intercity, commuter, and freight trains, six to seven southward trains per hour would be operating on the same track between Washington and Fredericksburg. The density of northward trains during the evening peak is such that the second main track cannot be used reliably as an overtaking track to relieve delay. Without overtaking facilities, all of the southward trains would be limited to the speed of the slowest train. Construction of a fourth-track between Crystal City and Alexandria and long stretches of third-track between Alexandria and Fredericksburg would mitigate this difficult situation.

Area of Special Complexity: Washington

The Washington area is the most critical section of the entire Corridor. Capacity improvements must occur here if the goals—particularly the reliability goals—of all service providers are to be met.

Coordination of intercity passenger service south of Washington with NEC train service would help reduce negative effects of planned increases in rail service using the lower level of Washington Union Station. This internal Amtrak schedule coordination would help the operators overcome the numerous constraints in the Union Station vicinity—the First Street Tunnel and the location of the station and other structures relative to the station tracks and platforms—all of which prevent wholesale changes.

Electrification of the Washington-Richmond Corridor would significantly improve operations at Washington Union Station, but its high cost (estimated at $300-400 million), and the difficulty in finding a location to exchange locomotives at Richmond, would place it at the bottom of the priority. (Main Street Station's elevated structures would severely limit the ability to make the extra movements required.) Therefore, it is not being recommended at this time.

The construction of additional tracks, the revision of several interlockings, and the construction of a new L'Enfant station would improve the passenger/freight interfaces in the segment between Washington Union Station and Alexandria and increase the reliability of the proposed Amtrak and VRE service improvements while minimizing interference with NS and CSX freight service. In particular, the listed projects would reduce congestion and operating problems between Arlington and Washington.

The following sections present further details on Corridor operations in the greater Washington area, as far south as Alexandria. Because Washington–Richmond Corridor operations interact with the larger railroad environment, the discussion begins in Prince George's County, Maryland, where the freight bypasses through the District of Columbia diverge from the passenger routes to Union Station.

Alexandria Junction (in Maryland) to Anacostia to CP-Virginia

CP-Virginia is the junction, located one mile from Washington Union Station, where freight and passenger operations merge: freight trains headed to and from the Conrail

Landover Line, and passenger trains to and from Union Station. The Conrail Landover Line is single tracked from CP-Virginia to M Street Interlocking, including the 3,600-foot-long Virginia Avenue Tunnel. The tunnel was single tracked in 1936 to provide clearance to enable the line to be electrified. The single-track has been retained to provide clearance for increased dimension freight cars. The limit of vertical clearance is 17' 3". Deteriorated track and structural conditions currently restrict speed through the tunnel to 10 mph. The tunnel is in need of extensive structural rehabilitation to restore it to a state of good repair.

The Landover Line is double-tracked from M Street, located at the north portal of the Virginia Avenue Tunnel, to Landover, but the double-track is only available to CSX trains for a distance of about one-mile, between M Street (Conrail M.P. 135.5) and Anacostia (Conrail M.P. 134.2, CSX M.P. 6.3). At Anacostia, located 2.5 miles north of CP-Virginia, CSX freight trains diverge from the Landover Line to the CSX Alexandria Extension. The Alexandria Extension is a single-track line to Riverdale (Alexandria Junction–M.P. 0), except for a double-track segment between Shepherd Junction (CSX M.P. 5.8) and Chesapeake Junction (M.P. 3.8). At Alexandria Junction, a connection is made to the main line of the CSX Capital Subdivision by means of a wye, allowing trains to travel east to Baltimore and west to Brunswick.

Conrail currently has limited trackage rights on CSX. With the Conrail Acquisition, NS would inherit these rights and CSX would have limited trackage rights on the NEC, south of Landover.

The single-track alignments and the slow speed through the tunnel result in numerous freight train delays throughout the day, as trains at one end of the single track await trains traversing the segment at 10 mph from the other end. For commuter and intercity train operations, it is the freight trains that stop on the double-track line between CP-Virginia and Long Bridge (described below) that seriously affect on-time performance on the segment of the Corridor that is currently dispatched by Conrail.

The segment between Shepherd Junction and CP-Virginia is a major choke point in the north-south movement of freight in the Eastern Seaboard Corridor and a major bottleneck in passenger train operations south of Washington.

CP-Virginia to Long Bridge.

The CP-Virginia junction has trackwork that permits train movements at speeds of between 15 and 30 mph, with medium speed crossovers and turnouts and a sharp compound curve into the First Avenue Tunnel. As mentioned above, freight trains being held for opposing freight trains are common, particularly at the single-track Virginia Avenue Tunnel.

VRE's L'Enfant Station is located just south of the interlocking. Presently a single platform is located west (north) of Track 2; however, it is proposed in a separate project to install a center-island platform (the existing platform would be removed after completion if the new platform) so that commuter trains can use either of two tracks, rather than being restricted to Track 2 as at present. If this is done, passenger flow to the street by means of stairs and ramps or elevators must be provided.

Intercity and commuter operations, as well as freight operations on the double-track between CP- Virginia and RO Interlocking (south of the Long Bridge over the Potomac River), are projected to increase. It is imperative to minimize the number of times that freight trains are held and to optimize the speed of freight movements. Curvature in this section is a significant constraint to both commuter and intercity trains. The curves at Seventh Street (Conrail M.P. 137.1) and Fourteenth Street (Conrail M.P. 137.7) are presently restricted to 30 mph, and substantial increases in speed are not readily achievable.

The potential for operating MARC commuter trains through Washington Union Station to L'Enfant and Northern Virginia is under review.

Crystal City (RO Interlocking) to Alexandria (AF Interlocking)

Congestion will increase as Amtrak and VRE attempt to add service between Washington Union Station and Alexandria while facing an uncertain, but increasing, level of NS and CSX freight service. Although rail operations between CP-Virginia and RO interlocking, at the south end of the Potomac River Bridge, will be most affected, projected intercity, commuter, and freight traffic between Crystal City and Alexandria requires more than the present three-track configuration that was completed between South RO (SRO) and Alexandria in early 1997.

Alexandria (AF Interlocking) to Fredericksburg

From Alexandria south to Fredericksburg (and beyond to Staples Mill Road Station, Richmond), the reliability, travel time, and capacity goals could be met with construction of selected third-track sections.

In the commuter territory between Alexandria and Fredericksburg, almost 33 miles of third-track (out of a possible 46 route-miles), with appropriate interlocking modifications, would need to be constructed. The changes in track configuration would ease congestion; ensure dependability of the train schedules; offset capacity constraints, particularly in the peak periods; and accommodate the increased level of intercity, commuter, and freight trains.

In particular, present Corridor congestion caused by the 6-mile long Franconia Hill section between Alexandria and Franconia, would be alleviated by reinstallation of the previously removed third-track. The revised configuration would provide for future levels of traffic by allowing overtakes of slower freight trains by the faster intercity and commuter trains in the segment.

Alexandria (AF Interlocking) to Occoquan

In the absence of betterments, congestion would increase between Alexandria and Fredericksburg . Capacity constraints, particularly in the peak periods, would be exacerbated by the increased level of intercity and commuter trains. Significant alterations to the track configuration would be needed to prevent significant operational conflicts. The recommended changes are summarized below and described in Appendix G.

AF Interlocking, located at the bottom of Franconia Hill, is the junction between the Washington-Richmond Corridor and the NS route to Manassas and Charlottesville (VRE Manassas Line). Freight activity along the south side of the Manassas Line effectively creates a single track passenger line for the last 4 miles approaching AF interlocking. With projections for 10 Amtrak, 44 VRE, and 10 freight trains per day each way negotiating, merging with, or diverting from the Corridor at AF interlocking,[48] the simulations showed that it was imperative to reconfigure and provide AF with additional higher speed crossovers and turnouts, along with a pocket track on the Manassas Line, in order to permit simultaneous (parallel) movements. The proposed configuration (Appendix D) greatly expands train capacity through AF interlocking by permitting simultaneous movement of Manassas Line passenger trains along with Corridor freight and passenger trains. Southbound CSX freight trains would have access to a reinstalled third-track up Franconia Hill at 40 mph instead of the existing 25 mph or starting from a stop. The benefits of these parallel capabilities to all operators are greatly magnified when one understands that the routes must typically be set and signals cleared for a movement 3-5 minutes before the train gets to an interlocking if signal-induced delays are to be avoided.

Elsewhere in this segment, existing Corridor congestion—particularly north of Franconia—would be aggravated by the speed differential between intercity, commuter, and freight trains and the increased number of potential train overtakes that the existing right-of-way is not sized to handle expeditiously. The RF&P was a three-track railroad between AF (MP104.3) and South Franconia (M.P. 98) until about 25 years ago when the third-track (located in the middle of the right-of-way) was removed. With the exception of a removed interior siding in the vicinity of the VRE Lorton Station and through the Amtrak Lorton Auto Train facility, the right-of-way was not configured to readily accommodate the construction of additional tracks.

The average gradient between M.P. 103.8 (at existing SY Interlocking) and M.P. 98.9 (south of Franconia) is approximately 0.8 percent ascending southbound. This location is known as Franconia Hill. The average gradient from M.P. 98.9 to approximately M.P. 93 is 0.6 percent descending. The 0.8 percent grade in particular is a major obstacle to freight train operations. Freight train speeds up the grade can average 15 to 17 mph, which can result in a transit time up the hill in excess of 20 minutes (including the time it takes the rear

[48] See Table 3-1.

of a long freight to clear the crest). This reduces capacity to approximately four freights an hour up the grade on the existing tracks. During the peak commuter periods it is anticipated that intercity trains would run hourly, and commuter trains would run every 20 minutes, making this grade a severe operational constraint. For all these reasons, the contemplated improvements include reinstallation of the previously removed third-track between AF and South Franconia Station.

Amtrak Auto Train Facility: Lorton, Virginia

The Auto Train facility is located at M.P. 92. The arrival/departure of a train from the facility currently ties up valuable track capacity.

Access to the Lorton Auto Train facility is provided by a turnout from Track 3, at the south end of the facility. The turnout is located north of the Lorton Road single lane undergrade bridge, resulting in the lack of space to make up the train and shift cars in the yard. Consequently, the process of making up (or yarding) the train occupies Track 3 for about an hour. This process results in a single track operation on Track 2 between RW Interlocking (M.P. 96.7) and Featherstone Interlocking (M.P. 86.8), a distance of ten miles, while Track 3 is occupied by the Auto Train. With the projected increased level of passenger and freight service the present train operations at this facility would limit operating capacity and result in conflicts and trains being held between Franconia/Springfield and Occoquan. Replacement of the Lorton Road bridge is presently underway.

Occoquan to Fredericksburg

The projected increase in intercity and proposed commuter rail service, at increased operating speeds, would require additional track capacity north of Fredericksburg for overtaking freight trains and other passenger trains. Operationally and environmentally viable endpoints for construction of a third-track, to provide additional capacity and thereby avoid holding trains, would include:

- Powells (M.P. 83) - Aquia (M.P. 71), including provision of additional track capacity over Quantico Creek; and
- Aquia (M.P. 71) to Dahlgren Jct (M.P. 61).

These segments of additional main track would require construction of new VRE platforms to enable northbound and southbound commuter trains to have access to platforms from all outside main tracks. This improved access would substantially increase operating flexibility, prevent delays to commuter trains, and facilitate freight and intercity train operations.

Fredericksburg to Staples Mill Road Station

Currently, a northbound freight train must reach an existing siding at Fredericksburg before a following passenger train, which left Richmond later, overtakes it, or the passenger train will be delayed. In the absence of capacity additions, the interaction of slow-moving freights and high-speed intercity passenger trains would increase the likelihood of such train overtakes, especially in view of the projected increase in intercity rail service frequencies and operating speeds.

Between Fredericksburg and Staples Mill Road, the construction of eight miles of third-track and three miles of fourth-track (out of a possible 54 route-miles), with appropriate interlocking modifications, would provide capacity for both freight and high-speed intercity trains. Two new sections of third-track (and a fourth-track south of Fredericksburg) would allow a freight train to be overtaken by a faster train that left Richmond or Washington at a later time. Simulations have shown that both train services would perform reliably in this segment of the Corridor, with the suggested improvements.

Operationally and environmentally viable endpoints for additional tracks would include:

- Fredericksburg (FB) (M.P. 58.8)—Hamilton (HA) (M.P. 55.7);
- Rixey (M.P. 43.4)—North Milford (M.P. 39); and
- South Anna (M.P. 19)—North Ashland (M.P. 15.5).

The program would also include track improvements to the rail-rail crossing diamonds at Doswell, where the former Chesapeake & Ohio line from Richmond to Charlottesville crosses the former RF&P. MAS over the diamonds is presently restricted to 50 mph. Recent improvements in crossing diamond construction techniques, in conjunction with enhanced maintenance practices, should enable MAS to be increased to at least 80 mph for passenger trains. This would relieve both a speed and, by extension, a capacity restriction at this location.

Area of Special Complexity: Richmond

New track construction and revisions to existing track configuration and train operations would increase track speeds and reduce freight-passenger train interfaces in the segment between Staples Mill Road Station and Main Street Station, in Richmond. This congestion relief would prevent operations from becoming more restricted in the vicinity of Acca Yard. The improvements also would allow re-institution of intercity train service into Main Street Station and enable the number of daily trains to Newport News to increase. Coordination of the proposed track improvements with on going design work by the City of Richmond for Main Street Station is essential. Plans by the NCDOT to introduce through, high-speed rail service from Charlotte and Raleigh to New York City also would be accommodated,[49] as would the Commonwealth of Virginia's proposed origination of three New York-bound trains at Main Street Station, and the proposed Lynchburg/Bristol service. The proposed track modifications would minimize the potential for conflicts between intercity and freight trains.

In addition to providing all-new trackage between Greendale Interlocking (GN—near Staples Mill Road Station) and Main Street Station, and rehabilitating the segment from Main Street south to Centralia to like-new condition, the contemplated improvements would address such critical points as the following:

AY Interlocking, South End of Acca Yard.

The present intercity passenger route uses a recently constructed track, referred to as the "Passenger Main," west of the South Yard at Acca. At AY this track connects to the north leg of the Wye to and from the A line tracks to the south. Located west of downtown Richmond, the Wye is heavily used by slow moving (5 to 10 mph) yard traffic. With increased intercity train traffic, AY would become a conflict point. Without improvements, significant delays to both passenger and freight trains routed to Main Street Station are likely to occur at this interlocking. To eliminate this problem, a passenger route would be built, east of the current trackage, to bypass the entire yard at Acca. Appendix G provides fuller details about this proposed bypass.

AM Junction

Amtrak trains to Newport News pass through this interlocking, which recently was reconfigured. Significant conflicting movements, and resulting delays, are anticipated at the junction because of the projected increase in both passenger and freight trains.

Main Street Station

Presently, only two daily trains to Newport News pass the east side of Main Street Station, but do not stop there for passengers. Passenger trains do not now use the west side of the Main Street Station. The City of Richmond is developing a program to reactivate the station and develop it as an intermodal passenger terminal. The existing station and train storage facilities in the vicinity of the station are inadequate to handle increased levels of Amtrak service and freight service. Clearly, if intercity passenger service were to be extended to downtown Richmond in the absence of fixed plant improvements, operations would be restricted by low track speeds, lack of facilities, and freight/passenger train conflicts. Under those circumstances, the introduction of through service to Charlotte, North Carolina and the origination of three trains at Main Street Station, would increase conflicts between intercity and freight trains. The contemplated improvements would

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[49] The improvements would likewise help facilitate any additional service resulting from Southeast Corridor extensions to South Carolina, Georgia, and Florida.

provide support for renewed rail operations through, and originating/terminating at, Main Street Station.

Improvements Evaluated By Others

The following projects were evaluated by others and are incorporated in this report to ensure that projects impacting train operations or facility considerations are included:

- Main Street Station Improvements;
- MARC And VRE Run-through Train Operations improvements; and
- Construction of new stations at Cherry Hill and Widewater.

Summary Of Contemplated Projects

Table 4 offers a preliminary list of projects that would address the Year 2015 requirements derived through this study. Cost estimates are included for those infrastructure items covered in the study scope. Items omitted from the study scope are labeled “to be determined” and excluded from the totals shown. **Some of the items “to be determined” (e.g., grade crossing hazard reduction) may be essential prerequisites to upgraded service on the line** and would need to enter into any further studies or implementation plans.

In response to funding limitations, the need to protect ongoing operations, and time requirements for further study, planning, design, and necessary environmental work, Amtrak and FRA have grouped the projects together by priority. These groupings describe a staging concept that subsequent analysts may use as a guide in considering improvements to this complex Corridor. The priority project groups appear in Table 5-2.

Table 5 categorizes the above projects by type and describes, in general terms, what each category includes.

Appendix G provides more detailed coverage of the contemplated improvements.

Table 5-1: Preliminary Listing of Projects for Washington–Richmond Corridor

NOTES: Project types excluded from the analysis are indicated as "to be determined (tbd)"
"Project Groups" refer to phasing priorities—see below.

Project	Estimated Cost[50]
PROJECT GROUP A:	
Bridges: Rebuild Lorton Road Bridge and Rebuild Auto Train™ Siding (Under construction)	6
Grade Crossings: hazard reduction	tbd
Route realignment/ augmentation: Install third-track Fredericksburg to Hamilton (3.1 miles)	11
Signaling and train control: Upgrade signal system to accommodate other improvements in Group A	2
Stations: Extend northbound platform at Alexandria	1
Track component upgrades: New and reconfigured interlockings	14
TOTAL, PROJECT GROUP A—exclusive of items to be determined	*34*
PROJECT GROUP B:	
Bridges: Construct Double-track Bridge – Quantico Creek	25
Route realignment/ augmentation: Install third-tracks and other capacity additions	25
Signaling and train control: Upgrade signal system to accommodate other improvements in Group B	15
Stations: Improve Crystal City VRE station	6
Stations: Implement Phase I and II Main Street Station improvements (Operational portions only)	13
Stations: Upgrade Amtrak Auto Train Facility, Lorton	4
Track component upgrades: Improve rail/rail crossings, install new interlockings	4
Tunnel work: Repair Virginia Avenue tunnel, D.C.; lengthen additional track north of tunnel	20
Vehicles: Trainsets for high-speed rail service	tbd
TOTAL, PROJECT GROUP B—exclusive of items to be determined	*112*
PROJECT GROUP C:	
Omnibus improvement: MARC And VRE Run-through Train Operations	23
Route realignment/ augmentation: Realign curves and spirals for higher speeds	21
Route realignment/ augmentation: Reconfigure tracks, upgrade speed in D.C.	2
Route realignment/ augmentation: Add 4th Track, Potomac River ("RO") to Alexandria ("AF")	12
Route realignment/ augmentation: Install 6.7 miles of third-track between "RW" (Milepost 96.7) and Colchester (Milepost 90.0)	34
Route realignment/ augmentation: Install 12 miles of third-track between Powells (Milepost 83) and Aquia (Milepost 71)	42
Route realignment/ augmentation: Construct inner zone turn-back track at Quantico Station	6
Route realignment/ augmentation: Install 8.7 miles of third-track between South Aquia (Milepost 69.8) and Dahlgren Junction (Milepost 61.1)	40
Route realignment/ augmentation: Install sections of third-track, new and modified interlockings, and turnback track between "FB" (Milepost 58.8) and North Ashland (Milepost 15.5)	44
Route Realignment/Augmentation: Reconfigure and upgrade track, Staples Mill Road--Acca Yard--Main Street Station--Centralia	45
Route realignment/ augmentation: Reconfigure tracks in Southwest D.C. and install center-island platform at VRE L'Enfant Station	52
Signaling and train control: Upgrade signal system to accommodate other improvements in Group C	26
Stations: Add second commuter platform at VRE stations	23
Stations: Complete Richmond Main Street Station (Operational portions only)	19
Stations: ADA access at key stations	tbd
Stations: Intercity and commuter parking	tbd
Stations: Amtrak station improvements	tbd
Support facilities: Build service facility and storage yard in Richmond	11
Track component upgrades: Rehabilitate Main Street to Centralia for access to and from Southeast Corridor	10
Vehicles: Trainsets for high-speed rail service	tbd
TOTAL, PROJECT GROUP C—exclusive of items to be determined	*409*
GRAND TOTAL—*exclusive of items to be determined*	555

[50] Fully loaded 1999 dollars in millions - includes design, construction management and contingency.

Table 5-2
Description of Project Groups

Illustrative Project Group	Service Goals	Projected time frame
A	Improved capacity and reliability at today's trip times, including: – More dependable current Amtrak timings between Staples Mill Road and Union Station (two hours, five minutes); and – More flexibility at the junction in Alexandria between the Manassas line and the Washington—Richmond Corridor, thus allowing more frequent VRE Manassas service.	Short term
B	Slight increases in intercity train frequency and up to a few minutes' trip time reduction; limited service to Main Street[51]; further improved reliability.	2005
C	Less than 2 hour Amtrak travel times, Main Street to Union Station; add Southeast Corridor services and additional VRE frequencies, as well as increased freight activity.	2015

Table 5-3 Potential Improvements by Category
(NOTE: Project types excluded from the analysis are indicated as "to be determined (tbd)")

Category	Description	Total Contemplated Investment ($ Millions)	Appears in Project Groups:
Bridges	All capacity-related bridge improvements, such as construction of a double-track bridge at Quantico Creek, and the rebuild (now under construction) of the Lorton Road bridge and the associated Auto Train siding	$31	A, B
Grade Crossings	All grade crossing hazard elimination projects. While critical to safety, these were not part of the project scope.	tbd	A
Route realignment/ augmentation	All curve realignments, and additions of third or fourth-track.	$333	Mostly C
Signaling and train control	Installation of signaling system improvements for at least 90 mph operation; this impacts both capacity and speed	$43	A, B, C
Stations	Includes track work, platform reconfigurations, and building construction. The Alexandria platform extension, provision of VRE platforms on two tracks, track-related portions of Main Street Station and other station improvements fall under this rubric.	$66	A, B, C
Support Facilities	Richmond servicing facility and storage yard	$11	C
Track component upgrades	New and redesigned interlockings; upgraded rail/rail crossings; track upgrading between Staples Mill Road and Main Street Stations.	$28	A, B, C
Tunnel work	Essential work in and near Washington's Virginia Avenue Tunnel to relieve congestion from freight service	20	B
Vehicles	High-speed rail locomotives and cars; not addressed in this analysis	tbd	B, C
Omnibus improvements	All track capacity and related improvements needed to facilitate thru operation of Maryland Diesel commuter trains to L'Enfant and Alexandria	23	C
Grand total—All categories included in scope	Excludes items to be determined	$555	A. B, C

[51] For Newport News trains only.

Chapter 6
CONCLUSIONS

This analysis of current and projected railroad operations and facilities on the Washington–Richmond Corridor has led to the following conclusions:

- **Protection of all freight and passenger services:** Numerous computerized simulations of the operations of all users of this Corridor (freight, commuter, and Amtrak) have identified a number of specific infrastructure changes that would provide the capacity to reliably handle all existing and projected services. Even with these changes, close scheduling and dispatching coordination among operators—extending to the Northeast Corridor and other contiguous routes—would be necessary to optimize the use of the improved facility and preserve the dependability and marketability of all passenger and freight operations.

- **Need for further engineering:** Detailed engineering construction plans need to be prepared for the various improvements. Work should begin promptly on the extensive, detailed design efforts that would be required for two particularly challenging areas: the changes required in the vicinity of L'Enfant Station in Washington, and the track and station changes required between Staples Mill Road Station and Main Street Station in Richmond.

- **Amtrak's commitment:** Amtrak endorses the development concept, described in this report, for the Washington–Richmond Corridor and commits itself—

  — To work with the Commonwealth of Virginia, FRA, the freight railroads, and other affected parties to obtain funding for the recommended improvements, to progress the necessary engineering work on a timely basis, and to arrange for any needed environmental/historic documentation; and

— To work with CSX and officials of the Commonwealth of Virginia and local governments to close or upgrade as many highway-rail grade crossings as possible on this route.

- **Feasibility of high-speed service:** Reliable high-speed passenger train service between Washington and Richmond is a feasible goal **provided** that requisite infrastructure improvements are constructed.

On the basis of this report's recommendations, and with the partnership of the interested government agencies, railroads, shippers, and members of the traveling public, Amtrak looks forward to the day when the Washington–Richmond Corridor will achieve its full potential for fast, reliable, convenient, market-driven railroad services of all types—intercity, commuter, and freight.

LIST OF ACRONYMS

Acronym	First Occurs on Page	Meaning
C&O	6	Chesapeake & Ohio Railway
CP	6	Control point—a term designating an interlocking, where trains can switch tracks. CP-Virginia is the current designation for the former "Virginia Interlocking."
CSX	2	CSX Transportation, Inc.
CTP	1	Corridor Transportation Plan
FRA	1	Federal Railroad Administration
M.P.	14	Milepost
MARC	3	Maryland Rail Commuter service, sponsored by the State of Maryland in the greater Washington and Baltimore metropolitan areas.
MAS	8	Maximum Authorized Speed
NCDOT	12	North Carolina Department of Transportation
NEC	1	Northeast Corridor
NS	2	Norfolk Southern Corporation
RF&P	5	Richmond, Fredericksburg & Potomac Railroad Company, former owner/operator of most of the Washington–Richmond Corridor
RMTC	11	Richmond Multi-modal Transportation Center (at Main Street Station)
SAL	6	Seaboard Air Line Railroad
STB	6	Surface Transportation Board, successor to the Interstate Commerce Commission
TPC	32	Train Performance Calculator
VDRPT	7	Virginia Department of Rail and Public Transportation
VRE	1	Virginia Railway Express