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Executive Summary

Introduction

The Virginia Railway Express (VRE) Strategic Plan 2004-2025 listed an extension to the Gainesville-Haymarket region as one of several viable options for a potential network expansion of the Manassas Line. The Gainesville-Haymarket Feasibility Study was initiated to fulfill this need.

The purpose of this Feasibility Study is to investigate the feasibility of expanding commuter service northwesterly for approximately 11 miles along the existing Norfolk Southern (NS) B Line from Manassas Station on the Manassas Line to the Gainesville-Haymarket region. The Feasibility Study will examine the project from an engineering, construction, ridership, operations, and cost perspective to aid in determining the value of adding commuter service for residents in the northern Virginia communities of Gainesville and Haymarket.



View of existing NS corridor.

Existing Service

Commuter rail service operates on two lines in northern Virginia: from Washington, DC to Fredericksburg on tracks owned by CSX Corporation (CSX) and from Alexandria, VA to Manassas on tracks owned by NS (Mainline). From Union Station in Washington, DC, these two lines share the same CSX owned right-of-way for about 9.6 miles, to just south of Alexandria, Virginia, where they diverge. The Fredericksburg Line roughly follows Interstate 95 (I-95) and the Potomac River to the City of Fredericksburg, and the Manassas Line runs in a westerly direction from Alexandria, roughly paralleling I-66 approximately five miles to the south, into the cities of Manassas Park and Manassas.

Service is currently oriented towards Washington, DC in the morning peak periods (5:00AM-8:00AM) and in the opposite direction in the evening peak periods (4:00PM-7:00PM). There is no service on weekends.

Per a Memorandum of Understanding (MOU) with CSX, VRE is limited to 40 trains per day system-wide for the CSX owned tracks from approximately one mile west of the Alexandria Station to Union Station, Washington, DC. Currently, 16 daily trains are operated on the Manassas Line and 14 daily trains on the Fredericksburg Line (13 of the Fredericksburg Line trains operate in revenue service and one operates in non-revenue service). The combined service results in a total of 30 daily trains in the corridor between Alexandria and Union Stations.

Service Extension Options to Gainesville-Haymarket

A few different options for the expansion of VRE commuter rail service have been developed to offer a range of investment of service opportunities.

Minimum Operating Segment

As a short-term approach to providing service to the Gainesville-Haymarket area, a minimum operating segment (MOS) option could be implemented to one station (single platform) in Gainesville. This option would be an overlay of the existing Broad Run service. Two round trips per day between Gainesville and Washington, DC would be added – two inbound trips to Washington, DC in the AM Peak Period and two outbound trips to Gainesville in the PM Peak Period. These trips would keep the total VRE service within the capacity constraint of 40 trains per day. Minor modifications to the current Manassas Line schedule would be needed. The service would be provided using spare equipment that is currently excess equipment (not required to meet the spare ratio), offering a starting point for regular service to/from the Gainesville-Haymarket area. It would still require building a second track parallel to the existing NS B Line, although it is possible to relocate portions of the existing mainline, thus accommodating two tracks in the existing right-of-way. Trains could be stored on a secure siding at the station to support the initial service plan. This option would require minimal capital resources, as no new vehicles would be needed.

Phased Approach

A second approach would be to pursue a phased implementation plan to the Gainesville-Haymarket area, with a more robust schedule of service than the MOS option to Gainesville as the first phase. The second phase would include extending the service to Haymarket. This option would require more capital

resources than the MOS option because it would run more frequent service (similar to the full build-out option). This service would make five round trip runs per day (10 total trips), which is within the capacity constraint of 40 trains per day. It would require more extensive modifications to the current Manassas Line schedule. The initial phase would include stations in Gainesville and in the Sudley/Innovation area. The second phase would add the Haymarket Station as funding permits. The phased approach would provide a transit benefit to more riders initially than the MOS through more frequent service and an additional station, but would cost less, at least initially, than the full build-out option.

Full Build-Out

The full build-out option includes adding the new branch of service all the way to Haymarket. Heading in a westerly direction along the NS B Line from Manassas Station, trains would stop at three stations in the Sudley/Innovation, Gainesville, and Haymarket areas. This option would require the most significant capital resources in one outlay but may be more cost effective than extending the investment over multiple years and phases. It would most effectively meet the transit needs of the growing population along the entirety of the Gainesville-Haymarket corridor.

The full build-out option could vary based on three potential service scenarios:

- ▶ Unconstrained Service
- ▶ Split Service Constrained
- ▶ Split Service Constrained (with rail shuttle service)

Unconstrained Service

The Unconstrained Service option would provide the following trips on the Manassas Line:

- ▶ Broad Run to Washington DC: 16 round-trip
- ▶ Haymarket to Washington DC: 16 round-trip

The total number of trips on the Manassas Line (32) combined with the existing Fredericksburg trains would exceed VRE's system wide constraint of 40 trains per day on the CSX tracks between NS mile 9.12 (Seminary CFP 103), approximately one mile south of Alexandria Station and Washington, DC Union Station. Implementation challenges for this alternative include the need to negotiate for additional slots above the 40 trains per day maximum as well as accommodate additional mid-day/overnight storage requirements.

Split Service Constrained

The Split Service Constrained option would evenly split the theoretical 20 trips per day for the Manassas Line evenly between Broad Run Station and Haymarket. As a result, five roundtrips per day would service each terminal. This would require modifying the current Manassas Line schedule. There are no major implementation challenges associated with this option since additional slots on CSX are not needed, although mid-day/overnight storage capacity may be a concern depending on the operating plan.

Split Service Constrained Plus Rail Shuttle

This option offers the same 10 daily roundtrips from the two Manassas Line terminals (Broad Run and Haymarket) to Washington, DC as in the previous Split Service Constrained option. In addition, this option adds a rail shuttle service that runs to/from Alexandria Station and primarily Haymarket. This shuttle would offer a two-seat ride to Washington, DC through a transfer at Alexandria Station to Metrorail and would also provide an all day reverse commute service from Alexandria to the Manassas and the Gainesville-Haymarket area. This shuttle service slightly overlaps the portion of the CSX controlled rail line that is subject to the capacity constraint. The 'split' between NS and CSX territory and the start of the capacity constraint is approximately one mile west of the Alexandria Station. Implementation challenges for this option include coordinating with NS and CSX for the rail shuttle service and to obtain expanded access to the Alexandria Station. Additional capacity improvements on CSX and improvements at the Alexandria Station and expansion of mid-day/overnight storage may be required in support of this option.

Areas of Evaluation

The feasibility of each of these commuter rail expansion options is assessed in the following six main areas:

- Capacity Constraints
- Equipment Needs
- Ridership
- Scheduling/Operations
- Costs
- Fare Revenue

Capacity Constraints

The Unconstrained option requires negotiations between all parties to identify and fund the modifications necessary to support the service expansion. The Split Service Constrained option assumes that service added works within the existing agreement and no new capacity improvements are required. The Split Service Constrained Plus Rail Shuttle option would also require negotiations to address the capacity issues on the CSX controlled territory. It is assumed that the cost of the solution may be less since the option only impacts a short one-mile segment and Alexandria Station. An alternative option would be to explore staying in NS territory, stopping short of Alexandria at an infill station at Van Dorn Metrorail or similar, but this would need to be further evaluated.

Equipment Needs

Based on the current fleet and anticipated system needs, VRE estimates that three locomotives could be available for a Gainesville-Haymarket service, helping to offset equipment purchase costs for the extension options. The total anticipated equipment needs and their associated capital costs for these extension options are summarized in Table 1.

Table 1: Summary of Equipment Needs and Associated Capital Costs for Extension Options.

	Total Equipment Needed			Net Equipment Purchase*		Capital Costs		
	Sets	Loco	Coaches	Loco	Coaches	Loco	Coaches	Total
MOS	2	2	6**	0	0	\$0 M	\$0 M	\$0 M
Phased Approach	1	1	10	0	10	\$0 M	\$23 M	\$23 M
Split Service Constrained	1	1	10	0	10	\$0 M	\$23 M	\$23 M
Split Service Plus Shuttle	6	6	32	3	32	\$14 M	\$74 M	\$88 M

* Net Equipment Purchase equals Total Equipment Needed less the available extra equipment (three locomotives).

** The MOS assumes a modification of existing train sets to obtain extra coaches to run this service.

Ridership

Ridership data for the Gainesville-Haymarket extension was initially compiled as part of the Strategic Plan in 2004. These ridership modeling results demonstrated an estimated 3,000 to 5,000 trips per day attributable to the Gainesville-Haymarket extension.

A second travel demand model forecasting process was developed as part of the Gainesville-Haymarket Alternatives Analysis to forecast the projected ridership for the extension options. This process was based on the current Metropolitan Washington Council of Governments (MWCOC) model set (Version 2.2), related work on other projects in the Washington metropolitan area, and adjustments to better match observed transit travel in the Gainesville-Haymarket corridor. These ridership modeling results demonstrated an estimated 1,000 to 3,600 trips per day attributable to the Gainesville-Haymarket extension.

One key difference between the two modeling processes was that the first model included unconstrained capacity, while the latter was modeled within the existing capacity constraint. Working within the capacity constraint lessens the service frequency and results in lower ridership forecast numbers.

It should be noted that the Metropolitan Washington Council of Governments (MWCOC) model is highly sensitive to service frequency. The calibration for transit service is closer to a rapid transit service (i.e. Metrorail) than it is to a commuter rail service frequency. Even slight adjustments in frequencies resulted in significant ridership shifts. To address this issue, two model test runs were conducted. These runs shifted all of the service to the Gainesville-Haymarket corridor to test the sensitivity of the model. These test runs resulted in forecast ridership attributed to the Gainesville-Haymarket extension of approximately 5,500 trips per day.

Table 2 summarizes of the ridership model findings for the Gainesville-Haymarket Alternatives Analysis. This includes the Full Build-Out options (Split Service Constrained and Split Service Constrained Plus Rail Shuttle), as well as the two test runs, 1G and 1H (service ending in Gainesville and Haymarket, respectively). Total Manassas Line Trips include all VRE trips (inbound and outbound service). Total Manassas Line Study Area Trips include all VRE trips (inbound and outbound service) to/from the study area stations: Manassas Park, Manassas, Broad Run, Sudley Manor/Innovation, Gainesville, and Haymarket.

Between the ridership projections from the Strategic Plan and the Gainesville-Haymarket Alternatives Analysis, it can be concluded that a rail extension to Gainesville-Haymarket would add needed capacity and choice to the VRE system. The forecast methodology differed among these two studies, but the range of ridership potential was identified as somewhere between 1,000 and 5,000 trips per day. These results demonstrate a market for commuter rail service in the Gainesville-Haymarket corridor, but the size of this market is dependent upon the frequency of the service offered. A key finding is that a new end of the line station in Gainesville or Haymarket has the potential to attract a similar level of ridership as Broad Run Station.

Table 2: Summary of Daily Ridership Model Findings

	Split Service Constrained (1B)	Split Service Constrained Plus Rail Shuttle (1C)	Test 1G Option	Test 1H Option
Total VRE Manassas Line Trips (Per Day)	11,394	17,500	9,388	10,046
Total Manassas Line Study Area Trips (Per Day)	6,126	9,156	4,174	6,058

1. Source: Appendix F of VRE Gainesville-Haymarket Alternatives Analysis

Key to establishing a final set of forecast ridership projections will be a determination regarding the level of service that can realistically be provided to the two Manassas Line termini: Broad Run and Gainesville-Haymarket. An initial starter service to one station in Gainesville is going to attract a smaller base of ridership than a full service plan to three new stations. The starter service would be helpful to start establishing a real demand for the service and provide a platform from which to build a full service plan.

Scheduling/Operations

Operating plans for the extension options were developed to allow the identification of vehicle requirements, estimation of capital costs, estimation of operating & maintenance (O&M) costs and modeling of ridership. The conceptual operating plans for the options consist of planned headway and travel times for each proposed and modified existing corridor.

The operating plans were established based on existing constraints, including the capacity constraint into Washington, DC. The service periods were defined as follows:

- AM Peak: 5-8 AM
- Mid-day: 8 AM-4 PM
- PM Peak: 4-7 PM

For the Minimum Operating Segment option, the existing Manassas Line schedule does not change. Two round trips per day (two inbound during the AM Peak and two outbound during the PM Peak) would be added to the new branch to Gainesville.

The Phased Approach option would reduce the number of trips on the current Manassas Line schedule serving Broad Run Station. The operating plan for this

option is the same as the operating plan for the Full Build-Out Split Service Constrained option, except that the Phased Approach ends in Gainesville.

Table 3 provides a summary of the number of trips and their scheduled departure times for the Split Service Constrained and the Split Service Constrained Plus Shuttle options.

Table 3: Number of Trips

		# Trips	# Trips	# Trips	# Daily Trips ¹
<i>Split Service Constrained</i>		<u>New CR From G-H to DC</u>	<u>Modified Existing CR from Broad Run to DC</u>		
AM Peak	In	3	4		
	Out	1	1		
Mid-day	In	1	0		
	Out	1	0		
PM Peak	In	1	1		
	Out	3	4		20
<i>Split Service Constrained Plus Shuttle</i>		<u>New CR from G-H to DC</u>	<u>Modified Existing CR from Broad Run to DC</u>	<u>New CR Shuttle from G-H to Alexandria</u>	
AM Peak	In	3	6	3	
	Out	0	1	2	
Mid-day	In	0	1	10	
	Out	0	1	9	
PM Peak	In	0	0	2	
	Out	3	5	4	20

1. VRE trips for the commuter rail options are on Manassas Line only.
2. CR = Commuter Rail; G-H = Gainesville-Haymarket
3. VRE operates Monday through Friday from 5:00 AM to 8:00 PM. This represents a 15-hour service day.
4. There are no pre-AM peak or post-PM peak train starts.

Costs

The capital cost estimates include infrastructure items, such as track installation, land acquisition, station design and parking, signal system installation, and equipment acquisition. The cost assumptions do not include grade separation projects along the B Line. These are independent projects that VRE will need to coordinate with VDOT and other agencies as required.

Infrastructure requirements were identified at a conceptual level based on the proposed alignments. For example, the quantity of new track that would be needed is based on assumptions about the design speed, operating plan, and available track. Site structures and the signal system to be installed were estimated based on assumed or existing conditions, such as where retaining walls may be needed and the capabilities of the current signal system on the



corridor. Improvements made by the Commonwealth of Virginia and NS, such as passing sidings and signalization updates were accounted for in the estimate. Improvements required to overcome the existing capacity constraint into Washington DC associated with any of the options are not included in the estimates.

Equipment requirements were estimated based on the modeling results, utilizing the conceptual operating plans developed for each option. The number of vehicles needed is a function of the length of the route, planned headways, the average speed, and the turnaround times. Vehicle requirements are estimated based on these factors and include accommodating for existing fleet. Note that the cost estimates do not include spare locomotives and coaches.

Vehicle parking requirements and lot sizes were estimated for each potential station based on the modeling results for test options 1G and 1H, which demonstrate the maximum ridership potential of stations along the Gainesville-Haymarket extension. The expansion of parking facilities at existing stations that would be attributed to the Gainesville-Haymarket service expansion was also included.

Conceptual O&M costs were also estimated based on alignments, operating plans, and service levels for the Build Alternatives. Operating and maintenance costs are the expenses incurred to provide day-to-day operations and maintenance of the transit system. Labor and direct expenses are two main components of O&M costs. Labor expenses include salaries of management, administrative, operations, and maintenance staff. The staffing level required for a project is based on the fleet size and the hours of operation for the proposed service. Direct expenses include costs for management, administration, operations, equipment and right-of-way maintenance, power/utilities, spares/consumables, cleaning/facilities maintenance, and other contingencies.

The capital cost for the MOS option includes the possibility of relocating portions of the existing mainline to accommodate the second track within the existing right-of-way. This would require negotiations with Norfolk Southern, as well as a detailed analysis of the most appropriate locations to do this along the corridor. The MOS option also includes a provision for eliminating costs that could potentially be covered by a development proffer, as shown in Table 4.

Total conceptual capital and O&M costs for each of the propose extension options are summarized in Table 4.

Table 4: Total Capital and O&M Costs (in \$2008)

	Minimum Operating Segment	Phased Option with 2 Stations	Full Build-Out Split Service Constraint (1B)	Full Build-Out Split Service Constraint + Rail Shuttle (1C)
Total Capital Cost	\$58 M/\$43 M*	\$122 M	\$159 M	\$243 M
Total Annual O&M Cost**	\$20 M	\$26 M	\$27 M	\$44 M

Note:

* Represents the total costs for the MOS option minus the costs that could potentially be covered through a private development proffer.

** The costs shown in this table represent the annual O&M costs for the entire Manassas Line service under this scenario.

Station Site Identification and Screening

In 2005, the Gainesville-Haymarket Extension Implementation Plan identified three future potential station locations for the project based on the ridership demand and regional roadway access capabilities. These potential station locations are:

- Sudley Manor (Sudley/Innovation) Area: Access from Sudley Manor Drive
- Gainesville Area: Access from US 29
- Haymarket Area: Access from US 15

The Implementation Plan identified the need for an assessment of potential station sites located within these areas. Potential sites located within these general areas include:

- Haymarket Site 1
- Haymarket Site 2
- Gainesville Site 1
- Dominion Station Site
- Gainesville Site 2
- Florida Rock Site
- Sudley/Innovation Site 1
- Sudley /Innovation Site 2
- Williams Site
- Vulcan Quarry Site
- Wellington Road Site

These potential station sites are shown in Figure 1.

Evaluation Criteria

Evaluation criteria were developed to assess the advantages and disadvantages of potential station locations. The evaluation criteria include station access, transit operations, land use compatibility, and project costs. Each station site was rated numerically from -2 to +2, with -2 being the most unfavorable and +2 being the most favorable based on each criterion. All ratings were totaled, and the strengths and weaknesses associated with each site were identified. The performance of each site relative to this evaluation criterion is summarized in Table 5. Table 6 provides a comparative matrix of potential impacts by site.

Site Location Recommendations

This evaluation performed in this study was not used to select preferred station site alternatives in each of the three general station areas (Haymarket, Gainesville, and Sudley/Innovation), but rather to identify the strengths and weaknesses of each site. Completion of the evaluation process did identify three sites that should potentially be dropped from the list of potential alternatives as the project development process moves forward.

The first of these sites is the Vulcan Quarry Site. This site performed poorly relative to the other sites in the evaluation scoring, predominantly because preliminary engineering analysis indicated that the site is very likely infeasible from an engineering perspective. While more detailed analysis could be completed in future stages of project development, the preliminary analysis indicates that this is a candidate for removal from the list of potential alternatives.

The second candidate for removal is the Sudley/Innovation Site 2. This site has good access off Sudley Manor Drive, but it performed poorly because it is dominated by existing uses that would be expensive and time consuming to displace. Other sites around Sudley/Innovation Site 2 (Sudley/Innovation Site 1 and the Williams Industrial Site) have comparable access and do not have the same issues as Sudley/Innovation Site 2.

A third potential site to be considered for removal is the Wellington Road Site. The site performed very well relative to environmental considerations, but it performed less well relative to accessibility issues and acquisition and displacement issues. With regard to accessibility, the site has relatively poor connections to the regional roadway network, making it relatively inaccessible to potential passengers arriving at the station via automobile. The site is also close to the Manassas Station, thus splitting the rider shed. With regard to acquisition and displacement issues, the site performed poorly because multiple properties would have to be assembled for a site large enough to accommodate a park and ride facility. Under this criterion, there would also be displacement of existing residential properties.

Table 6: Summary Matrix of Environmental Considerations¹

Site	Minority/Low-Income Populations	Historic Resources	Parks and Community Facilities	Prime Soils or Soils of Statewide Importance ²	Water Resources ³	Hazardous Materials/ Contamination	Wildlife Habitats
Haymarket Site 1	No	No	No	Yes, site is currently on undeveloped land	Yes – North Fork Stream, RPA, Floodplain and Wetlands	Unlikely, EPA reports no releases/known contamination for site; 2 sites reported within study buffer	Yes
Haymarket Site 2	Potentially, site within census block groups with higher than average low-income populations and housing is adjacent to site	No	No	Yes, site is currently on undeveloped land	Yes, intermittent stream, wetlands within study buffer	Unlikely, EPA reports no releases/known contamination at the site or within study buffer	Yes
Gainesville Site 1	No	Unlikely, however further research/ coordination is recommended	No	Yes, site is currently on undeveloped land	Yes, stream, wetlands	Potentially, additional coordination with DEQ/EPA needed (Atlantic Research Corporation site)	Yes
Dominion Station Site	No	No	No	Yes, site is currently on undeveloped land	Yes, wetlands	Unlikely, EPA reports no releases/known contamination at the site	Yes
Gainesville Site 2	No	Yes, further research/ coordination is recommended	No	Yes, site is currently on undeveloped land	No	Potentially, additional coordination with DEQ/EPA needed (Atlantic Research Corporation site)	Yes
Florida Rock Site	No	Yes, further research/ coordination is recommended	No	No, site is developed	Yes	Unlikely, EPA reports no releases/known contamination at the site; 3 sites reported within study buffer	No
Sudley/ Innovation Site 1	Potentially, site within census block groups with higher than average low-income populations and housing is adjacent to site	No	No	Yes, site is currently on undeveloped land	Yes, stream, wetlands	Unlikely, EPA reports no releases/known contamination at the site; numerous sites identified within study buffer	Yes

Table 6: Summary Matrix of Environmental Considerations (continued)¹

Site	Minority/Low-Income Populations	Historic Resources	Parks and Community Facilities	Prime Soils or Soils of Statewide Importance ²	Water Resources ³	Hazardous Materials/ Contamination	Wildlife Habitats
Sudley/ Innovation Site 2	Potentially, site within census block groups with higher than average minority & low-income populations and housing is adjacent to site	No	No	No, site is developed	Yes, wetlands	Unlikely, EPA reports no releases/known contamination at the site; numerous sites identified within study buffer	No
Williams Site	No	Yes, further research/ coordination is recommended	No	No, site is developed	Yes, wetlands	Potentially, EPA reports this site is listed as having/handling hazardous materials	No
Vulcan Quarry Site	Potentially, site within census block groups with higher than average minority & low-income populations and housing is adjacent to site	No	Yes, site is located near a school with athletic amenities that may be open to the public (undetermined)	No, site has been cleared for mining and is an active mine	Yes, fresh water ponds, streams, wetlands	Yes, EPA reports this site is listed as having/handling hazardous materials	No
Wellington Road Site	Potentially, site within census block groups with higher than average low-income populations and housing is on site	No	Yes, site is located near a school with athletic amenities that may be open to the public (undetermined)	Yes, site is mostly undeveloped	Yes, stream on site, wetlands	Unlikely, EPA reports no releases/known contamination at the site; numerous sites identified within study buffer	Yes

¹Environmental resources were evaluated largely based on readily available data, including information from National Wetlands Inventory (NWI). As the project advances, these resources would be examined in greater detail and field visits would be conducted to verify the evaluation as needed.

²Coordination with the Natural Resource Conservation Service (NCRS) is required to determine specific impacts. It should be noted that Prime Farmland is designated independently of current land use, but it cannot be areas of water or urban or built-up land.

³Water Resources includes surface waters, floodplains, wetlands and designated Resource Protection Areas (RPA). RPA areas, as defined by the Chesapeake Bay Act, include the land area within 100 feet of a perennial stream bank or edge of wetlands adjacent to the perennial stream. RPA areas are protected under state law and local ordinances.

Rail Infrastructure Assessment

This new branch of service would diverge from the existing Manassas Line service just west of the existing Manassas Station at Manassas Junction (MP 33) on NS's Piedmont Subdivision. It would extend northwesterly from Manassas Junction through Sudley Manor, Gainesville, and Haymarket, a distance of approximately 11 miles, along the NS B Line. Three potential station locations have been identified and evaluated as discussed in the previous section: Haymarket, Gainesville, and Sudley/Innovation.



Existing NS B Line

Overnight storage tracks would be located toward the end of the line. As previously discussed, equipment would be rotated through Broad Run to allow for every other day servicing of the equipment. The new facility at Gainesville or Haymarket would be for storage only.

Corridor Improvements

The general approach to the integration of commuter rail service along the 11-mile NS B Line corridor between Manassas Junction and Haymarket can be summarized as follows:

- The existing main line track, which is generally centered within the ROW, will remain “as is”. Minor adjustments to the alignment of the existing main line track will be considered to minimize and/or avoid environmental impacts, ROW acquisition, and/or excess need for retaining wall structures.
- A continuous second main line track will be constructed for the 11 mile length.
- The second main line track will be off-set to either the north (preferred) or south of the existing main line track as feasible.

Design criteria for the project corridor is located in Appendix H of the Gainesville-Haymarket Feasibility Study Report.

Rail Infrastructure Needs

Rail infrastructure needs vary based upon the selected approach to the service: Implementation of the minimum operating segment, a phased approach, or a full build-out from Manassas to Haymarket. Infrastructure improvements common to all three of these build options include:

- Building a second mainline track parallel to the existing NS B Line track, with variations as needed to accommodate the selected design speed. This second track would have the following components:
 - Continuous Welded Rail (CWR) with wood ties
 - Approximately 11 turnouts
 - Approximately 2 or 3 universal crossovers
 - Suitable for freight and commuter rail use
 - Upgraded crossings and signaling systems designed in accordance with NS's recent signalization upgrades and a Positive Train Control system.
- Right-of-way acquisition along some portions of the corridor to accommodate this second track.
- One storage yard along the alignment near the end of the line.

It should be noted that it is possible to relocate portions of the existing mainline track, thereby accommodating two tracks within the existing right-of-way. This would reduce the amount of land acquisitions, since acquisitions would not be needed if both tracks fit within the existing right-of-way. However, it would likely require some retaining walls or other structural modifications.

Infrastructure improvements that vary according to where the end of the line is (phased approach) and operating frequency include:

- Length of the second track.
 - If a full build-out to Haymarket is implemented, the second track would be about eleven miles long including NS's planned two-mile siding in Gainesville.
 - If a MOS or phased approach is implemented to Gainesville, the initial phase segment of the second track would be about eight miles long, depending on the exact location of the Gainesville Station. The length of the track would include NS's planned two-mile siding, thus reducing the new track construction requirement to approximately six miles.
- Number of stations. These stations would include low level platforms, elevators, fare collection equipment, and parking facilities.
 - If a full build-out to Haymarket is implemented, it is recommended that three stations (Sudley/Innovation, Gainesville, and Haymarket) be constructed.
 - If a phased approach is implemented, there are two possible options regarding the number of stations that would be constructed in the initial phase:
 - Two stations-one in Sudley/Innovation and one in Gainesville
 - One station-Gainesville
- The MOS would include one new station in Gainesville.

Other infrastructure improvements include parking expansions as needed at the existing Manassas Line stations to accommodate the increase in ridership. There

are several grade separations that have been identified as being critical to the Gainesville-Haymarket extension. These include the US 29/Linton Hall Road interchange and the Route 28/Wellington Road interchange. Both of these projects are VDOT initiatives with which this project would need to coordinate.

Environmental Considerations

As part of the Gainesville-Haymarket Alternatives Analysis, a qualitative assessment of potential environmental effects was conducted to determine the potential effects of extension options.

- One potentially significant archaeological site was identified in the Gainesville area south of the NS B Line. No other known sites were identified within the NS B Line corridor.

- Several streams traverse the NS B Line, many of which have designated floodplains associated with them. A large floodplain area was identified along the southern side of the NS B Line west of the intersection with US 29 to just past US 15 in Haymarket. Wetland areas were also identified along the corridor. Large wetland areas were identified in the vicinity of Sudley Manor Drive, along I-66 where the NS B Line parallels the interstate, and west of Route 29 along the southern side of the NS B Line. Portions of these streams, floodplains, and wetlands are adjacent to Resource Protection Areas, which are protected under the Chesapeake Bay Act. These would need to be evaluated further in the next phase of the project.

- For wetlands and floodplains, the linear feet along the NS B Line were calculated using Geographic Information Systems (GIS). Two scenarios are presented: linear feet of wetlands and floodplains between Manassas and Haymarket; and linear feet of wetlands and floodplains between Manassas and Gainesville. Table 7 provides these calculations.

Table 7: Linear Feet of Wetlands and Floodplains Identified Along the Rail Line

Alignment	Length of Alignment (in Feet)	Wetlands		Floodplains	
		Linear Feet	Percentage of Alignment	Linear Feet	Percentage of Alignment
Manassas to Haymarket	56,530	2,740	4.85%	7,270	12.86%
Manassas to Gainesville (to Route 29)	41,730	1,740	4.17%	300	0.72%



Based on the linear feet calculated, an alignment between Manassas and Gainesville would have the potential to impact considerably fewer wetland and floodplain areas.

- Based on the environmental factors indicated, potential impacts to water resources, such as floodplains and wetlands, are the greatest concern. Along the NS B Line west of US 29, large areas of wetlands and floodplains have been identified. Impacts to these resources may occur from land disturbing activities, such as acquiring additional right-of-way to construct a second track, or the provision of stations and park and ride lots. Impacts to these resources would require agency coordination, environmental permitting, and mitigation. Impacting these resources could impact project schedule and costs. As such, an extension that ends in the Gainesville area would be favorable to avoid potentially significant impacts to the water resources identified.
- Several potentially contaminated sites or hazardous waste generators were identified along the NS B Line. The greatest concentration of these sites was noted in the vicinity of the US 29 grade crossing.

Preliminary quantitative noise and vibration screening analyses were also performed in the Alternatives Analysis. The exact number of potentially affected sites depends on the specific land use and number of buildings located near the alignments. Extension options with the greatest number of trains in use and the most frequent service on the corridor would likely have the most impacts.

A greater amount of ambient noise can be observed in Gainesville versus Haymarket as a result of denser and more commercial development. Haymarket has less ambient noise and more residential development. Impacts would be more apparent with an alignment that extends all the way to Haymarket than one that ends in Gainesville.

Train Storage Requirements

The proposed extension of service to Gainesville/Haymarket would require additional sets of equipment. Since the new service would be located along the NS B Line, and the potential terminal stations are between eight and 11 miles northwest of Manassas (11 to 14 miles from Broad Run), an overnight storage facility for the new sets of equipment at or near the Gainesville/Haymarket terminal would reduce deadhead train miles. A separate storage facility for the proposed service would also reduce potential conflicts with NS operations and facilitate a more reliable service. This train storage facility would be for the parking of trains only; the maintenance, repairs, and cleaning of these train sets would still take place at the Broad Run Yard. This would be accomplished by rotating the fleet on a regular basis.

Storage Options

The size/type of facility that would be necessary varies by the level of service that would be provided. It is anticipated that the MOS and Phased Approach option would need storage capacity for two train sets (two six car trains; up to 14 units). The Full Build-Out constrained options (Split Service Constrained, and Split Service Constrained Plus Rail Shuttle) would need storage capacity for a minimum of three train sets (24 units) to six train sets (36 units). The unconstrained option could exceed the 36 units depending on the level of service ultimately offered. For planning purposes, the Split Service Constrained Plus Rail Shuttle was assumed as the maximum storage need [36 units – 3 full sets (2-6 and 1-8 car set) and 3 shuttle sets (3-3 car sets)]. The minimum facility size would be 14 units (two six car trains). The train storage facility options include the following:

- No facility: This option would utilize the existing Broad Run Yard for overnight storage and deadhead (run trains empty in non-revenue service) between Broad Run Yard and the first station of revenue service. This option might be sufficient in the short term for the MOS or the first stage of the phased approach but is not recommended as a long term solution. The principle drawbacks are the limited capacity of the Broad Run facility, the lack of room for expansion, and the additional cost of deadheading trains between overnight storage at Broad Run Yard and the start of revenue service in the Gainesville-Haymarket area.
- Siding only: With the MOS and Phased Approach options, a storage siding could be constructed in lieu of a full storage yard. This siding would need to hold at least two train sets (14 units). It would also need to be a double-ended siding so that a parked train is not trapped behind a disabled train. This single siding would need to be approximately 1,200 feet in length.
- Full storage yard: With the Full Build-Out option, a full storage yard would need to be constructed. This yard should be located as close as possible to the terminal station to avoid time and capacity-consuming deadhead moves to and from an alternate location. For the Split Service Constrained Plus Rail Shuttle option, the storage need would be 36 units in six sets of equipment [3 full sets (2-6 and 1-8 car set) and 3 shuttle sets (3-3 car sets)]. There would need to be three tracks approximately 800 feet in length and three tracks approximately 350 feet in length. There should be at least one “empty” track to accommodate moves within the yard.

Potential Sites for a Storage Yard

There are several factors to consider in determining the potential sites for a storage yard: the size of the facility, the potential operational impacts on the NS



B Line as well as the proposed service, finding a location with compatible surrounding land uses, and environmental resources. From an operational perspective, the facility should be as close to the terminal station as practicable. It also needs to be in a location that minimizes potential operational impacts on the NS B Line. The operation of the facility should be self contained; any yard equipment moves/shifts should not go past the limits of the yard unless absolutely necessary. The facility should be located in an area where the impact of idling diesel engines and/or the starting up of diesel engines in the early morning hours does not impact abutters. It should also be located to minimize potential impacts on environmental resources.

A factor worth considering is the close proximity of the general Gainesville Station site area to the Haymarket Station site area (approximately three miles). Given the possibility of an initial MOS or phased approach, a facility located in Gainesville may be able to facilitate both the initial as well as the long-term needs of the proposed service.

Three potential site locations were identified in the Gainesville-Haymarket Implementation Plan. These sites include Balls Ford Road, Haymarket, and the Vulcan Quarry. A list of potential sites, some within the general locations identified in the Implementation Plan, as well as potential sites located during site reconnaissance and through preliminary environmental analyses, was established. This list was intended to be inclusive of sites that could potentially serve as a station and park and ride lot and/or a storage yard and are shown in Figure 1.

End of Line Sites:

- Haymarket Site 1
- Haymarket Site 2

Mid-Corridor Sites:

- Gainesville Site 1
- Dominion Station
- Gainesville Site 2
- Florida Rock
- Sudley/Innovation Site 1
- Sudley/Innovation Site 2
- Williams
- Vulcan Quarry
- Wellington Road

Of these potential sites, there are a few that present unique challenges in accommodating storage yards. Table 8 identifies the operational and environmental/land use challenges associated with each potential site.



In terms of environmental/land use considerations, the most suitable sites include Haymarket Site 2, Florida Rock Site, Sudley/Innovation Site 1, Sudley/Innovation Site 2, Williams Site, and Wellington Road Site. In terms of operational considerations, the most suitable sites include Haymarket Site 2 and Dominion Station. Gainesville Site 2 also shows potential as a storage yard site, but it is farther from the end of the line. Haymarket Site 1, Gainesville Site 1, the Florida Rock Site, Sudley/Innovation Site 1, the Williams Site, the Vulcan Quarry Site, and the Wellington Road Site may be removed from consideration based upon operating constraints. From a location perspective, the Haymarket and Gainesville sites are the most favorable.

Based on the factors considered, the overall recommendation would be to initially consider the following sites for the Full Build-Out storage facility:

- Haymarket Site 2
- Dominion Station

Given the layout requirements of the Full Build-Out storage facility, it is likely that these sites may be able to accommodate the storage yard, as well as the station and park and ride facility.

Table 8 Challenges Associated with Potential Storage Yard Sites

Potential Site	Miles from Haymarket	Miles from Broad Run	Operational Challenges	Environmental/Land Use Challenges
Haymarket Site 1	0	13	-Not feasible.	-May impact water resources, including RPAs, floodplains and wetlands. -May impact soils and wildlife habitat.
Haymarket Site 2	0	13	-None observed.	-May impact water resources. -May impact soils and wildlife habitat.
Gainesville Site 1	3	10	-Cannot accommodate storage yard without sharp turn in and out of site.	-May impact water resources. -May impact historic resources. -May impact soils. -May have contamination from prior site use.
Dominion Station	3	10	-None observed.	-May impact wildlife habitat. -May impact soils.
Gainesville Site 2	3	10	-None observed, but site is far from the end of the line.	-May impact water resources. -May impact historic resources. -May impact soils. -May have contamination from prior site use.
Florida Rock			-Cannot accommodate storage yard without sharp turn in and out of site.	-May impact water resources. -May impact archaeological resources.
Sudley/Innovation Site 1			-Curved track frontage may present additional challenges when locating turnouts and site is far from the end of the line.	-May impact water resources. -May impact minority/low-income populations. -May impact soils and wildlife habitat.
Sudley/Innovation Site 2			-None observed, but site is far from the end of the line.	-May impact water resources. -May impact minority/low-income populations.
Williams Site			-Short, curved track frontage may make it difficult to fit the ladder and track lengths, as well as locate turnouts.	-May impact water resources. -May impact archaeological resources.
Vulcan Quarry			-None observed.	-May impact water resources. -May impact minority/low-income populations. -May contain hazardous materials. -Not compatible with existing Land Use (Agricultural Zoning A-1)
Wellington Road			-Site close to existing Broad Run Yard. Increased deadhead miles.	-May impact minority/low-income populations. -May impact soils and wildlife habitat.

The concept of a single storage track for the MOS and Phase Approach options could probably be incorporated into the Gainesville Site 1, Dominion Station, and Gainesville Site 2 station locations.

Findings

Ridership projections demonstrate that a Gainesville-Haymarket extension would attract additional riders to VRE service from the region. The extension would add needed capacity and choice to the corridor. The Gainesville-Haymarket extension has the potential to generate daily trips in the range of 1,000 to 5,000 per day, based on the projections developed for this Feasibility Study and the earlier Strategic Plan.

Terminus

Preliminary environmental assessments demonstrate that an end of line station in Gainesville is more favorable for the extension than an end of line station in Haymarket. This is a result of potential water resources impacts along the south side of the NS B Line west of US 29, particularly if the right-of-way must be expanded, as well as the potential for greater noise and vibration impacts.

Ridership forecasts suggest that there is a relatively small difference in daily boardings between a Haymarket and Gainesville terminus. With Gainesville as the terminus for the Gainesville-Haymarket extension, the cost range of alternatives drops approximately \$25 M.

Comparison of Extension Options

The advantages and disadvantages of pursuing each of the extension options (Minimum Operating Segment, Phased Approach, or a Full Build-Out) are summarized in Table 9.

Table 9 Advantages and Disadvantages of Extension Options

Options	Summary	Advantages	Disadvantages
Minimum Operating Segment (MOS)	A new service branch between Gainesville and Manassas provided while keeping the existing Manassas Line service frequency.	- Lowest Cost - No additional vehicles needed - Does not exceed 40 trains per day maximum	- Lowest Service Coverage - Lowest Ridership - Limited Service Frequency - Lowest Fare Revenue Recovery
Phased Approach Two Stations – Gainesville and Sudley/Innovation*	A new service branch to Gainesville (two stations) with modifications to existing Manassas Line service.	- Does not exceed 40 trains per day maximum	- Some New Equipment Needs - Limited Service Coverage
Full Build-Out Split Service Unconstrained (1A)	A new branch to Haymarket overlaying the existing service on the VRE Manassas Line, keeping the existing Manassas Line service frequency and exceeding VRE's capacity constraint.	- Greatest Service Coverage - Highest Service Frequency between G-H and DC	- Exceeds 40 train per day maximum with associated Implementation Challenges - High Costs - High Quantity of New Equipment Needs - Additional capacity improvements on CSX and improvements at the Alexandria Station may be required
Full Build-Out Split Service Constrained (1B)	A new branch to Haymarket overlaying the existing service on the VRE Manassas Line, modifying the existing Manassas Line service frequency, but working within VRE's capacity constraint.	- Does not exceed 40 trains per day maximum - Great Service Coverage	- Some New Equipment Needs
Full Build-Out Split Service Constrained Plus Rail Shuttle (1C)	A new branch to Haymarket overlaying the existing service on the VRE Manassas Line and a new rail shuttle service between Haymarket and Alexandria, modifying the existing Manassas Line service frequency, but working within VRE's capacity constraint.	- Highest Ridership - Great Service Coverage - Highest Fare Revenue Recovery - Frequent Shuttle Service between G-H and Alexandria - Does not exceed 40 trains per day maximum	- High Costs - Highest Quantity of New Equipment Needs - Additional capacity improvements on CSX and improvements at the Alexandria Station may be required

* Note: This would be the first phase of the Phased Approach Option. The second phase would be the Full Build-Out option to Haymarket.

Conclusions

There are a few general conclusions that can be made regarding the overall evaluation of the extension.

- Options with greater frequency (i.e. unconstrained) will demonstrate the highest ridership. This is because the model is very sensitive to service frequency.
- Options with greater frequency will have higher capital and O&M costs due to the need for more equipment and the increased train miles.
- Since options with greater frequency yield the highest ridership numbers, these options also yield the greatest revenue from fare collection.

- All extension options utilize the NS B Line and require coordination and negotiation with NS regarding required right-of-way. All of these options require the construction of a second track and must adhere to the design of NS's Passenger Rail Design Criteria.
- Options that are unconstrained (i.e. exceed the allocation of 40 trains per day maximum between NS mile 9.12 and Washington DC) require coordination and negotiation with CSX.

Options that propose a rail shuttle service to avoid most of the stretch of track that is subject to the capacity constraint still require coordination and negotiation with CSX, since approximately one mile of the constrained track is included in the rail shuttle route. Additionally, platform improvements are needed at Alexandria Station.

Implementation

To move forward, decisions need to be made regarding the appropriate terminus of the extension and the operating plan of choice (i.e. constrained or unconstrained and with or without rail shuttle). VRE has the option to implement the minimum operating segment to simply begin service along the corridor or to pursue more detailed studies and seek federal funding for the extension or to pursue both of these options. The Feasibility Study has determined that the most suitable terminus for the extension at this time (Gainesville), as well as the most appropriate operating plans depending on the level of funding (minimum operating segment to phased approach to full build-out).

If VRE desires to exceed the 40 trains per day maximum that is set forth in the agreement with CSX, then additional research needs to be done to determine modifications necessary to achieve this, including negotiations with CSX and the identification of the anticipated costs. If VRE does not want to exceed the 40 trains per day maximum, then the options remaining are to offer split service along the Manassas Line between Union Station/Broad Run and Union Station/Gainesville-Haymarket or to offer split service coupled with a rail shuttle.

Implementation steps for the Gainesville-Haymarket extension will vary depending on the selected funding source. The first step in implementation would therefore be to choose a funding path to work towards.

Funding options include federal, state and local.

Federal Funding Opportunities

There is one primary source of federal funds for major capital investment transit projects – the FTA’s New Starts Program. This program is highly competitive with projects across the country competing for a limited pool of funding. FTA assigns a rating designating a project’s eligibility for funding. The ratings are: High; Medium High; Medium; Medium Low; and Low. A project general needs to achieve a Medium rating to qualify for federal funds through the New Starts Program. The initial assessment of user benefit conducted as part of the Alternatives Analysis suggests that the Gainesville-Haymarket extension would likely be in the Medium Low to Low range, making funding through the New Starts Program unlikely. It is possible that adjustments to the travel demand forecasting process and a refinement of the cost estimates may improve the rating. At this point however, New Starts Program funding appears unlikely.

FTA now administers a second program called Small Starts. This program is for projects with a total capital cost of under \$250 million. One advantage of the Small Starts Program is that FTA relaxes some of the more stringent modeling requirements, allowing more flexibility in how the forecasts are prepared. An initial assessment of the Gainesville-Haymarket extension with respect to the Small Starts Program criteria indicates that the ratings could improve to Medium or better. One disadvantage to a Small Starts application is that the federal share is limited to \$75 million of the total cost.

State Funding Opportunities

The primary source of state funding would be through the Rail Enhancement Fund (REF). The Commonwealth has already invested in the NS B Line corridor using monies from the REF. This program is a competitive process that uses a cost benefit analysis approach developed by DRPT. Other state options include a budget line item appropriation or dedicated funding source being created.

Local Funding Opportunities

There are also a few sources of local funds that could be available for the project through general funds, and/or other local revenues or through bonding authority.

Other Funding Opportunities

There are also a few other sources funding that could be available for the project through taxation districts, partnership contributions, tax increment financing (TIF) or other revenues streams.



Special Transportation, Benefits Assessment, and Taxation Districts

Virginia statutes permit several types of districts to be formed with the potential for generating revenues to repay the initial capital investment or to fund ongoing maintenance and upkeep of the service and facilities. Some areas have created special assessment districts around transit stations. Transit projects can create returns through generating new economic development around transit stations that is focused on the transit system and its customer base.

Partnership Contributions

Private and non-profit partners may have their own revenue sources that can be used to build portions of the transit project. Virginia has a proffer system under which developers negotiate voluntary contributions to local infrastructure via either (1) any money voluntarily proffered in writing signed by the owner of property subject to rezoning, and accepted by a locality pursuant to the authority granted by §15.2-2298 or §15.2-2303 of the Code of Virginia; or (2) any payment of money made pursuant to a development agreement entered into under the authority granted by §15.2-2303.1 of the Code of Virginia. This is another potential funding opportunity for VRE. Transit-oriented development (TOD) is encouraged around transit stations, and this could be a funding source for VRE if the development is conducted in a manner to be beneficial to both the private investor and VRE. There has been some initial interest expressed to VRE by developers to establish a proffer agreement with the local jurisdiction. Such a proffer agreement could fund as much as:

- Land acquisition
- Permanent easements for public access
- Construction of public access across private land, through private facilities, or from private facilities down to the platform
- Elevators from the private facility down to the platform
- Construction of the station
- Associated parking, roadway and access improvements
- Utility relocation or consolidation
- Pedestrian improvements and landscaping

This would substantially reduce VRE's capital costs associated with the implementation of the extension and would provide the private investor with strong transit access for the development.

Tax Increment Financing (TIF)

TIFs are often called "public-private partnerships" because they rely on public action to stimulate private investment. TIFs fund projects through the issuance of bonds that pay for acquisition, demolition, and infrastructure costs associated with redevelopment. Generally, a public investment is made on a blighted area



that demonstrates potential as a private investment once the basic infrastructure needs are met. Property taxes increase over time after the private development occurs, and this change in taxes, or tax increment, is used to retire bonds that were sold to initially fund the public investment.

Under any of the funding scenarios considered, there would also be the potential to solicit private foundation contributions to support construction of the station and/or associated parking. There is also an opportunity to fully utilize state-funded rail improvements (through DRPT) on the Norfolk Southern Crescent Corridor as outlined in the DRAFT Virginia Statewide Rail Plan. This plan states that there are 39 individual projects identified in Virginia on the Crescent Corridor that will primarily expand single mainline tracks to double tracks, add passing sidings, and expand passing sidings. Some of these projects provide dual benefits to improve passenger and freight rail.