FAIRFAX COUNTY DEPARTMENT OF TRANSPORTATION

Comprehensive Transportation Analysis

User's Manual

OCTOBER 2024

Table of Contents

Appendices

The intent of the Comprehensive Transportation Analysis (CTA) User's Manual is to provide a multimodal analysis framework for different County processes and project types. The CTA is the County's primary tool for transportation analysis, and the requirements and parameters for CTAs vary based on project transportation and land use context.

This User's Manual will:

- Describe the Comprehensive Transportation Analysis (CTA) process in detail, including its multimodal performance measures, analysis parameters and methods, and guidelines.
- Provide clear guidance to:
  - Private entities conducting a CTA for zoning action or Site Specific Plan Amendment (SSPA) projects
  - County staff conducting CTA for corridor studies and comprehensive plans
  - County staff reviewing CTA submitted by private entities

The User's Manual is organized into the following chapters:

- **Chapter 1: What Is a CTA?** defines the purpose and need for a CTA in Fairfax County and summarizes the contributions from stakeholders in developing the process.
- **Chapter 2: When is a CTA Needed?** presents the overall MTS process. This chapter will help users understand the multimodal analysis requirements and modal emphases for their project based on project type and land use context, including a flowchart to illustrate the CTA process.
- **Chapter 3: How to Conduct the Analysis** provides detailed step-by-step instructions for how to conduct the multimodal analysis as part of the CTA process and includes summary sheets for each performance measure.
- **Chapter 4: How to Present the Results** provides a template to standardize the presentation of CTA analysis results, conclusions, recommendations, and next steps.
- **Chapter 5: How to Complete a CTA** provides a decision-making framework for County staff to use when reviewing CTA results.

The Quick Guide

To accompany the User's Manual, the **Quick Guide** provides a high-level snapshot of the Comprehensive Transportation Analysis process. The Quick Guide summarizes key information found in the full User's Manual, including measures, targets, modal emphasis, area type structures, and how to summarize and review results.

1

What Is a Comprehensive Transportation Analysis (CTA)?

Chapter 1

What Is a Comprehensive Transportation Analysis (CTA)?

A Comprehensive Transportation Analysis is Fairfax County's primary tool for evaluating the effects of zoning actions, comprehensive planning scenarios, and corridor study recommendations. The County is formalizing the CTA process to set consistent expectations and ensure data-driven outcomes for all County transportation projects.

Fairfax County encourages multimodal travel in its transportation network. Historically, transportation studies in the County have taken their cue from broader industry trends and used vehicular performance measures, such as vehicle delay, capacity, and throughput, to assess network effectiveness. To make transportation studies more comprehensive, the County developed a framework for the Comprehensive Transportation Analysis (CTA), which includes performance measures for transit, walking, and biking in addition to vehicles. CTAs also prioritize non-vehicular modes in studies conducted near Metrorail stations, Community Business Centers (CBCs), and other higher-density areas.

The CTA framework can be used by County staff or private entities to measure the multimodal effectiveness of planning and zoning projects. To create this framework, a working group comprised of individuals from the Fairfax County Department of Transportation, Department of Planning and Development, Health Department, and Virginia Department of Transportation was formed. The working group identified a set of guiding values and goals:

Values

- Safety, comfort, and improved access for everyone
- A connected active transportation network
- Mobility options that promote health and a clean environment
- Transportation decisions that improve equity

Goals

- Establish balanced measures of effectiveness and modal emphases for all travelers.
- Design streets to achieve safe auto speeds that align with their transportation and land use context
- Build transportation infrastructure that meets the needs of all travelers.
- Coordinate land use and transportation plans to reduce vehicle miles traveled (VMT).
- Encourage infill and mixed-use development.
- Reduce greenhouse gases and single-occupant vehicles (SOVs).
- Distribute transportation funding in an equitable manner.

These values and goals informed the working group as it evaluated Measures of Effectiveness (MOEs) for potential inclusion into the CTA framework. MOEs are multimodal performance measures that can be used to evaluate transportation projects. The County assessed 35 MOEs based on their ability to:

- Evaluate the multimodal impacts of projects, including corridor studies, zoning actions, and comprehensive planning projects.
- Quantify the performance of transit or active transportation infrastructure within a study area.
- Identify trade-offs between different travel modes.
- Facilitate conversations on the importance of mobility options.
- Avoid framing outcomes and solutions only in terms of vehicular and traffic impacts.
- Allow for flexibility and adaptability.

From the list of 35 MOEs to include in the CTA, the working group selected 10. These 10 MOEs, along with their associated targets, are the foundation of the CTA process. The 10 MOEs include:

- **Transit Measures**
  - Transit Access
  - Stop-Level Transit Ridership
- **Pedestrian Measures**
  - Pedestrian Level of Comfort/Gap Analysis
  - Pedestrian Delay
- **Vehicular Measures**
  - Volume to Capacity (V/C) Ratio
  - Motorist Queueing
  - Vehicle Miles Traveled
  - Vehicle Delay
- **Bicycle Measures**
  - Bicycle Level of Traffic Stress/Gap Analysis
- **Multimodal Safety Measures**
  - Crashes

The MOEs that are part of the CTA were developed after researching other localities where similar studies and metrics have been implemented. The MOEs have also been included in recent and ongoing transportation studies and included in publicly accessible materials on the Fairfax County website. For specific information on each MOE, refer to Chapter 3.

The CTA is intended to inform three major types of studies that FCDOT conducts and/or reviews and approves, including:

- *Zoning Action:* These studies are the process by which a developer or landowner gets approval for a new zoning classification or development option.
- *Comprehensive Planning:* The County's Comprehensive Plan (Plan) is a long-range guide for decision-making about the natural and built environment. The Plan provides recommendations for land use, transportation, and other topics at a countywide level through the Policy Plan, as well as more specific recommendations for specific areas through the Area Plans volumes. The Comprehensive Plan is used by the Board of Supervisors, the Planning Commission, County staff, and other stakeholders in the review of zoning actions.
    - *Site Specific Plan Amendments (SSPAs):* These studies evaluate a proposed land use change to the comprehensive plan for a single site or collection of parcels. Therefore, for some measures, analysis methods may be similar for SSPAs and zoning actions because they relate to a single or small collection of individual sites.
- *Corridor Studies:* Typically focus on transportation needs along specific routes such as highways, transitways, or major streets.

When a CTA is conducted for a *zoning action* or *SSPA*, it is intended to work in tandem with the County's existing transportation analysis processes, specifically:

- **VDOT Traffic Impact Analysis (TIA):** This is a standalone process, required by VDOT in accordance with Virginia Administrative Code, to assess the transportation impacts of a proposed change in a zoning land use that is forecasted to generate at least 5,000 average daily trips (ADT) or 400 vehicle trips per day for low volume residential roads (and at least as much as the roadway carries). The traffic impact analysis regulations (24 VAC 30-155) detail the analysis requirements and documents that must be submitted to VDOT to facilitate the required review.

  CTA measures should be added to the TIA for one single submission and scoping process. VDOT will be invited to attend scoping meetings and review CTA results.

  The requirements of the Code of Virginia take precedence in these processes.
- **Additional VDOT submissions** such as design waiver and design exception requests, access management exception requests, signal justification reports, iCAP assessments, require targeted analyses separate from those outlined within the CTA User's Manual.

Other existing documents that may serve as a helpful reference during the review process include:

- Urban Design Guidelines
- Guidelines for Development in Reston Transit Station Areas
- Tysons Urban Design Guidelines

Chapter 2 provides additional details on the process for determining the appropriate transportation analysis to conduct.

2

When Is a CTA Needed?

Chapter 2

When Is a CTA Needed?

A CTA is required for applicant-led zoning actions and Site Specific Plan Amendments (SSPAs) that meet County-defined trip generation tiers, and for County-led comprehensive planning efforts and corridor studies. The performance measures and modal priorities applied in each CTA vary based on the project's transportation and land use context.

Step 1: Determine If a Study Is Needed

Determination Process

Applicants for **SSPAs and zoning actions** submit project information to the Fairfax County Department of Transportation (FCDOT), and FCDOT staff determine whether a CTA is required. Applicants may also request a pre-submission meeting with the County to determine the appropriate analysis process.

A CTA is required for SSPAs and zoning actions based on the number of net new average daily vehicle trips generated by the proposed development. The requirements of CTAs for SSPAs and zoning actions are organized into three tiers based on the expected number of net new average daily vehicle trips:

- **Tier 1 –** proposal that generates less than 1,000 net new average daily vehicle trips
  - CTA/CTA-Z not required – applicant should submit a Transportation Statement
- **Tier 2 –** proposal that generates 1,000 to 2,999 net new average daily vehicle trips
  - Applicant should submit a CTA/CTA-Z, including:
    - Non-vehicular assessment for driveways, intersections, and streets within the project radius (quarter mile for pedestrian measures, half-mile for bicycle and transit measures)
    - Vehicular assessment for driveways and intersections providing access to the site and streets along the frontage of the site
- **Tier 3 –** proposal that generates 3000-4,999 net new average daily vehicle trips
  - Applicant should submit a CTA/CTA-Z, including:
    - Non-vehicular assessment for driveways, intersections, and streets within the project radius (quarter mile for pedestrian measures, half-mile for bicycle and transit measures)

- Vehicular assessment for driveways and intersections providing access to the site and streets along the frontage of the site, and for additional study intersections identified during the scoping process

A VDOT Traffic Impact Analysis (TIA) is required for proposals that generate over 5,000 net new average daily vehicle trips. CTA measures should be added to the TIA for one single submission and scoping process.

Further information on the CTA-Z and TIA processes is available on the Fairfax County website: https://www.fairfaxcounty.gov/transportation/traffic-impact-analysis

Key Word

Transportation Statement: provides supplemental transportation information for use in the review of a development proposal. It is required for all proposals that generate 999 or fewer average daily trips (ADT). The following information should be submitted as a separate document before or as part of the acceptance package:

- Site description and proposal
- Description of vehicular and pedestrian access
- Trip generation or approximate number of employees/residents/students/customers/etc.
- Prior site transportation mitigations and agreements, if applicable
- Proffered or planned transportation improvements at adjacent intersections
- Qualitative description of vehicular, accessible, and bicycle parking

Step 2: Develop a Context-Sensitive Approach

Scoping Form

If FCDOT determines a Tier 2 CTA/CTA-Z, Tier 3 CTA/CTA-Z, or TIA is required, the applicant's transportation consultant will need to prepare a Pre-Scoping Form outlining assumptions and supplemental information to be included in the transportation analysis.

The purpose of the scoping form is to identify key project characteristics so the County staff and/or applicants can reach consensus on the appropriate multimodal analysis requirements and modal emphases of their project based on project type and land use context. During this process, the County can also identify any specific project characteristics that may warrant adjustments to the CTA/CTA-Z analysis or to MOE targets.

The CTA scoping form is detailed below and included in **Appendix A**. If FCDOT determines a TIA is required, applicants will need to prepare a **VDOT scoping form**.

- **Project name**
- **Project type—***The type of project will help to determine which multimodal measures will apply. For reference, each measure summary sheet identifies which project type(s) that measure applies to.*
    - ☐ Comprehensive planning
    - ☐ Corridor study

- ☐ Zoning action

- **Project location—***The location of the project will help to identify the land use area type the project is located within. The area type will influence the modal priorities and multimodal measure thresholds.*
- **Development program—***The development program will help determine if the proposed use is generally consistent with the selected land use area type or if there are significant or unique characteristics that could change the modal emphasis or require a deviation in the CTA process (e.g., unusual land use, nearby large industrial area). Other information will help to determine the multimodal analysis required based on the development/project size.*
  - ☐ Proposed use
  - ☐ Project area boundaries
  - ☐ Site square footage
  - ☐ Floor area ratio
  - ☐ For corridor studies, proposed conceptual cross section options
- **Trip generation—***This includes site- or project-generated person trip estimates calculated from the most recent version of the ITE Trip Generation Manual or another agreed upon method. This can help address several questions during the scoping process, including:*
  - ☐ How many person trips is the site/area expected to generate in the future compared to the existing condition?[1]
    - Information about person trips will inform mitigation discussions with the County.
  - ☐ How many of those trips are expected to be made using motor vehicles?
    - Information about vehicle trips will inform whether a CTA is required.
  - ☐ What is the potential impact of the trips expected to be made using motor vehicles?
    - **Tier 1 –** Less than 1,000 net new average daily vehicle trips
    - **Tier 2 –** 1,000 to 2,999 net new average daily vehicle trips
    - **Tier 3 –** 3000-4,999 net new average daily vehicle trips
    - **VDOT Traffic Impact Analysis (TIA) –** 5,000 or more net new average daily vehicle trips.
  - ☐ What is the potential impact of trips expected to be made using motor vehicles if the development reaches its Transportation Demand Management (TDM) goals for the area/site?
- **Project area context —***This information will highlight project area characteristics that may impact the multimodal analysis, such as:*
  - ☐ Unique land uses. Examples may include universities with high student populations or large entertainment areas.

[1] See "Chapter 5: Person Trips" in the ITE Trip Generation Handbook for detailed guidance on estimating person trips.

- ☐ Locations that require special considerations. Examples may include areas with low car-ownership or low-income households, within walking distance to schools, parks, or other major trip attractors.
- ☐ Opportunities for improving access for those that travel to/from/within the project area. Examples may include improving transit access to benefit equity in the project area.

- **Confirm multimodal analysis requirements:**
  - ☐ Is a CTA necessary? This is decided based on the determination process (vehicle trip generation) and the project type. FCDOT must confirm this decision before the applicant can proceed with a CTA.
  - ☐ What is the modal emphasis for the CTA? This is determined based on project location. FCDOT must confirm modal emphasis before the applicant can proceed with a CTA. See Step 2 for guidance on the area type structure and modal emphasis.
  - ☐ What are the measures and targets for the CTA? This is determined based on project type and project location. FCDOT must confirm measures and targets before the applicant can proceed with a CTA. See Step 2 for guidance on which MOEs apply for each project type and Chapter 3 for specific information on MOEs, including thresholds.

Project Type

The project type will inform what MOEs are applicable for all CTAs. The three project types are:

- Comprehensive planning
- Zoning action
- Corridor study

Table 1 provides a summary of which CTA measures are required for each project type. Not all 10 MOEs will be used for each type of study. For some projects, additional measures may be applied to a study, if their relevance is demonstrated during the scoping process.

Table 1. Required CTA Measures of Effectiveness by Project Type

Measure	Comprehensive Planning	Zoning Action	Corridor Studies
Transit			
Transit Access/Walkshed	✓	✓	✗
Stop-Level Transit Ridership	✓	✓	✓
Pedestrian			
Pedestrian Level of Comfort/Gap Analysis	✓	✓	✓
Pedestrian Delay	✓	✓	✓
Vehicle			
V/C Ratio	✓	✗	✓
Motorist Queuing	✗	✓	✓
Vehicle Miles Traveled*	✓	✗	✓
Vehicle Delay	✓	✓	✓
Bicycle			
Bicycle Level of Traffic Stress/Gap Analysis	✓	✓	✓
Multimodal Safety			
Crashes	✗	✗	✓

*For comprehensive planning projects, the VMT measure only applies to area studies.

Area Type Structure

Fairfax County is large and diverse, and the needs of its stakeholders can be varied, especially as they relate to the various land uses and areas of the County. To account for this challenge, the County developed an **area type** structure that organizes areas based on land use characteristics, which are related to transportation network functioning and needs, and tailors the CTA evaluation process to the project location. The area types are linked to Fairfax County Concept for Future Development's Land Classification System as defined in the Comprehensive Plan. The area types are defined as:

- Area type 1: **Urban Centers** and **Transit Station Areas**
- Area type 2: **Suburban Centers** and **Community Business Centers**
- Area type 3: **Suburban Neighborhoods**
- Area type 4: **Low Density Residential**
- Area type 5: **Industrial Areas**

Washington Dulles International Airport, George Mason University, and Fort Belvoir are large institutional land areas in the Comprehensive Plan and are not assigned an area type. These locations will require a more detailed scoping and kickoff session to determine the appropriate modal priority.

To select the appropriate area type for a project, reference **Appendix B** for the Concept for Future Development Map and a list of locations corresponding to each area type.

Modal Emphasis

Each area type has a different modal emphasis. The modal emphasis defines which MOE modal categories (vehicle, pedestrian, bicycle, transit) are of highest priority for that project area.

The CTA evaluation will be conducted for all applicable measures for a specific project type, but the area type determines how the outputs will be analyzed. Projects should strive to meet all targets; however, a project can still be acceptable if it does not meet a target for a measure associated with a lower modal emphasis. Mitigation strategies will be needed should the project not meet the target of higher-priority measures (see Chapter 4 on interpreting CTA results). **Figure 1** summarizes the modal area type structure and the modal priorities for each area type. Modes highlighted in green indicate higher-priority modes, while others are of lower priority.

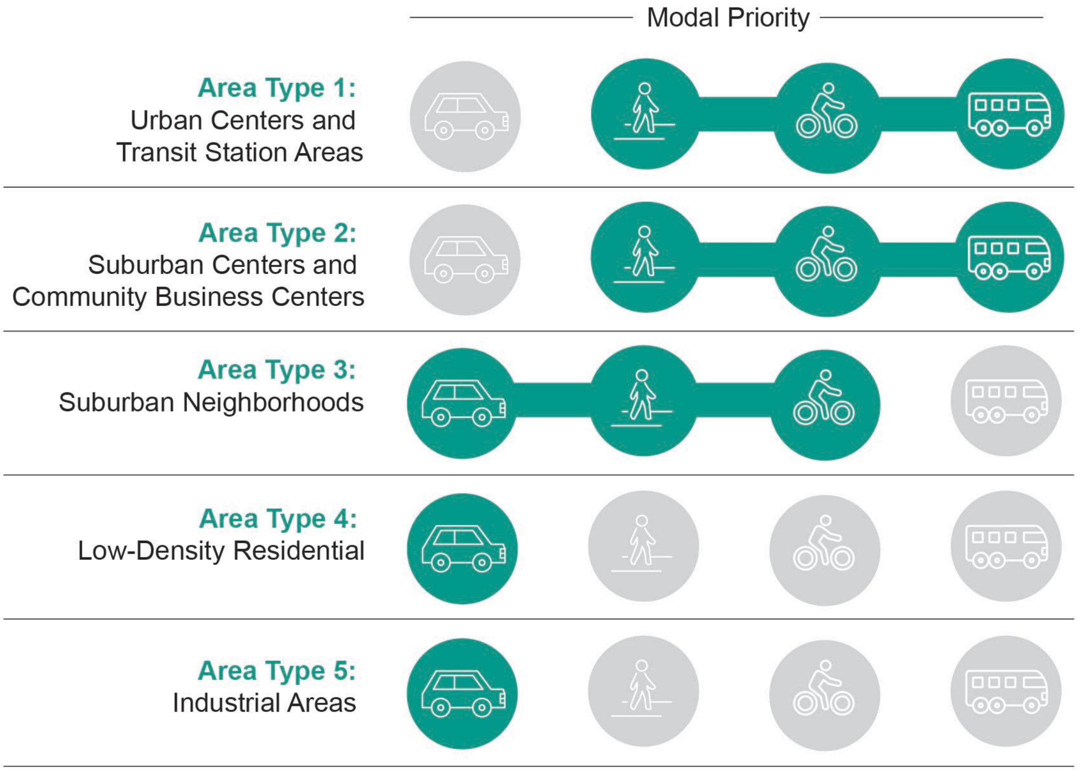


Figure 1. Area Type Structure and Modal Emphasis

A project site's area type and modal emphasis should be reviewed by the County and project team during scoping conversations. The modal emphasis will be confirmed by a formal scoping meeting at the start of the CTA process. The area types and modal emphases are guidelines, not hard rules. Specific elements may be adjusted based on context.

3

How to Conduct the Analysis

Chapter 3

How to Conduct the Analysis

Fairfax County thoughtfully selected 10 multimodal measures to evaluate land use scenarios and cross section tradeoffs associated with comprehensive planning, zoning action, and corridor study projects.

Transportation studies can include different performance measures depending on the study type and the context of the study area. To ensure the use of consistent measures for similar efforts, FCDOT's Comprehensive Transportation Analysis (CTA) process includes 10 multimodal Measures of Effectiveness (MOEs). This chapter covers which measures are appropriate for the different study types, what information each measure captures, and how to conduct analysis for each measure.

Each MOE includes the following information:

- **Applicable study types:** A CTA is used in conjunction with the following study types:
    - **Zoning action:** These studies are the process by which a developer or landowner gets approval for a new zoning classification or development option.
    - **Comprehensive planning:** The County's Comprehensive Plan (Plan) is a long-range guide for decision-making about the natural and built environment. The Plan provides recommendations for land use, transportation, and other topics at a countywide level through the Policy Plan, as well as more specific recommendations for specific areas through the Area Plans volumes. The Comprehensive Plan is used by the Board of Supervisors, the Planning Commission, County staff, and other stakeholders in the review of zoning actions. Under the umbrella of comprehensive planning, some measures differentiate between two different processes:
        - **Site Specific Plan Amendments (SSPAs).** These studies evaluate a proposed land use change to the comprehensive plan for a single site or collection of parcels. Therefore, for some measures, analysis methods may be similar for SSPAs and zoning actions because they relate to a single or small collection of individual sites.
        - **Area Plan Amendments.** These studies typically involve more extensive, strategic consideration to the transportation network compared to the zoning action and SSPA study types.
    - **Corridor studies:** These focus on transportation needs along specific routes such as highways, transitways, or major streets.
- **What is the measure?** This section includes a brief definition or explanation of the MOE.

- **What does it measure?**
    - "Comfort" refers to the availability of transit amenities, the level of comfort for pedestrians, and the level of traffic stress for bicyclists.
    - "Safety" refers to crash history, or roadway conditions (e.g., posted speed limit) where specific crash types (e.g., pedestrian and bicyclist crashes) are more likely to result in an injury or fatality.
    - "Operations" refers to variables including vehicle delay, vehicle queuing, and pedestrian delay.
    - "Access" includes connections to transit and the quality of facilities for pedestrians and bicyclists.
    - "Utilization" refers to the number of people using or expected to use a service or facility.
- **What is the acceptability target for the measure?** This section includes acceptability targets, to be confirmed during the scoping process, which vary by project type and area type. A target is a cutoff point or threshold for an MOE. Targets reflect the County's desired outcomes for each measure and help determine if mitigation measures are needed.
- **How is the measure used?** Each measure helps to identify different types of mitigation or opportunities for the transportation network. This section provides a high-level overview of these potential mitigations and opportunities.
- **How is the measure calculated?** This section includes step-by-step guidance for analysts to conduct the CTA analysis for the MOE. The analysis process can vary by study type.
- **What data or tools are needed?** This section lists any data and tools needed to conduct analysis for the specific measure. Data needs may include traffic, geospatial, ridership, or safety data, while tools needed may include GIS or modeling software.
- **For best results:** This section includes analysis tips, tricks, and best practice recommendations for conducting the analysis.
- **What are example outputs?** This section includes example maps, tables, and figures from previous studies in the County to help visualize the results of the CTA analysis.

Users conducting a CTA will assess a series of multimodal measures. As highlighted in Chapter 2, different CTA MOEs are required for each study type (See Table 1). The process for each measure is described below.

Transit Access

What types of studies should use the measure?

Comprehensive planning ▣ Zoning actions ▣ Corridor studies* ☐

*While not required, this measure could be appropriate for corridor studies that focus on transit capital improvements or that are adjacent to or run through transit centers.

What is the measure?

The **Transit Access** measure evaluates walking and biking connections to transit stop(s) (e.g., VRE, BRT, Metrorail, Metrobus, Fairfax Connector) from a specific site or a larger study area.

For **zoning action and site-specific plan amendment (SSPA)** projects, the measure is reported as the proportion of existing nearby bus and transit stops that are within walking- and biking-distance of the site.

For **comprehensive planning (area planning)** projects, the measure is reported as the number of households and low-income households that are within walking- and biking-distance of bus and transit stops within the study area.

What does it measure?

Comfort ☐ Safety ☐ Operations ☐ Access ▣ Utilization ☐

What is the acceptability target for the measure?

The site or study area is considered served by transit if there are walkable and bikeable connections between the site or study area and transit. A connection is defined as walkable or bikeable as follows:

- **Pedestrian:**
    - Bus stops located within a 0.25 mile radius of the site perimeter are also within a 0.25 mile walkshed (5-minute walk) from the site
    - VRE, BRT, or Metrorail stations located within a 0.5 mile radius of the site perimeter are also within a 0.5 mile walkshed (10-minute walk) from the site
- **Biking:**
    - Bus stops located within a 0.5 mile radius of the site perimeter are also within a 0.5 mile bikeshed (2 to 3-minute bicycle ride) from the site
    - VRE, BRT, or Metrorail stations within a 0.5 mile radius of the site perimeter are also within a 0.5 mile bikeshed (2 to 3-minute bicycle ride) from the site

For **zoning action** and **comprehensive planning** studies in ***area types 1, 2, and 3,*** there should be walkable and bikeable connections to existing bus stops and transit stations located within the noted site radii.

For **zoning action** and **comprehensive planning** studies in ***area types 4 and 5*** that include special land uses (e.g., major commercial corridors and higher density residential locations), there should be walkable and bikeable connections to existing bus stops and transit stations located within the noted site radii.

How is the measure used?

This measure identifies where a project should prioritize providing bicycle and pedestrian facility improvements to create walkable and bikeable connections between a site or study area and existing transit stops.

How is the measure calculated?

Step 1: Determine whether transit is within or near the project site or study area.

For zoning action and site-specific plan amendments (SSPAs): Calculate two (2) buffers (i.e., radii) around site perimeter (0.25 and 0.5 mile, as the crow flies). Then determine:

- Is a bus stop located within 0.25 miles of the site perimeter?
- Is a transit stop for BRT/VRE/Metrorail located within 0.5 miles of the site perimeter?
- Is a bus stop located within 0.5 miles of the site perimeter?

Note for transit routes that have multiple stops within the radius of the site, it is only necessary to include the closest stop to the site for each direction of service, unless an additional route or service is provided at a stop farther afield.

If "no" to all the above, evaluation is complete. If "yes" to any of the above, proceed to Step 2.

For comprehensive planning (area planning): Instead of calculating buffers around a single site, calculate buffers around each bus and transit stop located within the project area.

Step 2: Determine if there are walkable (pedestrian level of comfort 1 or 2) and bikeable (bicycle level of comfort 1 or 2) connections to transit located within the noted site radii.

For zoning action: Use the street network (excluding limited access facilities) to calculate 0.25-mile, and 0.5-mile isochrones (i.e., walksheds and bikesheds) around the site perimeter. Then determine:

- Are bus stops located within a 0.25-mile radius of the site **also** within a 0.25-mile walkshed from the site?
- Are VRE, BRT, or Metrorail stations located within a 0.5-mile radius of the site **also** within a 0.5-mile walkshed from the site?
- Are bus stops located within a 0.5-mile radius of the site **also** within a 0.5-mile bikeshed from the site?
- Are VRE, BRT, or Metrorail stations located within a 0.5-mile radius of the site **also** within a 0.5-mile bikeshed from the site?

For comprehensive planning (area planning and SSPAs):

- Use the pedestrian level of comfort (PLOC 1 or 2) network to calculate 0.25-mile and 0.5-mile isochrones (i.e., walksheds) around each bus and transit stop located within the project area.

- Use the bicycle level of traffic stress (BLTS 1 or 2) network to calculate 0.5-mile isochrones (i.e., bikesheds) around each bus and transit stop located within the project area.

- Overlay data from the Fairfax County Vulnerability Index with the isochrones to understand how many populations of interest (e.g., low car-ownership or low-income households) live within walking and biking distance of transit.

What data or tools are needed?

- **Data:**
  - Street network
  - Locations of transit stops, including planned changes to transit stops and service[2]
  - Pedestrian level of comfort network
  - Bicycle level of traffic stress network

- **Tools:**
  - ESRI ArcGIS Network Analyst Tool, QNEAT3, GeoNetworkX, or similar tools

For best results:

- GIS proficiency required.
- Recent aerial imagery or site visit is recommended to verify street network characteristics and transit stop locations.

[2] This data can be provided by FCDOT's Transit Services Division (TSD). It will help clarify discrepancies between existing bus stops, existing bus stops that will be served by planned bus service, and new bus stops for planned service.

What are example outputs?

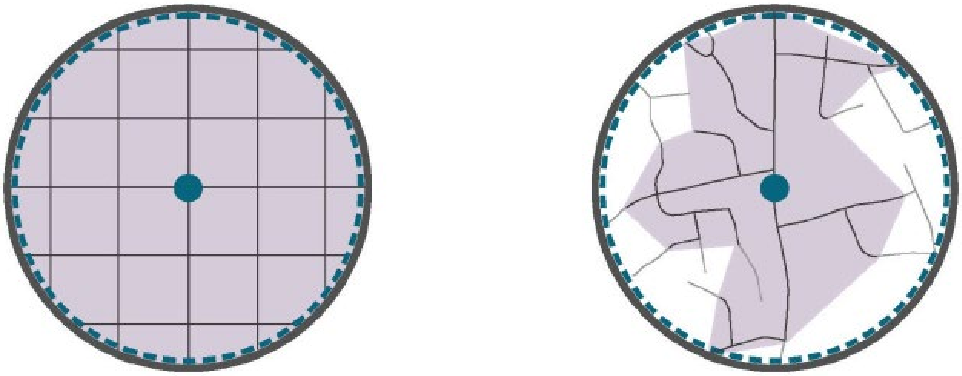


Figure 2. The Transit Access measure uses buffers (i.e., radii) to establish the analysis extents. It uses the isochrones (i.e., walksheds and bikesheds) to measure the effective walking and biking network within the analysis extents. In this figure, the teal point at the center of each circle represents the analysis site (e.g., project site or transit stop). The outer teal circle represents the "as the crow flies" buffer from the site. The purple shapes within each circle represent isochrones (i.e., walksheds or bikesheds) from the site. The isochrones vary based on overall connectedness of the street network.

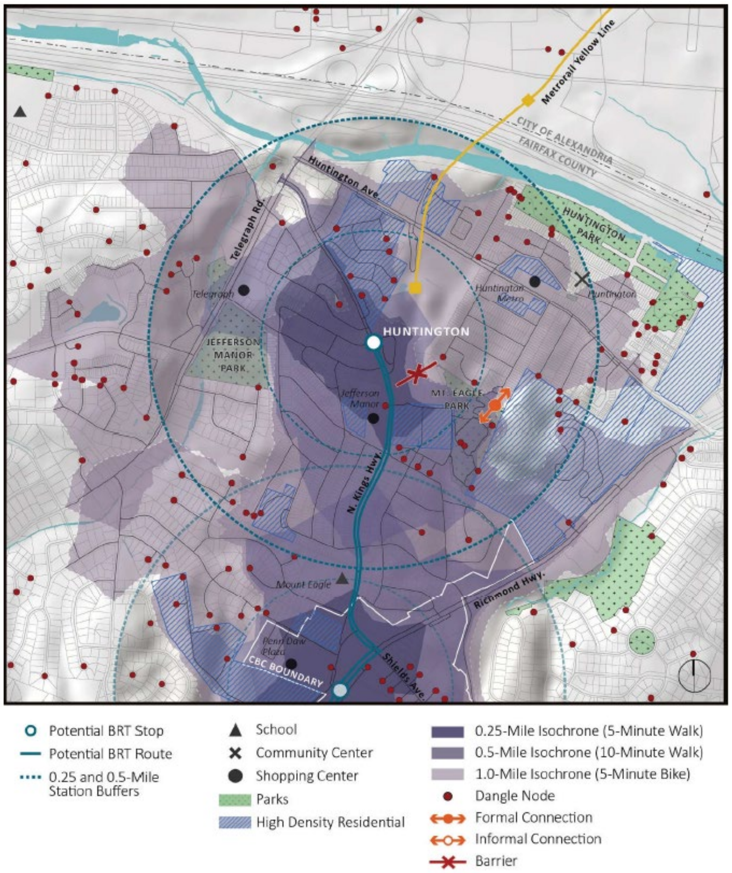


Figure 3. Buffers and isochrones (i.e., walksheds and bikesheds) calculated for bus stops in Fairfax County.

Transit Ridership

What types of studies should use the measure?

Comprehensive planning ▣ Zoning actions ▣ Corridor studies ▣

What is the measure?

Transit Ridership measures the number of existing and future transit rider boardings by stop within the study area.

For corridor study projects, assessment of transit ridership can be more complex. A corridor study may assess transit ridership at the line level and at a given point or points along the line.

What does it measure?

Comfort ▣ Safety ☐ Operations ☐ Access ▣ Utilization ▣

What is the acceptability target for the measure?

For **zoning action**, **comprehensive planning**, and **corridor study** projects in ***all land use area types***, the following transit stop amenities should be provided based on transit ridership:

Stops with high ridership (50+ existing or future boardings per day): An ADA-compliant bus shelter and pad with a trash can* may be installed for stops with 50 or more boardings per day (look at boardings within the past year), at a transit center or a park-and-ride lot owned by Fairfax County, or at a major activity center.

Stops with medium ridership (25+ existing or future boardings per day): Benches with pads may be installed for stops with 25 or more boardings per day, at a transit center or park-and-ride lot owned by Fairfax County, at a major activity center, or if the stop is located near significant populations of seniors, the disabled, students, or other special uses (e.g., tourist attractions).

*Waste receptacles can also be installed at all stops where there is a demonstrated issue with littering.

Note: The amenities described above may still be provided even if ridership threshold is not met subject to approval of the zoning reviewer.

How is the measure used?

Ridership is a key performance indicator and input for planning activities and transit amenity and operational decision-making. This measure can be used to prioritize transit stops for stop-level amenities that improve comfort and accessibility.

How is the measure calculated?

Step 1:
Determine what transit stops are in the study area using the following method:

For zoning action and SSPAs: Calculate 0.25- and 0.5-mile buffers (i.e., radii) around the site. Transit stops within these buffers are within the analysis area.

As part of the project scoping process, the study area may be extended to include transit stops that connect the site to major nearby generators.

For corridor studies: Include all transit stops along the corridor.

For comprehensive planning (area planning): Include all transit stops within the comprehensive planning area, at a minimum.

Step 2:
Determine if there are transit centers, park-and-ride lots, major activity centers, other special uses (e.g., tourist attractions) or significant populations (refer to Fairfax County Vulnerability Index) near each transit stop.

Confirm presence/absence of these generators and populations during analysis scoping meeting with Fairfax County.

Step 3:
Contact the Transit Services Division (TSD) to request the most current signup weekday average ridership data for stops each stop within the study area. Report highest observed weekday ridership per transit stop.

TSD may provide another representative dataset based on the professional judgement.

Step 4:
Estimate future stop-level ridership if additional transit trips are expected.

For zoning action: Use a trip generation tool like the EPA Mixed-Use Trip Generation Model.

For corridor studies and comprehensive planning: Broadly assess potential transit trip generation and allocate trips to area stops.

For transit-focused corridor studies: Conduct detailed forecasting on a case-by-case basis (FTA's STOPS model is applicable for fixed guideway services only, such as BRT).

What data or tools are needed?

- **Data:**
  - Observed passenger counts (boarding and alightings) from TSD
  - Relevant population data from Fairfax County Vulnerability Index
- **Tools:**
  - Modeling inputs vary by tool

For best results:

- Follow FCDOT's established process for determining site selection for amenities, as outlined in the Fairfax County Transit Strategic Plan (TSP) section *1.2.2 Transit Service Standards*.
- Reference Appendix A(1) of VDOT's Road Design Manual (RDM) for guidance on bus stop design.
- Forecasting can be more time consuming. Reference the EPA website for additional resources and case studies for the mixed-use trip generation model and FTA for the STOPS model. FTA provides technical assistance to agencies developing forecasts using STOPS.

What are example outputs?

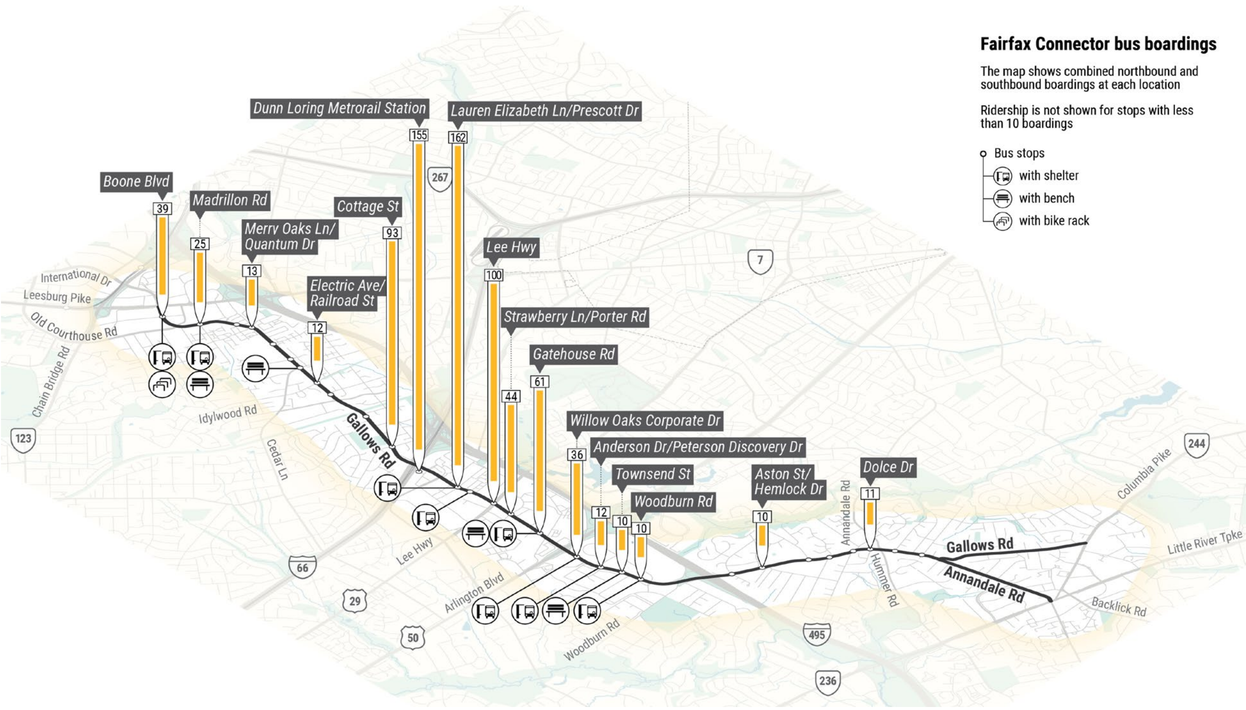


Figure 4. Transit ridership map.

Pedestrian Level of Comfort/Gap Analysis

What types of studies should use the measure?

Comprehensive planning ▣ Zoning actions ▣ Corridor studies ▣

What is the measure?

Pedestrian Level of Comfort (PLOC) measures a pedestrian's perception of comfort based on surrounding conditions. PLOC scores can be assigned to pathways/sidewalks, controlled crossings, and uncontrolled crossings.

What does it measure?

Comfort ▣ Safety ▣ Operations ☐ Access ▣ Utilization ☐

What is the acceptability target for the measure?

The measure develops ratings for pathways, sidewalks, and crossings that are based on facility characteristics including pathway width, posted speed limit, buffer width, presence of on-street parking, crosswalk type, and presence of street trees. There are five ratings that can be assigned to a pathway, sidewalk, or crossing. These ratings are:

- PLOC 1 (Very Comfortable)
- PLOC 2 (Comfortable)
- PLOC 3 (Somewhat Comfortable)
- PLOC 4 (Uncomfortable)
- PLOC 5 (No Pathway/ Crossing)

For **comprehensive planning**, and **corridor study** projects in ***all land use area types***, sidewalks, pathways, and crossings should be very comfortable (PLOC 1) or comfortable (PLOC 2).

For **zoning actions**, the existing conditions analysis should include a gap analysis of missing or substandard sidewalks within the analysis area. Substandard sidewalks are sidewalks that do not meet minimum standards per VDOT's Road Design Manual (RDM).

How is the measure used?

The measure is used to identify sidewalks, pathways and crossings that should be upgraded to achieve very comfortable (PLOC 1) or comfortable (PLOC 2) conditions.

Treatment options to improve PLOC for sidewalks, pathways, and crossings include proven safety countermeasures that also improve pedestrian safety (e.g., implementing lower speed limits, reduced crossing distance, high-visibility crossings, pedestrian refuges).

How is the measure calculated?

Step 1:
Determine what streets are within the study area.

For zoning actions and SSPAs: Calculate 0.25-mile buffer (as the crow flies) around the site perimeter. Streets within the buffer are within the analysis area.

As part of the project scoping process, the study area may be extended to include routes that connect the site to major nearby generators.

For corridor studies:
Include all streets within the corridor study area.

For comprehensive planning: Include all streets within the comprehensive planning area.

Step 2:
Assign PLOC scores to streets within the study area using the relevant following methods:

For zoning actions:
Use existing conditions analysis to identify gaps (i.e., missing/substandard sidewalks) within the analysis area.

For SSPAs:
Calculate PLOC scores for streets and crossings within the study area based on pathway/roadway characteristics and the County's preferred PLOC method.

For corridor studies:
Calculate PLOC scores for streets and crossings within the study area based on pathway/roadway characteristics and the County's PLOC method.

For comprehensive planning: Calculate PLOC scores for streets and crossings within the study area based on pathway/roadway characteristics and the County's preferred PLOC method.

Other notes:
Assign PLOC scores based on pathway and crossing characteristics and the FCDOT's PLOC method (**Appendix C**).

For combined zoning action/comprehensive planning projects, that applicant should defer to the analysis method for comprehensive planning (i.e., calculate PLOC scores for all streets within the study area).

The pathway PLOC method includes considerations for pathway width, posted speed limit, buffer width, presence of on-street parking and presence of street trees.*

The controlled crossing PLOC method includes considerations for road width, median type, crosswalk type, and posted speed limit.

The uncontrolled crossing PLOC method includes considerations for road width, median type, crosswalk type, and posted speed limit.

*PLOC scores for pathways vary by land use area type, with different scoring tables for area type 1-2 (High – Medium Density) and area type 3-5 (Minor-Low Density and Industrial)

What data or tools are needed

- **Data:** Characteristics of roadways and pedestrian pathways, including pathway width, posted speed limit, buffer width, presence of on-street parking, presence of street trees, road width, median type, and crosswalk type
  - **For zoning action:** Field verification required.
  - **For corridor studies and comprehensive planning:** Analysis may be completed using Fairfax County GIS data and imagery from programs like Google Maps or NearMap but field verification is highly recommended.
- **Tools:**
  - PLOC Tables (**Appendix C**). The latest version of the PLOC tables can be provided by the County during the scoping process.

For best results:

- GIS proficiency required for **corridor studies** and **comprehensive planning efforts**.

What are example outputs?

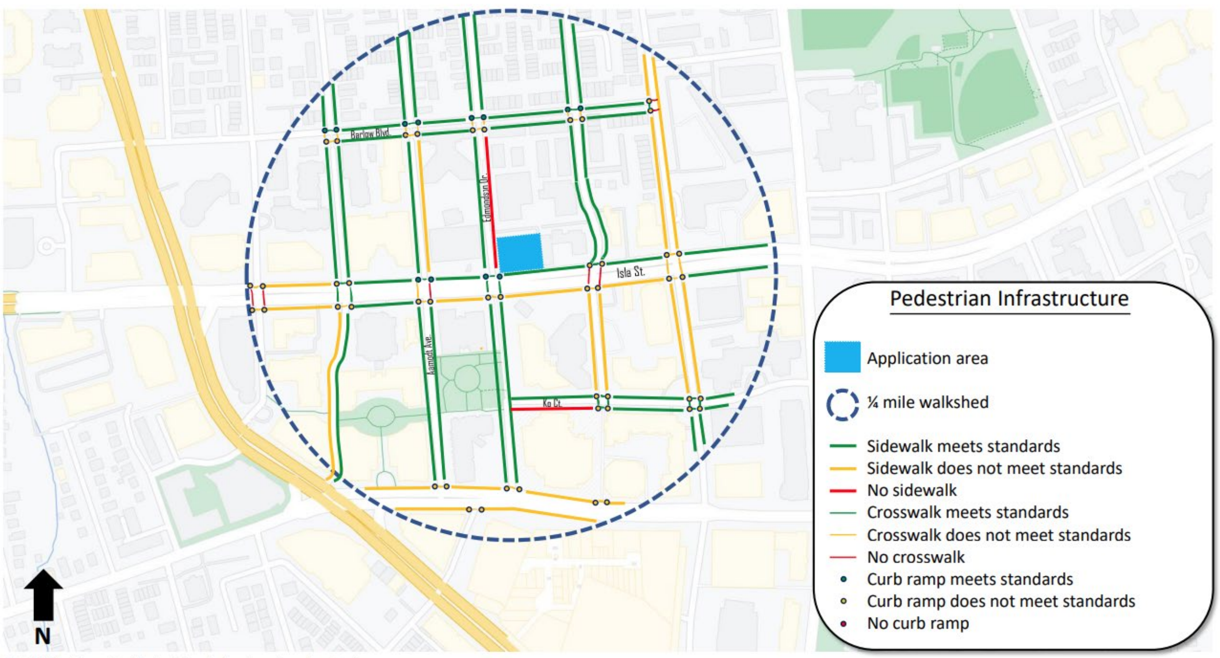


Exhibit 1: Sample Pedestrian Infrastructure Analysis

Figure 5. Pedestrian Gap Analysis for zoning action project.

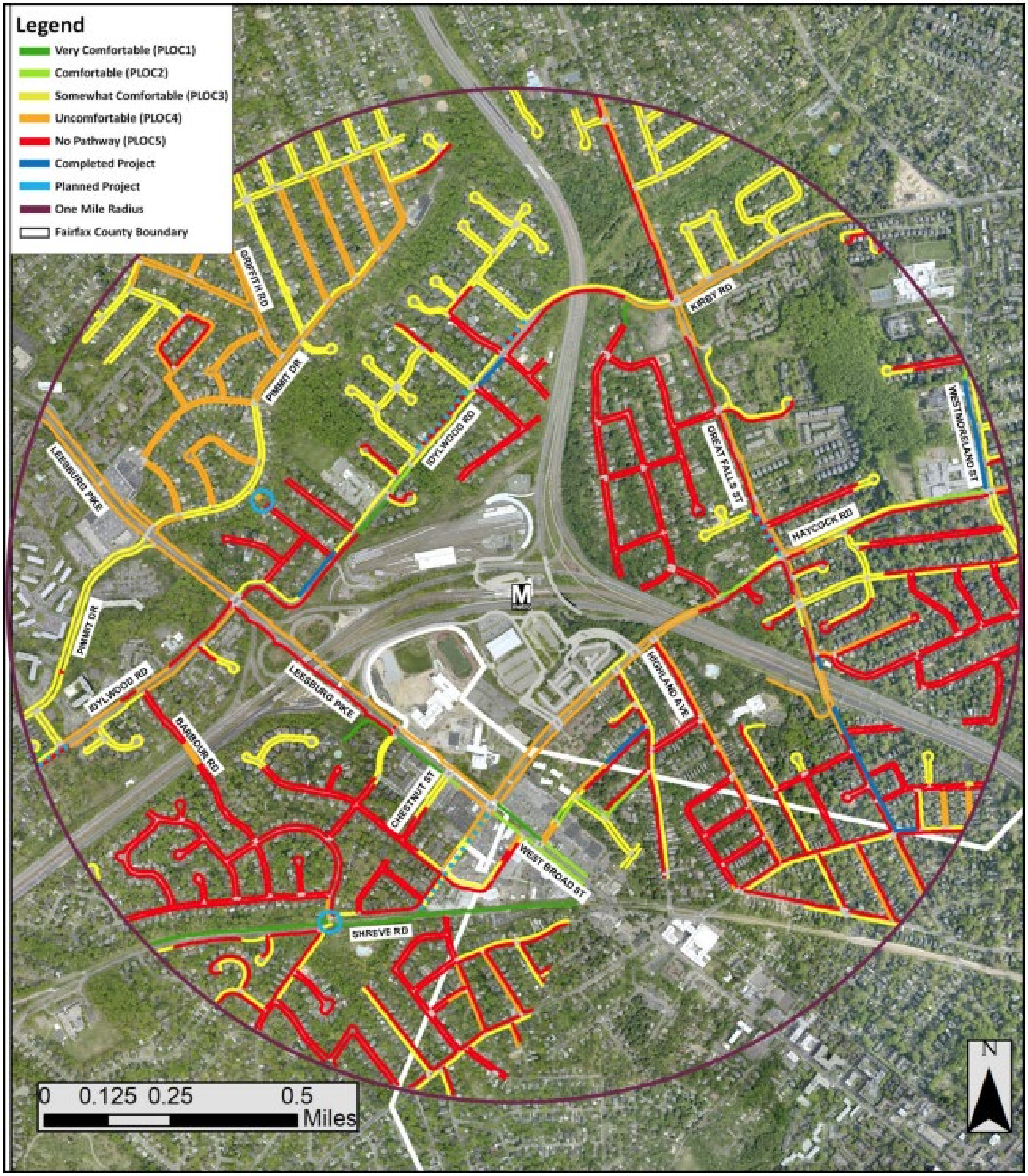


Figure 6. PLOC map for corridor study or comprehensive planning project

Pedestrian Delay

What types of studies should use the measure?

Comprehensive planning ▣ Zoning actions ▣ Corridor studies ▣

What is the measure?

Pedestrian Delay measures the time it takes a pedestrian to wait at a crosswalk of a signalized intersection before crossing the street. The metric is typically reported in seconds of delay per crosswalk.

What does it measure?

Comfort ▣ Safety ☐ Operations ▣ Access ☐ Utilization ☐

What is the acceptability target for the measure?

This measure assesses pedestrian delay at each crosswalk of a signalized intersection. Pedestrian delay changes based on the intersection cycle length, pedestrian walk and flash don't walk time allocated to each pedestrian phase, and pedestrian call mode (i.e., pedestrian recall versus actuated). Pedestrian delay is a function of signal timing and intersection design since larger intersections require longer pedestrian clearance times, which results in longer cycle lengths and therefore longer pedestrian delay.

Increased pedestrian delay is associated with increased likelihood of pedestrian noncompliance (e.g., crossing against the signal):

Pedestrian Delay (seconds/pedestrian)	Likelihood of Noncompliance
< 10	Low
≥ 10–20	
> 20–30	Moderate
> 30–40	
> 40–60	High
> 60	Very high

For **zoning action, comprehensive planning,** and **corridor** studies in ***area types 1 and 2,*** pedestrian delay at study intersections should not exceed 40 seconds per leg at any time of day.

For **zoning action, comprehensive planning,** and **corridor** studies in ***area types 3, 4 and 5***, pedestrian delay at study intersections should not exceed 60 seconds per leg at any time of day.

How is the measure used?

The measure is used to identify signalized intersections where signal timing (e.g., cycle length, pedestrian walk times) or intersection design (e.g., large intersections with longer cycle lengths) should be adjusted to reduce pedestrian delay.

How is the measure calculated?

Step 1: Identify the signalized intersections in the study area during the scoping process using the relevant following method.

For zoning action: Include all signalized intersections in the vicinity of the development site.

For corridor studies: Include all signalized intersections along the corridor.

For comprehensive planning: Include all signalized intersections within the comprehensive planning area.

Step 2: Calculate pedestrian delay per crosswalk in the a.m. peak, p.m. peak, and off-peak at signalized intersections within the study area.

For single-stage crosswalks that are on pedestrian recall, use equation (1) to calculate pedestrian delay. For single-stage crosswalks that use pedestrian actuation, equation (2) can be used to estimate pedestrian delay, which is a good and simple approximation for delay estimation.

$$Pedestrian\ Delay\ with\ Recall = \frac{(Cycle\ Length - g_{Walk})^2}{2 \times Cycle\ Length} \quad (1)$$

$$Pedestrian\ Delay\ with\ Actuation = \frac{Cycle\ Length}{2} \quad (2)$$

where g_{walk} is the effective Walk interval. Highway Capacity Manual 6th Edition (HCM6) suggests including additional Walk time in addition to the actual Walk duration as the effective Walk interval, recognizing many pedestrians still begin their crossing in the first few seconds of the Flashing Don't Walk Duration. HCM6 suggests adding 4 seconds of additional Walk time to the actual Walk duration to calculate g_{walk}.

What data or tools are needed?

- Data: Signal timing

For best results:

- Not required for unsignalized intersections.
- Note that *NCHRP Report 992: Guide to Pedestrian Analysis* includes a new method to calculate pedestrian delay at unsignalized intersections. The additional method is not a required component of this MOE.

What are example outputs?

Table 2. Table reporting pedestrian delay at signalized intersections.

Intersection		Cycle Length(s)		Pedestrian Delay for Crossing Mainline	
		a.m.	p.m.	a.m.	p.m.
1	Chain Bridge and Westmoreland Street	90	130	38.3	58.2
2	Chain Bridge and Ingleside Avenue	90	130	38.3	58.2
3	Old Dominion Drive and Beverly Road	90	130	38.3	58.2
5	Chain Bridge and Laughlin Avenue	90	130	38.3	58.2
6	Chain Bridge and Old Dominion Drive	180	130	55.6	55.8
		180	130	65.9	50.9
7	Dolley Madison Boulevard and Churchill Road	180	180	83.1	83.1
8	Chain Bridge Road and Old Chain Bridge Road*	60.4	71.3	23.6	29.0
9	Chain Bridge Road and Brawner Street	120	130	53.2	58.2
10	Dolley Madison Boulevard and Chain Bridge Road	180	180	83.1	83.1

*Intersection is running free (i.e., no fixed cycle length), therefore cycle length is variable.

Volume-to-Capacity (V/C) Ratio

What types of studies should use the measure?

Comprehensive planning ▣ Zoning actions ☐ Corridor studies ▣

What is the measure?

The **Volume-to-Capacity (V/C) Ratio** assesses whether existing or future motorist demand for a roadway falls below, at, or above roadway capacity. It is calculated by dividing the volume of traffic (existing or future) by the capacity of a roadway or lane(s).

What does it measure?

Comfort ☐ Safety ☐ Operations ▣ Access ☐ Utilization ▣

What is the acceptability target for the measure?

This MOE does not have a specific acceptability target.

Roadways with a v/c ratio below 1.00 are considered to have extra capacity. Roadways with a v/c ratio of 1.00 are at capacity. Although existing vehicle volumes cannot exceed capacity, future (e.g., predicted) volumes can exceed capacity. A roadway with a v/c ratio above 1.00 indicates that more vehicles are anticipated to demand to use the roadway than can be accommodated.

How is the measure used?

The MOE is meant to help identify clear opportunities for cross section reallocation (e.g., roads with low v/c ratios) or opportunities for targeted capacity changes (e.g., roads with v/c ratios at or above 1.0).

How is the measure calculated?

Step 1: Identify streets within the study area using the relevant following method:

For corridor studies: Include all streets within the corridor study area.

For comprehensive planning: Include all streets within the comprehensive planning area.

Step 2: Assess daily and/or peak-hour V/C for analysis scenarios:

- Existing conditions
- Future no-build conditions
- Future build conditions

What data or tools are needed?

- **Data:**
  - Baseline traffic data and turning movement counts
  - Geometric conditions (e.g., lane configuration and number of lanes)
  - Signal timing data
  - Field visit to confirm existing traffic conditions
- **Tools:** Fairfax County and Regional Travel Demand Models

For best results:

- Experience with Fairfax County and MWCOG Travel Demand Models (including experience forecasting future volumes) is required.

What are example outputs?

Table 3. Table comparing peak-hour v/c across roadway segments with the same capacity and different levels of peak-hour motorist demand (i.e., peak-hour volume).

Roadway Segment	Peak-Hour Volume	Capacity	Peak-Hour V/C
Segment A	1762	1292	1.36
Segment B	1409	1292	1.09
Segment C	1057	1292	0.82
Segment D	881	1292	0.68

Motorist Queuing

What types of studies should use the measure?

Comprehensive planning ☐ Zoning actions ▣ Corridor studies ▣

What is the measure?

Motorist Queuing is a measure of the length in feet of typical queues (i.e., lines) of vehicles waiting to be served at an intersection during an analysis period (e.g., peak hour, peak period). This measure reports average (50^{th} percentile) queues. In general, average (50^{th} percentile) queues that exceed available vehicle storage length indicate that motorists experience consistent delays during the analysis period.

What does it measure?

Comfort ☐ Safety ▣ Operations ▣ Access ☐ Utilization ☐

What is the acceptability target for the measure?

This measure assesses whether average (50^{th} percentile) queues exceed available storage length for critical intersections within the study area.

For **zoning action** and **corridor studies** in ***area types 1, 2, and 3*, **average queues at critical intersections should not spill back to upstream intersections outside of the peak hour.

For **zoning action** and **corridor studies** in ***area types 4 and 5***, average queues at critical intersections should not spill back to upstream intersections at any time.

How is the measure used?

Motorist queueing helps to define the level of delay experienced by motorists at intersections. The measure is used to identify intersections where signal timing (e.g., cycle length, phase splits) or intersection design (e.g., turn lane storage lengths) should be adjusted to reduce average queues. The measure may also be used to identify potential safety issues if queues extend beyond turn lanes or into upstream intersections. For projects that include transit corridors, this measure helps determine how the delay impacts person throughput. It is used to identify intersections and corridors where transit improvements (e.g., transit signal priority, queue jumps, dedicated transit lanes) should be implemented to reduce delay for transit riders.

How is the measure calculated?

Step 1: Identify intersections in the study area during the scoping process, using the following relevant method:

For zoning action: Select critical intersections within the vicinity of the development site.

For corridor studies: Select critical intersections along the corridor.

Step 2: Determine which traffic analysis software tool should be used to measure future queues (e.g., Synchro, SimTraffic, VISSIM, SIDRA).* Confirm appropriate tools during analysis scoping meeting with Fairfax County.

*For VDOT TIA projects, reference the latest edition of the VDOT Traffic Operations and Safety Analysis Manual (TOSAM) for guidance on analysis tools.

Step 3: Calculate average vehicle queues at intersections within the study area consistent with the latest edition of the *Highway Capacity Manual* for the following time periods:

For zoning action: Peak Hours – with the option to extend to shoulder hours if the Peak Hour(s) experience excessive queuing.

For corridor studies: Peak Periods (3 hours per peak period – report queues for each hour)

What data or tools are needed?

- **Data**
    - Baseline traffic data and turning movement counts
    - Geometric conditions (e.g., lane configuration and number of lanes)
    - Signal timing data
    - Field visit to vet existing traffic conditions
- **Tools**
    - Analysis tools selected by the County during the scoping process; example tools include Synchro, SimTraffic, VISSIM, and SIDRA
    - The Fairfax County and Regional Travel Demand Model may be used to predict future volumes

For best results:

- Experience with selected software tools required.
- Experience with Fairfax County and Regional Travel Demand Models may be required.

What are example outputs?

Figure 7. Figure reporting critical intersection queueing in the p.m. peak hour.

Note: Figure 7 is an example of how to express queues graphically, but a table is sufficient in most cases.

Vehicle Miles Traveled (VMT)

What types of studies should use the measure?

Comprehensive planning ▣ Zoning actions ☐ Corridor studies ▣

What is the measure?

The **Vehicle Miles Traveled (VMT)** measure reports the total number of miles driven in vehicles on County roadways.

What does it measure?

Comfort ☐ Safety ☐ Operations ▣ Access ☐ Utilization ▣

What is the acceptability target for the measure?

This measure does not have a specific acceptability target.

How is the measure used?

This measure is used to understand how countywide daily vehicle travel (in vehicle miles of travel per capita) could change because of the proposed project (i.e., order of magnitude increase or decrease). This in turn will help county staff understand how the project could advance the County's broader multimodal travel and environmental goals.

How is the measure calculated?

Step 1: Use the Fairfax County and MWCOG Travel Demand Model to estimate daily VMT and traffic volumes in the County. Use the model to estimate VMT specific to a corridor or comprehensive plan area, as well as total countywide VMT for analysis scenarios:

- Existing conditions
- Future no-build conditions (assumes no change to existing transportation infrastructure, and includes projected increases in traffic and population, consistent with the Comprehensive Plan)
- Future build conditions

Step 2: Combine AMVMT (Vehicle Miles Traveled during the a.m. peak period), OPVMT (Vehicle Miles Traveled during off-peak hours), and PMVMT (Vehicle Miles Traveled during the p.m. peak period) for each scenario to determine total daily VMT.

Step 3: Compare percent change in daily VMT.

What data or tools are needed?

- **Tools:**
  - Fairfax County and Regional Travel Demand Models
- **Data**
  - Baseline traffic data and turning movement counts
  - Geometric conditions (e.g., lane configuration and number of lanes)

For best results:

- Experience with Fairfax County and MWCOG Travel Demand Models may be required.

What are example outputs?

Table 4. Sample table reporting expected changes in a.m. peak period, off-peak, p.m. peak period, and total daily VMT by analysis scenario.

Alternative	Vehicle Miles Traveled during the a.m. peak period (AMVMT) (millions)	Vehicle Miles Traveled during off-peak hours (OPVMT) (millions)	Vehicle Miles Traveled during the p.m. peak period (PMVMT) (millions)	Total Daily VMT (millions)
Existing	5.06	12.54	4.40	22
Future No-Build	6.44	15.96	5.60	28
Future Build – Scenario A	5.06	12.54	4.40	22
Future Build – Scenario B	4.6	11.4	4.00	20
Future Build – Scenario C	4.14	10.26	3.60	18
Future Build – Scenario D	6.9	17.1	6.00	30
Future Build – Scenario E	4.14	10.26	3.60	18

Vehicle Delay

What types of studies should use the measure?

Comprehensive planning ▣ Zoning actions ▣ Corridor studies ▣

What is the measure?

Vehicle Delay is the average delay vehicles experience at a given intersection (signalized or unsignalized). Vehicle delay is typically reported in seconds per vehicle. This measure aligns with Level of Service: a qualitative measure, typically reported as a letter grade, which describes how motorists experience delay. The CTA does not include reporting of LOS letter grades due to the potential for public perception of a poor letter grade that may in fact translate to vehicle delay that is appropriate for a given area's context.

What does it measure?

Comfort ☐ Safety ☐ Operations ▣ Access ☐ Utilization ☐

What is the acceptability target for the measure?

General delay classifications for signalized intersections include:

- **Less than 55 seconds of delay:** Free flow to stable intersection operations.
- **55 seconds of delay or more:** More vehicles may access the intersection than can be processed. As seconds of delay increase, motorists may experience unstable operations and substantial delay.

General delay classifications for unsignalized intersections include:

- **Less than 35 seconds of delay:** Free flow to stable intersection operations.
- **35 seconds of delay or more:** More vehicles may access the intersection than can be processed. As seconds of delay increase, motorists may experience unstable operations and substantial delay.

For **zoning action, comprehensive plans**, and **corridor studies** in ***area type 1*****,** peak period intersection delay at critical signalized intersections may not exceed 150 seconds of delay. Peak period intersection delay at critical unsignalized intersections may not exceed 120 seconds of delay.[3]

For **zoning action, comprehensive plans**, and **corridor studies** in ***area type 2*****,** peak period intersection delay at critical signalized intersections may not exceed 80 seconds of delay. Peak period intersection delay at critical unsignalized intersections may not exceed 50 seconds of delay.

For **zoning action, comprehensive plans**, and **corridor studies** in ***area types 3, 4, and 5*****,** peak period intersection delay at critical signalized intersections may not exceed 55 seconds of

[3] Preexisting agreements with VDOT about vehicle delay metrics in Tysons Corner supersede these acceptability targets.

delay. Peak period intersection delay at critical unsignalized intersections may not exceed 35 seconds of delay.

How is the measure used?

This measure helps to define the level of delay experienced by motorists at intersections. The measure is used to identify intersections where signal timing (e.g., cycle length, phase splits) or intersection design (e.g., turn lane storage lengths) should be adjusted to reduce intersection delay.

For projects that include transit corridors, this measure also helps assess the impacts of vehicle delay on person throughput. It is used to identify intersections and corridors where transit improvements (e.g., transit signal priority, queue jumps, dedicated transit lanes) should be implemented to reduce delay for transit riders.

How is the measure calculated?

Step 1: Identify intersections in the study area during the scoping process, using the following relevant method:

For zoning action: Select critical intersections within the vicinity of the development site.

For corridor studies: Select critical intersections along the corridor.

For comprehensive planning: Select critical intersections within the study area.

Step 2: Determine which traffic analysis software tool should be used to measure intersection delay (e.g., Synchro, VISSIM)* Confirm appropriate tools during analysis scoping meeting with Fairfax County.

*For VDOT TIA projects, reference the latest edition of the VDOT Traffic Operations and Safety Analysis Manual (TOSAM) for guidance on analysis tools.

Step 3: Calculate average, movement, and approach intersection delay at intersections within the study area consistent with the latest edition of the *Highway Capacity Manual* for the following time periods:

For zoning action: Use peak hours (one hour per peak), with the option to extend to shoulder hours if the peak hour(s) exceed the relevant acceptability target.

For corridor studies and comprehensive planning: Use peak periods (3 hours per peak period – report delay for each hour).

What data or tools are needed?

- **Data:**
  - Baseline traffic data and turning movement counts
  - Geometric conditions (e.g., lane configuration and number of lanes)
  - Signal timing data
  - Field visit to vet existing traffic conditions
- **Tools:**
  - Analysis tools selected by the County during the scoping process; example tools include Synchro, VISSIM, and SIDRA*

    *For VDOT TIA projects, reference the latest edition of the VDOT Traffic Operations and Safety Analysis Manual (TOSAM) for guidance on analysis tools.
  - The Fairfax County and Regional Travel Demand Model may be used to predict future volumes

For best results:

- Experience with selected software tools is required (e.g., Synchro, VISSIM, SIDRA).
- Experience with Fairfax County and Regional Travel Demand Models may be required.

What are example outputs?

Table 5. Sample table reporting critical intersection delay in the a.m. and p.m. peak hour.

Intersection Information			A.M. Peak Hour		P.M. Peak Hour	
			Existing	Comp Plan	Existing	Comp Plan
	Intersection	Traffic Control	Delay (sec)	Delay (sec)	Delay (sec)	Delay (sec)
1	Intersection A	Signalized	24.9	56.4	37.6	73.6
2	Intersection B	Signalized	10.3	13.0	18.6	22.5
3	Intersection C	Signalized	9.5	16.1	23.5	33.4
4	Intersection D	AWSC	10.7	16.8	18.7	30.6
5	Intersection E	Signalized	3.8	8.2	16.5	13.6
6	Intersection F	Signalized	43.7	56.7	47.1	101.8

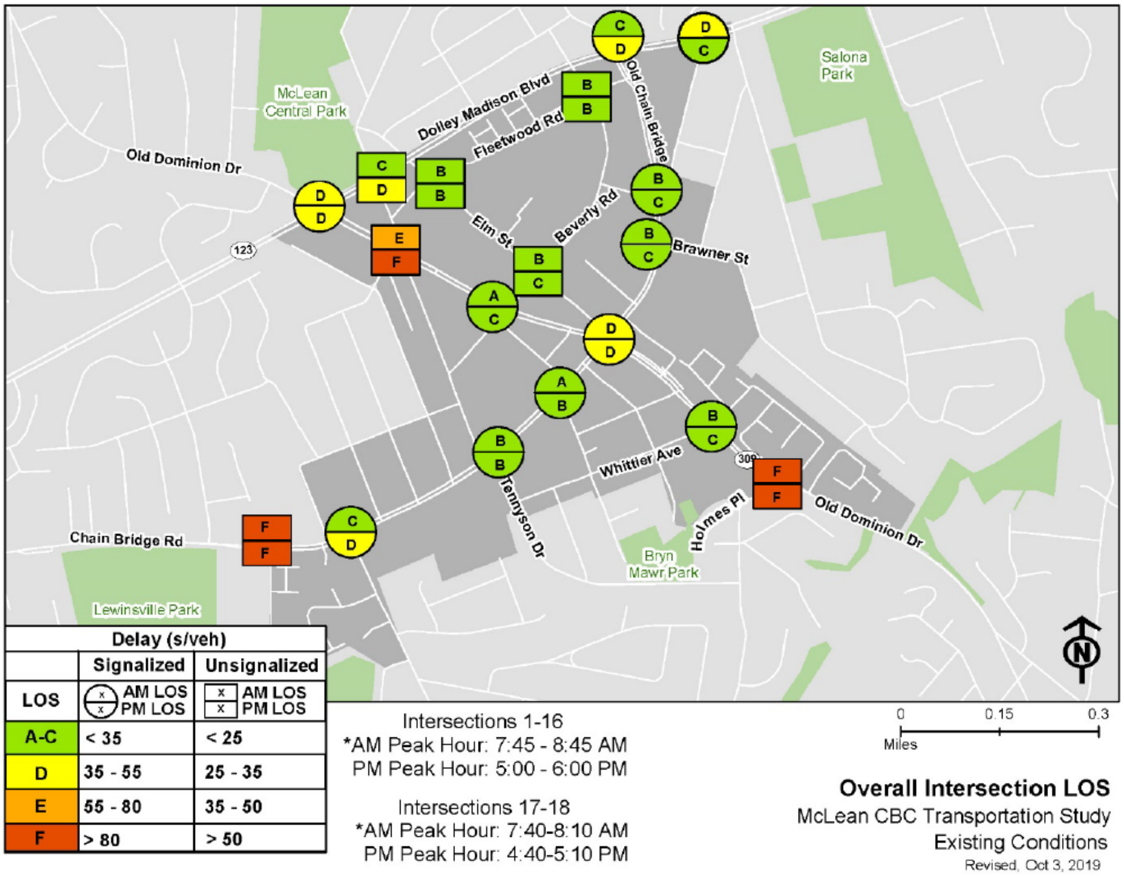


Figure 8. Figure reporting critical intersection delay in the a.m. and p.m. peak hour.

Note: Figure 8 shows LOS letter grades, which are not part of the CTA. The CTA only requires reporting vehicle delay in seconds.

Bicycle Level of Traffic Stress/Gap Analysis

What types of studies should use the measure?

Comprehensive planning ▣ Zoning actions ▣ Corridor studies ▣

What is the measure?

Bicycle Level of Traffic Stress (BLTS) measures how comfortable it is to bicycle on Fairfax County streets and trails based on traffic and roadway characteristics. BLTS scores can be assigned to streets and off-road trails.

What does it measure?

Comfort ▣ Safety ▣ Operations ☐ Access ▣ Utilization ☐

What is the acceptability target for the measure?

The measure develops ratings for road or path segments that are based on a variety of considerations including type of bicycle facility (e.g., physically separated bicycle facilities, bicycle lanes, mixed traffic), street width (through lanes per direction), speed limit, and presence and width of on-street parking. These ratings are:

- **Bicycle Level of Traffic Stress 1:** The street is comfortable for all ages and abilities, including children.
  - These streets are characterized by protected bicycle facilities or low-speed shared streets and very little to no intermingling with vehicular traffic.
- **Bicycle Level of Traffic Stress 2:** The street is tolerated by most adults.
  - While there may be some turning conflicts, cyclists are generally separated from vehicle traffic through bicycle facilities. These streets require more attention from riders compared to LTS 1 streets and may not be suitable for children.
- **Bicycle Level of Traffic Stress 3:** These streets are suitable for some experienced adults.
  - These streets are characterized by bicycle lanes next to multilane vehicular traffic with high traffic volumes and speeds. They can also include shared lanes on streets that are not multilane and experience moderate speeds and traffic volumes.
- **Bicycle Level of Traffic Stress 4:** These streets are only tolerated by the most experienced and able-bodied riders.

For **comprehensive planning**, and **corridor study** projects in ***all land use area types***, streets and trails should be low stress (BLTS 1 or BLTS 2).

For **zoning actions**, the existing conditions analysis should include a gap analysis of missing or substandard bicycle facilities within the analysis area. Substandard bicycle facilities are bicycle facilities that do not meet minimum standards per VDOT's Road Design Manual (RDM).

How is the measure used?

The measure is used to identify streets that should be upgraded to achieve low-stress (BLTS 1 or BLTS 2) conditions.

Treatment options to improve BLTS include proven safety countermeasures that also improve bicyclist safety (e.g., implementing lower speed limits and/or separated bicycle facilities).

How is the measure calculated?

Step 1: Determine what streets are within the study area.

For zoning actions and SSPAs: Calculate 0.5-mile buffer (as the crow flies) around the site perimeter. Streets within the buffer are within the analysis area.

As part of the project scoping process, the study area may be extended to include routes that connect the site to major nearby generators.

For corridor studies: Include all streets within the corridor study area.

For comprehensive planning: Include all streets within the comprehensive planning area.

Step 2: Assign Bicycle LTS scores to streets within the study area using the relevant following method:

For zoning actions: Use existing conditions analysis to identify gaps (i.e., missing/substandard bicycle facilities) within the analysis area.

For SSPAs: Calculate BLTS scores for streets and crossings within the study area based on bicycle facility/roadway characteristics and the County's preferred BLTS method.

For corridor studies: Calculate Bicycle LTS scores for streets within the study area based on bicycle facility/roadway characteristics and the County's preferred BLTS method.

For comprehensive planning: Calculate Bicycle LTS scores for streets within the study area based on bicycle facility/roadway characteristics and the County's preferred LTS method.

Other notes:

Assign Bicycle Level of Traffic Stress scores based FCDOT's BLTS method (**Appendix D**).

For combined zoning action/comprehensive planning projects, that applicant should defer to the analysis method for comprehensive planning (i.e., calculate Bicycle LTS scores for all streets within the study area).

What data or tools are needed?

- **Data:** Roadway and bicycle facility characteristics including roadway width, posted speed limit, bicycle facility presence, bicycle facility type, and on-street parking presence
  - **For zoning action:** Field verification required
  - **For corridor studies and comprehensive planning:** Analysis completed using Fairfax County GIS data and imagery from programs like Google Maps or NearMap; could need field verification if images are outdated
- **Tools:**
  - Bicycle LTS Tables (**Appendix D**). The latest version of the County's preferred BLTS tables can be provided by the County during the scoping process.

For best results:

- GIS proficiency is required for **corridor studies** and **comprehensive planning** efforts.

What are example outputs?

Table 6. Sample table reporting BLTS by percentage of roadway miles.

	Existing Conditions BLTS	2045 Future Baseline Comprehensive Plan BLTS
LTS 1 – Most Comfortable	30.5%	32.1%
LTS 2 – Somewhat Comfortable	20.3%	35.5%
LTS 3 – Less Comfortable	27.1%	21.8%
LTS 4 – Use Caution	22.0%	10.5%

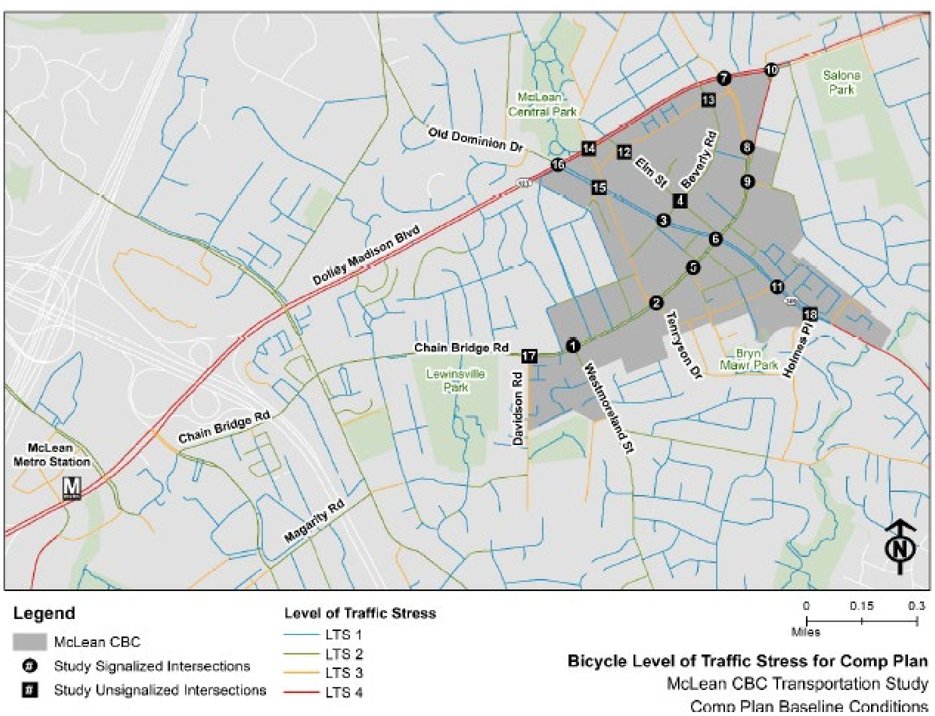


Figure 9. Bicycle Level of Traffic Stress Map.

Crashes

What types of studies should use the measure?

Comprehensive planning ☐ Zoning actions ☐ Corridor studies ▣

What is the measure?

This measure reports expected percent change in total crashes and crash frequency by crash severity (i.e., fatality, severe injury, moderate injury, minor injury, and property damage only).

What does it measure?

Comfort ☐ Safety ▣ Operations ☐ Access ☐ Utilization ☐

What is the acceptability target for the measure?

This measure does not have a specific acceptability target.

How is the measure used?

This measure is used to investigate and identify roadway configurations that can substantially minimize the expected frequency and severity of crashes for along a study corridor.

How is the measure calculated?

Two potential approaches for evaluating changes in expected crashes include:

Crash Modification Factors (CMF)

- Less data and time intensive
- Can be applied to all street types for which appropriate CMFs are available
- Uses five years of crash data, VDOT-preferred Crash Modification Factors*, and Virginia traffic crash costs to estimate the decrease in crashes and comprehensive crash costs as a result of cross section changes or intersection safety improvements

  * If VDOT-preferred CMFs are not available, work with VDOT to identify acceptable CMFs (e.g., new CMFs for separated bicycle lanes)
  No more than three CMFs should be applied to a crash.

AASHTO *HSM* Part C Predictive Method

- More data and time intensive
- Can be applied to urban and suburban arterials
- Use *HSM* Spreadsheet Tools to compare expected crash frequencies for the existing and proposed roadway configuration on the study corridor. The method relies on safety performance functions (SPF) that estimate expected average motor vehicle crash frequency as a function of traffic volume, roadway characteristics, and observed crash history

What data or tools are needed?

- Data
  - CMF Approach
    - Crashes (most recent five years) (GIS data and crash reports)
  - AASHTO *HSM* Part C Approach:
    - Crashes (most recent three years) (GIS data and crash reports)
      - Crashes are only needed if the fundamental geometry of the roadway will not change (e.g., no new travel lanes)
    - Roadway geometry (width, on-street parking, medians)
    - Posted speed limit
    - Intersection geometry and signal timing (number of approaches, signal phasing)
    - User demand (AADT, pedestrian crossing volumes)
    - Miscellaneous roadway characteristics (lighting, speed enforcement, driveway frequency, bus stops, schools, alcohol establishments, fixed-object density, offset to fixed objects)
- Tools
  - CMF Approach
    - The CMF Clearinghouse (www.CMFClearinghouse.com) provides resources to develop and apply appropriate combinations of CMFs
  - AASHTO *HSM* Part C:
    - *HSM* Urban and Suburban Arterials Spreadsheet v3.2 For best results:
- The *HSM* Part C—Predictive Model requires time-intensive data collection and entry.

What are example outputs?

Table 7. Sample table reporting total expected crash reduction at corridor intersections by crash severity over a 20-year period

Location	PDO or O Crashes* (Reduction)	B+C Crashes* (Reduction)	K+A Crashes* (Reduction)
Road A	4.99	1.35	-
Road B	52.41	16.29	1.11
Road C	11.02	3.89	0.65
Road D	12.69	4.48	0.75
Road E	14.33	6.57	-
Road F	16.12	3.58	1.19
Road G	7.12	3.77	0.42

*PDO (Property Damage Only), O (No Injury), B (Minor/Possible Injury), C (Moderate Injury), K (Fatality), A (Serious Injury).

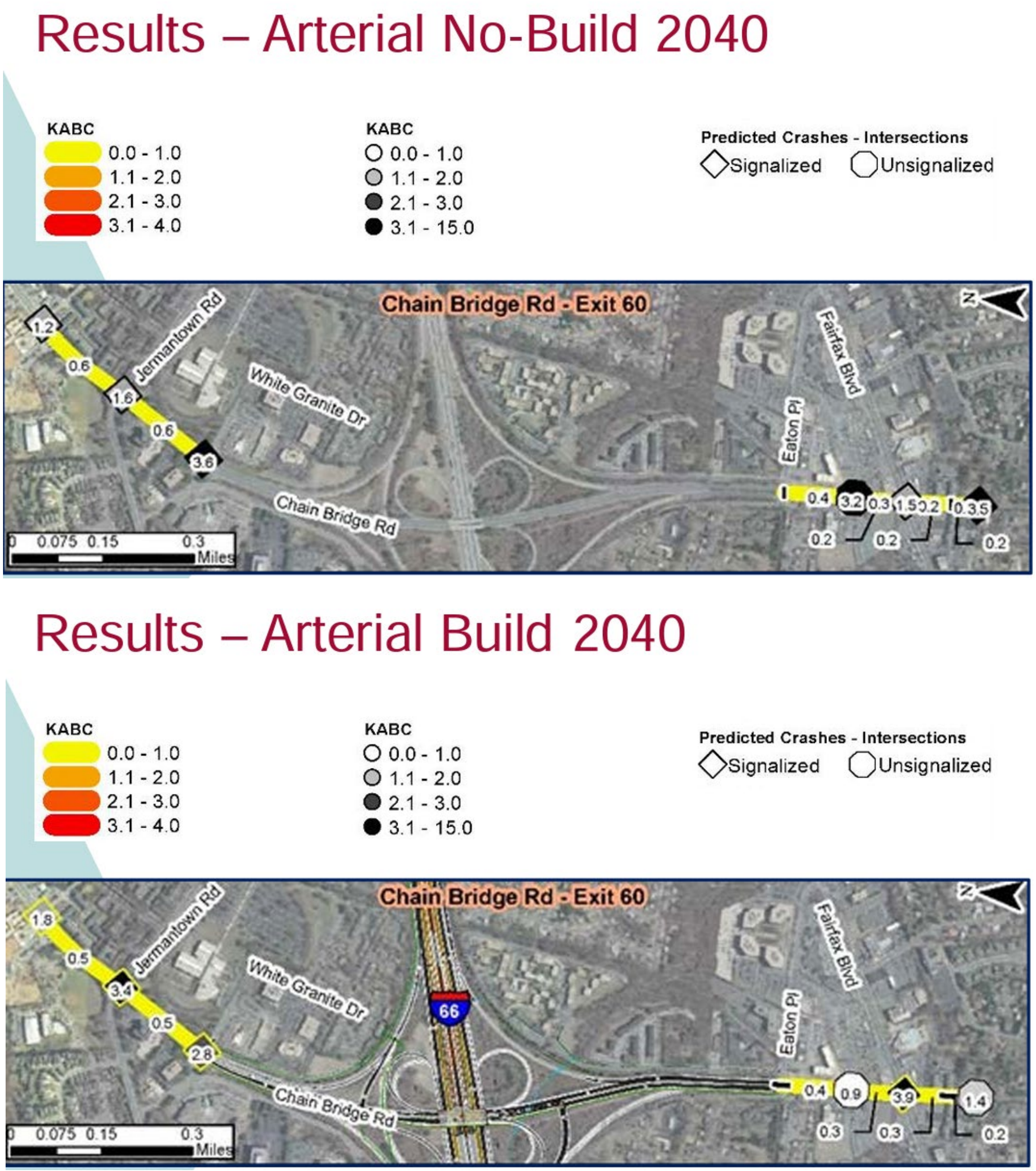


Figure 10. Maps comparing predicted corridor crash frequencies by crash severity.

4

How to Present the Results

Chapter 4

How to Present the Results

Fairfax County has provided a template that streamlines the display of analysis results. With the completed results report, the project team can easily communicate the results of the CTA.

This chapter offers guidance on compiling the CTA results from the analysis conducted in Chapter 3 into a **results report**.

When populated, the **results report** organizes the analysis results in a way that makes clear whether they are acceptable for the selected project type. Beyond this, and as detailed in Chapter 5, the results report can act as a launching pad to process conclusions, form recommendations and next steps, and identify needed discussions around mitigation.

Table 8 provides a template for completing the CTA results report.

Completing the Results Report

1. Each MOE, as defined by the County, is listed in Column 1. The targets for each measure, as defined in the individual MOE summary sheets, should be placed in Column 3.

   Some targets may vary depending on land use area type, project type, and scoping discussions between the County and applicant.

2. The level of importance assigned to each MOE (Column 2) varies based on modal emphasis within the project's land use area type. Levels of priority (higher or lower) are defined in the codification of the area type structure and modal emphasis section of Chapter 2.

   Column 2 should be completed according to the area type the project is located within and the modal emphases confirmed in the scoping process. Some measures may not apply depending on the project type and should be labeled N/A.

   Reference the individual MOE summary sheets or scoping process documentation to determine which measures apply for each project type.

3. For the applicable MOEs that are of higher priority, the results (Column 4) should meet the targets.
4. After the results report table is complete, proceed to Chapter 5 for guidance on what to do with the results, including interpreting the results and, if necessary, developing mitigation plans and re-running the CTA analysis.

If any higher-priority MOEs do not meet their targets, the County/applicant should develop a mitigation plan that addresses the shortcoming(s).

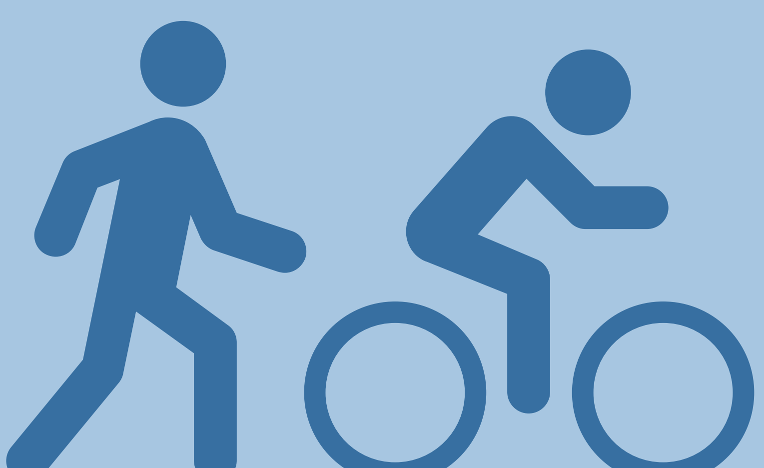
For MOEs in lower-modal emphases, the County/applicant should coordinate to determine if a mitigation plan is necessary. For further guidance on deciding what to do with the results, reference Chapter 5.

Table 8. Fairfax County Comprehensive Transportation Analysis (CTA) Results Report

Measure	Priority Level	Target	Result
Transit Access	☐ Higher ☐ Lower ☐ N/A		☐ Meets target ☐ Does not meet target
Stop-Level Transit Ridership	☐ Higher ☐ Lower ☐ N/A		☐ Number of boardings per day:____________
Pedestrian Level of Comfort/Gap Analysis	☐ Higher ☐ Lower ☐ N/A		☐ Meets target ☐ Does not meet target
Pedestrian Delay	☐ Higher ☐ Lower ☐ N/A		☐ Meets target ☐ Does not meet target
V/C Ratio	☐ Higher ☐ Lower ☐ N/A		☐ V/C ratio:____________
Motorist Queueing	☐ Higher ☐ Lower ☐ N/A		☐ Meets target ☐ Does not meet target
Vehicle Miles Traveled	☐ Higher ☐ Lower ☐ N/A		☐ Change in VMT: _______
Vehicle Delay	☐ Higher ☐ Lower ☐ N/A		☐ Meets target ☐ Does not meet target
Bicycle Level of Comfort/Gap Analysis	☐ Higher ☐ Lower ☐ N/A		☐ Meets target ☐ Does not meet target
Crashes	☐ Higher ☐ Lower ☐ N/A		☐ Percent change in total crashes and crash frequency by crash severity: ____________

5

How to Complete a CTA



Chapter 5

How to Complete a CTA

The final steps of the CTA process will depend on the outcome of analysis. Below, Fairfax County has provided materials and a step-by-step framework that applicants can use to make the most of their analysis.

This chapter presents a decision-making framework that can be applied to the outcome of analysis results. With a clear picture of the outcome from analysis results, County staff can use this framework to:

- Interpret results and develop recommendations for the project.
- Provide guidance on next steps for non-conforming MOEs, including steps to develop any mitigation plans or to revise analysis of a given project type (whether comprehensive planning, corridor study, or zoning action).

Overall CTA Results Decision-Making Framework

With analysis outputs completed and documented in the **results report** found in Chapter 4, the effort may be classified into one of three outcomes:

- All measures meet the defined targets.
- One or more higher-priority MOEs do not meet their targets.
- One or more lower-priority MOEs do not meet their targets.

If all targets have been achieved, the CTA is considered complete. However, additional follow-up is required if targets are not achieved. Next steps for each of these scenarios are provided below.

- ☐ All measures meet the defined targets.
  - The CTA is complete.
- ☐ One or more higher-priority MOEs do not meet their target.
  - **Corridor studies and comprehensive planning**
    - List non-conforming higher-priority measures from Chapter 4's results report.
    - Develop a proposed mitigation plan for each higher-priority measure in the list.

- Consider the impact of the proposed mitigation plan on all measures and rerun the CTA analysis for each affected MOE. As an example, if a project does not meet the Bicycle Level of Traffic Stress or Pedestrian Level of Comfort MOE, a proposed mitigation plan could be to provide an additional facility for people biking or walking. If the proposed mitigation reallocates space away from motor vehicles, that could impact other vehicular MOEs. Staff should update the CTA analysis to incorporate changes from the proposed mitigation for all impacted MOEs.
- Consider tradeoffs of the impacts and reach consensus among County staff on the proposed mitigation.

  - **Zoning action/SSPA**
    - List non-conforming higher-priority measures from the Chapter 4 results report.
    - Develop a mitigation plan for each higher-priority measure in the list.
    - Repeat analysis of all measures impacted by the proposed mitigation.
    - Submit proposed mitigation plans and revised CTA results to County for review.
    - Hold follow-up meeting with the County if proposed mitigation is missing or insufficient to meet County goals.

- ☐ One or more lower-priority MOEs do not meet their target.
  - **Corridor studies and comprehensive planning**
    - Develop potential mitigations.
    - Identify tradeoffs to determine if a mitigation plan should move forward and whether additional analysis is warranted.
  - **Zoning action/SSPA**
    - Coordinate with County staff to determine if any mitigation plans or additional analysis are needed. The requirements for mitigation plans for specific MOEs can also be defined in the scoping process.

The CTA is considered complete when:

1. The project meets all higher-priority MOE targets (or meets the targets as defined during the scoping process); **AND**
2. The County/zoning action applicant develop proposed mitigation plans for any MOEs that do not meet their target. FCDOT will engage VDOT and the public in mitigation decisions.

A

Scoping Form

Appendices

PRE-SCOPE OF WORK MEETING FORM

Comprehensive Transportation Analysis Base Assumptions

FCDOT
Serving Fairfax County Since 1977

The applicant is responsible for entering the relevant information and submitting the form below to FCDOT and VDOT alongside the request to schedule a scoping meeting.

Contact Information			
Consultant Name: Telephone: E-mail:			
Developer/Owner Name: Telephone: E-mail:			
Project Information (Background)			
Project Name:			
Submission Type:	Corridor Study ☐	Zoning Action ☐	Plan Amendment ☐
Area Type:	☐ Area Type 1: Urban Centers and Transit Station Areas ☐ Area Type 2: Suburban Centers and Community Business Centers ☐ Area Type 3: Suburban Neighborhoods ☐ Area Type 4: Low Density Residential ☐ Area Type 5: Industrial Areas		
Modal Emphasis:	Vehicle ☐ Pedestrian ☐	Bicycle ☐	Transit ☐
Project Description: (including details on the project location, land use, acreage, phasing, access location, attach GDP/Plan with Scope if available)			
Project Area Context: (Plan Amendment and Corridor Study Only)	Unique land uses: Special considerations: Opportunities for improving access:		

It is important for the applicant to provide sufficient information to staff so that questions regarding geographic scope, alternate methodology, or other issues can be answered at the scoping meeting.

PRE-SCOPE OF WORK MEETING FORM

Comprehensive Transportation Analysis Base Assumptions

FCDOT Serving Fairfax County Since 1977

Proposed Use(s): (check all that apply; attach additional pages as necessary)	**Residential Uses(s)** Number of Units: _____ ITE LU Code(s): _____ _____ _____ **Commercial Use(s)** ITE LU Code(s): _____ _____ _____ Square Ft or Other Variable(s):	**Other Use(s)** ITE LU Code(s): _____ _____ _____ Independent Variable(s): _____ _____ _____
Trip Generation (Attach table with calculations) ☐		
CTA Type:	Tier 2: (1000-2999 ADT) ☐	Tier 3: (3000-4999 ADT) ☐

Non-Auto Analysis Assumptions

Pedestrian Pathway Locations Quarter Mile Radius (Attach more if necessary)	*e.g. Grocery store, Park, School*	

Pedestrian Level of Comfort/ Gap Analysis – Quarter Mile Radius Location (attach map) ☐

Bicycle Level of Traffic Stress/ Gap Analysis – Half Mile Radius Location (attach map) ☐

Transit Access/ Bus Stop Inventory – Half Mile Radius Location (attach map if different than Bike Gap Map) ☐

Pedestrian Delay Analysis Signalized Intersections (Attach more if necessary)		

It is important for the applicant to provide sufficient information to staff so that questions regarding geographic scope, alternate methodology, or other issues can be answered at the scoping meeting.

PRE-SCOPE OF WORK MEETING FORM

Comprehensive Transportation Analysis Base Assumptions

Auto Analysis Assumptions			
Study Period	Existing Year:	Build-out Year:	Horizon Year:
Study Area Boundaries (attach map) ☐		Trip Distribution (attach map) ☐	
Number of Study Intersections (include site access, identify possible roundabouts, and show on Study Area Boundaries Map)			
External Factors That Could Affect Project (Planned road improvements, other nearby developments)			
Available Traffic Data (Historical, forecasts)			
Annual Vehicle Trip Growth Rate:		Peak Period for Study	☐ AM ☐ PM ☐ SAT ☐ SUN
		Peak Hour of the Generator	
Trip Adjustment Factors	Internal allowance: ☐ Yes ☐ No Reduction: _____% trips	Pass-by allowance: ☐ Yes ☐ No Reduction: _____% trips	
	Proposed TDM reduction: ☐ Yes ☐ No Reduction: _____% trips		
Software Methodology	☐ Synchro ☐ HCS (v.2000/+) ☐ aaSIDRA ☐ CORSIM ☐ Other _____		
Background Traffic Studies Considered			
Safety Analysis Intersections (Attach more if necessary)			
Potential Issues to be Addressed	☐ Queuing analysis ☐ Merge analysis ☐ Other _____	☐ Actuation/Coordination ☐ Bike/Ped Accommodations	☐ Weaving analysis ☐ Waiver/Exception

NOTES ON ASSUMPTIONS: _____

It is important for the applicant to provide sufficient information to staff so that questions regarding geographic scope, alternate methodology, or other issues can be answered at the scoping meeting.

SIGNED: ______________________________ DATE: _____________

Applicant or Consultant

PRINT NAME: ______________________________

Applicant or Consultant

SIGNED: ______________________________ DATE: _____________

FCDOT

PRINT NAME: ______________________________

FCDOT

SIGNED: ______________________________ DATE: _____________

VDOT

PRINT NAME: ______________________________

VDOT

It is important for the applicant to provide sufficient information to staff so that questions regarding geographic scope, alternate methodology, or other issues can be answered at the scoping meeting.

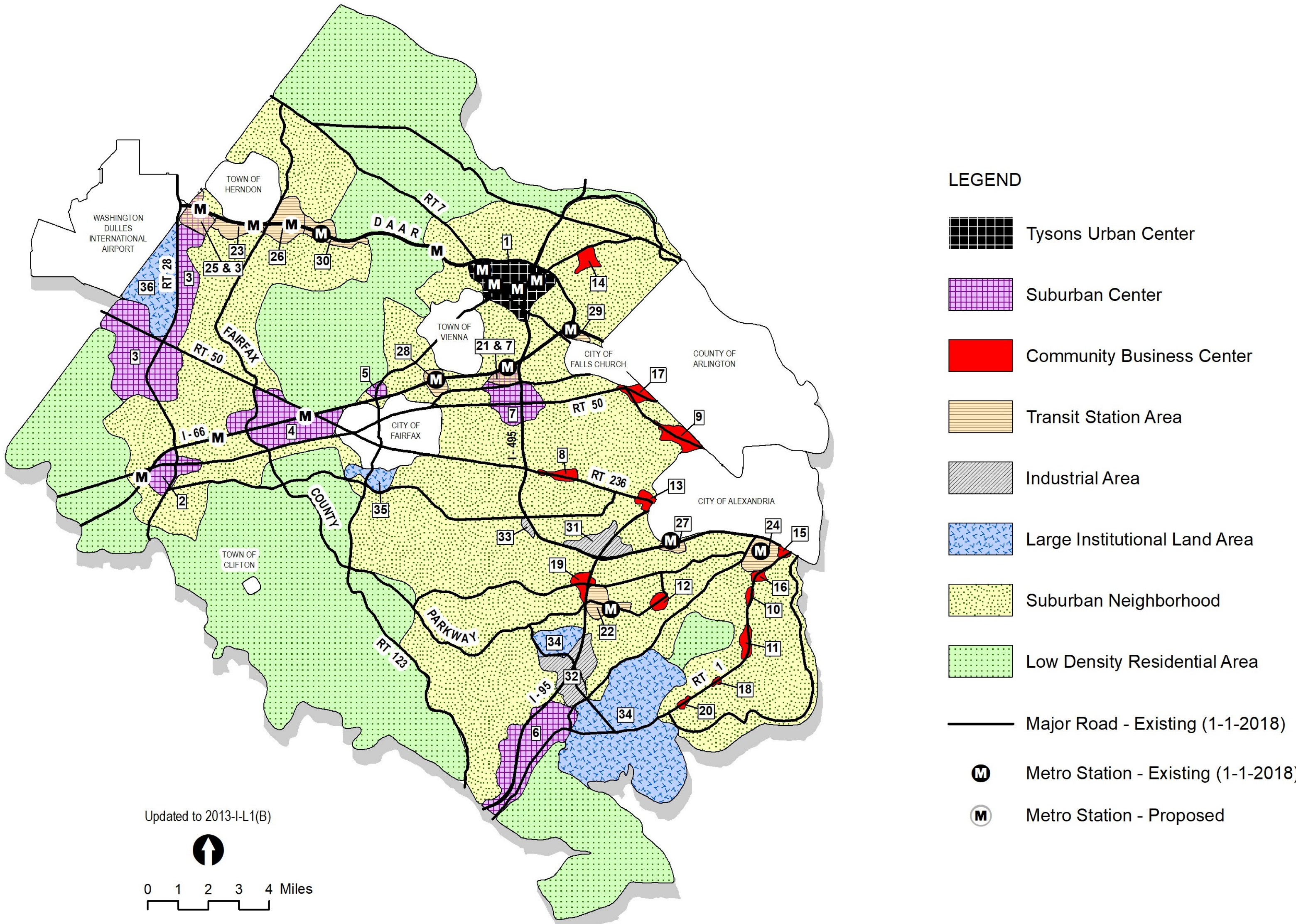
B

Concept for Future Development Map

Appendices

Appendix B

Concept for Future Development Map



Mixed-Use Activity Centers by Area Type

Area type 1

Urban Centers

1. Tysons Urban Center

Transit Station Areas

21. Dunn Loring
22. Franconia-Springfield
23. Herndon
24. Huntington
25. Innovation Center
26. Reston Town Center
27. Van Dorn
28. Vienna
29. West Falls Church
30. Wiehle-Reston East

Area type 2

Suburban Centers

2. Centreville
3. Dulles (Route 28 Corridor)
4. Fairfax Center
5. Flint Hill
6. Lorton-South Route 1
7. Merrifield

Community Business Centers

8. Annandale
9. Baileys Crossroads
10. Beacon/Groveton
11. Hybla Valley/Gum Springs
12. Kingstowne
13. Lincolnia
14. McLean
15. North Gateway
16. Penn Daw
17. Seven Corners
18. South County Center
19. Springfield
20. Woodlawn

Area type 3

Suburban Neighborhoods (see map)

Area type 4

Low-Density Residential (see map)

Area type 5

Industrial Areas

31. Beltway South
32. I-95 Corridor
33. Ravensworth

Other Areas

34. Fort Belvoir (Main Post and North Area)
35. George Mason University
36. Washington Dulles International Airport

C

PLOC Tables

Appendices

Pedestrian Level of Comfort

What is it?

Pedestrian Level of Comfort (PLOC) is a point-based system for rating pedestrian pathways along roadways and roadway crossings based on factors that contribute to or detract from pedestrian comfort. Points are assigned to each variable, added together, and converted to a PLOC score from a range of one, which is considered very comfortable, to four, which is considered uncomfortable. A roadway that lacks a pedestrian facility is assigned a score of PLOC 5. See **Table 1** for the range of scores.

Table 1 PLOC Scale

Level of Comfort
1 = Very Comfortable
2 = Comfortable
3 = Somewhat Comfortable
4 = Uncomfortable
5 = No Pathway/Crossing

What does it measure?

The primary variables included in the PLOC score for pathways are sidewalk width, posted speed limit, buffer width, and presence of parking lane and street trees. Wider pathways improve pedestrian comfort as pedestrians may be able to walk side-by-side, push strollers, or navigate a wheelchair without coming into conflict with other pedestrians. Slower roadway speed limits contribute to pedestrian comfort, as well as wider buffers along the pathway to increase the separation between cars and people. Wider buffers allow for the planting of larger street trees, which can enhance the physical and visual separation between facilities and may provide shade for pedestrians. The presence of on-street parking provides further separation between the pathway and travel lanes.

PLOC scores for roadway crossings must first identify whether the crossing is controlled or uncontrolled before reviewing the appropriate variables: number of lanes that must be crossed, presence and type of median and crosswalk, and posted speed limit.

Additional considerations

Additional elements are also considered, such as bike lanes, painted buffers, vertical barriers, and pedestrian-scale lighting. **Tables 2 and 3** include a list of the base PLOC variables and additional variables, respectively. Additional variables should be included in the PLOC score assessment where data is available. Note that this list is not extensive and there may be other factors that are considered important influences on comfort.

Operational factors at crossings could also affect the PLOC score. The ADA standard for pedestrian crossing speed is 3.5-feet per second. Comfort is negatively affected if the signal timing at a controlled crossing requires a pedestrian to cross at a higher speed. Pedestrian delay may influence comfort based on how long a pedestrian must wait to cross the roadway. Pedestrian delay greater than 40 seconds also results in a higher likelihood of crossing without a walk sign.

High turning volumes, expressed in vehicles per hour (vph), will also cause discomfort. In this report, right turning volumes equal to or greater than 150 vph are considered high. Thresholds for left turning movements depend on the number of opposing lanes crossed as a higher number of lanes can create sight distance issues for pedestrians and drivers. A left turn across one opposing lane has a threshold of 100 vph, and a left turn across two opposing lanes has a threshold of 50 vph. These turning volume thresholds are based on preliminary research from AASHTO's Bikeway Design Guide, so further refinement may be needed.

An operational variable that provides a benefit to pedestrian comfort is the presence of a leading pedestrian interval (LPI). An LPI provides walk time for pedestrians, typically from three to seven seconds, before vehicles get a green signal. Though not widely used, a pedestrian scramble phase would also provide an operational benefit to pedestrians as this allows a pedestrian only phase for crossing.

Table 2 Point Values for Base PLOC Variables

Base PLOC Variables			
Pathways	Pathway width	<5 ft	+2
		5 ft to <6 ft	+1
		6 ft to <8 ft	0
		≥8 ft	-1
	Buffer width	0 ft to <2 ft	+2
		2 ft to <4 ft	+1
		4 ft to <8 ft	0
		≥8 ft	-1
	On-street parking/ street trees	P & ST: No	+2
		P: Yes, ST: No	+1
		P: No, ST: Yes	0
		P & ST: Yes	-1
	Speed limit	≤25 mph	-1
		30 mph	0
		35 mph	+1
		≥40 mph	+2
Crossings	Uncontrolled crossing		+2
	Crossing lanes	2-3	0
		4-5	+1
		6+	+2
	Median type	Raised refuge island	-1
		Raised/ hardened centerline	0
		Painted/ none	+1
	Crosswalk type	High visibility	-1
		Standard	0
		Unmarked	+1

Table 3 Point Values for Additional PLOC Variables

Additional PLOC Variables			
Pathways	No curb		+1
	ADT ≥30k		+1
	Obstructions		+1
	Poor pavement quality		+1
	Vertical barrier (jersey wall)		-1
	Bike lane		-1
Crossings	Crossing speed >3.5' per sec		+1
	Pedestrian delay (seconds)	<20 sec	-1
		>20 and <40 sec	0
		>40 sec	+1
	High turning volumes		+1
	Substandard ramp		+1
	Auto left turn conflict		+1
	Lead ped interval (3-7 sec)		-1

How is it calculated?

Adding together the applicable variables produces an initial score, which is then adjusted to the 4-point PLOC scale (not including "No Pathway" and "No Crossing"). For pathways, a total score equal to or less than -1 is "Very Comfortable"; 0 to 1 is "Comfortable"; 2 to 4 is "Somewhat Comfortable"; and equal to or greater than 5 is "Uncomfortable". For crossings, a total score equal to or less than -2 is "Very Comfortable"; -1 to 0 is Comfortable"; 1 to 2 is "Somewhat Comfortable"; and equal to or greater than 3 is "Uncomfortable". Since there is a higher risk of conflict with a vehicle at crossings, the adjusted comfort scores are slightly different than the pathways scores.

Context is also important when assessing comfort on pathways. Urban areas have more people than areas with lower density, and will therefore need wider pathways to accommodate a higher number of pedestrians. The PLOC methodology accounts for this variance by separating scores into two tables:

- *Urban* – areas that fall within Fairfax County Land Use Tier 1: Tysons and Transit Station Areas and Tier 2: Suburban Centers and Community Business Centers
- *Non-urban* – Fairfax County Land Use Tier 3: Suburban Neighborhoods, Tier 4: Low Density Residential Area, and Tier 5: Industrial

Tables 4-7 show scores for all combinations of the base PLOC variables.

Table 4 Urban Pathway PLOC Scores

Urban Pedestrian Level of Comfort for Pathways (Tier 1-2)

Pathway width	Posted speed limit	Pathway buffer width/ parking lane (P) and street trees (ST)															
		Buffer width: 0 ft to <2 ft				Buffer width: 2 ft to <4 ft				Buffer width: 4 ft to <8 ft				Buffer width: ≥8 ft			
		P & ST: No	P: Yes, ST: No	P: No, ST: Yes	P & ST: Yes	P & ST: No	P: Yes, ST: No	P: No, ST: Yes	P & ST: Yes	P & ST: No	P: Yes, ST: No	P: No, ST: Yes	P & ST: Yes	P & ST: No	P: Yes, ST: No	P: No, ST: Yes	P & ST: Yes
<5ft	≤25 mph	4	3	3	3	3	3	3	2	3	3	2	2	3	2	2	1
	30 mph	4	4	3	3	4	3	3	3	3	3	3	2	3	3	2	2
	35 mph	4	4	4	3	4	4	3	3	4	3	3	3	3	3	3	2
	≥40 mph	4	4	4	4	4	4	4	3	4	4	3	3	4	3	3	3
5ft to <6ft	≤25 mph	3	3	3	2	3	3	2	2	3	2	2	1	2	2	1	1
	30 mph	4	3	3	3	3	3	3	2	3	3	2	2	3	2	2	1
	35 mph	4	4	3	3	4	3	3	3	3	3	3	2	3	3	2	2
	≥40 mph	4	4	4	3	4	4	3	3	4	3	3	3	3	3	3	2
6ft to <8ft	≤25 mph	3	3	2	2	3	2	2	1	2	2	1	1	2	1	1	1
	30 mph	3	3	3	2	3	3	2	2	3	2	2	1	2	2	1	1
	35 mph	4	3	3	3	3	3	3	2	3	3	2	2	3	2	2	1
	≥40 mph	4	4	3	3	4	3	3	3	3	3	3	2	3	3	2	2
≥8ft	≤25 mph	3	2	2	1	2	2	1	1	2	1	1	1	1	1	1	1
	30 mph	3	3	2	2	3	2	2	1	2	2	1	1	2	1	1	1
	35 mph	3	3	3	2	3	3	2	2	3	2	2	1	2	2	1	1
	≥40 mph	4	3	3	3	3	3	3	2	3	3	2	2	3	2	2	1

Level of Comfort
1 = Very Comfortable
2 = Comfortable
3 = Somewhat Comfortable
4 = Uncomfortable
5 = No Pathway

Table 5 Non-urban Pathway PLOC Scores

Non-urban Pedestrian Level of Comfort for Pathways (Tier 3-5)

Pathway width	Posted speed limit	Pathway buffer width/ parking lane (P) and street trees (ST)															
		Buffer width: 0 ft to <2 ft				Buffer width: 2 ft to <4 ft				Buffer width: 4 ft to <8 ft				Buffer width: ≥8 ft			
		P & ST: No	P: Yes, ST: No	P: No, ST: Yes	P & ST: Yes	P & ST: No	P: Yes, ST: No	P: No, ST: Yes	P & ST: Yes	P & ST: No	P: Yes, ST: No	P: No, ST: Yes	P & ST: Yes	P & ST: No	P: Yes, ST: No	P: No, ST: Yes	P & ST: Yes
<5ft	≤25 mph	3	3	3	2	3	3	2	2	3	2	2	1	2	2	1	1
	30 mph	4	3	3	3	3	3	3	2	3	3	2	2	3	2	2	1
	35 mph	4	4	3	3	4	3	3	3	3	3	3	2	3	3	2	2
	≥40 mph	4	4	4	3	4	4	3	3	4	3	3	3	3	3	3	2
5ft to <6ft	≤25 mph	3	3	2	2	3	2	2	1	2	2	1	1	2	1	1	1
	30 mph	3	3	3	2	3	3	2	2	3	2	2	1	2	2	1	1
	35 mph	4	3	3	3	3	3	3	2	3	3	2	2	3	2	2	1
	≥40 mph	4	4	3	3	4	3	3	3	3	3	3	2	3	3	2	2
6ft to <8ft	≤25 mph	3	2	2	1	2	2	1	1	2	1	1	1	1	1	1	1
	30 mph	3	3	2	2	3	2	2	1	2	2	1	1	2	1	1	1
	35 mph	3	3	3	2	3	3	2	2	3	2	2	1	2	2	1	1
	≥40 mph	4	3	3	3	3	3	3	2	3	3	2	2	3	2	2	1
≥8ft	≤25 mph	2	2	1	1	2	1	1	1	1	1	1	1	1	1	1	1
	30 mph	3	2	2	1	2	2	1	1	2	1	1	1	1	1	1	1
	35 mph	3	3	2	2	3	2	2	1	2	2	1	1	2	1	1	1
	≥40 mph	3	3	3	2	3	3	2	2	3	2	2	1	2	2	1	1

Table 6 Controlled Crossing PLOC Scores

Pedestrian Level of Comfort for Controlled Crossings

Number of Lanes	Median Type	Crosswalk Type	Posted Speed Limit			
			≤25 mph	30 mph	35 mph	≥40 mph
1-3	Raised Refuge Island	High-Vis	1	1	2	2
		Standard	1	2	2	3
	Raised Median	High-Vis	1	2	2	3
		Standard	2	2	3	3
	Painted/ None	High-Vis	2	2	3	3
		Standard	2	3	3	4
4-5	Raised Refuge Island	High-Vis	1	2	2	3
		Standard	2	2	3	3
	Raised Median	High-Vis	2	2	3	3
		Standard	2	3	3	4
	Painted/ None	High-Vis	2	3	3	4
		Standard	3	3	4	4
6+	Raised Refuge Island	High-Vis	2	2	3	3
		Standard	2	3	3	4
	Raised Median	High-Vis	2	3	3	4
		Standard	3	3	4	4
	Painted/ None	High-Vis	3	3	4	4
		Standard	3	4	4	4

Level of Comfort
1 = Very Comfortable
2 = Comfortable
3 = Somewhat Comfortable
4 = Uncomfortable
5 = Unmarked

Table 7 Uncontrolled Crossing PLOC Scores

Pedestrian Level of Comfort for Uncontrolled Crossings

Number of Lanes	Median Type	Crosswalk Type	Posted Speed Limit			
			≤25 mph	30 mph	35 mph	≥40 mph
1-3	Raised Refuge Island	High-Vis	1	2	2	3
		Standard	2	2	3	3
	Raised Median	High-Vis	2	2	3	3
		Standard	2	3	3	4
	Painted/ None	High-Vis	2	3	3	4
		Standard	3	3	4	4
4-5	Raised Refuge Island	High-Vis	2	2	3	3
		Standard	2	3	3	4
	Raised Median	High-Vis	2	3	3	4
		Standard	3	3	4	4
	Painted/ None	High-Vis	3	3	4	4
		Standard	3	4	4	4
6+	Raised Refuge Island	High-Vis	2	3	3	4
		Standard	3	3	4	4
	Raised Median	High-Vis	3	3	4	4
		Standard	3	4	4	4
	Painted/ None	High-Vis	3	4	4	4
		Standard	4	4	4	4

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BLTS Tables

Appendices

Bicycle Level of Traffic Stress

What is it?

Bicycle Level of Traffic Stress (BLTS) classifies streets based on how stressful they are to bike along. The metric was originally developed in 2012 by Mekuria, Furth, and Nixon in their paper Low-Stress Bicycling and Network Connectivity[1]. There are four levels of traffic stress, as follows:

- LTS 1: Strong separation from all except low speed, low volume traffic. Simple-to-use crossings. LTS 1 indicates a facility suitable for children.
- LTS 2: Except in low speed / low volume traffic situations, cyclists have their own place to ride that keeps them from having to interact with traffic except at formal crossings. Physical separation from higher speed and multilane traffic. Crossings that are easy for an adult to negotiate. Limits traffic stress to what the mainstream adult population can tolerate, those who are "interested but concerned".
- LTS 3: Involves interaction with moderate speed or multilane traffic, or proximity to higher speed traffic. A level of traffic stress acceptable to the "enthused and confident."
- LTS 4: Involves being forced to mix with moderate speed traffic or proximity to high-speed traffic. A level of stress acceptable only to the "strong and fearless."

What does it measure and how is it calculated?

The first step in determining BLTS for a roadway segment is to identify the facility type, if one exists. If bicyclists ride in mixed traffic (without a dedicated facility), the roadway's average daily traffic (ADT), number of through lanes, and prevailing or posted speed will influence the score. The latter two factors are also included in scores for on-road bicycle lanes, in addition to bicycle lane width and presence of an adjacent parking lane and/or marked buffer.

The tables at the end of this document display the BLTS scores for different facilities based on a combination of the relevant factors.[2] The "Separated bike lanes" and "Crossing stress" tables are based on a methodology that Toole Design has used in other jurisdictions to supplement the original BLTS methodology.[3]

Additional considerations

There are other variables that may affect one's perceived level of traffic stress while biking along a roadway. Several jurisdictions have modified the BLTS methodology to fit their needs, sometimes including additional levels of traffic stress to differentiate between facility types that were not as common when the original methodology was developed. The original methodology was also updated in June, 2017 (v.2) and again in May, 2022 (v.2.2) (Level of Traffic Stress | Peter G. Furth (northeastern.edu)) and Peter Furth has presented forthcoming updates, including a Crossing Level of Traffic Stress (XLTS) and a level of steepness criteria.

Similar metrics, such as Bicycle Level of Comfort (BLOC), may also be useful, especially if the project or study is geared toward providing better bicycle facilities. Through the Active Fairfax Plan, FCDOT is developing a methodology for BLOC that includes variables such as lighting (street level and pedestrian-scale), surface quality, and presence of street trees. Pending the adoption of the Active Fairfax Plan by the Board of Supervisors, this metric could help inform future studies. Regardless, it is important to acknowledge that people may not always agree with the outputs of these metrics since they are attempts at measuring perceptions, which are highly subjective. Rather, the utility of these metrics is derived from their ability to rate facilities based on defined characteristics which can ultimately provide an idea of where low-stress routes are located and where they should be recommended to better connect communities and surrounding neighborhood resources.

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[1] Maaza C. Mekuria, PhD, PE, PTOE. Peter G. Furth, PhD. Hilary Nixon, PhD. Low-Stress Bicycling and Network Connectivity. Mineta Transportation Institute, May 2012(https://transweb.sjsu.edu/sites/default/files/1005-low-stress-bicycling-network-connectivity.pdf)

[2] LTS Tables v2 June 1.xlsx (bpb-us-w2.wpmucdn.com)

[3] https://www.fortworthtexas.gov/files/assets/public/v/1/tpw/documents/atp/appendix-4-level-traffic.pdf

Mixed traffic criteria

Number of lanes	Effective ADT*	Prevailing Speed						
		≤ 20 mph	25 mph	30 mph	35 mph	40 mph	45 mph	50+mph
Unlaned 2-way street (no centerline)	0-750	LTS 1	LTS 1	LTS 2	LTS 2	LTS 3	LTS 3	LTS 3
	751-1500	LTS 1	LTS 1	LTS 2	LTS 3	LTS 3	LTS 3	LTS 4
	1501-3000	LTS 2	LTS 2	LTS 2	LTS 3	LTS 4	LTS 4	LTS 4
	3000+	LTS 2	LTS 3	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4
1 thru lane per direction (1-way, 1-lane street or 2-way street with centerline)	0-750	LTS 1	LTS 1	LTS 2	LTS 2	LTS 3	LTS 3	LTS 3
	751-1500	LTS 2	LTS 2	LTS 2	LTS 3	LTS 3	LTS 3	LTS 4
	1501-3000	LTS 2	LTS 3	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4
	3000+	LTS 3	LTS 3	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4
2 thru lanes per direction	0-8000	LTS 3	LTS 3	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4
	8001+	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4	LTS 4	LTS 4
3+ thru lanes per direction	any ADT	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4	LTS 4	LTS 4

* Effective ADT = ADT for two-way roads; Effective ADT = 1.5*ADT for one-way roads

Bike lanes and shoulders not adjacent to a parking lane

Number of lanes	Bike lane width	Prevailing Speed					
		≤ 25 mph	30 mph	35 mph	40 mph	45 mph	50+ mph
1 thru lane per direction, or unlaned	6+ ft	LTS 1	LTS 2	LTS 2	LTS 3	LTS 3	LTS 3
	4 or 5 ft	LTS 2	LTS 2	LTS 2	LTS 3	LTS 3	LTS 4
2 thru lanes per direction	6+ ft	LTS 2	LTS 2	LTS 2	LTS 3	LTS 3	LTS 3
	4 or 5 ft	LTS 2	LTS 2	LTS 2	LTS 3	LTS 3	LTS 4
3+ lanes per direction	any width	LTS 3	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4

Notes 1. If bike lane / shoulder is frequently blocked, use mixed traffic criteria.
2. Qualifying bike lane / shoulder should extend at least 4 ft from a curb and at least 3.5 ft from a pavement edge or discontinuous gutter pan seam
3.Bike lane width includes any marked buffer next to the bike lane.

Bike lanes alongside a parking lane

Number of lanes	Bike lane reach = Bike + Pkg lane width	Prevailing Speed		
		≤ 25 mph	30 mph	35 mph
1 lane per direction	15+ ft	LTS 1	LTS 2	LTS 3
	12-14 ft	LTS 2	LTS 2	LTS 3
2 lanes per direction (2-way)	15+ ft	LTS 2	LTS 3	LTS 3
2-3 lanes per direction (1-way)		LTS 2	LTS 3	LTS 3
other multilane		LTS 3	LTS 3	LTS 3

Notes 1. If bike lane is frequently blocked, use mixed traffic criteria.
2. Qualifying bike lane must have reach (bike lane width + parking lane width) ≥ 12 ft
3.Bike lane width includes any marked buffer next to the bike lane.

Separated bike lanes

Separation*	Number of lanes	Prevailing Speed ≤25 MPH	30 MPH	35 MPH	40+ MPH
Significant (curb, parking)	1 - 3 lanes	LTS 1	LTS 1	LTS 1	LTS 2
	4 lanes	LTS 1	LTS 1	LTS 1	LTS 3
	5+ lanes	LTS 1	LTS 1	LTS 1	LTS 3
Limited (flexposts)	1 - 3 lanes	LTS 1	LTS 1	LTS 2	LTS 3
	4 lanes	LTS 1	LTS 1	LTS 2	LTS 3
	5+ lanes	LTS 1	LTS 2	LTS 2	LTS 3

*Facilities that are completely separated from the roadway, such as off-street trails, are automatically scored LTS 1.

Crossing stress

Intersection control	Number of lanes to cross	Prevailing Speed ≤25 MPH	30 MPH	35 MPH	40+ MPH
Minor approach stop signs/ uncontrolled	1 - 3 lanes	LTS 1	LTS 1	LTS 2	LTS 3
	4 lanes	LTS 2	LTS 2	LTS 3	LTS 4
	5+ lanes	LTS 2	LTS 3	LTS 4	LTS 4
RRFB	1 - 3 lanes	LTS 1	LTS 1	LTS 2	LTS 3
	4 lanes	LTS 2	LTS 2	LTS 2	LTS 3
	5+ lanes	LTS 2	LTS 3	LTS 4	LTS 4
Signal/ HAWK/ functional priority	1 - 3 lanes	LTS 1	LTS 1	LTS 1	LTS 1
	4 lanes	LTS 2	LTS 2	LTS 2	LTS 2
	5+ lanes	LTS 3	LTS 3	LTS 3	LTS 3
Dedicated bicycle signal phase	1 - 3 lanes	LTS 1	LTS 1	LTS 1	LTS 1
	4 lanes	LTS 2	LTS 2	LTS 2	LTS 2
	5+ lanes	LTS 2	LTS 2	LTS 2	LTS 2