

# Route 1



## Multimodal Alternatives Analysis

### APPENDIX F

#### Detailed Evaluation of Alternatives Report

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# Route 1



## Multimodal Alternatives Analysis

### **ROUTE 1 MULTIMODAL ALTERNATIVES ANALYSIS**

### **DETAILED EVALUATION OF ALTERNATIVES REPORT**

June 2014

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# 1.0 Introduction

The purpose of this technical memorandum is to summarize the evaluation of alternatives and provide supporting documentation on the evaluation measures and methodology.

This memorandum describes the process of developing and evaluating the multimodal alternatives. It provides detail on performance measures and associated analysis methodologies used to screen and recommend a multimodal solution that best meets the needs of the corridor. The memorandum does not discuss the associated recommendations, which are described in the Final Report.

An important part of the alternatives evaluation is an assessment of potential funding and implementation steps for the alternatives. Implementation considerations are the levels of anticipated population and employment, the need for additional transportation infrastructure, and general viability of the preliminary funding plan including competitiveness for federal transit funding.

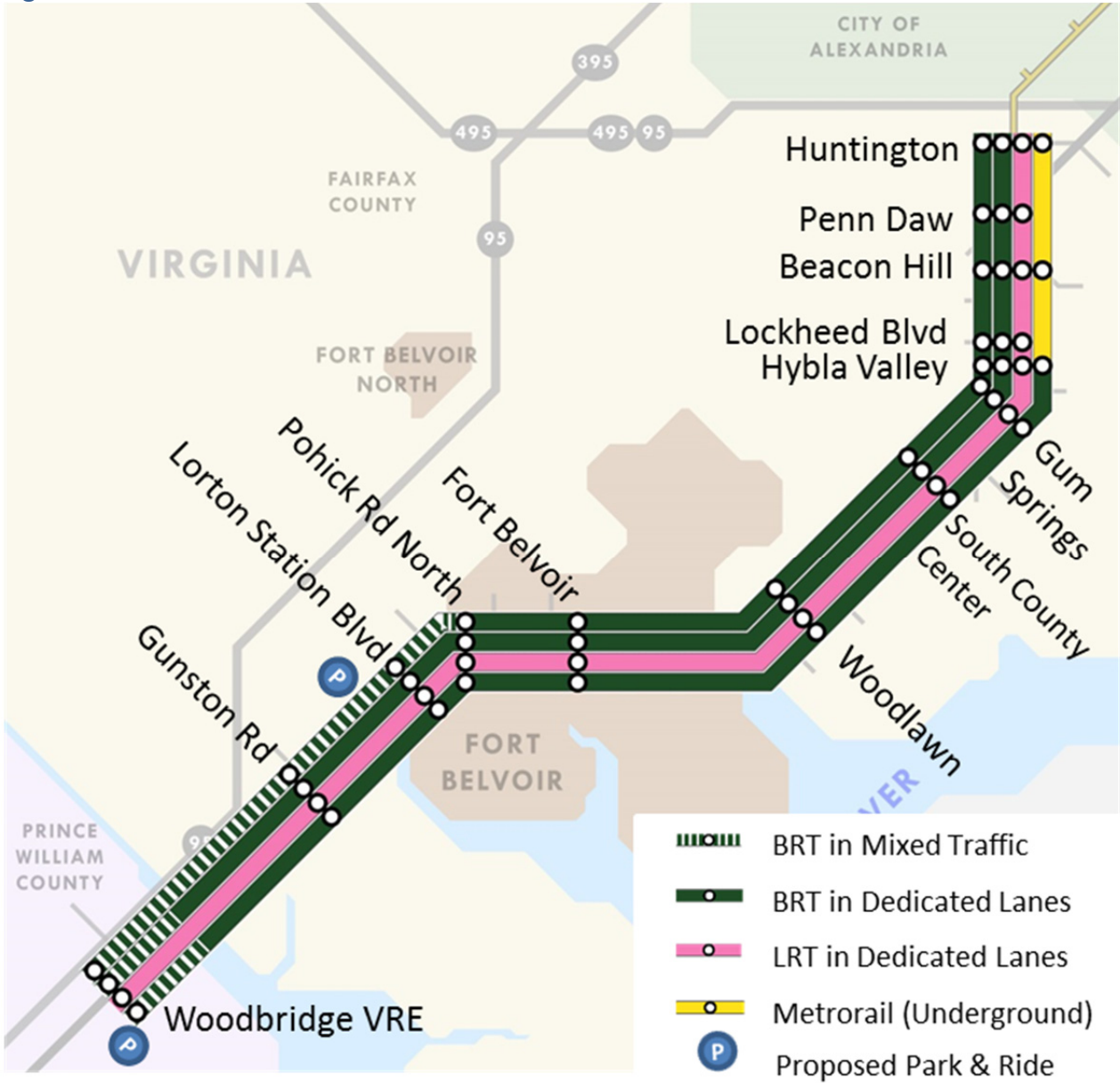
## 1.1 Refined Multimodal Alternatives

Four multimodal alternatives were evaluated in detail. The four alternatives assume the same vehicular lane and bicycle/pedestrian facility configuration, but the transit mode and operating assumptions vary. The multimodal alternatives assume a consistent, six-lane vehicular lane configuration and a 10-foot multi-use path along the majority of the corridor; however, the bicycle/pedestrian facility configuration will vary depending upon urban design, right-of-way availability, and other local considerations. The four alternatives are referred to by the transit component and include:

1. Alternative 1 - Bus Rapid Transit – curb running
2. Alternative 2 - Bus Rapid Transit – median running
3. Alternative 3 - Light Rail Transit – median running
4. Alternative 4 - Hybrid – Yellow line extension to Hybla Valley with supporting Bus Rapid Transit (median) to Woodbridge

**Figure 1-1** shows the refined multimodal alternatives for detailed evaluation. The more detailed description of each alternative is provided in Section 2.0 of the Final Report.

Figure 1-1: Refined Multimodal Alternatives





## 2.0 Evaluation of Multimodal Alternatives

### 2.1 Introduction and Summary of Findings

The goal of the evaluation is twofold:

1. Assess how well each alternative addresses the project goals and objectives
2. Assess feasibility of implementing each alternative (requirements articulated by public participants, elected officials, and technical staff).

The first evaluation considers the ability of each alternative to meet the project goals and objectives. This is performed using identified evaluation measures that provide either quantitative or qualitative data on how well each alternative meets the goals.

The second evaluation is a qualitative assessment of the feasible timing for implementation and financial feasibility of each Alternative. The evaluation focuses on development levels appropriate to the type of transportation investment, and ability to secure funding for recommended improvements.

#### 2.1.1 Summary of Findings

The study team recommends a phased implementation of the multimodal (roadway, bicycle/pedestrian, and transit) improvements of “Alternative 4 BRT/Metrorail Hybrid”, including:

- **Roadway Widening:** Widen roadway from four lanes to six lanes where necessary to create a consistent, six-lane cross section along the corridor;
- **Bicycle and Pedestrian Facilities:** Create a continuous facility for pedestrians and bicyclists along the 15 mile corridor; the configuration will vary depending upon urban design, right-of-way availability, and other local considerations; and
- **Transit:** Contingent upon increased land use density and project funding, implement a median-running Bus Rapid Transit (BRT) system from Huntington to Route 123 in Woodbridge (curb-running BRT in mixed traffic within the Prince William County portion) and a 3-mile Metrorail Yellow Line extension from Huntington to Hybla Valley as expeditiously as possible.

























**Table 2-1** presents the evaluation results that support this technical recommendation.

The next sections summarize the key findings by evaluation factor and present tables that show the comparative measures. Explanatory text for each measure is provided below the summary tables. Further detail on the technical methods that support the quantitative measures is presented in the following related reports:

- *Transportation Report*
- *Land Use and Economic Analysis Report*

- *Funding Analysis Report*
- *Environmental Scan Report*

Table 2-1: Evaluation of Alternatives Summary

Evaluation Factors (Goals)	Alternative 1: BRT-Curb	Alternative 2: BRT-Median	Alternative 3: LRT	Alternative 4: Metrorail-BRT (Hybrid)
Goal 1: Local and Regional Mobility	 0.7	 0.8	 0.8	 <b>1.00</b>
Goal 2: Safety and Accessibility	 0.7	 <b>0.8</b>	 <b>0.8</b>	 <b>0.8</b>
Goal 3A: Economic Development	 0.6	 0.6	 0.6	 <b>0.7</b>
Goal 3B: Cost Effectiveness	 <b>1.0</b>	 0.9	 0.7	 0.5
Goal 4: Community and Health Resources	 0.7	 0.7	 0.7	 <b>0.8</b>
Ability to Meet Project Goals Average	 0.7	 <b>0.8</b>	 0.7	 <b>0.8</b>

## 2.2 Ability to Address Project Goals and Objectives

At the beginning of this Alternatives Analysis study, goals and objectives were established to help guide development of the alternatives. The goals and objectives were created through public and stakeholder involvement and reflect the underlying locally adopted land use and transportation plans. The goals represent the combined vision of policy-makers, stakeholders, and members of the community.

In this evaluation each alternative is assigned a score for each measure, shown in grey text below each set of results. The best performing alternative for each measure receives a perfect score of 1.0. The other alternatives are assigned values relative to the best score. This methodology provides proportional comparison of the alternatives against one another.

For each goal, specific measures are weighted more heavily as the others, indicated by bold text. The weighting reflects input received from participants at the March 2014 public, results of a public survey posted on the project website from March 26 to April 26, 2014, and professional judgment of Project Management Team staff.

## 2.2.1 Goal 1 Evaluation and Summary

**Goal 1:** Expand attractive multimodal travel options to improve local and regional mobility

**Objectives:** Increase transit ridership  
Improve transit to reduce travel times  
Increase transportation system productivity  
Improve bicycle and pedestrian networks  
Integrate with other transit service

**Key Results:**

- All alternatives improve local and regional mobility by providing improved transit and bicycle/pedestrian facilities and connecting to the regional transit network
- Projected daily project ridership in 2035 ranges from 15,000-27,000; Alternative 4 attracts the highest ridership
- Transit travel time savings are highest for alternatives that operate in dedicated right-of-way (Alternatives 2, 3, and 4)

**Summary of Findings:**

Compared to the other alternatives, Alternative 4 provides the greatest improvement to corridor mobility. Alternative 4 attracts the highest ridership, carries the most people along the corridor, and provides a slightly faster travel time. Alternative 4 performs best under this goal due to Metrorail's relatively higher operating speed and direct connection with the regional rapid transit network. Because the transit vehicles operate in dedicated lanes in the median, Alternatives 2 and 3 provide greater travel time savings than Alternative 1. All alternatives provide improved bicycle and pedestrian improvements and connect to the regional transit system. The evaluation results are presented in **Table 2-2**.

**Table 2-2: Goal 1 - Expand Attractive Multimodal Travel Options to Improve Local and Regional Mobility**

<b>Evaluation Measures</b>	<b>Alternative 1 BRT-Curb</b>	<b>Alternative 2 BRT-Median</b>	<b>Alternative 3 LRT</b>	<b>Alternative 4 Metrorail-BRT (Hybrid)</b>
Daily project ridership (2035)*	15,200 0.57	16,600 0.63	18,400 0.69	26,500* (BRT 10,600; Metro 22,900) 1.00
Number of new transit riders	1,500 0.32	2,000 0.42	2,500 0.53	4,750 1.00
Number of transit dependent riders*	5,157 0.81	5,438 0.86	5,788 0.91	6,350 1.00
Transit Travel Time Savings (Ft Belvoir to Huntington Metro Station)*	6 min 0.59	9 min 0.85	9 min 0.92	10 min 1.00
Average transit person throughput	1,050 0.40	1,180 0.45	1,360 0.52	2,600 1.00
Ratio of transit person throughput to total person throughput, peak hour	26% 0.55	28% 0.60	32% 0.68	47% 1.00
Number of riders who walked to access transit	4,700 0.90	5,000 0.96	5,200 1.00	5,200 1.00
Provides improved bicycle and pedestrian facilities	High 1.00	High 1.00	High 1.00	High 1.00
Provides connections to regional transit network*	Connects to Huntington Metro Station 1.00	Connects to Huntington Metro Station 1.00	Connects to Huntington Metro Station 1.00	Connects to Huntington Metro Station 1.00
<b>Average Score</b>	<b>0.70</b>	<b>0.78</b>	<b>0.83</b>	<b>1.00</b>

\*Measure given double weighting in the Average Score

### Quantitative Measures:

- **Project ridership:** Average weekday ridership for the alternatives, assessed using the regional forecasting tool for 2035.
- **New transit riders:** number of average estimated weekday transit riders who did not take transit before. These figures represent a mode shift to the project alternatives.
- **Number of transit dependent riders:** Number of projected average weekday riders that use the system that are in the lowest income bracket as defined by MWCOC.
- **Transit travel time savings:** transit travel time savings from Fort Belvoir to Huntington Metrorail Station compared to the No Build. Transit travel time savings obtained from the VISSIM model tool (average of the two segments) were applied to REX No-Build travel time. REX No-Build travel time was calculated using schedule travel time for existing increased by 10 percent to account for future year traffic.
- **Ratio of transit person throughput to total person throughput, peak hour:** This measure compares one-way 2035 peak hour transit volumes against the total number of people traveling along Route 1 (by transit and automobile combined) in the peak hour. Peak direction transit person throughput (maximum load at the peak segment) was obtained from projections of daily ridership. Automobile throughput was calculated using the No-Build peak hour traffic volume in the peak direction at the same location as for transit, multiplied by average auto occupancy (assumed 1.15 persons/car).
- **Number of riders who walked to access transit:** this output from the ridership forecast tool approximates the number of average daily riders who accessed the alternatives by walking to a station. The other riders used a variety of modes including park and ride, kiss and ride, and transfers from other transit.

### Qualitative Measures:

- **Provides improved bicycle and pedestrian facilities:** All alternatives propose a 10-foot multiuse path along the entire length of the corridor to improve bicycle and pedestrian facilities. All alternatives are assumed to conform to ADA best practices and guidelines and therefore all alternatives perform well in this evaluation measure.
- **Provides connections to regional transit network:** All alternatives connect to the Huntington Metrorail Station, providing connections to the regional transit network; therefore, all alternatives are assumed to perform well in this evaluation measure.

## 2.2.2 Goal 2 Evaluation and Summary

### **Goal 2: Improve safety; increase accessibility**

**Objectives:** Provide accessible pathways  
 Reduce modal conflicts  
 Improve pedestrian crossings  
 Maintain traffic delays at acceptable levels

#### **Key Results:**

- All alternatives assume construction of additional lanes or guideway for transit vehicles, and therefore have comparable, relatively minor impacts on traffic operations.
- Alternative 1 operates in the curb lane, providing superior pedestrian access to stations, but results in slower travel time and precludes a future on-street bike lane.
- Alternative 1 operates in the curb lane which means that the frequent curb cuts and access points along Route 1 degrade reliability of the transit service.
- Alternatives 1 and 4 have the narrowest roadway section which minimizes the total distance of exposure for a pedestrian crossing the street.

#### **Summary of Findings:**

This goal relates to the performance of the overall transportation system; it compares the alternatives in terms of network performance and access to corridor destinations. All of the alternatives have been developed to improve accessibility and safety. Alternative 4 performs best overall under this goal, as the three-mile underground Metrorail extension allows for a narrower cross-section, full modal separation, reduced impact on turning vehicles, and convenient pedestrian access to stations.

This goal highlights the key trade-offs between median-running and curb-running transit, including pedestrian accessibility to stations, travel time, transit reliability, and flexibility for a future on-street bike lane. Alternative 1 operates in the curb lane, and Alternatives 2, 3, and 4 operate in the median. Although curb-running transit allows convenient pedestrian access to stations, it can lead to greater variability and slower travel times for transit and traffic because it shares its dedicated lane with local buses as well as cars making right turns. In general, traffic evaluation results show that impacts to the auto network are similar for curb-running versus median-running transit. However, in practice curb-running transit introduces more friction from an operations perspective; median-running transit preserves dedicated transit operations and allows different access and urban design approaches as property along Route 1 is developed and redeveloped.

With implementation of bike lanes, curb-running transit also introduces points of conflict between transit vehicles and bicycles and between transit passengers and bicyclists.

The evaluation results are presented in **Table 2-3**.

**Table 2-3: Goal 2 Evaluation – Improve Safety and Increase Accessibility**

<b>Evaluation Measures</b>	<b>Alternative 1 BRT-Curb</b>	<b>Alternative 2 BRT-Median</b>	<b>Alternative 3 LRT</b>	<b>Alternative 4 Metrorail-BRT (Hybrid)</b>
Pedestrian access to station stops*	Medium 0.60	Medium 0.60	Medium 0.60	Medium 0.60
Pedestrian crossing time (including signal delay)*	102 sec 0.95	116 sec 0.84	116 sec 0.84	97 sec 1.00
Automobile travel time (minutes during peak hour, Ft. Belvoir to Huntington Station)	24.0 0.99	23.7 1.00	24.0 0.99	23.7 1.00
Automobile network delay, Ft. Belvoir and Hybla Valley test segments (vehicle hr/hr)*	466 0.99	468 0.98	460 1.00	468 0.98
Traffic impacts due to turning vehicles (left turns)	Minimal impact 0.80	Moderate impact 0.40	Moderate impact 0.40	Moderate impact 0.40
Impacts due to turning vehicles (right turns )	Significant impact 0.20	No impact 1.00	No impact 1.00	No impact 1.00
Preserves flexibility for bike lane in higher activity nodes	Less flexible 0.40	More flexible 0.80	More flexible 0.80	More flexible 0.80
<b>Average Score</b>	<b>0.71</b>	<b>0.79</b>	<b>0.79</b>	<b>0.82</b>

\*Measure given double weighting in the Average Score

#### **Quantitative measures:**

- **Pedestrian crossing time (including signal delay):** measure of the total time it takes a pedestrian to cross from one side of the street to the other. In general, shorter crossing times and crossing distances encourage pedestrian compliance (preventing pedestrians from jay-walking) and improve pedestrian access to transit. Pedestrians prefer shorter crossing time. The crossing time is informed by the number of lanes and total right-of-way width, including buffer areas and a 10-foot multi-use path.
- **Automobile travel time:** estimated automobile travel times between Fort Belvoir and the Huntington Metrorail Station. Times are estimated based on the VISSIM traffic simulation modeling for each alternative for the Hybla Valley and Fort Belvoir segments of detailed analysis. The percent



change in travel times for the alternatives compared to the No-Build scenario were applied to the average peak direction, peak hour No-Build trip time between Fort Belvoir (Gunston Road/Route 1 intersection) and the Huntington Metrorail Station.

- **Automobile Network Delay, Hybla Valley and Fort Belvoir Segments (vehicle hr/hr):** measure of total network delay (including cross street vehicles and Route 1 vehicles) experienced by motorists during the peak hour for the Hybla Valley and Fort Belvoir segments. The measure combines delay for the two segments that were modeled in detail using VISSIM.

#### Qualitative measures:

- **Pedestrian access to stations:** evaluation of the convenience and ease for pedestrians to access a station stop. Alternative 1- BRT Curb allows pedestrians to board from the curb; however, pedestrians must cross the entire street width for stations providing service in the opposite direction. Alternatives 2, 3, and 4 require pedestrians to cross the street to board the vehicle in the median regardless of the direction of service. For the Metrorail segment of Alternative 4, the stations are assumed to be underground and pedestrians access the station from street-level.
- **Transit interaction with left turning automobiles:** for left turns, alternatives that operate in the median (Alternatives 2, 3, and 4) have a more significant impact on left-turning vehicles. This is due to: 1) left turn movements operate with protected phase-only under median running transit to improve safety, 2) median running transit conflict with both left turn phases (e.g., southbound left and northbound left movements on Route 1), therefore Transit Signal Priority (TSP) for transit has a greater impact in terms of delay on left turning vehicles.

Along some areas of the corridor it may be advisable to prohibit left turns at certain locations, and thus reduce delays to transit vehicles and general traffic. This approach may be more feasible in the longer term, as the local street network develops and provides more alternative pathways for access across Route 1. The VDOT Access Management Regulations and Standards and associated documents have provisions that apply.

- **Interaction with right turning vehicles:** for right turns, curb running BRT (Alt 1) has more impact on right-turning vehicles as they conflict with transit flow turning both in and out of intersecting streets and access points. The Metrorail segment of Alternative 4 does not affect left or right turns, as Metrorail operates underground. Alternatives 2 and 3 received the same score, while Alternative 4 performed slightly better due to the short Metrorail extension that would not cause additional impacts.

With ongoing redevelopment along Route 1—and differing configurations for access to that development—a curb-running configuration can lead to more obstacles in maintaining continuity of transit operations. In general, as the corridor redevelops, one of the objectives would be to consolidate access points and introduce additional cross streets and local street network. These measures will reduce some of the traffic delay associated with the current large numbers of access points and provide improved safety for travelers on all modes.



- **Preserves flexibility for bike lane in higher activity nodes:** as nodes develop, it is anticipated that bicycles would be re-accommodated (or separated from the proposed multiuse path) at the curb to reduce conflicts with pedestrians in these high-activity areas. With curb-running transit, bicycle traffic is routed behind the station boarding area, or moved into the curb lane where it can be in conflict with transit vehicles serving the stop. The result is degraded transit operations, increased bicyclist stress, and increased safety concerns. Transit vehicles operating in a dedicated median or underground do not conflict with on-street bicycle lanes.

### 2.2.3 Goal 3 Evaluation and Summary

#### **Goal 3: Increase economic viability and vitality of the corridor**

- Objectives:**
- Increase and improve connectivity to local and regional activity centers
  - Encourage and support compact, higher density, mixed use development consistent with local plans, policies, and economic objectives
  - Secure public and investor confidence in delivery and sustainability of new transit investments
  - Provide high-capacity transit facilities at locations where existing and future land uses make them mutually supportive

This goal encompasses two distinct categories of measures; results and findings are summarized under these two categories:

#### **3A: Ability to support corridor economic development, and**

#### **3B: Cost effectiveness**

##### **Key Results for 3A:**

- Alternatives 3 and 4 offer the greatest transit travel time savings, suggesting that these alternatives could increase the pace of new development built in the corridor and lead to additional new commercial development.
- All of the alternatives provide improved access to jobs and access by employers to workforce.
- Alternatives 1 and 2 have a higher probability of commencing operations within ten years. Alternatives 3 and 4 would not be operational within the next ten years given the greater engineering and construction requirements.

##### **Key Results for 3B:**

- Alternatives 3 and 4 are the most expensive to construct and operate, as well as the least cost effective.

### Summary of Findings, 3A:

This goal relates to both the viability of implementing the alternatives, and their utility as catalysts for development in the corridor. Alternative 2 performs best overall under this goal because it is relatively affordable, provides good support for development plans, and is more flexible than Alternative 1 to accommodate future conversion to a rail technology.

All alternatives improve corridor mobility by improving travel time and increasing accessibility; Alternative 4 performs highest in terms of supporting and potentially spurring economic development for the corridor because of its benefits to corridor mobility. This relationship between transportation and economic development suggests that as all alternatives improve corridor mobility, all will contribute and support economic development in the corridor. In terms of land redevelopment and the potential for a supporting street network expansion, literature reviews suggest that rail alternatives (Alternatives 3 and 4) are a stronger catalyst.

The evaluation results are presented in **Table 2-4**.

**Table 2-4: Goal 3a Evaluation – Economic Development**

<b>Evaluation Measures</b>	<b>Alternative 1 BRT-Curb</b>	<b>Alternative 2 BRT-Median</b>	<b>Alternative 3 LRT</b>	<b>Alternative 4 Metrorail-BRT (Hybrid)</b>
Tendency to encourage additional development*	Medium-Low 0.50	Medium 0.60	High 0.80	Medium-High 0.70
Tendency to accelerate pace of development	Some potential to increase pace of development 0.50	Some potential to increase pace of development 0.70	More potential to increase pace of development 0.80	More Potential to increase pace of development 0.80
Per passenger O&M cost savings associated with increased population and employment growth	\$0.75 0.66	\$0.68 0.60	\$1.14 1.00	\$0.86 0.75
Jobs within 60 minutes (change over No Build)*	636 0.22	920 0.32	1,163 0.40	2,878 1.00
Potential to begin transit operations within 10 years**	High 0.8	High 0.8	Low 0.4	BRT portion is high; Metrorail is Very Low 0.5
<b>Average Score</b>	<b>0.56</b>	<b>0.62</b>	<b>0.60</b>	<b>0.72</b>

\*Measure given double weighting in the Average Score

\*\*Measure given triple weighting in the Average Score

### Qualitative Measures:

- **Tendency to encourage additional land development:** Transportation, and transit investment in particular, can serve as a strong catalyst for land redevelopment. Different transit mode alternatives are associated with different levels of “catalyst” effect on land development. Among the alternatives, Metrorail encourages the highest densities and pace of development, followed by LRT then BRT.

Dedicated guideway transit (transit operating in its own facility) and especially rail transit, has a greater catalytic effect on land development than non-rail, shared lane transit. This redevelopment provides additional value and an opportunity to develop a more complete local street network. An expanded local network has several benefits including increasing alternative routes, potentially reducing trip distances by providing more direct linkages, promoting conversion to bicycle and pedestrian trips, and the opportunity for local trips (trips less than 3 miles) to be completed solely on the local network without adding traffic to the main line corridor. Alternative 3 and 4, both involving dedicated guideway rail, would serve as a stronger catalyst for land redevelopment and local network expansion.

- **Tendency to accelerate pace of development:** As with the catalyst effect of transit investment on the quantity of development, studies have also suggested a correlation between transit investment and the speed with which private projects are conceived and carried out. Among the transit modes, Metrorail encourages the highest densities and pace of development, followed by LRT then BRT. In the qualitative rating for Alternative 4, the effect of Metrorail is averaged with the effect of BRT.
- **Potential to begin transit operations within 10 years:** More favorable ratings are associated with alternatives with smaller right-of-way impacts, less intensive construction requirements, and existing technologies. More intensive construction, such as Alternative 3 and 4 could require more detailed design, environmental documentation, and funding approaches, which would expand the planning, engineering, and construction timeframes.

This measure also speaks to the question of which organizations will implement the recommended project. To construct the investments and begin operations within 10 years, the project will need to rely on an experienced agency or jurisdiction for construction and operations, and the project will most likely need to rely on transit technologies already in use in the Washington, DC area. This consideration again favors Alternatives 1 and 2 which rely on bus technologies that are operated currently by Fairfax County, Prince William County, and WMATA.

#### Quantitative Measures:

- **Jobs within 60 minutes (change over No build):** total number of jobs accessible within 60 minutes of the project. This measure is a function of transit corridor travel time. As travel time savings increase, the more jobs are accessible within 60 minutes from trip origins along the Route 1 corridor.
- **Difference in O&M cost per rider associated with theoretical 50% ridership increase:** this quantitative measure is a proxy for the capacity of an alternative to carry additional passenger demand without adding significantly to O&M costs. The measure assumes that if population and

employment increase, transit ridership would also increase. For each of the alternatives, a 50% increase in ridership would be accompanied by savings in per passenger costs related to the ease of adding passenger capacity. Alternative 3 performs best because the LRT vehicles have adequate capacity to accommodate the additional ridership; for Alternatives 1, 2, and 4 additional BRT vehicles would be added during peak periods.

### Summary of Findings, 3B:

This area relates to the cost of implementing the alternatives. Alternatives 1 and 2 are less capital and operating cost intensive, while Alternative 4 is the most capital and operating cost intensive. Cost effectiveness follows the same general trend.

The evaluation results are presented in **Table 2-5**.

**Table 2-5: Goal 3b Evaluation -- Cost Effectiveness**

Evaluation Measures	Alternative 1 BRT-Curb	Alternative 2 BRT-Median	Alternative 3 LRT	Alternative 4 Metrorail-BRT (Hybrid)
Estimated Capital Cost (\$)*	\$832 M (\$10M Ft Belvoir Shuttle)	\$1.01 B (\$10M Ft Belvoir Shuttle)	\$1.56 B (\$10M Ft Belvoir Shuttle)	\$2.46 B (Metro \$1.46B; BRT \$1B; Ft Belvoir Shuttle \$10M)
	1.00	0.83	0.53	0.34
Estimated Annual O&M cost (\$)*	\$18 M (BRT: \$13M, Ft Belvoir Shuttle: \$5M)	\$17 M (BRT: \$12M, Ft Belvoir Shuttle: \$5M)	\$24 M (LRT: \$19M; Ft Belvoir Shuttle: \$5M)	\$31 M (Metro: \$17M; BRT: \$8M; Ft Belvoir Shuttle: \$5M)
	0.94	1.00	0.71	0.50
Cost per rider (\$) (Annualized capital + operating cost)/ Average of 2015 and 2035 ridership)	\$21	\$22	\$30	\$30 (Metrorail: \$26; BRT: \$32)
	1.00	0.95	0.70	0.70
<b>Average Score</b>	<b>0.98</b>	<b>0.93</b>	<b>0.65</b>	<b>0.54</b>

\*Measure given double weighting in the Average Score

### Quantitative Measures:

- **Estimated Capital Cost:** estimated project capital cost by alternative, including bicycle and pedestrian improvements, roadway, and transit improvements. Capital cost estimates at this stage in project development are very general. These estimates do, however, reflect an accurate order-of-magnitude comparison among transit alternatives.

- **Estimated Annual Operating and Maintenance (O&M) cost:** estimated yearly transit operations and maintenance cost by alternative. Unit operating costs are based on regional experience and peer systems. In general, costs are lower for Bus Rapid Transit and higher for Light Rail and Metrorail.
- **Cost per rider (\$):** Annualized capital cost of the project plus the annual operating and maintenance cost, divided by yearly estimated project ridership (average of 2015 and 2035 project boardings). This measure corresponds to the FTA evaluation criterion on cost effectiveness, where a “medium” rating is below \$10 per annualized project boarding. Note that for the full 15-mile corridor, none of the alternatives is very close to this threshold, so all fall far below the 1.0 scoring level.
- 

## 2.2.4 Goal 4 Evaluation and Summary

### **Goal 4: Support community health and minimize impacts on community resources**

**Objectives:** Minimize negative impacts to the natural environment

Contribute to improvements in regional air quality

Increase opportunities for bicycling and walking to improve community physical health

#### **Key Results:**

- Alternative 1 requires the least additional right-of-way impacts and therefore would affect relatively fewer community resources.
- Alternatives 3 and 4 have the greatest ability to convert auto trips to non-auto alternatives, leading to a greater reduction in Vehicle Miles Traveled (VMT) and diversion of trips from I-95 and I-395 to transit—both of which minimize air quality impacts.
- Alternatives 3 and 4 would lead to the greatest temporary construction impacts. Alternative 4 includes tunneling.
- Alternatives 3 and 4 would add the most to land value which, in turn, could be leveraged to help construct the local street network and fund other supporting services.

#### **Summary of Findings:**

This goal relates to both the ability of an alternative to increase transit mode share and decrease automobile use as well as the potential impacts on the environment to the proposed project. Alternative 1 has fewer potential environmental effects because it proposes less right-of-way expansion, while Alternatives 2, 3, and 4 would attract more riders and lead more people to use transit rather than drive.

Several of the measures are drawn from an “environmental scan” conducted for each alternative according to typical approaches for assessing project impacts. Additional detail is provided in the *Environmental Scan Report*.

The evaluation results are presented in **Table 2-6**.

**Table 2-6: Goal 4 Evaluation -- Support Community Health and Minimize Impacts on Community Resources**

Evaluation Measures	Alternative 1 BRT-Curb	Alternative 2 BRT-Median	Alternative 3 LRT	Alternative 4 Metrorail-BRT (Hybrid)
Change in Vehicle Miles Traveled*	(20,000) 0.44	(26,000) 0.58	(34,000) 0.76	(45,000) 1.00
Trips diverted from I-95/I-395	700 0.58	900 0.75	1,200 1.00	1,200 1.00
Temporary Construction Impacts	Least Intensive 0.40	Moderate 0.60	Intensive 0.20	Intensive 0.20
Ratio of environmental benefits to annualized project cost (FTA criterion)	2.0% 0.91	2.2% 1.00	1.9% 0.86	1.7% 0.77
Total additional right-of-way required*	20-30 1.00	30-40 0.73	35-35 0.67	30-40 0.73
Environmental Impacts: Parklands, Cultural Resources, Wetlands	Fewest Impacts 1.00	Some impacts 0.75	Moderate impacts 0.62	Some impacts 0.75
<b>Average Score</b>	<b>0.75</b>	<b>0.69</b>	<b>0.69</b>	<b>0.77</b>

\*Measure given double weighting in the Average Score

#### Quantitative Measures:

- Change in Vehicles Miles Traveled:** Represents the change in total vehicle miles traveled in the region, compared to the No Build Alternative. This measure correlates with travel time and the attractiveness of the transit mode. Because Alternative 4 has the fastest corridor travel time and integrates with the regional Metrorail system, more people would change their travel choices away from private automobile. Alternatives 1, 2, and 3 have a measureable effect on travel choice.
- Total right-of-way (ROW) required (acres):** measure of the area of additional ROW required for the Multimodal alternatives. Alternative 1 has the narrowest typical cross section and has the fewest potential ROW impacts. Alternatives with a dedicated median for transit operations (Alternatives 2, 3, and 4) have more potential ROW impacts. **Table 2-7** is a summary of the initial right-of-way impact assessment.

**Table 2-7: Summary of Potential Right-of-Way Impacts**

Category of Potential Impacts	Alternative 1 BRT-Curb	Alternative 2 BRT-Median	Alternative 3 LRT	Alternative 4 Metrorail-BRT (Hybrid)
Total Area (acres)	20-30	30-40	35-35	30-40
Number of Parcels	290-310	340-360	350-370	340-360
Number of Buildings	15-20	25-30	25-30	25-30

- **Ratio of environmental benefits to annualized project cost:** this measure considers four different elements of projects' projected environmental benefits - air quality, greenhouse gas emissions, energy savings, and safety – and presents those benefits as a ratio relative to annualized project cost. This is one of the six Project Justification Criteria that FTA uses to evaluate a project. All alternatives perform similarly, and each would receive a Medium rating, defined as 0% to 5% for this criterion.

#### Qualitative Measures:

- **Environmental impacts:** this measure combines several of the resource areas that would be documented in subsequent environmental analysis including parklands, wetlands, and architectural/archaeological resources. It takes an average of the total potential area and number of impacts for each of these resources, and then assigns a qualitative measure. Alternative 1 tends to have the fewest impacts, as it has the narrowest right-of-way, while Alternative 2, 3 and 4 with their wider cross-sections have greater impacts.
- **Temporary construction impacts:** this measure is a preliminary comparison of the degree of potential temporary construction impacts associated with each alternative. Alternative 1 performs best in this category because it requires the least amount of roadway widening and reconfiguration. Alternatives 3 and 4 are the most capital intensive, and would cause more temporary construction impacts; impacts could include lane closures and land reserved for temporary laydown and storage. The current Alternatives Analysis has not included detailed assessment of the staging or sequencing of construction activities.

## 2.3 Project Implementation Factors

This section of the report focuses on the Project Implementation Factors: critical indicators of successful and timely implementation, and financial feasibility of the project Alternatives.

The implementation factors were developed based on input received by public participants at the March 26, 2014, public meeting; County leadership and elected officials during the Executive Steering Committee meeting on March 20, 2014; and technical advisors during the Technical Advisory Committee Meeting on March 6, 2014. Supplemental analysis was undertaken during Summer 2014 to complete a



phasing and funding assessment that helped to differentiate the study alternatives and highlight the trade-offs surrounding implementation. The focus was on Alternatives 2 and 4, which performed best in the evaluation against the project goals and objectives.

The implementation factors are organized below as follows:

- **Development levels appropriate to the type of transportation investment**
  - Projected population and employment levels should support the intensity of land use typically associated with the mode.
  - County Comprehensive Plans should reflect the density required to support the mode.
  - A supporting street grid and other public infrastructure and services should be reflected in updated Comprehensive Plans.
- **Ability to secure funding for recommended improvements**
  - The recommended project should be potentially competitive for federal funding through FTA Capital Investment Program.
  - Project costs should not exceed the reasonable expectation for local funding

The evaluation and comparison of alternatives according to these factors are described in the subsequent sections.

### 2.3.1 Development Levels and Supporting Infrastructure

Population and employment levels in the corridor are increasing, and transportation services and infrastructure are necessary to accommodate growth. This assessment seeks to gauge the appropriate transportation investments given the projected levels of development.

#### Development Factor 1: Anticipated growth levels and appropriate transportation investment

##### Key Results:

- Alternatives 1 and 2 are most appropriate given the current and anticipated levels of population and employment growth.
- Major changes in the amount and concentration of population and employment growth would be necessary before Alternatives 3 and 4 are viable.

##### Summary of Findings:

Transportation investments are developed to respond to defined needs. The need for transit service relates to the levels of activity along the project corridor. In other words, a major transit investment must be supported by an appropriate level of population and employment density.

Transit investment can serve as a catalyst for growth in a project corridor, but unless there is a basic level of activity and land value already in place, decision makers run the risk that transit investments are too far ahead of activity levels and service is not utilized to an extent that—in the context of other pressing needs—justifies the expense of the project.



The DRPT Multimodal Design Guidelines describe population and employment density thresholds typically associated with levels of transit service investment. Taking into account the MWCOG projections for population and employment in 2035, and in consideration of the adopted Fairfax County and Prince William County Comprehensive Plans, Alternatives 1 and 2 are the most appropriate near-term transit investments given the projected growth and anticipated development levels. To support Alternatives 3 or 4, there would need to be a different expectation for the level of population and employment growth, and a revision to the Comprehensive Plans to accommodate the higher growth levels.

## **Development Factor 2: County Comprehensive Plans should reflect activity levels and station locations**

### **Key Results:**

- At the northern end of the corridor, the current Fairfax County Comprehensive Plan allows for growth levels to support BRT (Alternatives 1 and 2) or LRT (Alternative 3). Current County Comprehensive Plans for areas south of Fort Belvoir do not generally support a premium transit investment.
- Changes in the planned amount and concentration of development would be necessary before Alternatives 3 and 4 are viable.

### **Summary of Findings**

In consideration of the adopted Fairfax County and Prince William County Comprehensive Plans, Alternatives 1 and 2 are the most appropriate near-term transit investments given the projected growth and anticipated development levels. To support Alternative 3 or the Metrorail extension as part of Alternative 4, there would need to be a different expectation for the level of population and employment growth, and significant revisions to the Comprehensive Plans to accommodate the higher growth levels.

The Fairfax County and Prince William County Comprehensive Plans articulate a development vision for the corridor and specify the density levels and FAR planned for this corridor. This study has developed a comparison of the Comprehensive Plan development levels against the DRPT Multimodal Design Guidelines thresholds for activity levels typically associated with transit investment types. BRT alternatives (Alternatives 1 and 2) are generally supported by the Comprehensive Plan activity density levels, while rail alternatives (Alternatives 3 and 4) are not currently supported by the Plans.

With regard to transit station areas, the Fairfax County Comprehensive Plan establishes Community Business Centers along the corridor between Fort Belvoir and Huntington. Transit stations for each of the alternatives have been located according to these clusters of higher-intensity development. Future updates to the Comprehensive Plans would reinforce proposed transit station areas by focusing planned development and investment in these areas.

### Development Factor 3: A supporting street grid and other public infrastructure and services

#### Key Results:

- Traffic analysis shows that with growth levels that support BRT/LRT, an enhanced local street grid would be required, including continuous street capacity parallel to Route 1—the equivalent of one new two-lane street.
- With growth levels that support Metrorail, more robust local street grid enhancements would be required, including continuous street capacity parallel to Route 1—the equivalent of up to six new two-lane streets.
- To accommodate growth, Route 1 transportation investment must be complemented by other major features including roads, schools, public safety, and parks. Metrorail supportive growth levels require significantly more infrastructure investment than BRT or LRT levels.

#### Summary of Findings:

A supporting street grid and other public infrastructure and services would need to be in place to support the alternatives and should be reflected in updated Comprehensive Plans. Even though these investments fall outside the formal scope of the Route 1 Multimodal Alternatives Analysis, they are important as the Counties plan for the future development and redevelopment of the Route 1 corridor.

## 2.3.2 Project Funding

### Funding Factor 1: Ability to secure Federal Transit Administration grant funding for recommended transit projects

#### Key Results:

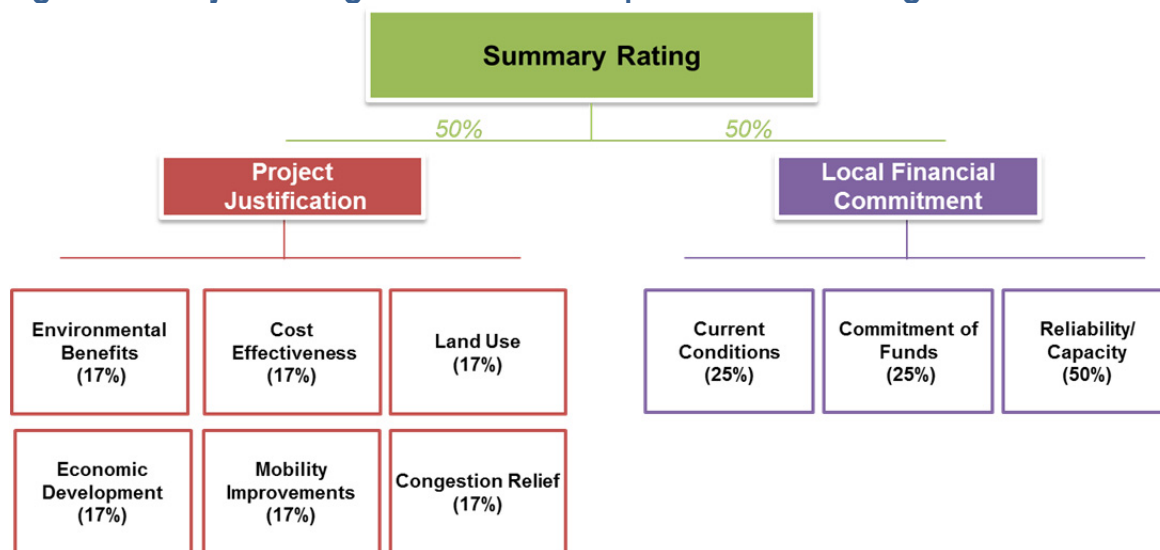
- None of the Alternatives—as a full 15-mile multimodal project—is competitive for a grant through the FTA Capital Investment Program.
- The northern segments of Alternatives 1 and 2, between Fort Belvoir and Huntington, could be competitive for a grant through the FTA Capital Investment Program.
- Alternatives 3 and 4 are more capital-intensive, and would likely not be competitive for FTA grants.
- With significant population and employment growth, and strong growth in transit ridership, a Metrorail extension (Alternative 4) could be competitive for an FTA grant in the long term.

#### Summary of Findings:

Given constrained local, regional, and state budgets, the transit elements of the recommended multimodal project should be potentially competitive for federal funding through FTA Capital Investment Program, which has typically funded eligible transit projects at 50 percent of project capital costs.

Federal funding competitiveness for the FTA Transit Capital Investment Program is based on Project Justification Criteria and Local Financial Commitment (see **Figure 2-1**). For each criterion FTA assigns a rating from Low to High; a project must receive at least a Medium rating on both project justification (average of six criteria) and local financial commitment to obtain a Medium or better rating overall.

**Figure 2-1: Project Rating Factors for FTA Capital Investment Program**



#### *Project Justification Criteria*

Regarding Project Justification, several criteria would be consistent across alternatives; differentiators relate to Mobility Benefits (ridership) and Cost Effectiveness (cost per rider). None of the alternatives performs well for Cost Effectiveness, but the BRT alternatives, Alternatives 1 and 2, come closest to reaching a Medium rating. Section 9 below provides more detail related to potential performance of the alternatives related to the Project Justification Criteria.

#### *Local Funding Commitment*

Over the past ten years, federal funding grants have become increasingly competitive, as more projects apply for the program while the amount of available funding remains generally consistent. Recently updated guidance from the Federal Transit Administration indicates that projects with higher levels of local funding are more competitive and more likely to receive a federal grant.

Programming for locally funded transportation projects in Fairfax County and Prince William County shows commitments to major projects through 2020. After 2020 there are opportunities to commit local funds to a new significant project.

## **Funding Factor 2: Project costs should not exceed the reasonable expectation for local funding**

### **Key Results:**

- Without a strong commitment of funds from Fairfax County and Prince William County, the project will not only be less competitive for federal funding, it will not be feasible. The local funding commitment is an indicator of the likelihood that the project will be implemented in a reasonable time frame.
- Alternatives 1 and 2 are the least capital intensive projects and therefore are more easily funded through existing funding sources.
- Alternatives 3 and 4 are more capital intensive, and would exceed the capacity of current programs and funding sources.

### **Summary of Findings:**

The project team developed funding assumptions for each of the Alternatives, and these were presented and discussed with senior County staff. First, these discussions confirmed the assumption that a mix of local, regional, state, and federal funds will be required to implement any of the Alternatives. Second, the project is constrained by the fact that local and regional transportation funding has been programmed and committed to other projects for the next six years (through 2020). Section 9 below provides more detail related to the project funding assumptions.

Beyond 2020, transportation and capital improvement programs will allow for addition of new projects, but there are other committed projects that will limit the amount of funding that may be available for Route 1. Therefore Alternatives 3 and 4, with their high overall capital and O&M costs, would be difficult to implement in the near term. Alternatives 1 and 2 are more likely to be funded in the near term.