WMATA
CONNECTGREATERWASHINGTON

TRANSIT CORRIDOR EXPANSION GUIDELINES

FINAL REPORT

February 2015

Washington Metropolitan Area Transit Authority

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1. Introduction

This report summarizes the development of proposed transit corridor expansion guidelines for evaluating candidate high-capacity transit corridors in the service area of the Washington Metropolitan Area Transit Authority (WMATA or "Metro"). The proposed guidelines were developed based on a review of the planning literature, including standards used in other regions and tailored to address the specific characteristics of the transit system in the Washington metropolitan area.

1.1. Study Purpose

The purpose of the current study is to review and, where appropriate, refine the initial corridor evaluation criteria used by Metro in prior planning processes based on more in-depth research. The proposed guidelines resulting from the study are intended to:

- Provide criteria that regional partners and Metro's Board of Directors can use to screen, select, and recommend new regional high-capacity transit proposals and support those previously identified in *Connect Greater Washington (CGW)*;
- Assist transit planning efforts and coordination among local jurisdictions; and
- Support goals and directives of MWCOG regional plans as well as Metro's plans and policies.

1.2. Background – *ConnectGreaterWashington* Planning Process

Article VI of WMATA's compact agreement states that Metro is responsible for planning to address long-range transit needs throughout its service area in coordination with local member jurisdictions and their comprehensive plans. Currently, Metro is preparing *ConnectGreaterWashington*: the Region's Transit System Plan (*CGW*), which identifies the future high-capacity transit service network that will be needed to support continued growth in population, employment, and economic activity across the Washington, DC metropolitan area through 2040. *CGW* pairs new high-capacity transit corridors of regional significance with critical Metrorail core capacity improvements.

1.2.1. Identification of New High-Capacity Transit Corridors

The recommended plan identifies approximately 25 regionally significant high-capacity, high-frequency surface transit corridors in addition to those in the regional Constrained Long-Range Plan (CLRP) and the Metrobus Priority Corridor Network (PCN) in Metro's *Momentum* strategic plan. During the *CGW* planning process, 70 initial candidate corridors were identified from:

- The regional CLRP;
- Metro's PCN;
- Long-range plans developed by local jurisdictions;
- Potential extensions from end-of-line Metrorail stations; and
- New regional connections identified by planners at Metro that were not included in the above.

These corridors were modeled and tested as part of packages of transit strategies in the *CGW* process. The CLRP and PCN corridors were evaluated as "Tier 1" for the planned 2040 network, part of the base transit network assumed to be in place by then. The additional corridors that performed well in the

scenario modeling were further evaluated based on 2040 land use, ridership, and service to Regional Activity Centers (RACs) designated by the Metropolitan Washington Council of Governments (MWCOG).

1.2.2. Initial *CGW* Corridor Evaluation Criteria

The specific evaluation criteria, rating process, and prioritization for inclusion in the *CGW* plan for 2040 were as follows:

- *2040 Land Use Suitability* – household and employment density along corridors (or Metrorail station areas), based on MWCOG Round 8.1 Cooperative Land Use Forecast Aspirations Scenario;
- *2040 Forecast Ridership* – boardings per corridor mile using previous *CGW* model runs; and
- *Service to RACs* – number connected per corridor mile.

A combination of national data, local data, and national standards were used as sources for establishing the rating thresholds for each transit mode. Rather than solely using a strict application of thresholds from the technical literature, regional project examples and characteristics of the existing Metrorail system were also used to guide the development of thresholds. The *CGW* criteria also used available ridership modeling outputs from the planning process, so criteria were based on land use assumptions and future forecast years that were consistent with the modeling. Candidate projects were tested using standards for various high-capacity transit modes (Metrorail, light rail, bus rapid transit, streetcar, and limited-stop bus); in addition, a proposed extension of an existing commuter rail corridor was evaluated using rating criteria specific to that mode.

1.2.3. Prioritization of Corridors for Inclusion in the *CGW* 2040 Recommended Network

The prioritization process grouped projects (corridor and transit mode type assumed in the modeling) in three tiers:

- *Tier 1* – Projects already planned in the CLRP and Momentum (WMATA's Metro 2025 projects);
- *Tier 2* – High performing, regionally significant travel corridors; and
- *Tier 3* – Potential high-capacity transit corridors evaluated in the *CGW* process.

All three criteria were weighted equally in rating overall suitability. The final *CGW* recommended network designates the Tier 2 corridors as high-capacity surface transit corridors, but does not specify modes, except for the commuter rail extension from Manassas to Haymarket due to its existing rail right-of-way. New Metrorail lines in the core were developed and assessed using a separate process due to the specific operational considerations of connecting to the existing Metrorail network and primary purpose of relieving core capacity constraints and crowding.

See **Appendix A** for a detailed description of the *CGW* corridor prioritization process, including the rating criteria and thresholds by mode.

1.3. Study Process

The proposed guidelines developed as part of this study were informed by:

- *State of the Practice Review* – reviewed relevant plans, policies, and studies from across the country to identify criteria used to evaluate the feasibility or performance of planned and existing high-capacity transit corridors;
- *Regional Transit System Benchmarks* – selected key criteria identified in the State of the Practice Review (density, ridership, and built environment characteristics) and applied them to existing transit corridors in the Washington, DC metropolitan area; and
- *Guidelines Development* – developed minimum thresholds for new or expanded high-capacity transit lines and identified local planning activities needed to support corridor development and comply with relevant federal guidelines.

1.4. Modes Considered

1.4.1. High-Capacity Transit Modes

High-capacity transit is defined as modes with:

- High passenger throughput capacity, either accommodated by large vehicles (rail vehicles or articulated buses) or frequent service (6-minute maximum headways); and
- Exclusive guideway or shared right-of-way with infrastructure that gives priority to transit vehicles to provide faster travel times and greater service reliability.

The following high-capacity transit modes were considered:

Heavy Rail (Metrorail)

This mode uses multi-car trains on fixed rails operating in separate rights-of-way from which all other vehicular and foot traffic are excluded, with high speed and rapid acceleration, sophisticated signaling, and high platform boarding. The analysis of new or extended Metrorail lines treats the service as two different types:

- *Suburban Metrorail* – has average station spacing greater than one mile and is located outside of the urban core (central DC and adjacent areas of Arlington) typically with above ground track and stations.
- *Urban Metrorail* – has station spacing of less than one mile and is located in dense urban areas of the region's central jurisdictions (central DC and adjacent areas of Arlington) typically with underground track and stations.

Light Rail Transit (LRT)

This mode uses single or multiple-car vehicles operating on fixed rails, largely in an exclusive right-of-way (although it can operate in mixed traffic), powered by an overhead electric line via pantograph. LRT typically has average stop spacing of ½ mile or greater.

Bus Rapid Transit (BRT)

This mode comprises bus service with a mix of features to increase travel speeds, including traffic signal priority, exclusive lanes along a significant portion of its route, off-board fare collection, floor-level platforms at stops, and increased stop spacing (½ mile or greater) compared to local bus service.

Modern Streetcar

Mode uses single or multiple-car vehicles operating on fixed rails, largely in mixed traffic (although can operate in exclusive right of way), powered by an overhead electric line via pantograph. Modern streetcar typically provides local service with shorter stop spacing (½ mile or less) compared to light rail.

Commuter Rail

Rail service connects outlying suburban areas to the city center, sharing track or right-of-way with intercity or freight trains. Stops are typically widely spaced (two to ten miles) and average passenger trip lengths are over twenty miles. Commuter rail service typically serves peak-period, peak-direction travel.

Limited-Stop Bus

Mode has fewer stops than regular local bus service to increase average speeds. Bus stops and vehicles may have higher levels of amenities than local services and special branding.

1.4.2. Modes Not Considered

Local Bus

Local bus service, that may have high-frequency service but lacks right-of-way with transit priority treatments, is distinguished from enhanced bus service, which has high-frequency service and right-of-way with transit priority treatments. These treatments include items such as signal priority and queue jump lanes for transit vehicles, which require a significant capital investment to implement along entire corridor segments. Enhanced bus services may include other types of enhancements (e.g., limited-stop service, special branding, higher levels of stop amenities) above local bus service. Upgrades to local bus service (short of implementing new enhanced bus service with transit priority treatments) are typically operational improvements related to service planning and are not considered in this study.

Commuter Bus

Commuter bus is not considered in the guidelines, because this type of service tends to run on regular shared highway lanes or existing HOV lanes without additional priority treatments for transit and the services require little in the way of capital investments beyond additional vehicles.

1.5. Regional Plans and Policies for New High-Capacity Transit

Table 1-1 lists the region's adopted plans and policies for transit services and, more broadly, land use and transportation in the Washington, DC metropolitan area. Generally, the goals in these plans and policies support:

- Improving the performance of transit services;
- Increasing ridership;
- Improving transit station access by facilitating walking and bicycling;
- Concentrating development near transit;

- Connecting the clusters of housing and employment designated as RACs by MWCOG; and
- Clearly defining capital and operating funding responsibilities for new corridors.

The principal regional plans and policies relevant to the transit corridor expansion guidelines are described below.

Table 1-1: Relevant Plans and Policies Related to New High-Capacity Transit

Plan/Year	Agency	Relevant Provisions for High-Capacity Transit
Region Forward (2010)	Greater Washington 2050 Coalition and MWCOG	• Linking Regional Activity Centers • Increasing the share of walk, bike, and transit trips • Prioritizing management, performance, and safety of all transportation modes and facilities
Regional Transportation Priorities Plan for the National Capital Region (2013)	National Capital Region Transportation Planning Board	• Concentrating growth in Regional Activity Centers • Providing transportation options of transit, walking, and bicycling
Momentum (2013)	Washington Metropolitan Area Transit Authority	• Increasing mode shares for bicycle and pedestrian access to transit • Maximizing safe, barrier-free, direct access to stops/stations for all users and modes • Linking riders to jobs
ConnectGreaterWashington (internal review draft, October 2014)	Washington Metropolitan Area Transit Authority	• Facilitating transit-oriented, mixed-use communities that capture employment and household growth • Providing transit choices in RACs and mixed-use corridors • Improved mobility throughout the region, measured by the number of households and jobs near transit and transit ridership • Improved pedestrian and bicycle facilities • Ensuring that street and development patterns near stations are pedestrian-friendly

In addition to regional plans, Metro's 2000 Board Resolution #2000-35: Policy for Capital and Operating Costs for New Starts Projects is relevant for future Metrorail extensions. The policy states that capital costs for rail extensions will be funded by the local jurisdictions in which they are located, and that the operating deficits will be allocated among all WMATA Compact member jurisdictions according to the operating subsidy formula. Thus, the local communities sponsoring the project construction have an interest in ensuring that the project is supported by their development plans, and all local member jurisdictions have an interest in ensuring that new Metrorail projects attract sufficient ridership to justify their costs.

1.6. Criteria Selected for the Guidelines

Density (Residential and Employment)

Density serves as a basic measure of transit corridor suitability and is used by almost all guidelines. Density correlates with potential ridership and number of destinations served by a corridor. Both residential and employment density are used as separate measures and used together to accommodate the varied land uses in the Washington region's locations of potential new high-capacity transit corridors. Future corridors may be located in heavily residential areas with relatively low commercial uses, employment centers with relatively low residential uses, and mixed-use centers and corridors that have intermediate concentrations of both uses.

Density serves as an approximation of the clusters of housing and employment designated as RACs by MWCOG. The *CGW* assessment of candidate high-capacity corridors using RACs per mile as one of the three criteria did not serve as a significant differentiator of potential transit corridors, so the currently proposed criteria do not use service to RACs as a separate criterion from density.

Ridership

Forecast ridership reflects the effects of a corridor within the broader transportation network (connecting lines, feeder services, trip distribution and availability of alternate modes) on transit utilization as well as the basic trip generation effect of land use density.

Ridership is often a component of cost effectiveness measures. As the corridor assessment guidelines presented in this memorandum would typically be applied at early conceptual planning stages for a proposed transit corridor, capital and operating cost estimates may not be available to use as part of a cost effectiveness criterion. Thus, ridership alone, rather than combined with a cost criterion is used as one of the proposed criteria to broadly assess corridor suitability.

Built Environment

The built environment (street connectivity and block lengths) is a measure of walkability, which is critical for transit station access. The built environment criterion serves to verify if the corridor density really does promote transit use, because relatively high densities may have poorly connected street and pedestrian networks that inhibit transit station and stop access. Street connectivity is also generally correlated with bicycle suitability for station access.

1.7. Organization of the Report

The report is organized as follows:

- **Section 2** reviews the planning literature and other metropolitan areas for criteria used to assess the suitability of high-capacity transit corridors;
- **Section 3** summarizes the characteristics of existing high-capacity transit corridors in the Washington region relative to the suitability criteria;
- **Section 4** outlines proposed criteria for evaluating new high-capacity transit corridors in the region, addressing the Washington DC region's system characteristics and policy goals; and
- **Section 5** examines potential additional policy criteria for consideration to supplement the corridor expansion guidelines and discusses next steps in further development of the guidelines.

2. State of the Practice Review

This section describes the standards found in the literature for transit corridor density, ridership, and built environment characteristics.

2.1. Documents Reviewed

22 planning studies and guidelines for high-capacity transit corridors were reviewed and analyzed. These documents included some with a national scope, as well as those specific to a metropolitan region or transit system.

2.1.1. Initial Review of Documents

The 22 documents fell into the following general categories:

System Expansion Policies or Criteria

These documents establish policies or performance criteria for rating proposed new high-capacity transit lines or extensions to existing systems. This category of documents is the most similar to the desired products of the current study. Examples include:

- *Bay Area Rapid Transit* (*BART) System Expansion Policy* (2002);
- *Metropolitan Transportation Commission (MTC) Resolution 3434 Transit-Oriented Development Policy* (2004); and
- *Federal Transit Administration* (*FTA) New and Small Starts Evaluation and Rating Process Final Policy Guidance* (2013).

Transit-Oriented Development (TOD) Plans and Guidelines

These documents establish guidelines for station area development and infrastructure along existing or planned transit lines. Although useful in illustrating desired characteristics for existing transit lines and stations, the TOD plans and guidelines do not provide criteria for considering the suitability of a proposed transit corridor. However, these documents can serve as useful references in evaluating neighborhood plans and policies along potential transit corridors. Examples include:

- *Florida TOD Guidebook* (2012); and
- *Atlanta Regional Commission Transit Oriented Development Implementation Strategy Assistance* (2013).

Regional System Plans

These documents evaluate potential corridors for new or expanded high-capacity transit lines within a metropolitan area or transit system service area. However, the criteria and scoring systems typically use relative rankings for prioritization of corridors rather than set minimum criteria for consideration of corridors. Examples include:

- *DC's Transit Future* (2009); and
- *Portland Metro Regional High Transit System Plan* (2009).

Service Guidelines

These documents establish guidelines for minimum transit service standards or define methodologies to assess transit service. The guidelines generally address operational characteristics or facilities, such as frequency, span of service, travel times, station/stop amenities and access, or service coverage area, typically for an already-defined network. These guidelines may report existing or planned characteristics of the corridors such as land use density or ridership, compared to areas outside of the corridors; however, evaluating potential network extensions is generally not treated. Examples include:

- *Transit Capacity and Quality of Service Manual* (Third Edition, 2013); and
- Vancouver, BC *TransLink Transit Service Guidelines* (2004).

2.1.2. Documents Selected for More Detail Review

The following documents in **Table 2-1** were selected for more detailed review, comprising a mixture of different types of documents with the most relevant criteria for the current study:

Table 2-1: Documents Selected for Detailed Review

Document	Publication Year	Description
New and Small Starts Evaluation and Rating Process Final Policy Guidance, Federal Transit Administration	2013	Describes the evaluating criteria used for prioritizing federal funding for new large- and small-scale transit projects built in the United States.
Guerra and Cervero Research[1]	2010-2011	Erick Guerra and Robert Cervero of the University of California, Berkeley, published several studies on the relationship between corridor density and cost-effectiveness for fixed-guideway systems in the United States.
BART System Expansion Policy	2002	Provides a framework for evaluating proposed candidate corridors and station locations for system expansion. Many of the policy's evaluation criteria were based on the FTA New Starts evaluation criteria in place at the time the policy was developed, although FTA has since released several revised versions of New Starts criteria.
MTC Resolution 3434 Transit-Oriented Development Policy	2004 and 2007 Evaluation	Provides minimum density and land use planning criteria for proposed transit projects within the region to be considered in regional transportation plans. It also provides a framework for developing walkable, mixed-use neighborhoods around new stations.
Florida TOD Guidebook, Florida Department of Transportation	2012	Provides a framework for promoting and enhancing TOD, classifying station area environments into one of three typologies and establishing specific thresholds and measures for each depending upon the transit mode.
Multimodal System Design Guidelines, Virginia Department of Rail and Public Transportation	2013	Establish a framework for multimodal planning throughout Virginia, illustrating both TOD concepts and complete streets concepts. The planning process outlined is based on Congress for New Urbanism land use and design typologies.

[1]Includes "Transit and the 'D' Word" (2011), "Mass Transit and Mass: Densities Needed to Make Transit Investments Pay Off" (2011), and "Cost of a Ride: The Effects of Densities on Fixed Guideway Transit Ridership and Cost" (2010).

Density, ridership, built environment, and planning criteria from the six documents are summarized in the following sections.

2.2. Density Criteria

Each of the documents reviewed provided guidelines for population, employment, or combined densities recommended for sustaining high-capacity transit. Some documents had criteria for future planned densities as well as existing densities. **Table 2-2, Table 2-3,** and **Table 2-4** summarize the most relevant density measures, using a standardized measure of density within a ½ mile station area radius or corridor buffer. **Appendix B** lists the detailed density criteria of the documents described below.

FTA New and Small Starts Evaluation Guidance

FTA uses existing persons per square mile and employees per square mile within ½ mile of the entire transit corridor to rate corridors from Low to high, without being specific to mode.

Guerra and Cervero Research

The authors' "Transit and the D Word" paper identifies the average minimum ½ mile station area population density for heavy rail and LRT transit facilities to be cost effective. The minimum densities are given for a range of per-mile capital costs.

BART System Expansion Policy

BART's policy uses density ratings similar to FTA's 1999 New Starts guidance, based on residential units and employees per acre within ½ mile of transit stations to rate corridors from Low to High, without being specific to mode.

Bay Area MTC Resolution 3434, TOD Policy

MTC provides minimum residential densities for each mode, given as minimum total number of residential units (existing or planned) within the ½ mile station area. New affordable housing units are given a 50 percent density bonus. For planned residential units to be considered, corridor planning efforts must meet minimum criteria. MTC also provides higher future "target" residential and employment densities for transit corridor TOD plans.

Florida TOD Guidebook

The Guidebook classifies transit station areas into different types, identifies the modes that can be supported in each, and specifies the recommended density range by mode, including residential unit and employment density within the ½ mile station area. Minimum and maximum ratios of jobs per housing unit are recommended to encourage a mixture of uses.

DRPT Multimodal System Design Guidelines

DRPT identifies seven types of multimodal centers based on the intensity of residents and jobs, corresponding to the Congress for New Urbanism's "place" framework (P-1, P-2, etc.). For each multimodal center type, the guidelines recommend activity density (population plus employment), floor area ratio, and types of transit technology that can be supported.

Table 2-2: Residential Density – Households per Acre within ½ mile of Station

Mode	New and Small Starts Evaluation[1]		BART System Expansion Policy		Guerra and Cervero Research[2]		Florida TOD Guidebook		Bay Area MTC Resolution 3434	
	Min.	High	Min.	High	Min.	High	Min.	High	Min.	High
High Capacity Transit (Non-Specific Mode)	3	9	10	25	-		-		-	
Heavy Rail	-		-		19	-	12	55	8	-
LRT/Streetcar	-		-		25	-	9	35	7	-
BRT	-		-		-		7	20	5	-
Commuter Rail	-		-		-		9	35	4	-

[1]Density measured within ½ mile of entire corridor. Adapted from Persons per Square Mile using U.S Census 2013 ACS 3-Year Estimates for Average Household Size (2.64).

[2]Adapted from population density using U.S Census 2013 ACS 3-Year Estimates for Average Household Size (2.64). Guerra & Cervero provide minimum densities to support different project capital costs per mile; for heavy rail and light rail, the ConnectGreaterWashington (2013) conceptual capital costs per mile were used as the basis for these numbers.

Table 2-3: Employment Density – Jobs per Acre with ½ mile of Station

Mode	BART System Expansion Policy		Florida TOD Guidebook	
	Min.	High	Min.	High
High Capacity Transit (Non-Specific Mode)	21	100	-	
Heavy Rail	-		20	90
LRT/Streetcar	-		15	65
BRT	-		10	45
Commuter Rail	-		15	65

Table 2-4: Activity Density – Population + Jobs per Acre with ½ mile of Station

Mode	Guerra and Cervero Research				DRPT Multimodal System Design[2]	
	"Average Bare Minimum" Density[1]		Densities of "High Scoring Projects"[1]			
	Min.	High	Min.	High	Min.	High
Heavy Rail	27	-	76	-	70	-
LRT/Streetcar	14	-	116	-	33.75	70
BRT	-	-	17	-	33.75	70

[1]Residents and Employees per Gross Acre within ½ mile Station Area using Capital Cost Estimates from ConnectGreaterWashington Appendix I (based on Dulles Metrorail Extension, Purple Line Light Rail, and Crystal City/Potomac Yard BRT)

[2]Residents and Employees per Gross Acre within a Multimodal Center. Multimodal Center is defined as a small area of multimodal connectivity and intense activity, measured as a 1 mile radius. The DRPT guidelines classifies 6 multimodal centers, ranging from most intense (urban core) to least intense (rural or village center).

2.3. Ridership Criteria

Two of the documents reviewed in detail provide ridership criteria. These two documents and the Guerra and Cervero research also provide guidelines for cost effectiveness based on cost per rider; however, cost effectiveness criteria are not proposed for the current study's recommended guidelines. **Table 2-5** summarizes the ridership thresholds for Medium to high ratings. **Appendix B** lists the detailed cost effectiveness criteria of the documents reviewed.

Table 2-5: Ridership Criteria

Document	New and Small Starts Evaluation	BART System Expansion Policy		
Criteria by Overall Suitability	Mobility Improvements	Existing Estimated Ridership based on Land Use Densities		Horizon Year Forecast Ridership based on Ridership Development Plan
	Estimated Annual Trips[1]	Daily Residential Trips[2] (Average per New Station)	Daily Employment Trips[3] (Average per New Station)	Daily Ridership[4] (Average per New Station)
High	30 Million or more	Greater than 9,000	Greater than 10,000	Greater than 20,000
Medium-High	15 Million – 29.9 Million	5,401 - 9,000	5,001 - 10,000	14,000 - 20,000
Medium	5 Million – 14.9 Million	3,601 - 5,400	2,001 - 5,000	10,000 - 13,999

[1]Number of trips by non-transit-dependent persons plus trips by transit-dependent persons would be multiplied by 2.
[2]Trip generation based on existing number of households within ½ mile station area, 1.2 workers per household and 30% mode share.
[3]Trip generation based on existing commercial development within ½ mile station area, assumes 3 employees per 1,000 square feet of commercial space and 10% mode share.
[4]Corridor-wide station average for daily trips to and from (entries and exits) new stations with planned TOD and access improvements.

FTA New and Small Starts Evaluation Guidance

FTA provides annual project-wide ridership thresholds. Forecast trips by transit-dependent riders are given a 100 percent bonus. The criteria evaluate the transit project's forecast linked trips, but do not assess net new transit system ridership.

BART System Expansion Policy

BART provides daily ridership thresholds based on 1999 FTA New Starts guidance, which used existing station area land use and assumed trip generation factors to generate ridership estimates. If corridor-wide estimated ridership does not meet the minimum threshold, then a Ridership Development Plan with planned TOD and station access improvements must be prepared, adopted and implemented by the local jurisdictions. The required elements in the RDP are described in **Section 2.5 Planning Criteria**.

2.4. Built Environment Criteria

Although some of the documents reviewed provided general qualitative recommendations for shorter block lengths or cross section dimensions for complete streets, there were no quantitative measures for overall station area built environment used in the planning literature or by transit. As a result, two measures used in the Washington, DC region were selected:

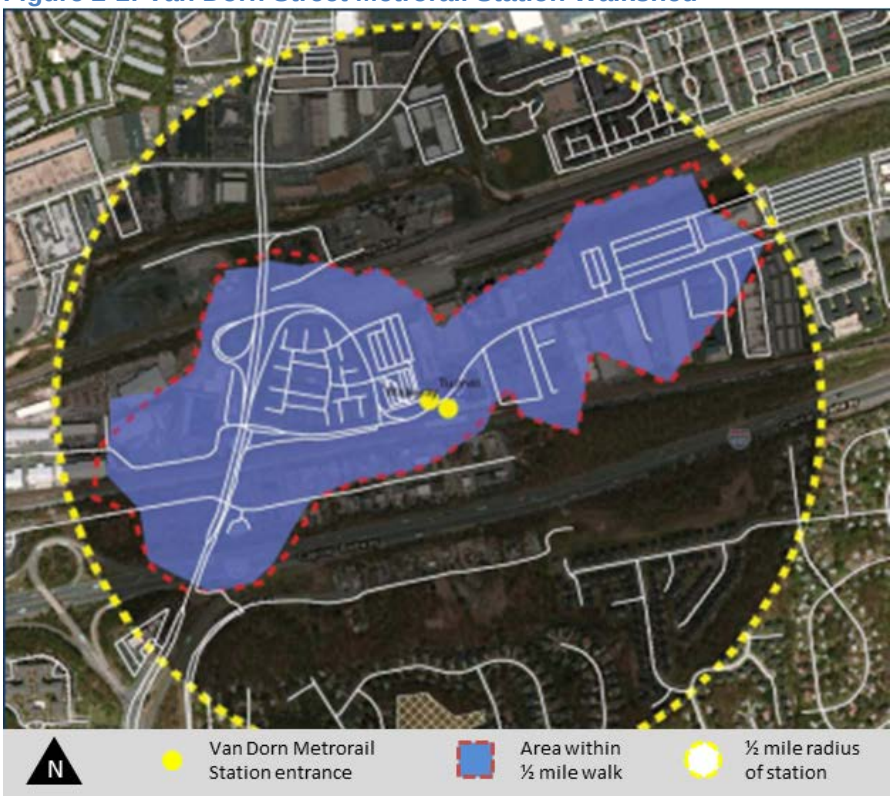
Pedestrian Environmental Factor

The Pedestrian Environment Factor (PEF) was developed by WMATA as part of the *CGW* model to improve mode choice modeling in the TPB Version 2.3 Travel Model for transit stations. PEF measures the number of census blocks within a transportation analysis zone (TAZ) divided by the area of the TAZ in square miles. TAZs with a dense street grid have a higher PEF score than suburban areas with relatively few intersecting streets.

WMATA Walkshed Rating

The walkshed rating was developed by WMATA to evaluate the walkability of Metrorail stations. It calculates the percentage of the developable area within the ½ mile station radius that is within a ½ mile walking distance based on the street and pathway network and the station entrances. WMATA uses 63.7 percent, which is the maximum area within a circular radius that a rectilinear street grid can cover, to designate a high-performing walkshed. 47 of the existing stations in the system are under 63.7 percent, while 39 stations are above this level. **Figure 2-1** provides an example for how these areas are calculated at the Van Dorn Street Metrorail station, which is at 26.6 percent. These data are currently only available for existing Metrorail stations, but can be developed for any location using ESRI's Network Analyst tool.

Figure 2-1: Van Dorn Street Metrorail Station Walkshed



2.5. Planning Criteria

Five of the six documents reviewed in detail provide qualitative guidelines for recommended corridor or station area plans and policies (such as zoning or parking requirements). Some of the documents specify required elements and status regarding adoption and implementation. The criteria are not specific to transit modes. **Table 2-6** summarizes the recommended plans and policies. **Appendix B** lists the detailed planning criteria of the documents described below.

Table 2-6: Plans and Policies Criteria

Criteria	New and Small Starts Evaluation	Bay Area MTC Resolution 3434	BART System Expansion Policy	Florida TOD Guidebook
Plans	• Policies for transit-supportive development patterns • Adoption of station area/ corridor plan prior to grant agreement • Revisions to comprehensive plans in progress prior to grant agreement	• Adoption of planned corridor land uses through general plans • Identification of current and planned land uses, barriers to station access, and implementation plans for station area plans	• Policies to increase corridor and station area development • Policies to enhance transit-supportive character • Conformity to inter-jurisdictional consensus on land use	• Model language for local governments to include in comprehensive plans to support TOD • TOD measures include increased density, mixed land uses, and pedestrian and transit-friendly design elements
Zoning	• Zoning changes underway, and preferably adopted, prior to grant agreement	• Adoption of planned land uses through zoning codes • Identification of zoning policies and standards that promote mixed uses and pedestrian-scale development in station area plans	• Increases development density in station areas • Encourages mixed-use development, parking reduction, and traffic mitigation	• Model zoning regulations for local governments to implement form-based zoning code provisions and transit-supportive design standards
Other Policies	• Financial and regulatory incentives • Capital improvements • Adoption of policies, and preferably implementation, prior to grant agreement	• Creation of a Corridor Working Group to assess projects and assist in identifying improvement strategies	• Community outreach in support of land use planning • Regulatory and financial incentives to promote transit-supportive development	• Agencies responsible for TOD implementation • Potential funding sources for transit and TOD

FTA New and Small Starts Evaluation Guidance

FTA conducts extensive reviews of local transit-supportive plans and policies as part of the New Starts/Small Starts process. Criteria specify what plans, zoning changes and policies need to be adopted or efforts that should be underway both at the time of the initial application for New Starts/Small Starts funding (prior to preliminary engineering) and prior to the Full Funding Grant Agreement for construction.

Bay Area MTC Resolution

If a proposed high-capacity transit corridor does not meet the MTC density threshold based on its existing land use, then the establishment of a Corridor Working Group is required to evaluate the corridor and initiate station area planning. The resulting Station Area Plan outlines TOD and policies that will achieve the corridor density threshold. Adoption of the plan and its implementation (revision of general plans, zoning, financing, MOUs) are required prior to final design and construction, respectively. MTC specifies required minimum elements in the plan and provides a more extensive recommended checklist for plan content.

BART System Expansion Policy

Planning criteria are based on FTA's 1999 New Starts guidance and Ridership Development Plans developed specifically as part of BART's corridor planning process.

Florida TOD Guidebook

The Florida TOD Guidebook provides model comprehensive plan provisions, land development regulations, and process guidance for local jurisdictions to develop and adopt the amendments to their regulations. Under Florida state law, local governments must ensure consistency between land development regulations and adopted comprehensive plans.

3. Regional Transit System Benchmarks

Existing high-capacity transit corridors in the Washington, DC region were evaluated using density, ridership, and built environment criteria to serve as benchmarks in developing guidelines specific to the region. Different thresholds (Low, Medium, and high values) for the rating criteria were tested using the benchmark data.

Plans and policies for transit-supportive development and infrastructure were not used as evaluation criteria, because the transit corridors being studied are well-established rather than planned corridors and have transit-supportive plans and policies in place.

3.1. Corridors Evaluated

The corridors evaluated are listed below and shown in **Figure 3-1:**

Metrorail Corridors

- Orange Line - Rosslyn to Ballston (VA)
- Blue Line - King Street to Franconia-Springfield (VA)
- Blue/Silver Line - Capitol Heights to Largo Town Center (MD)
- Red Line - Bethesda to Shady Grove (MD)
- Red Line - NoMa to Silver Spring (DC-MD)
- Orange/Blue Line - Foggy Bottom to Capitol South (DC)

MetroExtra (PCN) Corridors

- 30s Line - Downtown DC to Friendship Heights via M Street and Wisconsin Avenue
- 90s Line - U Street/Garfield Line
- 28A - Leesburg Pike
- K6 - New Hampshire Avenue (MD) Line

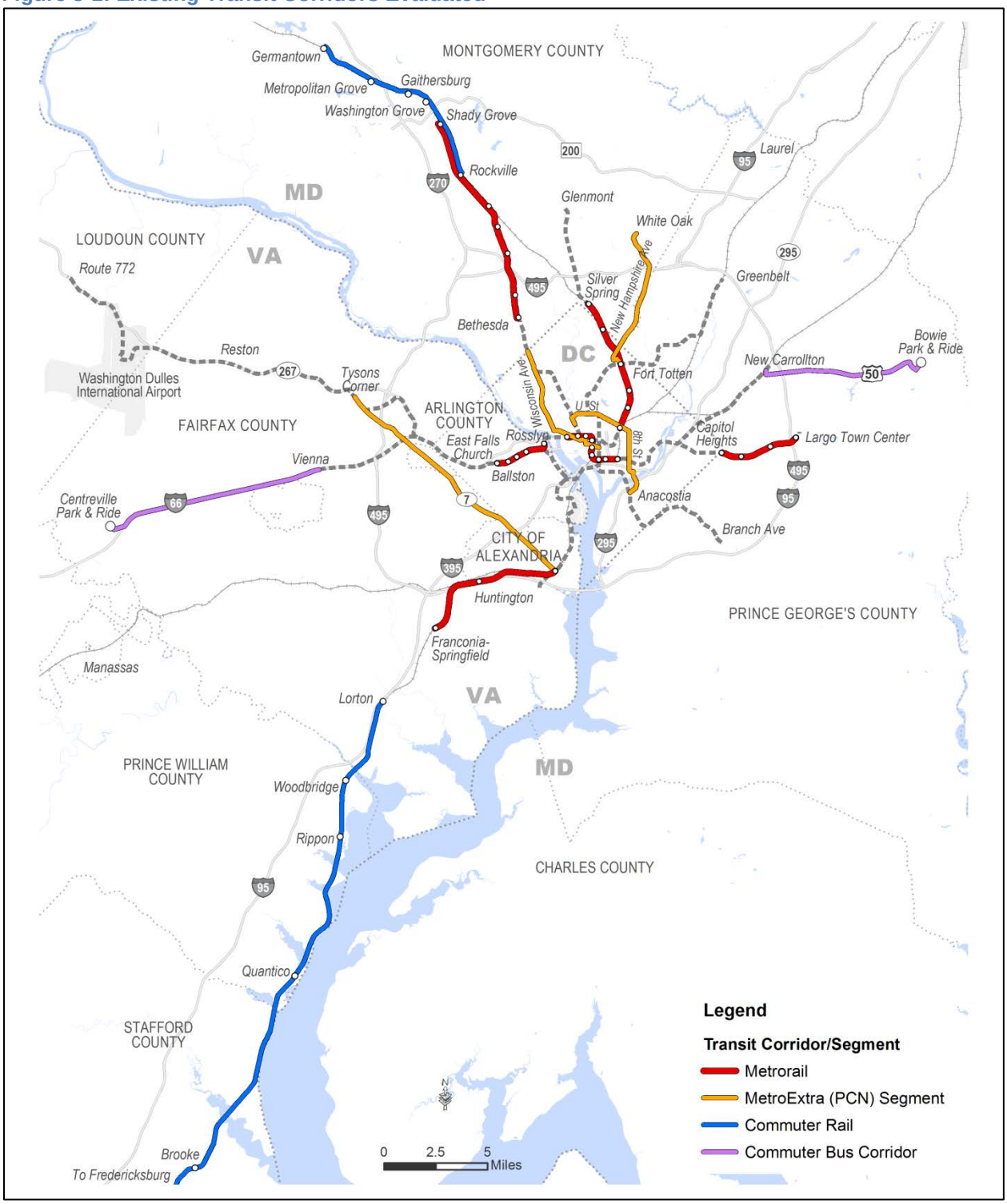
Commuter Bus Corridors

- I-66 Vienna to Centreville (FC 644)
- US-50 New Carrollton to Bowie (B29, B31)

Commuter Rail Corridors

- VRE - Lorton to Fredericksburg
- MARC - Rockville to Germantown

Figure 3-1: Existing Transit Corridors Evaluated



3.2. Transit Corridor Benchmark Data

Table 3-1 lists the transit corridors and their existing characteristics for each of the criteria. Data sources and methodology are listed in the table notes.

Table 3-1: Transit Corridor Benchmark Data

	Transit Corridor/Segment and Stations	Segment/ Corridor Length (Miles)	Density Criteria[1]				Average Weekday Ridership		Built Environment Characteristics[1]	
			Population per Acre	Employment per Acre	Population + Employment per acre	Households per acre	Station or Line	Per Mile	Pedestrian Environment Factor[2]	WMATA Walkshed[3]
A	**METRORAIL**									
1	**Orange Line - Rosslyn to Ballston (VA)**	2.62	28	52	80	15	55,715	21,265	155	68%
	Rosslyn		20	68	88	12	18,086		141	67%
	Court House		39	47	85	21	10,686		152	65%
	Clarendon		27	34	60	14	8,715		167	78%
	Virginia Square		29	50	79	16	5,716		172	65%
	Ballston		32	72	104	18	12,512		143	63%
2	**Blue Line - King Street to Franconia-Springfield (VA)**	7.42	9	15	23	4	23,733	3,199	105	44%
	King Street-Old Town		14	32	46	7	8,483		140	72%
	Van Dorn Street		7	7	14	3	3,965		81	27%
	Franconia-Springfield		6	4	11	2	11,285		95	35%
3	**Blue/Silver Line - Capitol Heights to Largo Town Center (MD)**	3.87	7	3	10	3	14,566	3,764	101	49%
	Capitol Heights		11	2	13	4	2,674		140	72%
	Addison Road		6	1	7	2	3,449		109	52%
	Morgan Boulevard		7	1	9	3	1,679		73	27%
	Largo Town Center		6	6	12	2	6,764		80	46%
4	**Red Line - Bethesda to Shady Grove (MD)**	10.47	13	28	41	6	61,716	5,895	94	58%
	Bethesda		25	63	88	12	13,639		127	68%
	Medical Center		4	40	44	2	5,705		90	64%
	Grosvenor-Strathmore		17	2	18	8	6,768		89	49%
	White Flint		12	29	41	6	5,226		82	58%
	Twinbrook		13	34	47	5	6,577		91	60%
	Rockville		12	23	34	5	5,890		93	68%
	Shady Grove		6	5	11	3	17,911		86	39%
5	**Red Line - NoMa to Silver Spring (DC-MD)**	6.6	18	19	38	8	51,318	7,775	139	55%
	NoMa-Galludet U		18	40	58	8	8,820		161	65%
	Rhode Island Avenue		16	11	27	7	7,939		126	31%
	Brookland-CUA		13	11	24	4	4,311		145	63%
	Fort Totten		15	2	17	7	6,899		142	38%

	Transit Corridor/Segment and Stations	Segment/ Corridor Length (Miles)	Density Criteria[1]				Average Weekday Ridership		Built Environment Characteristics[1]	
			Population per Acre	Employment per Acre	Population + Employment per acre	Households per acre	Station or Line	Per Mile	Pedestrian Environment Factor[2]	WMATA Walkshed[3]
	Takoma		15	7	21	6	6,578		132	72%
	Silver Spring		32	46	78	15	16,771		129	72%
6	**Orange/Blue Line - Foggy Bottom to Capitol South (DC)**	3.46	18	166	184	10	158,345	45,764	196	66%
	Foggy Bottom		36	187	223	15	22,323		216	73%
	Farragut West		18	353	371	7	29,364		214	73%
	McPherson Square		19	313	333	12	21,352		209	71%
	Metro Center		16	255	271	10	20,353		200	78%
	Federal Triangle		4	177	181	3	10,112		197	53%
	Smithsonian		0	143	143	0	9,474		179	56%
	L'Enfant Plaza		5	141	146	3	28,484		165	74%
	Federal Center SW		9	121	131	6	5,475		179	51%
	Capitol South		17	63	80	10	11,408		206	63%
B	**MetroExtra (PCN) Segments**									
1	30s Line - Downtown DC to Friendship Heights via M Street and Wisconsin Avenue NW	6.63	17	85	102	8	29,698	4,479	178	79%
2	90s Line - U Street/Garfield Line	6.67	28	36	63	14	10,705	1,605	182	81%
3	28A - Leesburg Pike	12.98	12	15	26	5	2,980	230	91	41%
4	K6 - New Hampshire Avenue (MD) Line	7.25	14	4	17	5	4,326	597	96	43%
C	**Commuter Bus Corridors**									
1	I-66 Vienna to Centreville (FC 644)	9.63	5	3	8	2	2,049	213	42	19%
	Vienna		6	4	10	2			55	25%
	Centreville		5	1	6	2			28	12%
2	US-50 New Carrollton to Bowie (B29, B31)	8.58	5	2	7	2	1,651	192	49	22%
	New Carrollton		7	3	10	2			68	30%
	Bowie		3	1	4	1			30	13%
D	**Commuter Rail**									
1	**VRE- Lorton to Fredericksburg**	34	2	1	4	1	2,555	75	25	11%
	Lorton		3	2	5	1	307	0	30	13%
	Woodbridge		3	2	5	1	1,419	0	32	14%
	Rippon		3	1	5	1	115	0	31	14%
	Quantico		1	1	3	0	16	0	16	7%

	Transit Corridor/Segment and Stations	Segment/ Corridor Length (Miles)	Density Criteria[1]				Average Weekday Ridership		Built Environment Characteristics[1]	
			Population per Acre	Employment per Acre	Population + Employment per acre	Households per acre	Station or Line	Per Mile	Pedestrian Environment Factor[2]	WMATA Walkshed[3]
	Brooke		0	0	1	0	79	0	4	2%
	Leeland Road		1	1	2	0	46	0	27	12%
	Fredericksburg		3	2	5	1	575	0	34	15%
2	**MARC - Rockville to Germantown**	9.73	6	4	10	2	2,461	253	56	25%
	Rockville		6	7	13	2	635	0	68	30%
	Washington Grove		6	6	13	2	n/a	0	59	26%
	Gaithersburg		7	6	13	3	789	0	59	26%
	Metropolitan Grove		8	4	12	3	191	0	53	24%
	Germantown		5	2	7	2	847	0	40	18%

Notes:

[1] Densities and Build Environment were measured for the following areas:
Metrorail: ½ mile station area
PCN: ½ mile corridor buffer
Commuter Bus: 3 mile corridor buffer
Commuter Rail: 3 mile station area

[2] Pedestrian Environment Factor (PEF) is calculated as the sum of the number of U.S. Census blocks in a Transportation Analysis Zone (TAZ) divided by the area of the TAZ in square miles. PEF was originally developed for the CGE Travel Model.

[3] WMATA Walkshed Rating is calculated as the percentage of the developable area within the ½ mile radius that is accessible within a ½ mile walking distance using the existing pedestrian network.

N/A= Data not available.

Data Sources:

Density: 2012 population, households and employment data from MWCOG Round 8.3 Cooperative Land Use Forecast
Ridership: 2012 forecast using *CGW* Travel Model from TPB Version 2.3 Travel Model
Built Environment: the *CGW* "Improving Mode Choice Modeling in the TPB Version 2.3 Travel Model

3.3. Testing of Rating Criteria

Rating thresholds (Low, Medium, and High values) were tested for each criterion. Three iterations of threshold values were tested.

State of the Practice Criteria

A first iteration of rating thresholds was established using the findings of the State of the Practice review. For specific mode criteria without examples in the literature, observed local and national data were used to establish rating thresholds (see **Table 3-2**). A Low rating does not meet minimum standards.

Natural Breaks Criteria

A second iteration modified the rating thresholds to reflect the natural breaks (based on the clustering around the median value) in existing data for regional corridors in the Washington metropolitan area, establishing thresholds that were more suited to the local context (see **Table 3-3**).

Hybrid Criteria

A third iteration used a combination of the national standards from the State of the Practice review and the local thresholds using the ones that were found to be most relevant in the Washington metropolitan area (see **Table 3-2**). For instance, the State of the Practice Criteria found the Medium threshold for the population and employment criterion to be 27-76 (*Guerra and Cervero, 2010*); however, the Medium, based on natural breaks around the median observed data in the Washington Metropolitan area Metrorail system, was found to be 30-60. In this case, the threshold from the Natural Breaks Criteria became the threshold for the Hybrid Criteria.

Table 3-2: Project Rating Criteria Iteration #1: State of the Practice

CRITERIA	RATING THRESHOLDS			Source for Thresholds
	1- Low	**2**- Medium	**3**- High	
DENSITY CRITERIA				
Population + Employment Per Acre				
Metrorail	<27	27 - 76	>76	"Cost of a Ride", Guerra and Cervero, 2010; assumes Capital Cost per Mile is $75M
MetroExtra (PCN)	<17	17 - 88	>88	"Cost of a Ride", Guerra and Cervero, 2010; assumes Capital Cost per Mile for a BRT type corridor in the range of $10M - $25M
Commuter Bus Corridors	<2	2 - 17	>17	"Cost of a Ride", Guerra and Cervero, 2010; assumes Capital Cost per Mile for a BRT type corridor in the range of $5 - $10M
Commuter Rail	<14	14 - 51	>51	Florida TOD Guidebook - total residential units within station area assuming an average household size of 2.5 persons to arrive at 10 - 15 pop/acre; employees per acre of 4 - 36 employees/acre (503 gross acres in the ½ mile Station Area)
Households Per Acre				
Metrorail	<15	15 - 24	>24	BART System Expansion Policy – Residential Units per Gross Acre within Station Area
MetroExtra (PCN)	<7	7 - 20	>20	Florida TOD Guidebook – Gross Density (Residential units/acre) within ½ mile Station Area
Commuter Bus Corridors	<5	5 - 10	>10	Bay Area MTC Resolution 3434 for BRT (503 gross acres in the ½ mile Station Area)
Commuter Rail	<2	2 - 4	>4	Public Transportation and Land Use Policy Pushkarev and Zupan (1977)
RIDERSHIP CRITERIA				
Average Daily Station Ridership				
Metrorail	<10,401	10,401 - 19,000	>19,000	BART System Expansion Policy - Existing Estimated Ridership Based on Land Use Densities
MetroExtra (PCN)	N/A	N/A	N/A	N/A
Commuter Bus Corridors	N/A	N/A	N/A	N/A
Commuter Rail	<200	200 - 500	>500	Natural breaks in existing data
Average Daily Ridership per Mile				
Metrorail	< 3,500	3,500 - 5,500	> 5,500	NTD 2011 Ridership By Mode (Existing Heavy Rail Lines) using average DC Ridership per Mile
MetroExtra (PCN) Segments	< 1,000	1,000 - 2,000	> 2,000	Medium based on average of Projected Ridership along PCN corridors in *CGW* Phase II in 2040 (outliers excluded)
Commuter Bus Corridors	<100	100 - 200	>200	Natural breaks in existing data
Commuter Rail	< 80	80 - 90	> 90	NTD 2011 Ridership By Mode (Existing Commuter Rail) using average MARC (79) and VRE (98) Ridership per Mile
BUILT ENVIRONMENT CHARACTERISTICS				
Pedestrian Environment Factor				
Metrorail	<100	100 - 180	>180	Natural breaks in existing data.
MetroExtra (PCN) Segments	<120	120 - 200	>200	Natural breaks in existing data – more stringent than Metrorail because people walk smaller distances to access buses
Commuter Bus Corridors	N/A	N/A	N/A	N/A
Commuter Rail	N/A	N/A	N/A	N/A
WMATA Walksheds				
Metrorail	<49%	49 - 64%	>64%	WMATA uses 63.7% as high performance indicator
MetroExtra (PCN)	<55%	55 - 69%	>69%	Natural breaks in existing data
Commuter Bus Corridors	N/A	N/A	N/A	N/A
Commuter Rail	N/A	N/A	N/A	N/A

Table 3-3: Project Rating Criteria Iteration #2: Natural Breaks

CRITERIA	RATING THRESHOLDS			Source for Thresholds
	1- Low	**2**- Medium	**3**- High	
DENSITY CRITERIA				
Population + Employment Per Acre				
Metrorail	<30	30 - 60	>60	Natural breaks in existing data
MetroExtra (PCN)	<20	20 - 70	>70	Natural breaks in existing data
Commuter Bus Corridors	<5	5 - 8	>8	Natural breaks in existing data
Commuter Rail	<5	5 - 13	>13	Natural breaks in existing data
Households Per Acre				
Metrorail	<12	12 - 18	>18	Natural breaks in existing data
MetroExtra (PCN)	<6	6 - 10	>10	Natural breaks in existing data
Commuter Bus Corridors	<1	1 - 2	>2	Natural breaks in existing data
Commuter Rail	<1	1 - 2	>2	Natural breaks in existing data
RIDERSHIP CRITERIA				
Average Daily Station Ridership				
Metrorail	<8,000	8,000 - 15,000	>15,000	Natural breaks in existing data
MetroExtra (PCN)	N/A	N/A	N/A	N/A
Commuter Bus Corridors	N/A	N/A	N/A	N/A
Commuter Rail	<150	150 - 350	>350	Natural breaks in existing data (lower thresholds)
Average Daily Ridership per Mile				
Metrorail	< 3,500	3,500 - 8,000	> 8,000	Natural breaks in existing data (increased "high" threshold)
MetroExtra (PCN)	< 1,800	1,800 - 2,800	> 2,800	Natural breaks in existing data (higher thresholds)
Commuter Bus Corridors	<100	100 - 200	>200	Natural breaks in existing data
Commuter Rail	< 80	80 - 90	> 90	NTD 2011 Ridership By Mode (Existing Commuter Rail Lines) using average MARC (79) and VRE (98) Ridership per Mile
BUILT ENVIRONMENT CHARACTERISTICS				
Pedestrian Environment Factor				
Metrorail	<150	150 - 200	>200	Natural breaks in existing data (higher thresholds)
MetroExtra (PCN)	<100	100 - 180	>180	Natural breaks in existing data (lower thresholds)
Commuter Bus Corridors	N/A	N/A	N/A	N/A
Commuter Rail	N/A	N/A	N/A	N/A
WMATA Walksheds				
Metrorail	<49%	49 - 64%	>64%	WMATA uses 63.7% as high performance indicator
MetroExtra (PCN)	<55%	55 - 69%	>69%	Natural breaks in existing data
Commuter Bus Corridors	N/A	N/A	N/A	N/A
Commuter Rail	N/A	N/A	N/A	N/A

Note: Pink cells denote threshold modified from Iteration #1 State of the Practice.

Table 3-4: Project Rating Criteria Iteration #3: Hybrid

CRITERIA	RATING THRESHOLDS			Source for Thresholds
	1- Low	**2**- Medium	**3**- High	
DENSITY CRITERIA				
Population + Employment Per Acre				
Metrorail	<30	30 - 60	>60	Natural breaks in existing data
MetroExtra (PCN)	<20	20 - 70	>70	Natural breaks in existing data
Commuter Bus Corridors	<5	5 - 8	>8	Natural breaks in existing data
Commuter Rail	<5	5 - 13	>13	Natural breaks in existing data
Households Per Acre				
Metrorail	<12	12 - 18	>18	Natural breaks in existing data
MetroExtra (PCN)	<6	6 - 10	>10	Natural breaks in existing data
Commuter Bus Corridors	<1	1 - 2	>2	Natural breaks in existing data
Commuter Rail	<1	1 - 2	>2	Natural breaks in existing data
RIDERSHIP CRITERIA				
Average Daily Station Ridership				
Metrorail	<8,000	8,000 - 15,000	>15,000	Natural breaks in existing data
MetroExtra (PCN)	N/A	N/A	N/A	N/A
Commuter Bus Corridors	N/A	N/A	N/A	N/A
Commuter Rail	<200	200 - 500	>500	Natural breaks in existing data (maintain higher thresholds like Rating Criteria #1)
Average Daily Ridership per Mile				
Metrorail	< 3,500	3,500 - 5,500	> 5,500	NTD 2011 Ridership By Mode (Existing Heavy Rail Lines) using average DC Ridership per Mile
MetroExtra (PCN)	< 1,800	1,800 - 2,800	> 2,800	Natural breaks in existing data (higher thresholds)
Commuter Bus Corridors	<100	100 - 200	>200	Natural breaks in existing data
Commuter Rail	< 80	80 - 90	> 90	NTD 2011 Ridership By Mode (Existing Commuter Rail Lines) using average MARC (79) and VRE (98) Ridership per Mile
BUILT ENVIRONMENT CHARACTERISTICS				
Pedestrian Environment Factor				
Metrorail	<150	150 - 200	>200	Natural breaks in existing data (higher thresholds)
MetroExtra (PCN)	<120	120 - 200	>200	Natural breaks in existing data - High is the same as Metrorail threshold; Medium threshold is lower than Metrorail
Commuter Bus Corridors	N/A	N/A	N/A	N/A
Commuter Rail	N/A	N/A	N/A	N/A
WMATA Walksheds				
Metrorail	<49%	49 - 64%	>64%	WMATA uses 63.7% as high performance indicator
MetroExtra (PCN)	<55%	55 - 69%	>69%	Natural breaks in existing data
Commuter Bus Corridors	N/A	N/A	N/A	N/A
Commuter Rail	N/A	N/A	N/A	N/A

Note: Pink cells denote threshold modified from Iteration #1 State of the Practice.

3.4. Corridor Results

This section reports how the existing regional transit corridors perform under the evaluation criteria.

3.4.1. Density Criteria

Table 3-5 and **Table 3-6** list the corridor ratings for the two density criteria tested.

Table 3-5: Corridor Ratings under the Population + Employment Criteria

	Iteration 1 State of Practice	Iteration 2 Natural Breaks	Iteration 3 Hybrid
Metrorail			
Orange Line - Rosslyn to Ballston (VA)	High	High	High
Yellow Line - King Street to Franconia-Springfield (VA)	Low	Low	Low
Blue/Silver Line - Capitol Heights to Largo Town Center (MD)	Low	Low	Low
Red Line - Bethesda to Shady Grove (MD)	Medium	Medium	Medium
Red Line - NoMa to Silver Spring (DC-MD)	Medium	Medium	Medium
Orange/Blue Line - Foggy Bottom to Capitol South (DC)	High	High	High
MetroExtra (PCN)			
30s Line - Downtown to Friendship Heights via M Street/Wisconsin Ave	High	High	High
90s Line - U Street/Garfield Line	Medium	Medium	Medium
28A - Leesburg Pike	Medium	Medium	Medium
K6 - New Hampshire Avenue (MD) Line	Medium	Low	Low
Commuter Bus			
I-66 Vienna to Centreville (FC 644)	Medium	High	High
US-50 New Carrollton to Bowie (B29, B31)	Medium	Medium	Medium
Commuter Rail			
VRE- Lorton to Fredericksburg	Low	Low	Low
MARC - Rockville to Germantown	Low	Medium	Medium

Table 3-6: Corridor Ratings under the Households Criteria

	Iteration 1 State of Practice	Iteration 2 Natural Breaks	Iteration 3 Hybrid
Metrorail			
Orange Line - Rosslyn to Ballston (VA)	Medium	Medium	Medium
Yellow Line - King Street to Franconia-Springfield (VA)	Low	Low	Low
Blue/Silver Line - Capitol Heights to Largo Town Center (MD)	Low	Low	Low
Red Line - Bethesda to Shady Grove (MD)	Low	Low	Low
Red Line - NoMa to Silver Spring (DC-MD)	Low	Low	Low
Orange/Blue Line - Foggy Bottom to Capitol South (DC)	Low	Low	Low
MetroExtra (PCN)			
30s Line - Downtown to Friendship Heights via M Street/Wisconsin Ave	Medium	Medium	Medium
90s Line - U Street/Garfield Line	Medium	High	High
28A - Leesburg Pike	Low	Low	Low
K6 - New Hampshire Avenue (MD) Line	Low	Low	Low
Commuter Bus			
I-66 Vienna to Centreville (FC 644)	Low	High	High
US-50 New Carrollton to Bowie (B29, B31)	Low	Medium	Medium
Commuter Rail			
VRE- Lorton to Fredericksburg	Low	Low	Low
MARC - Rockville to Germantown	Medium	High	High

3.4.2. Ridership Criteria

Table 3-7 lists corridor ratings for the ridership criteria tested. For Metrorail and commuter rail, the ratings are an average of the two metrics: ridership per station and ridership per mile. For MetroExtra (PCN) and commuter bus, the ratings are based on ridership per mile.

Table 3-7: Corridor Ratings under the Ridership Criteria

	Iteration 1 State of Practice	Iteration 2 Natural Breaks	Iteration 3 Hybrid
Metrorail			
Orange Line - Rosslyn to Ballston (VA)	High	High	High
Yellow Line - King Street to Franconia-Springfield (VA)	Low	Low	Low
Blue/Silver Line - Capitol Heights to Largo Town Center (MD)	Medium	Medium	Medium
Red Line - Bethesda to Shady Grove (MD)	High	Medium	High
Red Line - NoMa to Silver Spring (DC-MD)	High	Medium	High
Orange/Blue Line - Foggy Bottom to Capitol South (DC)	High	High	High
MetroExtra (PCN)			
30s Line - Downtown to Friendship Heights via M Street/Wisconsin Ave	High	High	High
90s Line - U Street/Garfield Line	Medium	Low	Low
28A - Leesburg Pike	Low	Low	Low
K6 - New Hampshire Avenue (MD) Line	Low	Low	Low
Commuter Bus			
I-66 Vienna to Centreville (FC 644)	High	High	High
US-50 New Carrollton to Bowie (B29, B31)	Medium	Medium	Medium
Commuter Rail			
VRE- Lorton to Fredericksburg	Low	Low	Low
MARC - Rockville to Germantown	High	High	High

3.4.3. Built Environment Criteria

Table 3-8 lists corridor ratings for the Built Environment criteria tested. Only Metrorail and MetroExtra (PCN) corridors were evaluated. The commuter bus and commuter rail corridors were not evaluated, because the State of the Practice review did not find standards for these modes which tend to attract park-and-ride users rather than depend on walkable station area environments.

Table 3-8: Corridor Ratings under the Built Environment Criteria

	Iteration 1 State of Practice	Iteration 2 Natural Breaks	Iteration 3 Hybrid
Metrorail			
Orange Line - Rosslyn to Ballston (VA)	High	High	High
Yellow Line - King Street to Franconia-Springfield (VA)	Medium	Low	Low
Blue/Silver Line - Capitol Heights to Largo Town Center (MD)	Medium	Medium	Medium
Red Line - Bethesda to Shady Grove (MD)	Medium	Medium	Medium
Red Line - NoMa to Silver Spring (DC-MD)	Medium	Medium	Medium
Orange/Blue Line - Foggy Bottom to Capitol South (DC)	High	High	High
MetroExtra (PCN)			
30s Line - Downtown to Friendship Heights via M Street/Wisconsin Ave	Medium	Medium	Medium
90s Line - U Street/Garfield Line	Medium	Medium	Medium
28A - Leesburg Pike	Low	Low	Low
K6 - New Hampshire Avenue (MD) Line	Low	Low	Low

3.4.4. Overall Evaluation Scores

Table 3-9 shows how the corridors performed overall under the three iterations of thresholds for all criteria, based on their average score. The scores in red denote corridors that would fall below the minimum threshold, represented by a Medium rating. The scores in green denote High performing corridors.

Table 3-9: Overall Corridor Ratings by Mode

	Iteration 1 State of Practice	Iteration 2 Natural Breaks	Iteration 3 Hybrid
Metrorail			
Orange Line - Rosslyn to Ballston (VA)	Medium-High	Medium-High	Medium-High
Yellow Line - King Street to Franconia-Springfield (VA)	Medium-Low	Medium-Low	Medium-Low
Blue/Silver Line - Capitol Heights to Largo Town Center (MD)	Medium	Medium	Medium
Red Line - Bethesda to Shady Grove (MD)	Medium	Medium	Medium
Red Line - NoMa to Silver Spring (DC-MD)	Medium-High	Medium	Medium-High
Orange/Blue Line - Foggy Bottom to Capitol South (DC)	**High**	Medium-High	**High**
MetroExtra (PCN)			
30s Line - Downtown to Friendship Heights via M Street/Wisconsin Ave	Medium-High	Medium-High	Medium-High
90s Line - U Street/Garfield Line	Medium	Medium	Medium
28A - Leesburg Pike	Medium-Low	Medium-Low	Medium-Low
K6 - New Hampshire Avenue (MD) Line	Medium-Low	Medium	Medium
Commuter Bus			
I-66 Vienna to Centreville (FC 644)	Medium-High	**High**	**High**
US-50 New Carrollton to Bowie (B29, B31)	Medium	Medium-High	Medium-High
Commuter Rail			
VRE- Lorton to Fredericksburg	Medium-Low	Medium-Low	Medium-Low
MARC - Rockville to Germantown	Medium-High	**High**	**High**

3.4.5. Conclusion

In general, the Project Rating Criteria Iteration #3-Hybrid thresholds capture the characteristics of the existing Washington, DC region transit system and, where feasible, also incorporate standards from the State of the Practice. The testing of these iterations informed the proposed criteria described in the following chapter.

4. Guidelines Development

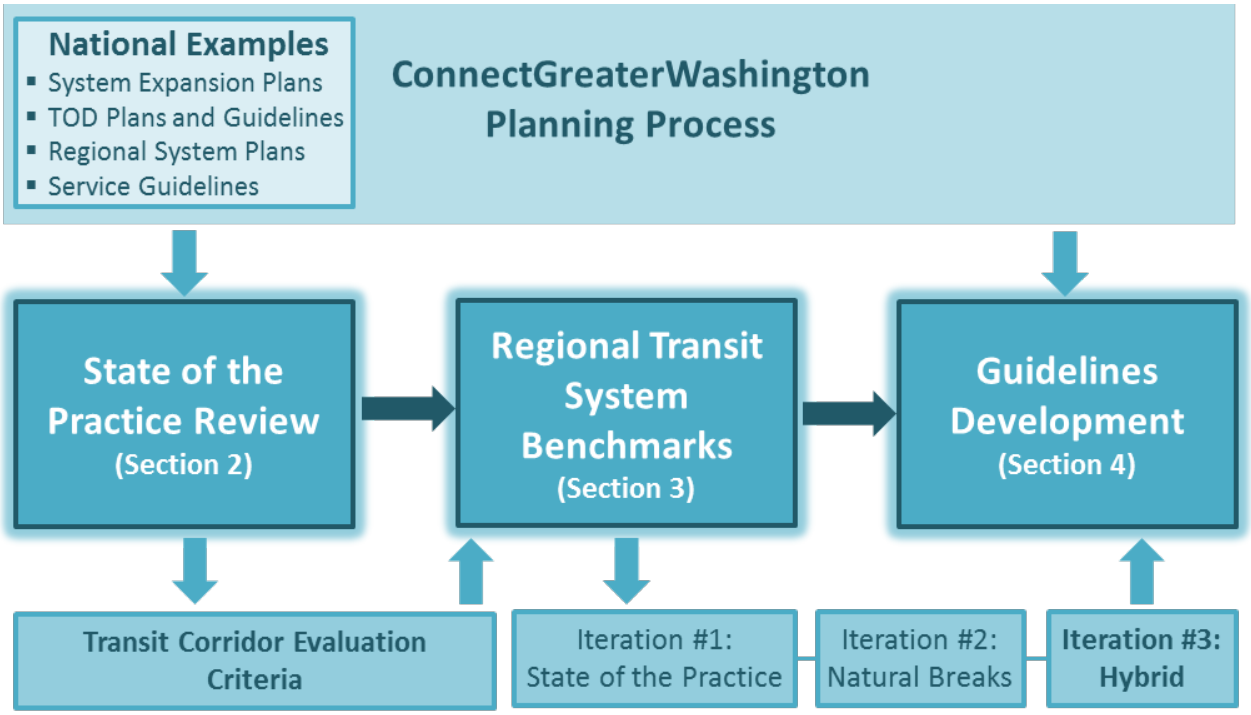
The literature review described in **Section 2** helped determine the criteria – density, ridership and built environment – on which transit corridors would be assessed. As described in **Section 3,** evaluating transit corridors in the Washington metropolitan area in comparison with national best practices benchmarks helped arrive at a hybrid set of thresholds for each criterion. As described in **Figure 4-1**, this section proposes guidelines for evaluating proposed transit corridors in the Washington metropolitan area by combining the hybrid set of thresholds from **Section 3** with corridor evaluation criteria of the *CGW* planning process. Each criterion has the following rating thresholds:

- *Low* – below the minimum threshold needed to support the transit mode;
- *Medium* – meets the minimum threshold to support the mode; and
- *High* – exceptionally supports the transit mode, based on natural breaks in observed range of data or national standards.

The criteria thresholds are specific to each transit mode, based on the varied service area and operating characteristics of each. The thresholds are based on a combination of national standards and observed data for transit corridors in the region. The sections below summarize the background for the criteria in the previous study tasks and describe the proposed criteria, the specific metrics, their basis, how they are measured, and how they are scored.

The proposed criteria were tested using a sample of existing Metrorail and proposed new high-capacity transit corridors.

Figure 4-1: Process of Guidelines Development



4.1. Density

The density criterion proposes the use of two separate metrics for residential and commercial activity:

- Residential density (households per acre); and
- Employment density (jobs per acre).

The two metrics rather than a combined population and employment metric provide more information about the corridor. For example: Is it primarily residential? Is it primarily commercial? Is it mixed-use? How strong is the residential density, the employment density, or the mixed-use density?

Gross densities, which include all land area in density calculation, are used rather than net densities, which include only developable land area in density calculation. Net densities are useful for describing transit-supportive development at the site level, but not at the station area or corridor level. If a significant proportion of a station area is occupied by highway right-of-way, open space, water bodies, or other types of undevelopable land, the transit utilization is generally lower than a station area with more residential and employment uses.

Proposed infill stations along existing lines could also be assessed using the criteria. **Table 4-1** and **Table 4-2** list thresholds for the density criteria**.**

Figure 4-1 and **Figure 4-2** show example locations along major transit corridors in the Washington metropolitan region that meet the Medium density thresholds.

Table 4-1: Rating Thresholds for Households per Acre by Mode

MODE	Analysis Area	DENSITY CRITERIA RATING THRESHOLDS			Source for Thresholds
		Households per Gross Acre			
		Low	Medium	High	
Suburban Metrorail	½ Mile of Stations	<12	12-18	>18	Based on observed natural breaks among existing Metrorail station area densities for stations spaced more than 1 mile apart
Urban Metrorail	½ Mile of Stations	<15	15-20	>20	Based on observed natural breaks among existing Metrorail station area densities for stations spaced less than 1 mile apart
Light Rail	½ Mile of Stations	<2	2-5	>5	Based on observed average 2010 density within a ½ mile of the MTA Purple Line corridor
Bus Rapid Transit	½ Mile of Corridor	<2	2-5	>5	Based on observed 2010 net densities along Metrobus PCN lines in the 2013 *Metrobus Market and Effectiveness Study* (2013), adjusted for gross density
Streetcar	½ Mile of Corridor	<2	2-5	>5	TRB Transit Capacity and Quality Of Service Manual, 2nd Edition (2012)
Commuter Rail	3 Miles of Corridor	<1	1-2	>2	Based on natural breaks in observed data for existing VRE and MARC corridor densities
Limited-Stop Bus	½ Mile of Corridor	<1	1-2	>2	Based on natural breaks in observed data for existing MetroExtra corridor densities

Table 4-2: Rating Thresholds for Employment per Acre by Mode

MODE	Analysis Area	DENSITY CRITERIA RATING THRESHOLDS			Source for Thresholds
		Employment per Gross Acre			
		Low	Medium	High	
Suburban Metrorail	½ Mile of Stations	<19	19-26	>26	Based on observed natural breaks among existing Metrorail station area densities for stations spaced more than 1 mile apart
Urban Metrorail	½ Mile of Stations	<75	75-150	>150	Based on observed natural breaks among existing Metrorail station area densities for stations spaced less than 1 mile apart
Light Rail	½ Mile of Stations	<6	6-13	>13	Based on observed average 2010 density within a ½ mile of the MTA Purple Line corridor
Bus Rapid Transit	½ Mile of Corridor	<6	6-13	>13	Based on observed 2010 net densities along Metrobus PCN lines in the 2013 *Metrobus Market and Effectiveness Study* (2013), adjusted for gross density
Streetcar	½ Mile of Corridor	<4	4-11	>11	TRB Transit Capacity and Quality Of Service Manual, 2nd Edition (2012)
Commuter Rail	3 Miles of Corridor	N/A	N/A	N/A	N/A
Limited-Stop Bus	½ Mile of Corridor	<4	4-11	>11	TRB Transit Capacity and Quality Of Service Manual, 2nd Edition (2012)

N/A = Not Applicable. New commuter rail corridors in the Washington, DC region will mostly comprise suburban extensions in residential areas.

Measurement

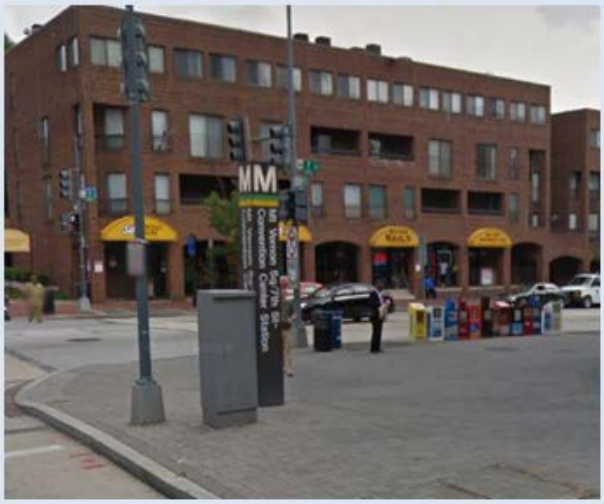
Densities are measured based on existing population and employment and are measured differently for each mode to address assumptions about ridership capture and stop/station spacing:

- *Metrorail and Light Rail* – ½ mile radius of each station.
- *Bus Rapid Transit, Streetcar, and Limited-Stop Bus* – ½ mile buffer of the corridor. Stop spacing for these modes is typically shorter than Metrorail and light rail, such that using station areas often results in overlapping analysis zones. In addition, stop locations for those modes at the early conceptual planning stage are often less defined than modes with more capital intensive stations. For any stations located greater than one mile from the nearest station on the corridor, a ½ mile radius of the station can be used.
- *Commuter Rail* – 3 mile buffer of the corridor rather than stations, as much of the potential ridership for this mode drives to stations in outer suburban areas.

Figure 4-2: Example Locations with Medium Ratings for Residential Density

Metrorail (Urban)

15 to 20 HH per Acre



Example: Mt Vernon Square (20 HH per Acre)

Metrorail (Suburban)

12 to 18 HH per Acre

Example: Courthouse (16 HH per Acre)

Light Rail/Streetcar/ Bus Rapid Transit

2 to 5 HH per Acre

Example: Benning Road (5 HH per acre)

Commuter Rail/ Limited Stop Bus

1 to 2 HH per Acre

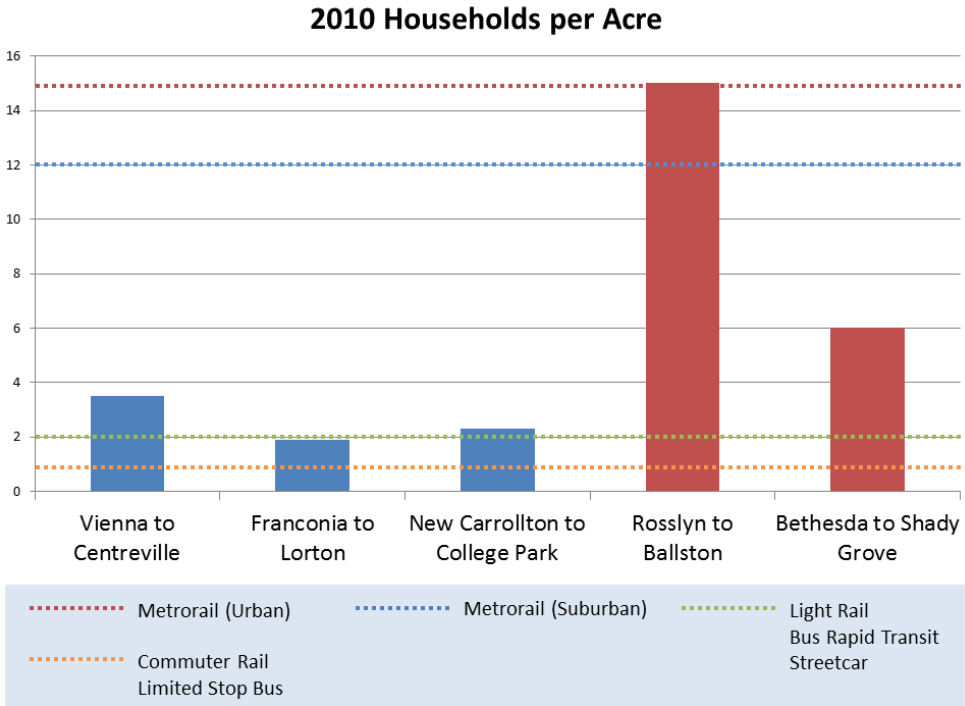
Example: College Park (1 HH per Acre)

Figure 4-3: Example Locations with Medium Ratings for Employment Density

Test Corridors

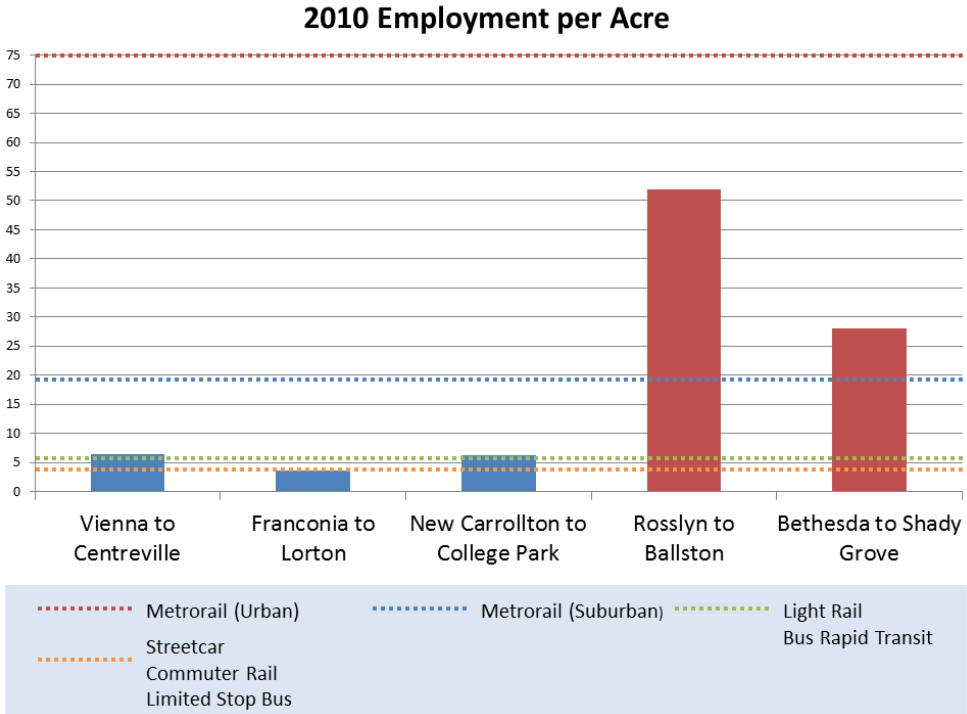
Figure 4-4 and **Figure 4-5** demonstrate how several test corridors perform compared to the Medium density thresholds for each mode.

Figure 4-4: Residential Density in Test Corridors



Source: MWCOG Round 8.3 Cooperative Land Use Forecast

Figure 4-5: Employment Density in Test Corridors



Source: MWCOG Round 8.3 Cooperative Land Use Forecast

Scoring

Under each density metric, corridors are evaluated by the average of station areas or corridor area for the proposed expansion. Each metric is scored individually as Low, Medium, and High before being combined to develop a score for the density criteria.

In cases where a corridor is rated as High for one metric and Low for the other, the density rating would be considered Medium. In cases where the metric scores are different by one step (for example, households per acre is Medium, but employment per acre is High), the density rating would be whichever metric rating is the lower of the two.

4.2. Ridership

The ridership criterion proposes the use of the following metric:

- Average daily ridership per corridor mile

Using the average daily ridership per mile provides a simple metric that can be used for Metrorail and commuter rail modes that have a few capital-intensive stations, as well as for bus and streetcar modes that may have more frequent stops and for which ridership is measured on a corridor basis. The per-mile metric also allows for an even comparison of longer versus shorter corridors. **Table 4-3** lists thresholds for the ridership criterion**.**

Figure 4-6 shows example locations along major transit corridors in the Washington metropolitan region that meet the Medium thresholds for the Urban Metrorail and Suburban Metrorail ridership metrics.

Table 4-3: Rating Thresholds for Ridership Criteria by Mode

MODE	RIDERSHIP CRITERIA RATING THRESHOLDS			Source for Thresholds
	Daily Ridership per Mile			
	Low	Medium	High	
Suburban Metrorail	<3,500	3,500-7,000	>7,000	Based on 2011 observed Metrorail data reported in National Transit Database and observed natural breaks among 2014 Metrorail ridership for stations spaced more than 1 mile apart
Urban Metrorail	<7,000	7,000-20,000	>20,000	Based on observed natural breaks among 2014 Metrorail ridership for stations spaced less than 1 mile apart
Light Rail	<2,500	2,500-3,500	>3,500	Based on Maryland Transit Administration's 2012 forecast MTA Purple Line ridership in 2040
Bus Rapid Transit	<1,000	1,000-2,000	>2,000	Based on average 2040 forecast ridership (excluding outliers) of PCN corridors modeled in *CGW*
Streetcar	<1,500	1,500-2,500	>2,500	Based on 2040 forecast Benning Road Streetcar ridership modeled in *CGW*
Commuter Rail	<80	80-90	>90	Based on observed 2011 VRE and MARC data reported in National Transit Database
Limited-Stop Bus	<1,000	1,000-2,000	>2,000	Based on average 2040 forecast ridership (excluding outliers) of PCN corridors modeled in *CGW*

Figure 4-6: Example Locations with Medium Ratings for Metrorail Ridership

Metrorail (Urban)	Metrorail (Suburban)
7,000 to 20,000	3,500 to 7,000
	
Example: Smithsonian (10,911 Average Daily Entries)	Example: Twinbrook (4,470 Average Daily Entries)

Measurement

Corridor ridership for all modes is measured using:

- Total of average weekday boardings at all stations or stops along the new corridor
- Opening year forecast
- Net new ridership – used for corridors that are extensions of existing transit lines or run parallel to existing lines of the same mode or Metrorail infill stations. Net new ridership accounts for boardings at stations along the existing transit line that shift to stations along the new segment.

Figure 4-7 provides an example of the methodology for calculating ridership per mile, and **Figure 4-8** provides an example of the methodology for calculating net new ridership.

Figure 4-7: Example Calculation of Ridership per Mile

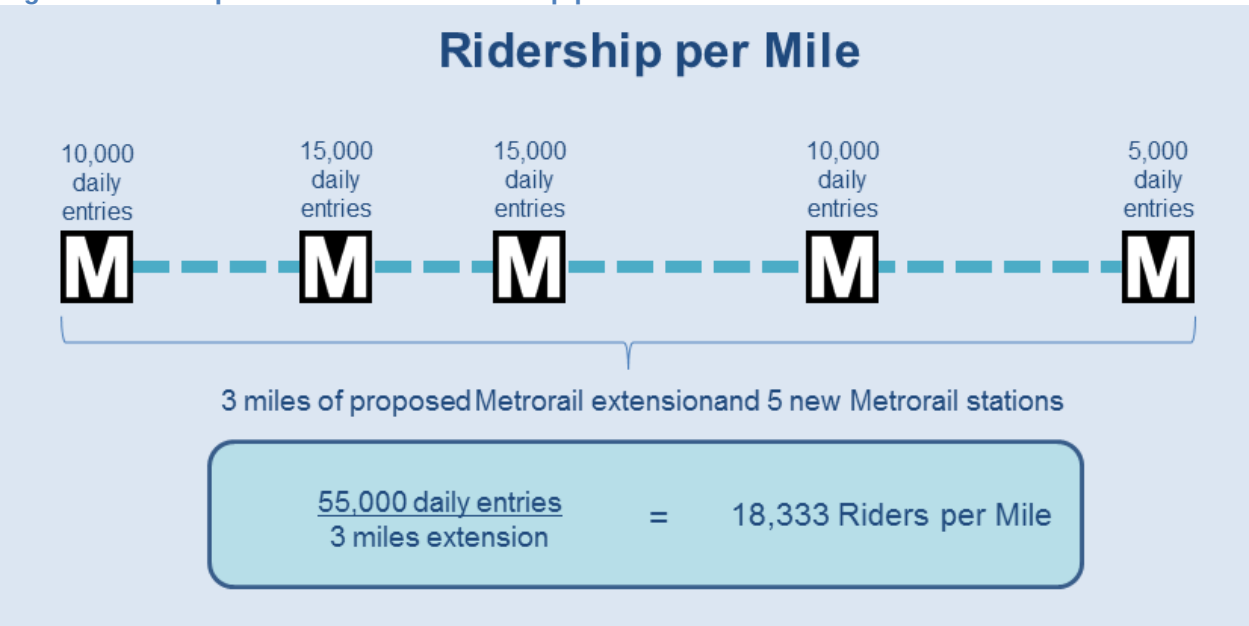
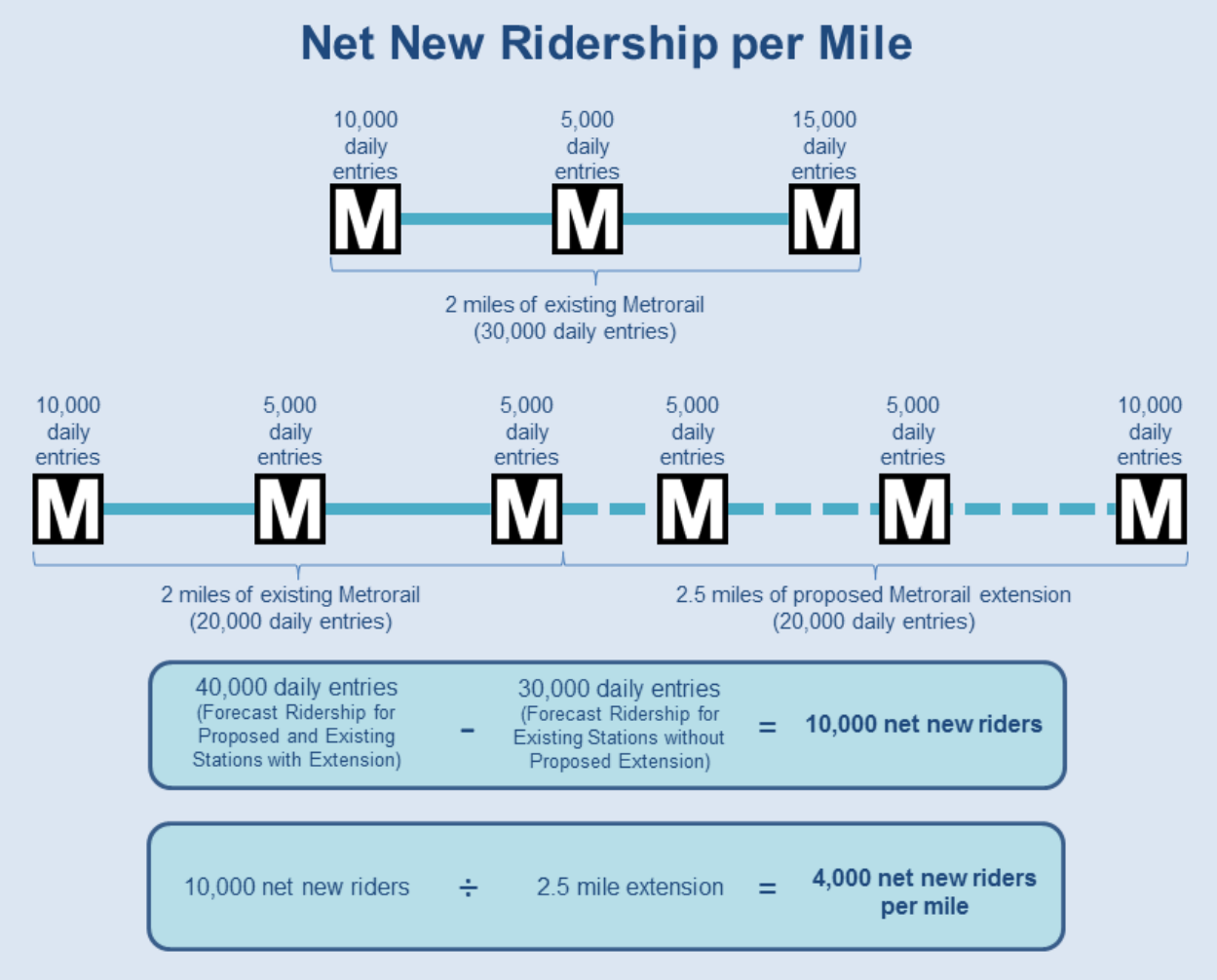


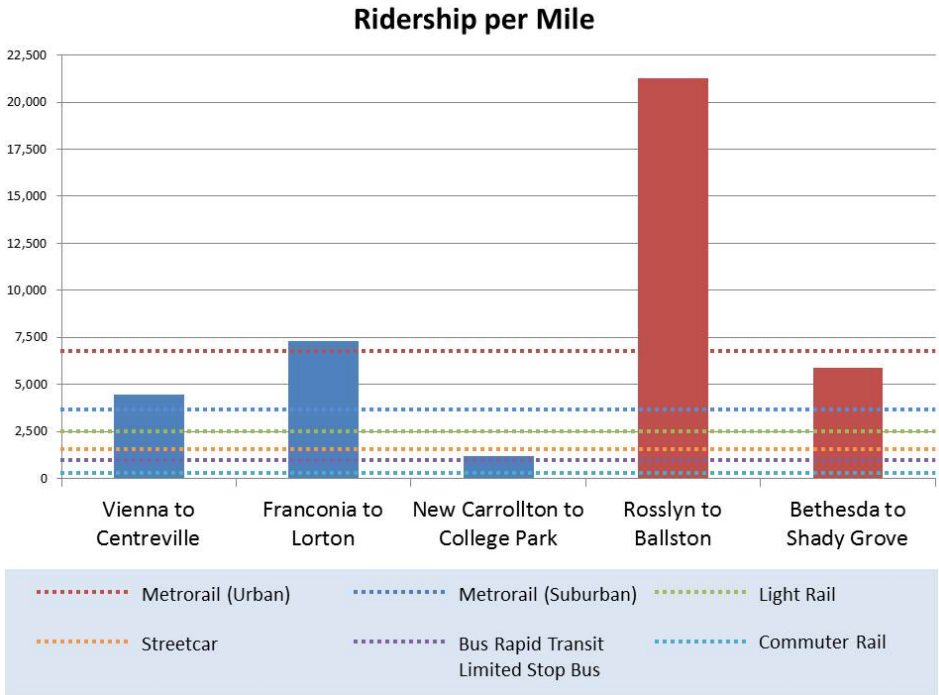
Figure 4-8: Example Calculation of Net New Ridership per Mile



Test Corridors

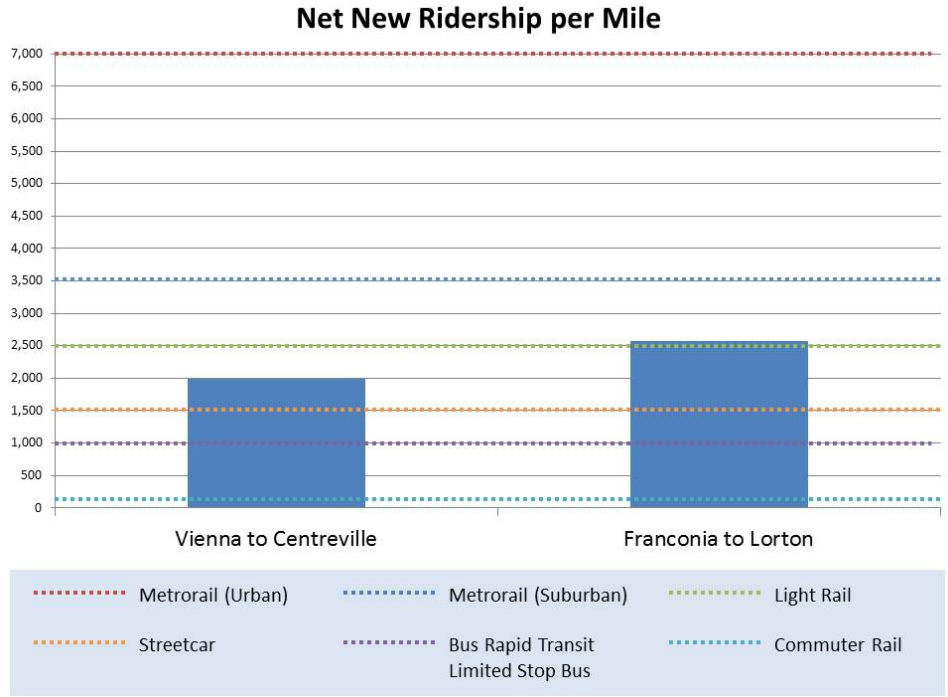
Figure 4-9 demonstrates how several test corridors would perform compared to the Medium ridership thresholds for each mode. Because the Vienna-to-Centreville and Franconia-to-Lorton corridors would serve as extensions of existing Metrorail lines, these corridors were also tested for net new ridership per mile, which is shown in **Figure 4-10.**

Figure 4-9: Ridership per Mile in Test Corridors



Source: *ConnectGreaterWashington* model using TPB Version 2.3 Travel Model
Note: Test corridors (in blue) assume an opening year of 2040, while existing corridors (in red) use 2012 ridership data.

Figure 4-10: Net New Ridership per Mile in Test Corridors



Source: *ConnectGreaterWashington* model using TPB Version 2.3 Travel Model
Note: Test corridors (in blue) assume an opening year of 2040.

Scoring

A single rating is assigned for Low, Medium, or High based on the thresholds.

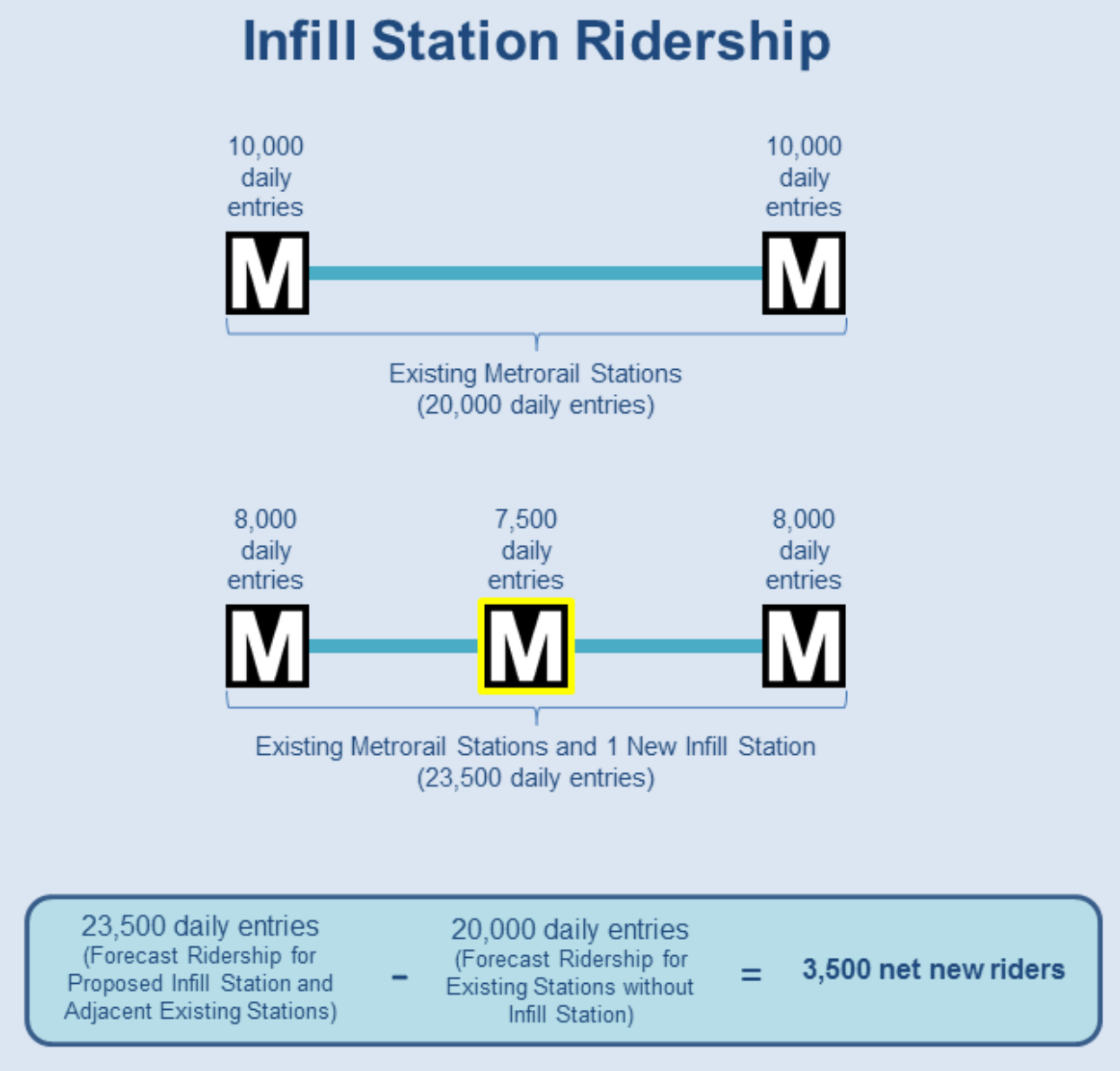
4.2.1. Infill Station Ridership

Considerations for an infill metric include:

- *Net new ridership* – Infill stations typically draw some ridership from adjacent existing stations, so net new ridership along the line should be used to assess the full impact of the new station.
- *Horizon year for planned redevelopment* – Infill stations also typically require some time to reach full build out (e.g., Potomac Yard, expected to open in 2019 with full build-out expected in about 2040), so ridership should be assessed based on an appropriate future horizon year.
- *Ridership per station versus per mile* – Although, ridership per mile would be consistent with the corridor ridership criteria, it may not be relevant for infill stations – if a line is already built, any net increase in ridership helps the performance of the line.
- *Minimum ridership to justify station investment and operations impacts* – The question is what is the minimum station ridership needed to justify the station capital investment, O&M costs, and the travel time impacts to the line. Potomac Yard's net new ridership in 2040 would be similar to adding another Georgia Ave-Petworth (6,400 daily entries in 2014, the median of the system.)

Thus, for Metrorail infill station projects, net new ridership can be assessed by applying the metrics for Suburban Metrorail corridors for the station rather than per mile. Given that average spacing of planned or recently studied infill stations is approximately just over a mile, similar to the average system station spacing, this spacing aligns with suburban stations. **Figure 4-11** illustrates the calculation of net new ridership at proposed infill stations.

Figure 4-11: Example Calculation of Infill Station Ridership



Infill Station Examples

As shown in **Table 4-4**, ridership for infill stations was assessed using net new daily ridership for the planned infill station at Potomac Yard and infill stations included in the initial modelling for the regional transit system plan, *ConnectGreaterWashington.* Average daily station entries for the infill station at New York Avenue, NoMa-Gallaudet, were included for comparison.

Table 4-4: Metrorail Infill Station Examples – Existing and Forecast Ridership

Status	Station Location, Year	Average Distance to Adjacent Station (mi.)	Average Daily Station Entries	Net New Daily Ridership on Line	Net New Daily Ridership per Mile**
Existing (2014 data)	NoMa-Gallaudet (2014)	0.9	9,098	N/A	-
Planned (Draft EIS)	Potomac Yard (2016)	1.5	3,600	1,300	860
	Potomac Yard (2040)	1.5	10,000	6,400	4,220
Modeled (*CGW* Phase I)	Saint Elizabeth's East Campus (Green Line) (2040)	0.6	9,300	5,000	7,840
Modeled (*CGW* Phase I)	Kansas Avenue NW (Red Line) (2040)*	0.9	3,700	1,250	1,320
Modeled (*CGW* Phase I)	Montgomery College, Rockville (Red Line) (2040)*	1.3	2,000	550	420
Modeled (*CGW* Phase I)	Eisenhower Valley, Alexandria (Blue Line) (2040)*	1.9	1,000	400	210

* 2040 land use based on MWCOG forecast, which did not assume a future Metrorail station and intensive TOD-type development.

** Based on average distance to adjacent station.

4.3. Built Environment

The built environment criterion proposes the use of the following metric:

- WMATA Walkshed Rating

For the transit corridor expansion guidelines, the WMATA Walkshed Ratings would be used for evaluation, rather than PEFs, as the WMATA Walkshed Ratings are calculated using ESRI's Network Analyst tool which is easily available to most local jurisdictions in the region. Thresholds for the WMATA Walkshed Ratings are based on Project Rating Criteria Iteration #3 from the Regional Transit System Benchmarks technical memorandum and use a ½ mile radius and walking distance from stations.

The WMATA Walkshed Ratings are not considered a useful metric for assessing the suitability of outlying commuter rail extensions, because riders often drive from less walkable areas to access this mode.

Proposed infill stations along existing lines could also be assessed using the criteria.

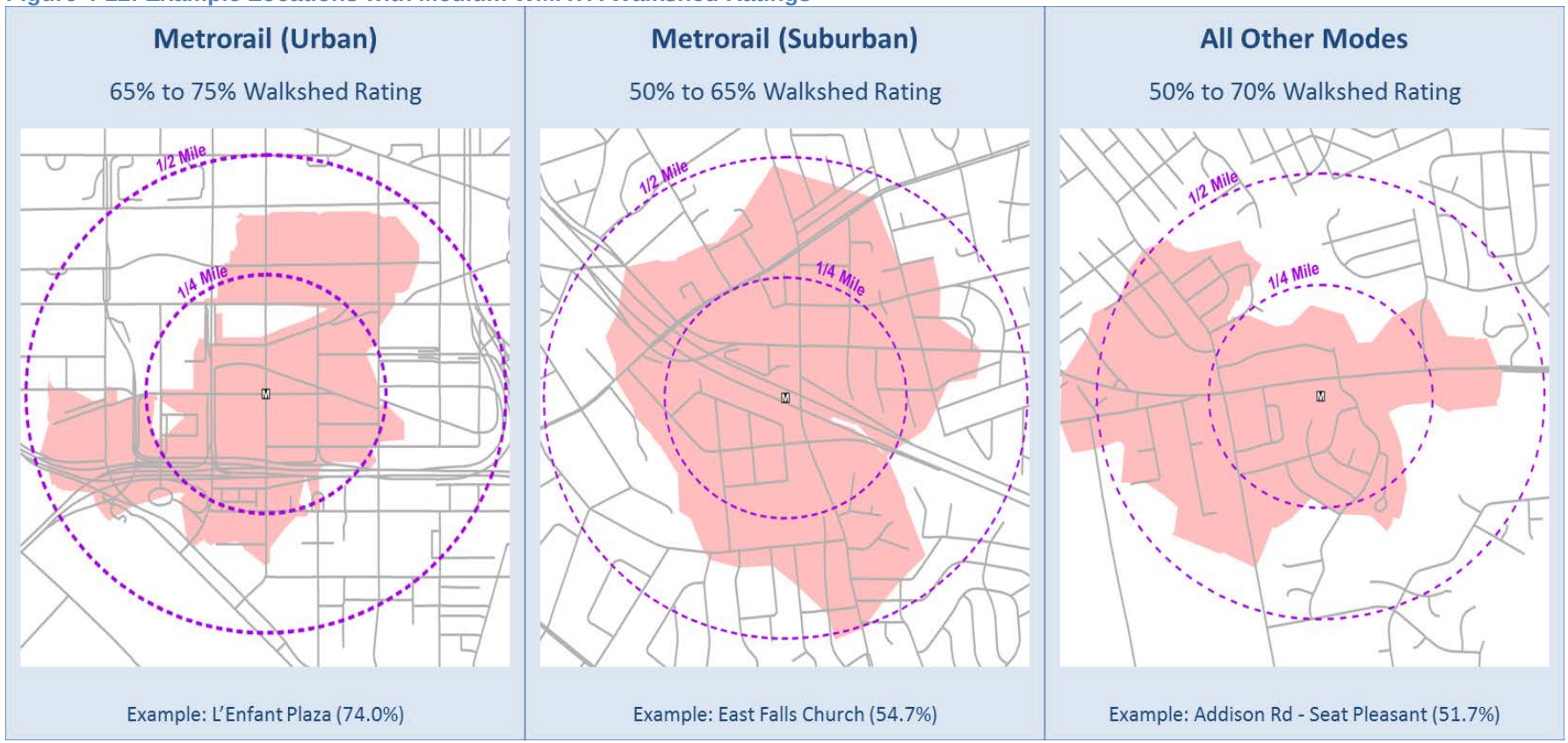
Table 4-5 lists thresholds for the built environment criterion. **Figure 4-12** provides examples of locations in the Washington metropolitan region that meet the Medium thresholds for the WMATA Walkshed Rating metric.

Table 4-5: Rating Thresholds for Built Environment Criteria by Mode

MODE	Analysis Area	BUILT ENVIRONMENT CRITERIA RATING THRESHOLDS			Source for Thresholds
		WMATA Walkshed Rating			
		Low	Medium	High	
Suburban Metrorail	Within ½ Mile of Stations	<50%	50%-65%	>65%	Natural breaks in existing data for suburban Metrorail station areas
Urban Metrorail	Within ½ Mile of Stations	<65%	65%-75%	75%	Natural breaks in existing data for urban Metrorail station areas
Light Rail	Within ½ Mile of Stations	<50%	50%-70%	>70%	Proposed range, based on assumed reduced investment in comparison to Metrorail
Bus Rapid Transit	Within ½ Mile of Corridor	<50%	50%-70%	>70%	
Streetcar	Within ½ Mile of Corridor	<50%	50%-70%	>70%	
Commuter Rail	Within 3 Miles of Corridor	N/A	N/A	N/A	N/A
Limited-Stop Bus	Within ½ Mile of Corridor	<50%	50%-70%	>70%	Proposed range, based on assumed reduced investment in comparison to Metrorail

N/A = Not Applicable. New commuter rail stations in outlying suburban areas are generally accessed by park-and-ride passengers.

Figure 4-12: Example Locations with Medium WMATA Walkshed Ratings



Measurement

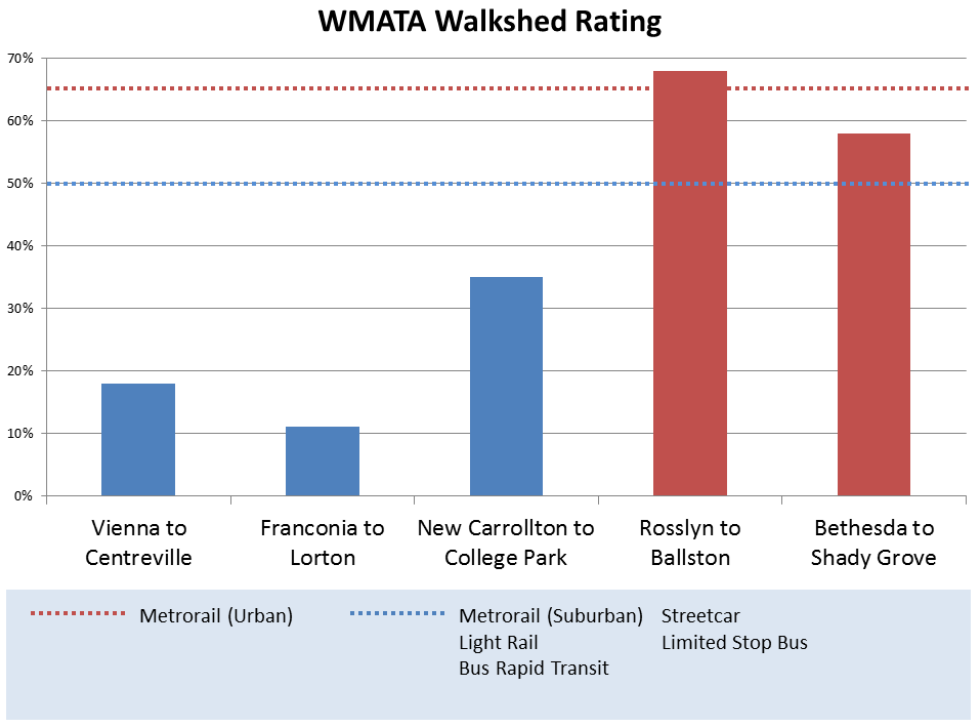
For the purpose of developing the guidelines, thresholds for the modes other than Metrorail that do not currently have the WMATA Walkshed ratings were developed from PEFs, based on the correlation between PEFs and Walkshed Ratings.

Similar to density criteria, the geographic area for the WMATA Walkshed Ratings uses either the station area or corridor buffer, depending on the transit mode. Metrorail and light rail modes measure the WMATA Walkshed Rating using the area within a ½ mile of each station. Bus rapid transit, streetcar, and limited-stop bus evaluate WMATA Walkshed Rating based on an area within a ½ mile of the corridor, because the spacing between stops is shorter and ½ mile station areas often overlap; for stations that are greater than one mile from the nearest station on the corridor, a ½ mile station area can be used.

Test Corridors

Figure 4-13 demonstrates how several test corridors would perform compared to the Medium density thresholds for each mode.

Figure 4-13: WMATA Walkshed Ratings for Test Corridors



Source: Pedestrian Environment Factors adjusted using a correlation factor to estimate WMATA Walkshed Rating

Scoring

A single rating is assigned for Low, Medium, or High based on the thresholds.

4.4. Summary Table of Proposed Criteria

Table 4-6 summarizes the corridor rating criteria by mode.

Table 4-6: Rating Criteria by Mode

Mode	Criteria	Metric	Thresholds		
			Low	Medium	High
Suburban Metrorail	Density	Households per Acre	<12	12-18	>18
		Employment per Acre	<19	19-26	>26
	Ridership	Ridership per Mile	<3,500	3,500-7,000	>7,000
	Built Environment	WMATA Walkshed Rating	<50%	50%-65%	>65%
Urban Metrorail	Density	Households per Acre	<15	15-20	>20
		Employment per Acre	<75	75-150	>150
	Ridership	Ridership per Mile	<7,000	7,000-20,000	>20,000
	Built Environment	WMATA Walkshed Rating	<65%	65%-75%	75%
Light Rail	Density	Households per Acre	<2	2-5	>5
		Employment per Acre	<6	6-13	>13
	Ridership	Ridership per Mile	<2,500	2,500-3,500	>3,500
	Built Environment	WMATA Walkshed Rating	<50%	50%-70%	>70%
Bus Rapid Transit	Density	Households per Acre	<2	2-5	>5
		Employment per Acre	<6	6-13	>13
	Ridership	Ridership per Mile	<1,000	1,000-2,000	>2,000
	Built Environment	WMATA Walkshed Rating	<50%	50%-70%	>70%
Streetcar	Density	Households per Acre	<2	2-5	>5
		Employment per Acre	<4	4-11	>11
	Ridership	Ridership per Mile	<1,500	1,500-2,500	>2,500
	Built Environment	WMATA Walkshed Rating	<50%	50%-70%	>70%
Commuter Rail	Density	Households per Acre	<1	1-2	>2
		Employment per Acre	N/A	N/A	N/A
	Ridership	Ridership per Mile	<80	80-90	>90
	Built Environment	WMATA Walkshed Rating	N/A	N/A	N/A
Limited-Stop Bus	Density	Households per Acre	<1	1-2	>2
		Employment per Acre	<4	4-11	>11
	Ridership	Ridership per Mile	<1,000	1,000-2,000	>2,000
	Built Environment	WMATA Walkshed Rating	<50%	50%-70%	>70%

4.5. Overall Scoring

After a project corridor has been assigned ratings under each of the criteria, the project corridor will be assessed for its overall viability. A corridor must achieve Medium thresholds for two out of the three criteria to be considered as above the minimum threshold. If a criterion does not have a rating available for the corridor's mode (for example, commuter rail has no Built Environment metric), then at least one of the two remaining criteria should achieve the Medium threshold.

4.6. Metrorail Performance under the Proposed Rating Criteria

This section shows how existing and proposed Metrorail corridors would perform under the overall scoring of the three criteria.

4.6.1. Existing Metrorail Lines

The Metrorail corridors used as benchmarks in Chapter 3 for testing various iterations of rating criteria were evaluated based on the final set of proposed criteria (see **Table 4-7**).

Table 4-7: Existing Metrorail Corridor Benchmarks under the Proposed Criteria

Transit Corridor/Segment	Segment/ Corridor Length	Density		Ridership	Built Environment	Meets Minimum Threshold
		HH per acre	Emp. per Acre	Average Daily Ridership Per Mile	WMATA Walkshed Rating	
Orange Line - Rosslyn to Ballston	2.6	15.2	52.5	21,265	68%	-
Suburban Metrorail	-	Medium	High	High	High	Yes
Urban Metrorail	-	Medium	Low	High	Medium	Yes
Yellow Line - King Street to Franconia-Springfield	7.4	4.1	14.6	3,199	44%	-
Suburban Metrorail	-	Low	Low	Low	Low	No
Urban Metrorail	-	Low	Low	Low	Low	No
Blue/Silver Line - Capitol Heights to Largo Town Center	3.9	2.8	2.8	3,764	49%	-
Suburban Metrorail	-	Low	Low	Medium	Low	No
Urban Metrorail	-	Low	Low	Low	Low	No
Red Line - Bethesda to Shady Grove	10.5	5.8	28.0	5,895	58%	-
Suburban Metrorail	-	Low	High	Medium	Medium	Yes
Urban Metrorail	-	Low	Low	Low	Low	No
Red Line - NoMa to Silver Spring	6.6	7.7	19.4	7,776	55%	-
Suburban Metrorail	-	Low	Medium	High	Medium	Yes
Urban Metrorail	-	Low	Low	Medium	Low	No
Orange/Blue Line - Foggy Bottom to Capitol South (DC)	3.5	9.6	166.5	45,765	66%	-
Suburban Metrorail	-	Low	High	High	High	Yes
Urban Metrorail	-	Low	High	High	Medium	Yes

4.6.2. Proposed New Metrorail Lines in *ConnectGreaterWashington*

The proposed *CGW* Core Loop was assessed using the Urban Metrorail criteria (see **Table 4-8**). The express line from East Falls Church to Rosslyn has longer stop spacing and is assessed with the Core Loop separately under both Suburban and Urban metrics.

Table 4-8: Proposed *CGW* Core Loop and Orange-Silver Express Line

Transit Corridor/Segment	Segment/ Corridor Length	Density		Ridership*	Built Environ.	Meets Minimum Threshold
		HH per acre	Emp. per Acre	Avg. Per Mile	WMATA Walkshed Rating	
Core Loop	8.4	10.8	88.4	15,600	87%	-
Urban Metrorail	-	Low	Med	Med	High	Yes
Core Loop, including Virginia Orange-Silver Express Line	16.6	10.0	76.5	8,500	82%	-
Suburban Metrorail	-	Low	High	High	High	Yes
Urban Metrorail	-	Low	Med	Med	High	No

***** Ridership estimate is from the *CGW* Round 3 Scenario modeling, which includes surface transit improvements as well as the Metrorail Core Loop and Orange-Silver Express Line.

4.7. Planning Requirements

Proposed high-capacity transit corridors that do not achieve the minimum (Medium) thresholds based on their existing land use and built environment factors can use future projections and adopted plans and policies to demonstrate their future suitability. The proposed required planning and policy elements for corridors that do not currently meet minimum thresholds are described in this section. Proposed corridors that currently meet the Medium rating thresholds but do not yet meet High thresholds based on their existing land use and built environment factors would be encouraged to implement these planning elements as well.

4.7.1. Methodology for Applying Planned Future Corridor Metrics

Density

A methodology similar to FTA's New Starts/Smalls Starts guidance could be applied, by averaging future planned density and existing density to meet the minimum threshold:

a) Existing household and employment density; and
b) MWCOG Cooperative Land Use Forecast for a horizon year 10 or 20 years in the future.

The MWCOG population and employment forecast for a specific area is largely based on local jurisdiction plans, adjusted for total regional population and employment forecasts. Thus, using the MWCOG Cooperative Land Use Forecast would incorporate both local planning and regional inputs, providing a common data source for assessing various proposed corridors projects across the region.

Ridership

Ridership forecasts would use the future MWCOG Cooperative Land Use Forecast, consistent with the future planned density.

Built Environment

The WMATA Walkshed rating could be adjusted for planned future conditions, incorporating adopted local corridor plans that demonstrate the planned extension of the street grids within redevelopment areas and connections of gaps in the existing pedestrian network.

4.7.2. Corridor Plan Elements

Plans must demonstrate how the proposed high-capacity transit corridor will attain the land use density and build environment characteristics by the horizon year projections, guiding the development of the corridor to be transit supportive in scale and character. Local planning documents could be specific to the corridor itself, such as station area or corridor plans, or broader in scope, such as comprehensive plans, as long as they have sufficient detail to demonstrate how higher densities and more walkable built environment characteristics will be implemented by the horizon year.

Local plans would be required to contain elements that support transit corridor development, addressing both the future land uses and transportation infrastructure within the corridor. For example, the San Francisco Bay area Metropolitan Transportation Commission (MTC) *Resolution 3434* requires the following minimum elements in plans:

- Current and proposed land use
- Station access and circulation plans
- Estimate of transit pedestrian access volumes within ½ mile radius
- Transit village design policies and standards
- TOD parking demand and requirements
- Implementation plan

4.7.3. Local Jurisdictional Support

Evidence of support from local jurisdictions for transit expansion in a corridor and local plans that promote transit-supportive development of a corridor must be present. Examples of support include:

- Adoption of transit-supportive plans by the governing boards of all jurisdictions along a corridor;
- Establishment of institutional mechanisms to coordinate corridor planning among multiple jurisdictions, agencies, neighborhoods and other stakeholder groups, for example:
    - Corridor planning committee with regularly scheduled meetings and clearly defined mission and scope of work; or
    - Formal policy that directs local government agencies to coordinate actions in the corridor with each other and with counterpart agencies in neighboring jurisdictions along the corridor;
- Adopted policies and actions that promote or mandate transit-supportive development within the corridor, such as financial incentives for transit-oriented development, transportation

demand management strategies, appropriate parking policies, access, and street block standards.

4.7.4. Implementation Requirements

Progress toward implementation of local plans by the jurisdictions should be demonstrated in advance of project development milestones for the corridor, e.g., alternatives analysis, initiation of the NEPA process, preliminary engineering, New Starts/Small Starts Full Funding Grant Agreement, etc. For example, the New Starts/Small Starts guidance specify what plans, zoning changes, and other policies need to be adopted or underway at the time of the initial New Starts/Small Starts application and prior to the Full Funding Grant Agreement for construction.

Types of implementation steps include: updates to comprehensive plans for consistency with corridor plans, adoption of zoning amendments, and the programming and development of transit-supportive infrastructure. A schedule of how implementation steps will be achieved in advance of project development milestones needs to be one of the minimum planning requirements.

5. Conclusions

The proposed criteria described in the previous section can serve as an initial approach to screening and prioritizing potential new high-capacity transit corridors in the Washington metropolitan area. These guidelines are generally consistent with those used in the *ConnectGreaterWashington* planning process. Changes included adding the Built Environment criterion and planning criteria for projects with existing land use that does not yet meet the minimum density thresholds. In addition, the proposed guidelines use more generalized metrics rather than those specific to the *CGW* planning process, which used a 2040 horizon year and the MWCOG Aspirations land use scenario.

This section describes additional considerations and next steps in developing a set of regional transit corridor expansion guidelines.

5.1. Potential Policy Criteria for Further Consideration

The proposed guidelines for transit corridor expansion will help direct future transit planning efforts and investment into areas with supportive density, ridership potential, and built environments. Additional regional policy and federal planning factors that may be considered to supplement the criteria are described below.

Transit-Dependent Populations

Transit-dependent populations are defined by the Federal Transit Administration (FTA) *New and Small Starts Evaluation and Rating Process- Final Policy* Guidance as persons in households having no cars or as persons living in households in the lowest income bracket as defined locally. In its evaluation of New and Small Starts grant applications, FTA allows forecast ridership of transit-dependent populations to be counted twice in calculating the total corridor ridership.

To ensure that transit expansion in the region adequately addresses the travel demand of transit-dependent populations, the evaluation of corridor ridership could include a similar weighting to the calculation of average ridership per mile, based on the transit-dependent population of the corridor. In addition to expanding travel options for transit-dependent populations, the inclusion of this policy into the criteria would result in the selection of projects that may be more competitive in the New and Small Starts grant application process.

Affordable Housing

FTA also assesses corridors for New and Small Starts funding based on the share of legally binding affordable housing. Regional plans for the Washington metropolitan area that prioritize affordable housing include:

- *Regional Transportation Priorities Plan for the Capital Region* – cites affordable housing as essential for balanced development in designated RACs.
- *Region Forward* – identifies development of affordable housing and maintenance of affordable housing stock as targets for ensuring livability in the region.

To include housing affordability in the evaluation of potential new high-capacity transit corridors, a bonus could be added. For example, the San Francisco Bay area MTC *Resolution 3434* has minimum density criteria for transit corridors that give new affordable housing units a 50 percent density bonus.

An affordable housing bonus could also tie into regional goals, such as the 10 percent affordable housing target proposed in *Region Forward*.

Service to Regional Activity Centers

RACs are identified in all regional plans as priority areas for both new development and new transit investments in the Washington metropolitan area. The proposed density criteria measure existing land use, while some RACs are classified as emerging centers targeted for future growth but that may not have significant densities yet. Thus, the density criteria may not always prioritizes transit service to RACs.

One method for prioritizing RACs could be to give added support to them in the assessment of the density criteria. The density scoring could be calculated differently to promote corridors that serve at least one RAC.

5.2. Next Steps

The proposed criteria and thresholds provide an initial framework for evaluating potential high-capacity transit corridors in the region. Additional policy considerations may be explored to address specific regional goals. With the completion of these next steps, the fully formed guidelines should be capable of siting corridors for transit expansion in areas that promote growth and transit-oriented development as well as support ridership.

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Appendix A:

ConnectGreaterWashington Corridor Prioritization Process

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1.0 Introduction

This appendix describes the process used in identifying new regionally significant surface transit corridors for the *ConnectGreaterWashington* (CGW) recommended 2040 network. These high-capacity transit projects are referred to as the "Tier 2" corridors, building on the already planned "Tier 1" network of new high-capacity transit projects in the region's Constrained Long-Range Plan (CLRP) and WMATA's *Momentum* strategic plan.

2.0 Process Overview

Over the course of the planning process, 66 potential new or expanded high-capacity transit corridors were tested over a variety of modes. The vast majority of these corridors were identified by Metro's local partners in their long-range plans, while others were developed as Metrorail end-of-line extensions and missing connections. Ultimately, the CGW network includes Metrorail expansion and a set of regionally significant high-capacity, high-frequency surface transit corridors, which are a subset of all possible corridors that were tested as part of CGW's analysis. These corridors will require the appropriate level of local and federal review, including more detailed corridor-level alternatives analyses, prior to implementation.

The regional significance of the transit corridors and suitability for future high-capacity transit projects were rated and ranked based on the following criteria:

- *2040 Land Use Suitability* – household and employment density;
- *2040 Forecast Ridership* – boardings per mile; and
- *Service to Regional Activity Centers (RACs)* – number connected per mile.

The prioritization process grouped projects (corridor and appropriate mode types for modeling) in three tiers:

- *Tier 1* – Projects already planned in the CLRP and *Momentum* (WMATA's Metro 2025 projects);
- *Tier 2* – High performing, regionally significant travel corridors; and
- *Tier 3* – Potential high-capacity transit corridors evaluated in the CGW process.

Conceptual capital cost estimates for each project and whether the corridor would provide cross-jurisdictional transit service were not used as considerations in determining the recommended list of Tier 2 regionally significant corridors.

3.0 Methodology

The following steps were used in selecting, evaluating, and prioritizing projects for inclusion in the Round 3 recommended network:

1. Selection and refinement of corridors and categorization by mode;
2. Development of evaluation metrics and rating thresholds; and
3. Evaluation and prioritization of candidate projects.

These steps are described in detail below.

3.1 Selection and Refinement of Previously Tested Corridors and Categorization by Mode

The potential new transit corridors for the Round 3 scenario recommended transit network were identified from the previous Round 1 and Round 2 scenario evaluations. Individual transit corridor projects were reviewed by the project team, Technical Advisory Group (TAG), and local jurisdictions to make refinements to corridor routes and end points based on the latest jurisdictional transportation and land use plans.

Transit corridor projects consisted of the following modes: Metrorail, commuter rail, light rail transit (LRT), streetcar, bus rapid transit (BRT), Metrobus Priority Corridor Network (PCN), and other enhanced bus. Corridors from the LRT strategy were evaluated based on both LRT and BRT modes. Streetcar projects that used PCN corridors were evaluated both as streetcar and PCN modes.

3.2 Development of Evaluation Metrics and Rating Thresholds

3.2.1 Corridor Data Sources

- *2040 Land Use Suitability* – forecast household and employment data for 2040 were obtained from the Metropolitan Washington Council of Governments (MWCOG) Round 8.1 Cooperative Land Use Forecast Aspirations Scenario. Using geographic information systems (GIS), the household and employment densities were calculated along each of the corridors. Metrorail corridor densities were calculated around the stations.
- *2040 Forecast Ridership* – forecast ridership estimates were obtained from previous CGW model runs from the Rounds 1 and 2 scenario testing.
- *Service to Regional Activity Centers (RACs)* – draft 2013 MWCOG RACs number connected per corridor mile.

3.2.2 Rating Thresholds

Low, Medium and High threshold values were then identified for each mode for each of the three criteria: corridor density, ridership, and RACs. All three criteria were weighted equally in rating overall suitability. A combination of national data, local data, and national standards were used as sources for establishing the thresholds. Rather than solely using a strict application of thresholds from the technical literature, regional project examples and characteristics of the existing Metrorail system were also used to guide the development of thresholds.

For instance, for LRT density thresholds, the planned Maryland Transit Administration (MTA) Purple Line was used as a guide, because it is a local project with sufficient prior planning and analysis to be included in the CLRP. LRT density thresholds were established as follows:

- *Households per Acre* – Using MWCOG Round 8.1 land use data for 2010, the existing household density within ½ mile of the Purple Line alignment was calculated at 5 households (HH) per acre. Based on this average corridor residential density, a range of 3-7 HH per acre was developed to serve as the medium rating for LRT projects; less than 3 HH per acre would constitute a low rating, and greater than 7 HH per acre would constitute a high rating.
- *Employees per Acre* – Similarly, employment density within ½ mile of the Purple Line alignment was calculated using MWCOG 2010 data. The average corridor employment density of 13 employees per acre served as the basis for developing a range of 8-18 employees per acre to serve as the medium rating for LRT projects; less than 8 employees per acre would constitute a low rating; and greater than 18 employees per acre would constitute a high rating.

Table 1 lists the rating thresholds used for corridor evaluation and their sources. A range above and below the average number from the source cited was used as the medium threshold rating, for which the corridor received a score of 2 (out of a possible 3). For each mode, the medium range was established based on the observed natural

breaks in the results for the proposed corridors. Metrics lower than the medium range received a low rating (score of 1), and metrics higher than the medium range received a high rating (score of 3).

Table 1: Rating Thresholds by Mode and Source

CRITERIA	RATING THRESHOLDS			Source for Minimum Thresholds
	1 Low	2 Medium	3 High	
HOUSEHOLD DENSITY – 2040 HOUSEHOLDS PER ACRE				
Metrorail[3]	< 12	12 - 18	> 18	Based on observed average 2010 HH per acre (within developable areas) within a 1/2 mile radius of existing central jurisdiction stations
Light Rail[4]	< 3	3 - 7	> 7	Based on observed average 2010 HH per acre (within developable areas) within 1/2 mile of Purple Line corridor
BRT/PCN	< 3	3 - 6	> 6	WMATA Metrobus Effectiveness Study, June 2013
Streetcar/Enhanced Bus	< 3	3 - 6	> 6	*TRB Transit Capacity and Quality Of Service Manual*, 2nd Edition (2012)
Commuter Rail	< 2	2 - 4	> 4	*Public Transportation and Land Use Policy*, Pushkarev and Zupan (1977)
EMPLOYMENT DENSITY – 2040 EMPLOYEES PER ACRE				
Metrorail[3]	< 25	25 - 35	> 35	Based on observed average 2010 employment per acre (within developable areas) within a 1/2-mile radius of existing central jurisdiction stations
Light Rail[4]	< 8	8 - 18	> 18	Based on observed average 2010 employment per acre (within developable areas) within 1/2 mile of Purple Line corridor
BRT/PCN	< 8	8 - 18	> 18	WMATA Metrobus Effectiveness Study, June 2013
Streetcar/Enhanced Bus	< 5	5 - 15	> 15	*TRB Transit Capacity and Quality Of Service Manual*, 2nd Edition (2012)
Commuter Rail[5]	N/A	N/A	N/A	N/A
RIDERSHIP – 2040 FORECAST BOARDINGS PER MILE				
Metrorail	< 3,500	3,500 - 5,500	> 5,500	Average Metrorail ridership per mile, from NTD 2011 Ridership By Mode (Existing Heavy Rail Lines)
Light Rail	< 2,500	2,500 - 3,500	> 3,500	Forecast Purple Line ridership in 2040
BRT/PCN	< 1,000	1,000 - 2,000	> 2,000	Average forecast 2040 ridership of PCN corridors (outliers excluded) from CGW Round 2 scenario modeling
Streetcar/Enhanced Bus	< 1,500	1,500 - 2,500	> 2,500	Forecast Benning Road Streetcar ridership in 2040
Commuter Rail	< 80	80 - 90	> 90	Average MARC and VRE ridership per mile, from NTD 2011 Ridership By Mode (Existing Commuter Rail Lines)
SERVICE TO REGIONAL ACTIVITY CENTERS – NUMBER PER MILE				
Metrorail	< 0.4	0.4 - 0.5	> 0.5	MWCOG 2013 Regional Activity Centers; thresholds based on observed natural breaks among project results
Light Rail	< 0.4	0.4 - 0.5	> 0.5	
BRT/PCN	< 0.4	0.4 - 0.5	> 0.5	
Streetcar/Enhanced Bus	< 0.4	0.4 - 0.5	> 0.5	
Commuter Rail	< 0.15	0.15 - 0.25	> 0.25	

Notes:
[3] All Metrorail corridors evaluated were located in the Inner or Outer Suburbs. Thresholds were based on observed densities for existing Central Jurisdiction stations, because existing suburban station densities tended to be skewed lower by their Park & Ride facilities.
[4] All Light Rail corridors evaluated were located in the Inner or Outer Suburbs, so the suburban characteristics of the Purple Line were considered an appropriate basis of comparison.
[5] N/A = Not applicable; commuter rail extensions primarily serve trip productions from residential areas.

The rating thresholds by mode for the three criteria are described in detail below:

3.3 Rating Thresholds for Household and Employment Densities

Densities for future corridors were calculated using the MWCOG Round 8.1 Aspirations land use scenario for the year 2040. The MWCOG Aspirations scenario densities were used, because the Round 2 Scenario ridership projections along the corridors were based on the Aspirations land use. Density was measured only within the developable area; parkland, water features and transportation right-of-way were not included. The thresholds for rating corridor density were developed as described below.

Metrorail

The medium threshold was based on the observed average households (HH) and employment per acre within a ½-mile radius of existing central jurisdiction stations in 2010 from the MWCOG Round 8.1 Cooperative Land Use Forecast. Only the developable area was used as the basis for calculating density. The observed average densities for Metrorail in the central jurisdiction station areas were 15 HH/acre and 31 employees/acre; a range of 12-18 households per acre and 25-35 employees/acre became the medium threshold, and anything lower or higher was given a low or high rating.

Light Rail

The medium threshold was based on the 2010 observed average HH and employment per acre within a ½ mile of the planned Purple Line alignment, from the MWCOG Round 8.1 Cooperative Land Use Forecast. Density was calculated within a ½-mile buffer of the entire corridor instead of at station locations alone. Similar to Metrorail, density was measured only within the developable area in the ½-mile buffer.

BRT and PCN

WMATA's *Metrobus Market and Effectiveness Study* (data from June 2013, study ongoing) measured 2010 average densities within 1/4-mile grids along all Metrobus PCN lines using the MWCOG Round 8.0 Cooperative Land Use Forecast. These observed densities were 5 HH/acre and 14 employees/acre, and were used for the purpose of comparing service area standards. Based on these observed densities, threshold densities of 3-6 HH/acre and 8-18 employees per acre were established as the medium rating thresholds for BRT and PCN. Densities within a ½-mile buffer of the entire corridor were used and were based only on the developable area.

Streetcar and Enhanced Bus

The Transportation Research Board *Transit Capacity and Quality of Service Manual*, 2012 was used to set the medium threshold for streetcar and enhanced bus. While the household thresholds matched those of BRT and PCN, the employment thresholds were relatively less stringent, with 5-15 employees/acre being the medium rating. Similar to LRT, BRT and PCN modes, the densities for streetcar and enhanced bus were measured within a ½-mile buffer of the entire corridor and were based only on the developable area.

Commuter Rail

Household density thresholds along the commuter rail corridors were based on standards from *Public Transportation and Land Use Policy* (Pushkarev & Zupan, 1977). The densities for commuter rail were measured within a ½-mile buffer of the entire corridor and were based only on the developable area. Employment densities around the commuter rail stations were not rated because outlying commuter rail extensions primarily serve trip productions from suburban residential areas.

3.4 Rating Thresholds for Ridership Potential

Thresholds for ridership potential were based on a combination of sources: average ridership of U.S. systems, using the Federal Transit Administration's National Transit Database (NTD) 2011 ridership data, ridership forecasts for planned transit projects in the Washington metropolitan area, and CGW ridership forecast results.

Metrorail

The average Washington Metrorail system ridership per mile (4,500) obtained from NTD 2011 for existing heavy rail lines was used to set a medium threshold range for Metrorail of 3,500-5,500 boardings/mile.

Light Rail

The rating thresholds for LRT were based on the Maryland Transit Administration's 2012 forecast for Purple Line ridership in 2040. The medium threshold was set at 2,500-3,500 boardings/mile.

BRT and PCN

The medium threshold for BRT, PCN and enhanced bus was based on the average 2040 forecast ridership along corridors in the CGW Round 2 scenario modeling; outliers were excluded. The medium threshold was set at 1,000-2,000 boardings/mile.

Streetcar/Enhanced Bus

The medium rating threshold for streetcar and enhanced bus was based on forecast ridership in 2040 from the DDOT Benning Road Streetcar Extension Feasibility Study, 2013. The medium threshold was set at 1,500 – 2,000.

Commuter Rail

The medium threshold for commuter rail was based on the average observed ridership of existing local commuter rail lines (VRE and MARC) and was set at 80-90 boardings/mile.

3.5 Rating Thresholds for Service to Regional Activity Centers

Regional Activity Center connectivity along the corridors was assessed using the MWCOG 2013 Regional Activity Centers (RACs). The numbers of RACs served per mile by the future candidate corridors were calculated and ranged from 0.0 to 1.1 per mile.

Thresholds were established based on observed natural breaks among project results. The same threshold was used for all modes, with the exception of commuter rail. For commuter rail, a lower threshold was used, because stops are typically spaced 2 to 10 miles apart and lines follow older freight and passenger rail corridors, which tend to serve fewer activity centers in outlying areas than more recently established transportation corridors.

3.6 Evaluation and Prioritization of Candidate Projects

Candidate project corridors were evaluated and scored based on the Low, Medium, and High rating system for each criterion (1 point was awarded for a Low score, 2 points for a Medium score, and 3 points for a High score). The scores from the three criteria were weighted equally and summed. Corridors received overall scores between 3 and 9 based on the total of the three individual criteria scores.

Corridors were then prioritized into tiers based on the overall scores as follows:

- *Tier 1* – Projects included in the CLRP, already considered regionally significant and assumed in the 2040 Baseline Transit Network;
- *Tier 2* – High performing, regionally significant travel corridors – overall scores of 7 and above; and
- *Tier 3* – Potential high-capacity transit corridors (not recommended for inclusion in CGW at this time) – overall scores of 6 and below.

Transit corridors that did not initially meet the Tier 2 minimum score for their assumed mode were then evaluated again as modes with lower capital investment and/or a lower degree of dedicated right-of-way, which have correspondingly lower criteria thresholds (Heavy Rail > LRT > BRT/PCN > Streetcar/Enhanced Bus). The corridors were evaluated at the successively lower modes until they either met the Tier 2 minimum score or did not meet the Tier 2 threshold for any high-capacity transit mode and were prioritized as Tier 3 corridors.

For the Tier 2 corridors, the highest qualifying transit mode was used to inform the Round 3 scenario modeling assumptions for each corridor; however, the CGW recommended 2040 plan does not specify a given mode for each surface transit corridor.

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Appendix B:

Detailed Criteria from State of the Practice Review

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Density Criteria

Document	New and Small Starts Evaluation		BART System Expansion Policy			
	Population	Employment	Population		Employment	
Criteria by Overall Suitability for Premium Transit	Persons per Square Mile Within Corridor (½ mile)	Total Employees Within Corridor (½ mile)	Residential Units per Gross Acre within Station Area (½ mile)[1]	Residential Units per Net Acre within Station Area (½ mile)[2]	Employees per Gross Acre within Station Area (½ mile)	Million Sq. Ft. of Commercial Space within Station Area (½ mile)
High	Greater than 15,000	Greater than 222,000	Greater than 25	Greater than 75	Greater than 100	Greater than 16.6
Medium-High	9,600 - 15,000	140,000 - 219,999	15 - 24	46 - 75	51 - 100	8.4 - 16.6
Medium	5,770 - 9,599	70,000 - 139,999	10 - 14	26 - 45	21 - 50	3.4 - 8.3

[1]Gross acre refers to the total amount of land

[2]Net acre refers to the total amount of land suitable for development (excludes roadway and other public right-of-way, parklands, and water bodies)

Document	Guerra and Cervero Research											
	Population						Combined					
Criteria by Mode	"Cost Effective" Minimum Population Density: Residents per Gross Acre within Station Area (½ mile)[3]						"Average Bare Minimum" Density: Residents and Employees per Gross Acre within Station Area (½ mile)[5]	Average Densities of "High-Scoring Projects": Residents and Employees per Gross Acre within Station Area (½ mile)[6]				
Heavy Rail	Pop. Density	9	22	36	50	119	27	Combined Density	12	41	76	146
	Cap. Cost per mile	$100M	$150M	$200M	$250M	$500M		Cap. Cost per mile	$25M	$50M	$75M	$100M
LRT/Streetcar	Pop. Density	14	32	50	67		14	Combined Density	3	16	56	116
	Cap. Cost per mile	$25M	$50M	$75M	$100M			Cap. Cost per mile	$10M	$25M	$50M	$75M
BRT	--[(4)]						--	Combined Density	2	17	88	312
								Cap. Cost per mile	$5M	$10M	$25M	$50M

[3]Based on model of average city size for heavy rail and LRT, keeping jobs constant: heavy rail city contains 350,000 jobs within 1/2 mile of all transit stations; light rail city contains 100,000 jobs within 1/2 mile of all transit stations. Costs are in 2009 dollars. Cost effectiveness defined as investments that increased passenger-miles for a smaller estimated subsidy than either fare reductions or increased train frequencies on existing systems. From "Transit and the D Word", Guerra and Cervero, 2011; Table 2, page 8.

[4] A density threshold for BRT cost effectiveness was not evaluated in "Transit and the D Word", Guerra and Cervero, 2011.

[5] Based on regression curve of cost per rider and densities for database of U.S. transit projects. Minimum density corresponds to the approximate inflection point of the regression curve (bottom 35th percentile of projects), below which costs increase at a significantly higher rate as density decreases. From "Cost of a Ride", Guerra and Cervero, 2010; Figure 3, page 18.

[6] "High-scoring projects" are top 25th percentile of database of U.S. transit projects in terms of capital cost per rider (target =$66.54). Costs are in 2008 dollars. From "Cost of a Ride", Guerra and Cervero, 2010; Table 8, page 20.

Document	Florida TOD Guidebook					Bay Area MTC Resolution 3434			DRPT Multimodal System Design
	Population		Employment		Combined	Population		Employment	
Criteria by Mode	Total Residential Units within Station Area (½ mile)[1]	Gross Density (residential units/acre) within Station Area (½ mile)	Total Employees within Station Area (½ mile)[2]	Gross Density (jobs/acre) within Station Area (½ mile)	Jobs/Housing Ratio[3]	Minimum Residential Units within Station Area (½ mile)[4]	Target Residential Units within Station Area (½ mile)	Target Jobs within Station Area (½ mile)	Multimodal Center Activity Density (jobs + people per acre)[6]
Heavy Rail	3,000 - 6,000	12 - 65	2,000 - 24,000	20 - 90	1:1 - 3:1	3,850	8,000 - 30,000	40,000 - 150,000	Greater than 70
LRT/Streetcar	2,000 - 5,000	9 - 35	2,000 - 18,000	15 - 65		3,300	5,000 - 15,000	5,000 - 30,000	33.75 - 70
BRT	1,000 - 3,000	7 - 20	1,000 - 12,000	10 - 45		2,750	2,500 - 5,000	750 - 1,500	33.75 - 70
Commuter Rail	2,000 - 5,000	9 - 35	2,000 - 18,000	15 - 65		2,200	3,000 - 7,500	2,000 - 7,500[5]	

[1]Range represents the typical number of residential units present in the station area within suburban town centers (low end) and urban town centers (high end).

[2]Range represents the typical number of employees present in the station area within suburban town centers (low end) and urban town centers (high end).

[3]Represents the recommended ratio of employees to the number of residential units within ½ mile of the station area, ranging from suburban town centers (low end) to urban town centers (high end). The recommended ratio is applicable to all modes.

[4]Represents the average number of housing units needed within ½ mile of each station to support a transit corridor extension of the corresponding mode. For example, a light rail corridor extension would need approximately 3,300 housing units per planned station for the extension.

[5]Indicative of infill commuter rail stations, such as those found in suburban town centers. Does not reflect stations located at park & ride lots.

[6]Multimodal Center is defined as a small area of multimodal connectivity and intense activity, measured as a 1 mile radius. The DRPT guidelines classifies 6 multimodal centers, ranging from most intense (urban core) to least intense (rural or village center). Multimodal center ratings are based on activity density (the sum of people and jobs per given area divided by the total acreage). The numbers in this column represent the recommended activity densities to support each mode listed.

Planning Requirements Criteria

Document	New and Small Starts Evaluation			BART System Expansion Policy		
	Plans	Zoning	Other Policies	Plans	Zoning	Other Policies
Criteria	**Guidelines for Transit Supportive Corridor Plans**	**Guidelines on Supportive Zoning near Transit**	**Guidelines for Transit Supportive Corridor Policies**	**Policies contained in Plans**	**Supportive Zoning Regulations near Transit Stations**	**Tools to Implement Land Use Policies**
	High: • Developed corridor and/or station area plans • Proposed development patterns strongly supportive of transit investment • *By Full Funding Grant Agreement* – Revisions made to comprehensive plans	High: • Process underway to recommend zoning changes strongly supportive of transit • *By Full Funding Grant Agreement* – zoning changes adopted	High: • Agencies working proactively to promote transit-supportive planning and development • Joint-development program • Financial incentives • Capital improvements programs under development • *By Full Funding Grant Agreement* – adopted local policies and programs and capital improvements programmed	• Increase corridor and station area development • Enhance transit-friendly character of station area development • Commitment to inter-jurisdictional consensus on land use	• Increases development density in transit station areas • Encourages mixed-used development • Enhances transit-oriented character and pedestrian access • Reduces parking and traffic mitigation	• Community outreach in support of land use planning • Regulatory and financial incentives to promote transit supportive development
	Medium: • Corridor and/or station area plans under development • Proposed development patterns moderately supportive of transit investment • *By Full Funding Grant Agreement* – Adoption of Corridor and/or station area plans. Comprehensive plan revisions in progress.	Medium: • Process underway to recommend zoning changes moderately supportive of transit • *By Full Funding Grant Agreement* – zoning changes in process of being adopted	Medium: • Limited efforts by agencies to promote transit-supportive planning and development • Moderate financial incentives • Limited effort to identify capital improvements • *By Full Funding Grant Agreement* – development of local policies and programs or adoption of moderately effectives policies and programs			

Document	Florida TOD Guidebook	Bay Area MTC Resolution 3434	DRPT Multimodal System Design Guidelines
Criteria	**Comprehensive Plan and Development Regulations**	**Station Area Plan Elements**	**Multimodal System Planning Products**

	Comprehensive Plan model provisions cover the following elements:
	
	• Future Land Use
	• Transportation
	• Capital Improvements
	• Housing
	• Intergovernmental Coordination
	
	Model Land Development Regulations cover the following elements:
	
	• Zoning Districts
	• Uses
	• Density, including form-based regulations
	• Frontage standards
	• Civic open space standards
	• Parking and access standards
	• Street block standards
	
	Recommended process to Adopt TOD Model Comprehensive Plan Amendments & Regulations
		Minimum elements:
		
		• Current and proposed land use
		• Station access and circulation plans
		• Estimate of transit pedestrian access volumes within ½ mile radius
		• Transit village design policies and standards
		• TOD parking demand and requirements
		• Implementation plan
			The Multimodal planning process plans and policies:
			
			• TOD plans for each transit station area
			  o Defined Multimodal centers
			  o Defined TOD nodes
			• Multimodal corridor plans for each transit corridor
			  o Prototype cross sections based on place and corridor type
			  o Modified cross sections based on modal emphasis (pedestrians, bike, transit, auto)
			• Transportation Demand Management Strategies

Cost Effectiveness Criteria

Document	New and Small Starts Evaluation		BART System Expansion Policy
Criteria by Overall Suitability	**New Starts Cost Effectiveness[1]**	**Small Starts Cost Effectiveness[2]**	**Cost per New Rider- Base Case (2002 $)[3]**
High	Less than $4.00	Less than $1.00	Less than $10
Medium-High	$4.00 - $5.99	$1.01 - $1.99	$10 - $15
Medium	$6.00 - $9.99	$2.00 - $3.99	$15.01 - $25

Notes

[1] For New Starts, cost effectiveness is calculated as the annualized capital cost plus annual O&M cost of the project divided by the annual number of estimated trips on the project.

[2] For Small Starts, cost effectiveness is calculated as the annualized federal capital share of the projected divided by the annual number of trips using the project.

[3] Based on 1999 New Starts criteria. BART assesses base ridership estimates (not including future TOD plans), and also uses these same criteria to assess future ridership based on the Ridership Development Plan for the future horizon year.

Document	Guerra and Cervero Research		
Criteria by Mode	**Capital Cost per Rider (2009 $)[4]**		**Net Annual Cost per Passenger Mile (2008 $)[6]**
Heavy Rail	Average Observed: $126	Top 25th percentile (all modes): $66.54[(5)]	Cost Effective Cost Threshold: $0.58[(7)] Median Observed Cost: $0.93 Average Observed Cost: $1.55
LRT/Streetcar	Average Observed: $156		
BRT	Average Observed $67		--

Notes

[4] Capital cost per average weekday rider. Costs are in 2008 dollars. From "Cost of a Ride", Guerra and Cervero, 2010; Table 3, page 11.

[5] Top 25th percentile cut-off of all fixed guideway projects surveyed (all modes). From "Cost of a Ride", Guerra and Cervero, 2010; Table 8, page 20.

[6] Net annual cost = operating costs and annualized capital costs minus fare revenues. From "Transit and the D Word", Guerra and Cervero, 2011; page 4 and page 6.

[7] Cost effectiveness defined as investments that increased passenger-miles for a smaller estimated subsidy than either fare reductions or increased train frequencies on existing systems. From "Transit and the D Word", Guerra and Cervero, 2011; page 6.