TECHNICAL GUIDE FOR THE IDENTIFICATION AND PRIORITIZATION OF THE VTRANS MID-TERM NEEDS

VTRANS | VIRGINIA'S TRANSPORTATION PLAN








PREPARED BY THE OFFICE OF INTERMODAL PLANNING AND INVESTMENT FOR THE COMMONWEALTH TRANSPORTATION BOARD

DRAFT OCTOBER 2020

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FOR MORE INFORMATION

Visit vtrans.org for additional details, updates, and documentation about the VTrans development process.

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LIST OF ACRONYMS

AC	Activity Center
ACS	American Community Survey
BRT	Bus Rapid Transit
CoSS	Corridor of Statewide Significance
CTB	Commonwealth Transportation Board
DRPT	Virginia Department of Rail and Public Transportation
EEA	Equity Emphasis Area
GTFS	General Transit Feed Specification
IEDA	Industrial and Economic Development Area
LEHD	Longitudinal Employer-Household Dynamics
LEP	Limited English Proficiency
LODES	LEHD Origin-Destination Employment Statistics
LOTTR	Level of Travel Time Reliability
LRS	Linear Referencing System
MPO	Metropolitan Planning Organization
MUTCD	Manual on Uniform Traffic Control Devices
NAICS	North American Industry Classification System
NHTS	National Household Travel Survey
OIPI	Office of Intermodal Planning and Investment
PECC	Percent of Person-miles Traveled in Excessively Congested Conditions
PMT	Person-miles Traveled
PSAP	Pedestrian Safety Action Plan
PSI	Potential for Safety Improvement
RAC	Residence Area Characteristics
RITIS	Regional Integrated Transportation Information System
RN	Regional Network
ROC	Ratio of Concentration
TDM	Transportation Demand Management
TMC	Traffic Message Channel
TTI	Travel Time Index
TTILT13	Travel Time Index less than 1.3
UDA	Urban Development Area
US DOT	United States Department of Transportation
VBRSP	Virginia Business Ready Sites Program
VDOT	Virginia Department of Transportation
VEDP	Virginia Economic Development Partnership
VGIN	Virginia Geographic Information Network
VMT	Vehicle-miles of Travel
VRE	Virginia Railway Express
WAC	Workplace Area Characteristics

1. PURPOSE OF THE TECHNICAL GUIDE

This Technical Guide is a companion document to the *Policy Guide for the Identification and Prioritization of the VTrans Mid-term Needs* and provides detailed technical information for planners, engineers, and other professionals interested in the data sources, processes, and methods used to implement the Commonwealth Transportation Board's (CTB) policies.

In light of limited transportation funding, the purpose of the CTB Policy for the Identification and Prioritization of the VTrans Mid-term Needs is to provide a transparent, data-driven, systematic, and replicable process that is informed by public feedback to:

1. Identify pressing transportation needs that may require policies or investments, and
2. Prioritize transportation needs and locations with more pressing issues and where solutions may make the biggest contribution to making progress toward the achievement of the CTB's transportation goals.

The CTB policy in the Policy Guide is executed using technical methods and processes documented in this Technical Guide.

1.1 Public Involvement

Gathering and considering feedback from local and regional transportation partners and the public is an integral part of the CTB's policy development process as well as integral to the methods used to implement the CTB policies.

This Technical Guide is a synthesis of technical methods and processes used to execute an established CTB policy, the Identification of VTrans Mid-term Needs, as well as those developed to support a draft policy for the CTB's consideration, the Prioritization of VTrans Mid-term Needs.

Comments and feedback on the draft policy for the Prioritization of VTrans Mid-term Needs will be considered prior to presenting the policy to the CTB for consideration. Comments and feedback on the existing CTB policy for the Identification of VTrans Mid-term Needs[1] and associated technical methods and processes will be considered for future modifications of the policy.

1.2 Document Organization

This document is organized as follows:

- Section 2 provides an overview of the process used to establish the Needs Categories in keeping with the VTrans Vision, Guiding Principles, Goals, and Objectives.
- Section 3 provides details on the technical steps taken to identify the VTrans Mid-term Needs.
- Section 4 provides details on how the VTrans Mid-term Needs are prioritized within their respective Needs Categories, and how they are aggregated and weighted to establish the Priority Locations.

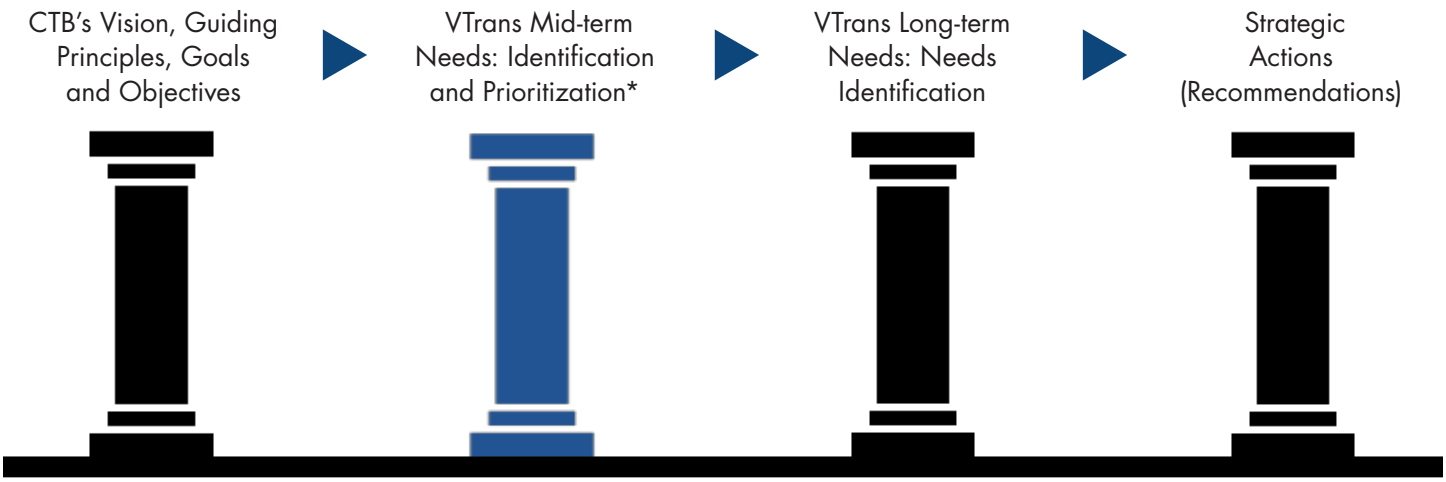
This symbol is used to visually differentiate policy decisions from technical decisions.

[1] Commonwealth Transportation Board, Actions to Approve the 2019 VTrans Vision, Goals, Objectives, Guiding Principles and the 2019 Mid-term Needs Identification Methodology and Accept the 2019 Mid-term Needs, January 15, 2020

2. INTRODUCTION TO VTRANS – VIRGINIA'S TRANSPORTATION PLAN

VTrans is the Commonwealth of Virginia's multimodal transportation plan to advance the CTB's vision for transportation in the Commonwealth. The CTB, with assistance from the Office of Intermodal Planning and Investment (OIPI),[1] develops VTrans to identify transportation needs which may be addressed by multimodal infrastructure projects, transportation strategies, creation of new policies, or modifications to existing policies. This Technical Guide addresses technical methods and processes related to one of the four VTrans major components, VTrans Mid-term Needs Identification and Prioritization, as depicted in Figure 1.

Figure 1: Major Components of VTrans



*Focus of this Policy Guide

[1] Office of Intermodal Planning and Investment of the Secretary of Transportation established pursuant to § 2.2-229

2.1 VTrans Vision, Guiding Principles, Goals, and Objectives

The first major component of VTrans, the development of the Vision, Guiding Principles, Goals, and Objectives, forms the basis upon which the remaining three major components, the VTrans Mid-term Needs, VTrans Long-term Needs, and Strategic Actions, are established with the intent to advance the CTB's vision. The CTB updated and adopted the VTrans Guiding Principles, Goals, and Objectives in 2020.[1] The VTrans Mid-term Need Categories and associated performance measures described in this Technical Guide are based on the CTB's Goals and Objectives for transportation planning and development in the Commonwealth.

2.2 VTrans Planning Horizons

The CTB identifies needs for the following two planning horizons. This Technical Guide focuses on the identification and prioritization of the VTrans Mid-term Needs.

- Mid-term Planning Horizon: VTrans' analysis for the mid-term planning horizon identifies some of the most pressing transportation issues that need to be addressed over the next ten years. These needs are referred to as VTrans Mid-term Needs. The needs are identified so that they can inform or guide transportation policies, strategies, and infrastructure improvements developed and implemented by the Virginia Department of Transportation (VDOT) and the Department of Rail and Public Transportation (DRPT), as well as local and regional entities.
- Long-term Planning Horizon: VTrans' analysis for long-term planning identifies needs for a zero- to 20-plus-year planning horizon that may require gradual and systematic shifts in policy. These needs are referred to as VTrans Long-term Needs.

[1] Commonwealth Transportation Board, Actions to Approve the 2019 VTrans Vision, Goals, Objectives, Guiding Principles and the 2019 Mid-term Needs Identification Methodology and Accept the 2019 Mid-term Needs, January 15, 2020

2.3 VTrans Travel Markets for Mid-term Needs

VTrans Mid-term Needs are established for the following VTrans Travel Markets per Virginia State Code § 33.2-353 as well as by CTB Policy.

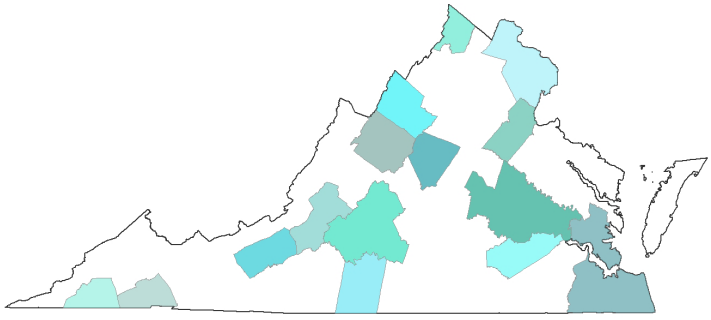
Corridors of Statewide Significance (CoSS)

- **Number:** 12
- **Definition:** An integrated set of multimodal transportation facilities to support interregional travel of people and goods within and outside the state
- **Purpose:**
- Support inter-regional and interstate travel
- Connect major centers of activity within and through the Commonwealth
- Promote the movement of people and goods essential to the economic prosperity of the state
- **Established:**
- Eleven (11) corridors were established as part of VTrans2035[1] in 2009, and one in May 2011[2].
- **Characteristics**
- Multimodal - must involve multiple modes of travel or must be an extended freight corridor
- Connectivity - must connect regions, states, and/or major activity centers
- High volume - must involve a high volume of travel
- Function - must provide a unique statewide function and/or address statewide goals

[1] Commonwealth Transportation Board, VTrans2035 – Virginia's Statewide Multimodal Long-Range Transportation Plan, December 17, 2009.
[2] Commonwealth Transportation Board, Northern Virginia North-South Corridor of Statewide Significance, May 28, 2011.

Regional Networks (RN)

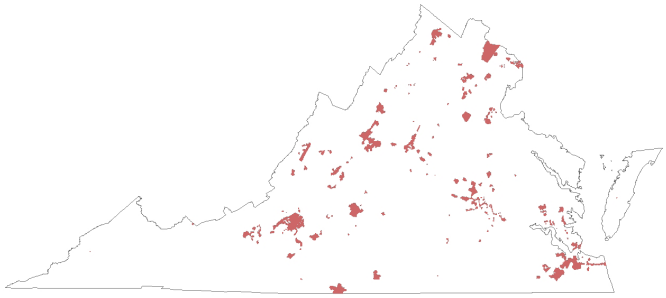
- **Number:** 15
- **Definition:** Based on designated Metropolitan Planning Organizations (MPO) within the Commonwealth. If an MPO boundary includes only a portion of a county, the entire county will be included in the needs analysis area.
- **Purpose:**
- Support intra-regional travel
- Bridge the gap between existing conditions and the desired future for the state's economy
- **Established:**
- Regional Networks were established as part of VTrans 2040[1].
- **Characteristics**
- At least 50,000 people in an urbanized area per US Census estimates
- Regional Networks include VTrans Activity Centers, which are "areas of regional importance that have a high density of economic and social activity" and are associated with the Regional Networks (RNs)



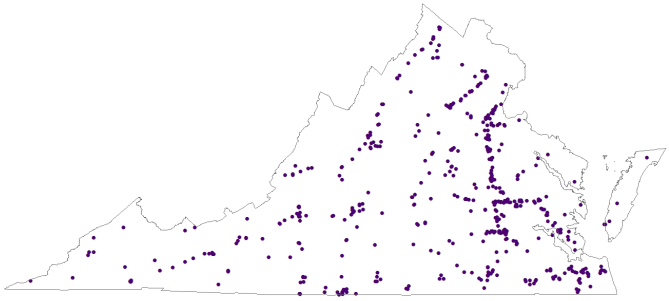
[1] Commonwealth Transportation Board, VTrans2040 Virginia's Statewide Multimodal Long-Range Transportation Plan Vision Plan and Needs Assessments, December 9, 2015

Urban Development Areas (UDA)

- **Number of UDAs**: 230 UDAs[1]; 535 Industrial and Economic Development Areas (IEDA)[2]
- **Definition:** Urban Development Areas are locally-designated growth areas based on local initiatives pursuant to VA Code § 15.2-2223. Industrial and Economic Development Areas (IEDAs) are locally-identified industrial and economic development sites submitted to Virginia Economic Development Partnership (VEDP)'s Business-Ready Site Program pursuant to § 2.2-2238.
- **Purpose:**
- The purpose of UDAs is to: (1) support local, walkable places; and, (2) to the extent possible, to direct federal, state and local transportation, housing, water and sewer facility, economic development, and other public infrastructure funding to designated UDAs. The purpose of IEDAs is to support economic development.
- **Established:**
- UDAs are established on an ongoing basis, per local government designation in a locality's Comprehensive Plan pursuant to §15.2-2223. IEDAs are also established or removed on an ongoing basis.
- **Characteristics of UDAs**
- Pedestrian-friendly road design
- Interconnection of new local streets with existing local streets and roads
- Connectivity of road and pedestrian networks
- Preservation of natural areas
- Mixed-use neighborhoods, including mixed housing types, with affordable housing to meet the projected family income distributions of future residential growth
- Reduction of front and side yard building setbacks
- Reduction of subdivision street widths and turning radii at subdivision street intersections



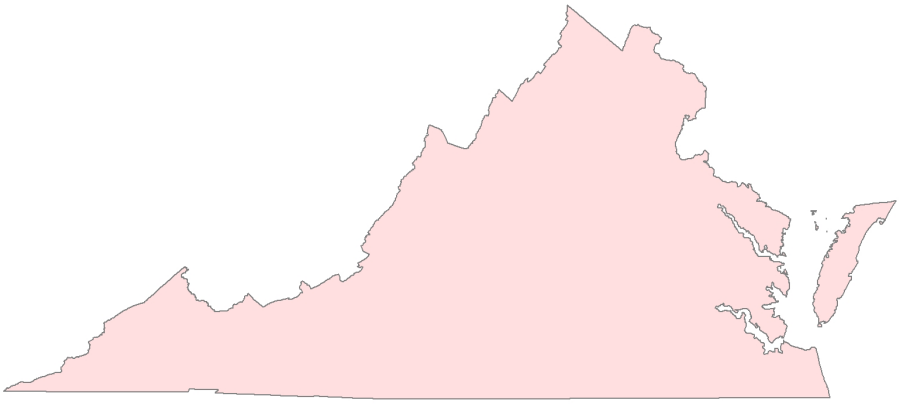
- **Characteristics of IEDAs**
- Pursuant to § 2.2-2238 and consistent with Virginia Economic Development Partnership (VEDP)'s Business Ready Sites Program (VBRSP)
- Minimum of 100 contiguous acres (statutory); VEDP accepts sites of 25+ acres
- Allows for industrial and research parks
- Applicants to the program must be political subdivisions of the Commonwealth of Virginia, including counties, cities, towns, industrial/economic development authorities, and redevelopment and housing authorities or regional industrial facility authority



[1] As of November 30, 2019
[2] As of November 30, 2019

Safety

- **Definition:** A Safety analysis is conducted for all public roadways in the Commonwealth
- **Established:** The Safety Travel Market was established as part of VTrans 2040[1]



[1] Commonwealth Transportation Board, VTrans2040 Virginia's Statewide Multimodal Long-Range Transportation Plan Vision Plan and Needs Assessments, December 9, 2015

2.4 VTrans Need Categories and Geographic Assignment

The CTB policy for the Identification of VTrans Mid-term Needs establishes transportation needs by multimodal need categories that correspond to the Board-adopted VTrans Vision, Goals, and Objectives.[1] Each need category has one or more performance measures and thresholds to identify one or more needs. These need categories and thresholds benefited from extensive feedback from public as well as from local and regional transportation partners.

Table 1 outlines need categories and corresponding measures established per the CTB policy for the Identification of VTrans Mid-term Needs.[1] A transportation need is identified for locations where performance, as determined by an applicable performance measure, is outside of the Board-approved threshold. The identified need is then assigned to roadway segments and points, or nodes, on the VDOT Linear Referencing System ([LRS]; see Table 1).

The VDOT LRS is used as a common means of identifying features along a highway route (e.g., VA 288) by its milepost or distance from the starting point of the route. The VDOT LRS is based on the Virginia Geographic Information Network (VGIN) Road Centerline data, which provides a consistent and seamless statewide digital dataset of all roads in the Commonwealth of Virginia.[2] VGIN collects centerline data from Virginia localities to continually update the network. The VDOT LRS is updated on a quarterly basis. For more information on the VDOT LRS, see https://www.arcgis.com/apps/Cascade/index.html?appid=dfd5ea4d540f485f9ab2a8fe7697c256

VDOT LRS version 19.1 was used to develop the 2019 VTrans Mid-term Needs and establish Priority Locations.

[1] Commonwealth Transportation Board, Actions to Approve the 2019 VTrans Vision, Goals, Objectives, Guiding Principles and the 2019 Mid-term Needs Identification Methodology and Accept the 2019 Mid-term Needs, January 15, 2020

[2] https://www.vita.virginia.gov/integrated-services/vgin-geospatial-services/transportation/

Table 1: VTrans Goals, Associated VTrans Mid-term Needs Categories, and Geographic Assignment

Need Category	VTrans Travel Market(s)	Geographic Assignment in VDOT LRS	
		Identification of VTrans Mid-term Needs	Prioritization of VTrans Mid-term Needs
Goal A: Economic Competitiveness and Prosperity			
Congestion Mitigation	CoSS, RN	Roadway Segments	Roadway Segments
Improved Reliability (Highway)	CoSS, RN	Roadway Segments	Roadway Segments
Improved Reliability (Intercity and Commuter Rail)[1]	CoSS	Nodes (Intercity and Commuter Rail Stations)	Roadway Segments
Goal B: Accessible and Connected Places			
Transit Access to Equity Emphasis Areas	RN	Roadway Segments	Roadway Segments
Transit Access to Activity Centers[2]	RN	Nodes (Activity Centers)	Roadway Segments
Pedestrian Access to Activity Centers	RN	Roadway Segments	Roadway Segments
Bicycle Access to Activity Centers	RN	Roadway Segments	Roadway Segments
Access to Industrial and Economic Development Areas (IEDAs)[3]	Statewide	Nodes (IEDA Sites)	Roadway Segments
Urban Development Areas (UDAs)	UDA	Roadway Segments	Not Applicable
Goal C: Safety for All Users			
Roadway Safety[4]	Statewide	Roadway Segments, Nodes (Intersections)	Roadway Segments
Pedestrian Safety	Statewide	Roadway Segments	Roadway Segments
Goal D: Proactive System Management			
Capacity Preservation	CoSS, RN	Roadway Segments	Roadway Segments
Goal E: Healthy Communities and Sustainable Transportation Communities			
Transportation Demand Management	CoSS, RN	Roadway Segments	Roadway Segments

[1] The method and process for this need category in Section 4.2.3 describes conversion of node-based need assignment to roadway segment-based need assignment.

[2] The method and process for this need category in Section 4.2.5 describes conversion of node-based need assignment to roadway segment-based need assignment.

[3] The method and process for this need category in Section 4.2.8 describes conversion of node-based need assignment to roadway segment-based need assignment.

[4] The method and process for this need category in Section 4.2.9 describes conversion of node-based need assignment to roadway segment-based need assignment.

The assignment of all needs and priorities to roadway segments is performed to ensure the following:

- **Common unit of reporting or communicating:**
  This method ensures that there is a common and widely known unit of reporting to communicate a wide range of multimodal needs. A unit of reporting is essentially a communication method used to convey the issue. The sheer size and complexity of the transportation system in Virginia requires establishing a common unit of reporting for multimodal analysis such that a host of complex issues can be identified and prioritized in a transparent manner.

- **Visualizing and analyzing interactions among multimodal need categories:**
  A common unit of reporting based on LRS allows for overlaying and visualizing a wide range of multimodal needs developed using data from more than 200 sources in a cohesive and concise manner.

  This, in turn, allows users to visualize, query, and further analyze the nexus among different need categories. For example, although knowing the location of a Need for Safety Improvement is important, the information becomes much more valuable when one can also see whether the same location also has Need for Improved Reliability.

  Finally, overlaying a multitude of multimodal needs (a) allows for greater awareness of overlapping multimodal needs and (b) helps achieve the goal of developing more comprehensive multimodal solutions that offer greater return on investment.

2.5 Opportunities for Continuous Improvement

The execution of the policy for the Identification and Prioritization of the Mid-term Needs relies on data and computations to ensure transparent, data-driven, and replicable methods. The following should be noted:

- Data: The execution relies on more than 200 sources of data from local, regional, state, and national sources. Each of these sources relies on various methods, techniques, and technologies to develop its datasets and, therefore, has its own limitations such as:
  - Lack of readily usable data: There are instances in which completeness and accuracy of datasets are not ready to be used to execute the Policy for the Identification and Prioritization of the VTrans Mid-term Needs. For example, more information on the reliability or frequency of transit services can result in more accurate needs identification and prioritization of the CTB-adopted VTrans Mid-term Need Category Transit Access to Activity Centers.
  - Confounding variables: The identification and prioritization of VTrans Mid-term Needs, even in the presence of very precise, readily available data, can be prone to errors due to confounding variables. For example, slower speeds based on INRIX Traffic Message Channel (TMC) data may show slower speeds due to temporary construction zones, periodic speed restrictions due to nearby schools, or vehicles slowing down for sightseeing. Such location, for example, may get flagged for a Need for Congestion Mitigation. Therefore, application of transportation planning or engineering judgment is recommended prior to developing solutions.
- Computations: The sheer size and magnitude of the effort relies on complex computations using nearly 200 million data points that rely on more than 200 sources of data to perform computations for more than one million roadway segments. The effort requires synthesis, format conversions, and computations, such as those required by the following examples, that could result in inadvertent errors. In those instances, the Board-adopted Policy and the methods, processes, and techniques documented in this Technical Guide take precedence.
  - Units: Different data sources have different units. Some are available by directional segment, whereas other datasets are available by area or sub-area levels. For example, Amtrak's on-time performance is available for each station served by an Amtrak service, whereas Virginia Railway Express (VRE) provides on-time performance by line level (e.g., Fredericksburg line, Manassas line).
  - Levels of aggregations: Some datasets are more aggregated than others. For example, INRIX data used for observed travel speeds on highways provide information by direction of travel. However, household-level Census data, used to identify areas with higher than average concentrations of minority or low-income populations, are aggregated and made available at the Census Block Group level.
  - Frequency of updates: Some datasets are updated in real time, whereas other datasets are updated once per year or even less frequently.
  - Reporting time frame: In addition to the variations in data collection, some datasets are reported in real time, where other datasets are reported once a year.

The VTrans Team at OIPI sees these considerations as opportunities for continuous improvement of the methods to ensure that the methodology outlined in the Technical Guide for the Identification and Prioritization of the VTrans Mid-term Needs can continue to evolve and improve based on advances in technology, data quality, data collection, and reporting tools. To the extent that any such improvements modify or affect the policy, public review and CTB's approval will be sought.

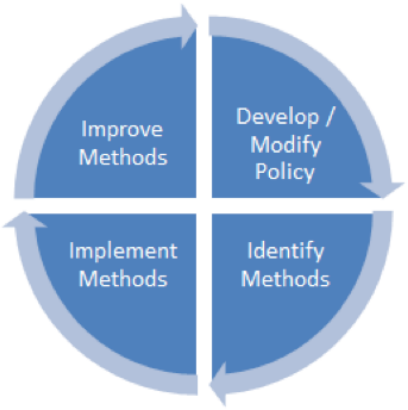


Figure 2: Opportunities for Continuous Improvement

3. IDENTIFICATION OF VTRANS MID-TERM NEEDS[1]

3.1 Need Category: Congestion Mitigation

Needs for Congestion Mitigation are identified through two performance measures:

- Percent Person-Miles Traveled in Excessively Congested Conditions (PECC): PECC is used to identify Needs for Congestion Mitigation for: (1) Interstate roadways within CoSS; and, (2) other select Limited Access Facilities (LAF), as noted in Appendix B.
- Travel Time Index (TTI). TTI is used to identify Needs for Congestion Mitigation for: (1) non-limited access roadways within CoSS; and, (2) all other roadways within RNs.

Performance Measure: Percent Person Miles Traveled in Excessively Congested Conditions (PECC)

What it Means: Percent of the total person-miles traveled (PMT) that takes place in conditions deemed as excessively congested (observed speed 75% or less of the posted speed limit). A higher number indicates more person-miles traveled are impacted by excessively congested conditions.

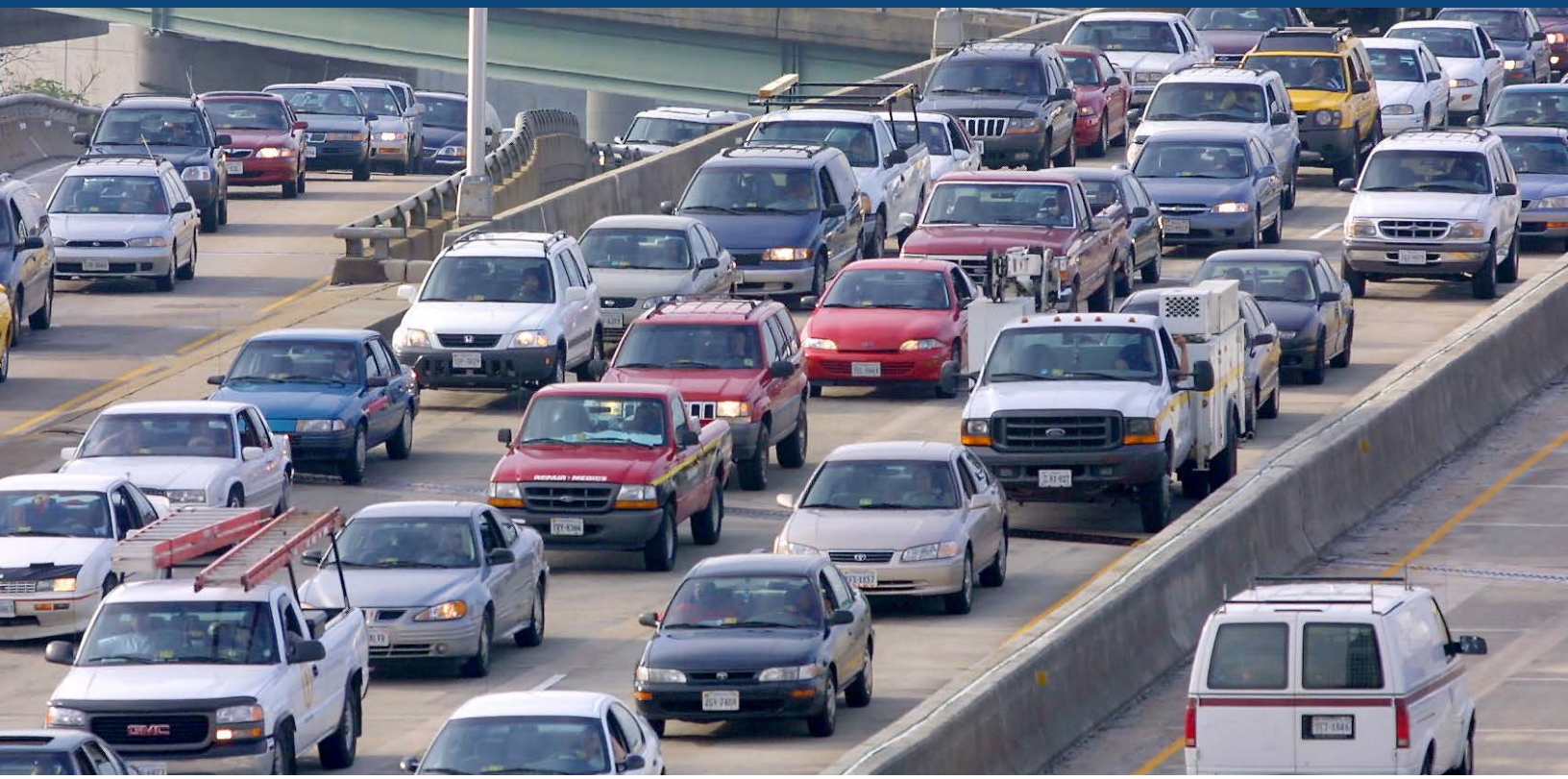
Applicable VTrans Travel Market: CoSS, RN

Identification of Needs

- Data Sources:
  - INRIX, Observed speed
  - VDOT Traffic Monitoring System, Traffic volume
  - Federal Highway Administration, 2018 National Household Travel Survey (NHTS) and Virginia supplement (additional surveys conducted) to the NHTS (Vehicle occupancy)
  - VDOT, Speed limit
- Year of analysis: 2018
- Period of analysis: A 14-hour period between 6 a.m. and 8 p.m. on weekdays and weekend days.
- Calculations

1. Develop Vehicle-Miles Traveled (VMT) utilizing average traffic volume for each weekday and weekend day hour between 6 a.m. and 8 p.m. in the year of analysis.
2. Locate hourly speed data along INRIX Traffic Message Channels (TMC) for each weekday and weekend day hour between 6 a.m. and 8 p.m. in the year of analysis.
3. Summarize occupancy results from NHTS vehicle occupancy travel surveys and calculate average vehicle occupancy.
4. Utilize the average vehicle occupancy to convert VMT to PMT.
5. Assemble roadway characteristics layer with posted speed limit.
6. Identify average speeds in each time period for the period of analysis that fall below the posted speed limit.
7. **Threshold for Defining "Excessive Congestion":** Roadway segments where average hourly travel speed is below 75 percent of the posted speed limit.
8. Identify roadway segments with excessive congestion in three weekday time periods: 6 a.m. - 10 a.m.; 10 a.m. - 4 p.m. and 4 p.m.-8 p.m., or one weekend day time period: 6 a.m. - 8 p.m.
9. Select the one of the three weekday time periods with the highest percentage of PMT in excessively congested conditions (Output X) and select percentage of person-miles traveled in excessively congested conditions for the one weekend day period (Output Y)
10. Identify the share of PMT that occurs in excessively congested conditions by performing the following: [(Output X * 5 weekdays) + (Output Y * 2 weekend days)] / 7 days.
11. **Threshold for Need for Congestion Mitigation:** Roadway segments where the average weekday and weekend day share of person miles traveled in excessively congested conditions exceeds policy threshold of 2% are identified as those with Need for Congestion Mitigation

[1] Commonwealth Transportation Board, Actions to Approve the 2019 VTrans Vision, Goals, Objectives, Guiding Principles and the 2019 Mid-term Needs Identification Methodology and Accept the 2019 Mid-term Needs, January 15, 2020



Need Category: Congestion Mitigation

Performance Measure: Travel Time Index (TTI)

What it Means: The Travel Time Index is the ratio of the travel time during the peak period to the time required to make the same trip at reference (a.k.a typical) speeds. A higher number indicates more congestion.

Applicable VTrans Travel Market: CoSS, RN

Identification of Needs

- Data Sources
  - INRIX, Travel Time Index
- Year of analysis: 2018
- Period of analysis: A 14-hour period between 6 a.m. and 8 p.m. on weekdays and weekend days.
- Calculations
  1. Utilizing RITIS[1], export weekday and weekend day average hourly travel time index for the year of analysis for every INRIX TMC.
  2. Calculate the number of hours for weekdays and weekend days between 6 a.m. and 8 p.m. for which hourly TTI exceeds 1.5.
  3. Calculate the number of hours for weekdays and weekend days between 6 a.m. and 8 p.m. for which hourly TTI exceeds 1.3.
  4. Calculate the weighted average of weekday and weekend TTI. First, multiply weekday TTI by 5/7 (i.e. weekdays/ all days). Second, multiply weekend TTI by 2/7 (i.e. weekend days/ all days). Sum the two figures.
  5. **Threshold for Need for Congestion Mitigation:** Roadway segments where the average weekday and weekend day TTI is greater than 1.5 for at least one hour, or 1.3 for at least three hours, are identified as those with a VTrans Mid-term Need for Congestion Mitigation.

[1] Regional Integrated Transportation Information System, www.ritis.org

3.2 Need Category: Improved Reliability (Roadway)

Performance Measure: Level of Travel Time Reliability (LOTTR)

What it Means: Number of hours where the ratio of longer (80th percentile) travel times to "normal" (50th percentile) travel time exceeds 50%. A higher number indicates less reliable travel.

Applicable VTrans Travel Market: CoSS, RN

Identification of Needs

- Data Sources
  - Observed speed: INRIX
  - Traffic volume: VDOT Traffic Monitoring System
- Year of analysis: 2018
- Period of analysis: A 14-hour period between 6 a.m. and 8 p.m. on weekdays and weekend days.
- Calculations
  1. Develop VMT utilizing average traffic volume for each weekday and weekend day hour between 6 a.m. and 8 p.m.
  2. Join vehicle miles traveled (VMT) data with segments with available speed data with INRIX TMCs.
  3. Gather average speed for each measured roadway segment for each hour of weekday and weekend day in the year of analysis.
  4. Calculate the ratio of the 80th percentile travel times (equivalent of the 20th percentile slowest speeds) to the 50th percentile (median speed) for each weekday and weekend day hour between 6 a.m. and 8 p.m. for the year of analysis. This ratio is referred to as LOTTR.
  5. Count the number of weekday and weekend day hours between 6 a.m. and 8 p.m. where the LOTTR exceeds 1.5.
  6. Calculate the weighted average of weekday and weekend LOTTR. First, multiply weekday LOTTR by 5/7 (i.e. weekdays/ all days). Second, multiply weekend LOTTR by 2/7 (i.e. weekend days/ all days). Sum the two figures.
  7. **Threshold for Need for Improved Reliability:** Roadway segments where the average weekday and weekend day LOTTR is greater than 1.5 for are identified as those with a VTrans Mid-term Need for Improved Reliability.

3.3 Need Category: Improved Reliability (Intercity and Passenger Rail)

Measure: Intercity and Commuter Rail On-time Performance

What it Means: Passenger rail stations or lines where the average on-time performance of rail services is below the operator-specific performance threshold.

Applicable VTrans Travel Market: CoSS

Identification of Needs

- Data Sources:
  - Virginia Department of Rail and Public Transportation (DRPT), Amtrak on-time performance - Stations served by state-sponsored lines: Station-level Annual on-time performance (percent of trains arriving on time) for stations on Amtrak's state-sponsored lines from Amtrak
  - Virginia DRPT, Amtrak on-time performance - Stations served by Amtrak national-sponsored lines only: Daily on-time performance data (on-time status and number of minutes of delay) for stations that are only served by Amtrak's long-distance trains for Amtrak fiscal year 2018
  - Virginia Railway Express (VRE), via DRPT, VRE on-time performance: Monthly on-time performance data (number of trains arriving on-time) for VRE lines

- Year of analysis: Fiscal Year 2018 [based on Amtrak's Fiscal Year (10/2017–09/2018) and VRE's Fiscal Year (07/2017–06/2018)

- Period of analysis:
  - Amtrak on-time performance - Stations served by state-sponsored lines: all applicable service hours
  - Amtrak on-time performance - Stations served by Amtrak national-sponsored lines only: all applicable service hours
  - VRE on-time performance: all applicable service hours

- Calculations

1. Format data:
   - Amtrak on-time performance - Stations served by state-sponsored lines: Monthly, directional on-time performance for state-sponsored arrivals at each Amtrak station.
   - Amtrak on-time performance - Stations served by Amtrak national-sponsored lines only: Daily, directional on-time performance for each train serving each station (Train departures were substituted for train arrivals when arrival data for a specific train was missing.).
   - VRE on-time performance: Monthly, non-directional on-time performance for VRE lines.
2. Amtrak on-time performance - Stations served by state-sponsored lines: Average northbound and southbound performance to generate average performance.
3. Amtrak on-time performance - Stations served by Amtrak national-sponsored lines only: Convert daily statistics to annual average by summing the number of trains delayed by 15 minutes or more per station and dividing by the total number of trains.
4. VRE on-time performance: Convert monthly statistics to annual average by summing the number of trains delayed by 5 minutes or more per line and dividing by the total number of trains per line. For stations serving both VRE lines, attribute the performance using the least on-time line.
5. **Threshold for Need for Improved Reliability (Intercity and Commuter Rail):**
   i. Amtrak passenger rail stations, represented as nodes, with state-sponsored rail service where on-time performance is below 80% are identified as those with VTrans Mid-term Need for Reliability Improvement. Service is considered on-time if they are within 15 minutes of schedule.
   ii. Amtrak passenger rail stations, represented as nodes, with Amtrak's long-distance service only where on-time performance is below 70% are identified as those with VTrans Mid-term Need for Reliability Improvement. Service is considered on-time if they are within 15 minutes of schedule.
   iii. VRE passenger rail stations, represented as nodes, where on-time performance is below 90% are identified as those with VTrans Mid-term Need for Reliability Improvement. Service is considered on-time if they are within 5 minutes of schedule.

3.4 Need Category: Need for Transit Access for Equity Emphasis Areas

Measure: Transit Access for Equity Emphasis Areas

What it Means: Areas that are identified as Equity Emphasis Areas (EEAs) that are considered transit-viable, and are underserved by public transit.

Applicable VTrans Travel Market: RN

Identification of Needs

- Data Sources:
  - U.S. Census Bureau, American Community Survey (ACS) 2018 Five-year Estimates, Census Block Group-level:
    i. Table C17002: Ratio of Income to Poverty Level;
    ii. Table B01001: Sex by Age;
    iii. Table B03002: Hispanic or Latino Origin by Race;
    iv. Table B16004: Age by Language Spoken at Home by Ability to Speak English for the Population 5 Years and Over;
    v. Table B01003: Total Population
  - Census Bureau, American Community Survey 2018 Five-year Estimates, Census Tract-level:
    i. Table S1810: Disability Characteristics
  - U.S. Census Bureau, Cartographic Boundary Files – Shapefile. Virginia Block Groups (500k)
  - OIPI, Shapefile of RN boundaries
  - Virginia DRPT, Shapefile of transit stops in Virginia
- Year of analysis: 2017 (demographic data), 2019 (transit data)
- Period of analysis: n/a

- Calculations:

Calculate Equity Emphasis Areas (EEAs)

1. Collect resident data on income, age, race and ethnicity, English proficiency, disability, and total population.
2. Calculate from US Census ACS tables the number of residents whose income is below 150% of the poverty level, who are 75 or older, who belong to a racial minority, who are Hispanic/Latino, and who do not speak English "very well."
3. Estimate the number of residents with a disability in each Block Group by multiplying the share of residents with disabilities in the census tract by the Block Group's population.
4. Convert count of residents in each Virginia Block Group who are low-income, age 75 or older, racial minority, Hispanic/Latino, limited English proficiency (LEP), or have a disability to population shares for each by dividing by the Block Group population.
5. Join Block Group population and shares of residents in each category to the Block Group shapefile.
6. Identify the centroid of each Block Group and intersect the centroid with the RN shapefile. For each RN and each category (i.e., low-income, age 75 or older, racial minority, Hispanic/Latino, LEP, or disabled), calculate the mean concentration across the Block Groups. (This is the regional average concentration.)
7. Identify for each Block Group the RN that contains its centroid or the nearest RN if the Block Group is outside an RN.
8. Divide the Block Group's concentration for each resident category by the regional concentration to calculate the ratio of concentration (ROC).
9. Sum all six ROCs into an index, converting all ROCs above 3 to 3, low-income ROCs below 1 to 0, and ROCs for the other categories below 1.5 to 0.
10. Flag a Block Group as an EEA if the index is 2 or greater, and either the ROC for low-income or disability is at least 1.
11. **Threshold for Need for Transit Access for Equity Emphasis Areas:** An Equity Emphasis Area is defined as a Census Block Group that has a higher concentration of residents who are considered low-income, minority, LEP, disabled, or over age 75, or Hispanic/Latino than the regional average concentration.

Calculate Transit Viability

12. Calculate Block Groups' population density by dividing population by the Block Group area.
13. Identify each Block Group's centroid and add a 1/4 -mile buffer to the transit stop shapefile.
14. Intersect the centroids with the transit stops buffer.
15. Intersect the result with the RN shapefile.
16. Compare each Block Group's population density to the density of Block Groups served by transit stops. The threshold for viability for fixed-route transit in each RN is the 10th-percentile population density of the intersected Block Groups.
17. Flag Block Groups as transit viable if population density is at least as high as the relevant RN threshold.
18. **Threshold for Need for Transit Access for Equity Emphasis Areas:** Transit Viable Areas are those that have a level population density matching at least the bottom 10th percentile density of areas that are currently served by transit.

Calculate Underserved by Transit

19. Utilize transit stops in shapefile format.
20. Calculate Block Groups' area.
21. Add a 1/4-mile buffer to the transit stop shapefile to represent the transit service area.
22. Intersect the transit stops buffers with the Block Group shapefile.
23. Recalculate Block Groups' area post-intersection. If the post-intersection area (served by transit) is at least half of the pre-intersection Block Group area, flag the Block Group as being served by transit. The remaining Block Groups are considered underserved by transit.
24. **Threshold for Need for Transit Access for Equity Emphasis Areas:** Transit-viable areas that have less than half of their area within ¼-mile of a bus stop are considered underserved by transit.

Identify Final Needs

25. Designate Needs in Block Groups that are EEAs, are transit-viable, and are underserved by transit.
26. Intersect Block Group-level Needs to corresponding roadway segments.
27. **Threshold for Need for Transit Access for Equity Emphasis Areas:** Roadway segments in areas that are identified as EEAs, are considered Transit-viable, and are considered underserved by transit are identified as those with a VTrans Mid-term Need for Transit Access for Equity Emphasis Areas.

3.5 Need Category: Need for Transit Access to Activity Centers

Measure: Transit Access to Activity Centers for Workers

What it means: Number of people that can access a given VTrans Activity Center via public transit versus a private automobile. VTrans Activity Centers are identified as "areas of regional importance that have a high density of economic and social activity" and are associated with the Regional Networks Travel Market. Activity Centers have been identified through stakeholder input.

Applicable VTrans Travel Market: RN

Identification of Needs

- Data Sources:
  - OIPI, Shapefile of Activity Centers by category (Knowledge-based, Industrial, Local-serving) (See Appendix C)
  - U.S. Census Bureau, LEHD Origin-Destination Employment Statistics (LODES) Resident Area Characteristics (RAC)
  - InfoUSA, Business location data aggregated at the Block Group level
  - HERE Technologies, street network database
  - VDOT Transportation Mobility Planning Division and Virginia DRPT, General Transit Feed Specification (GTFS) text files
  - VDOT Transportation Mobility Planning Division, TransCAD Transportation Accessibility Model

- Year of analysis: 2017

- Period of analysis: n/a

- Calculations
  1. Calculate total employment for each VTrans Activity Center as employment within a 1-mile radius of the Activity Center. (When Block centroids are within 1 mile of more than one Activity Center, they are assigned to the nearest Activity Center.)
  2. For Activity Centers with significant military and national security employment, calculate total employment within 1-mile radius, from additional Block Group-level data.
  3. Incorporate statewide street network with forecasted land use data (from VDOT TransCAD Accessibility model) by Block Group (number of workers) and decay curve for job access by car.
  4. Incorporate statewide route system with forecasted land use data by Block Group and decay curve for job access by transit.
  5. **Threshold for Need for Transit Access to Activity Centers:** Determine the number of workers who can reach an Activity Center by transit within 45 minutes as compared to by automobile.
  6. Utilize VDOT's TransCAD Accessibility model to determine the number of workers who can reach the primary Block Group associated with an Activity Center by automobile and by transit within 45 minutes. Outputs include:
     - Automotive Accessibility: Number of workers that can Access an Activity Center with a 45-minute automobile ride
     - Transit Accessibility: Number of workers that can Access an Activity Center with a 45-minute bus, commuter rail, bus rapid transit, rail rapid transit, or light rail transit ride
  7. Calculate transit access deficit: The difference between automotive accessibility and transit accessibility.
  8. Normalize the transit access deficit by the total of the Activity Center's employment. Any normalized transit deficit greater than zero constitutes a Need.
  9. **Threshold for Need for Transit Access to Activity Centers:** Activity Centers, represented as nodes, where fewer workers can access the Activity Center within 45 minutes by transit than by automobile are identified as those with a VTrans Mid-term Need for Transit Access to Activity Centers.

3.6 Need Category: Need for Pedestrian Access to Activity Centers

Measure: Activity Centers Pedestrian Walk-sheds

What it means: Areas within walking distance of VTrans Activity Centers. VTrans Activity Centers are identified as "areas of regional importance that have a high density of economic and social activity" and are associated with the Regional Networks Travel Market. Activity Centers have been identified through stakeholder input.

Applicable VTrans Travel Market: RN

Identification of Needs

- Data Sources:
  - OIPI, Shapefile of Activity Centers by category (Knowledge-based, Industrial, Local-serving) (See Appendix C)
  - Existing, Planned and Under-Construction Fixed-Guideway and bus rapid transit (BRT) lines: Northern Virginia and Fredericksburg Regional Networks, Dulles Corridor Metrorail Project, Hampton Roads Regional Network, Greater Richmond Transit Company, Washington Metropolitan Area Transit Authority
  - U.S. Census Bureau, American Community Survey Five-year Estimates:
    - i. Table B08534: Means of Transportation to Work by Travel Time to Work
  - U.S. Census Bureau, Shapefile of Metropolitan Planning Organization (MPO) boundaries in Virginia, 2014
  - *Manual on Uniform Traffic Control Devices* (MUTCD). 2009 Edition. Chapter 4E. Pedestrian Control Features
  - Virginia DRPT, Shapefile of transit stops in Virginia, 2019

- Year of analysis: 2017

- Period of analysis: n/a

- Calculations:
  1. Retain only knowledge-based and local-serving Activity Centers inside of MPO boundaries.
  2. Create a shapefile of all fixed-guideway transit and commuter rail stations, and BRT lines inside of Metropolitan Planning Area boundaries
  3. Extract walk speed from Manual on Uniform Traffic Control Devices[1] (2.4 mph in 2009 Edition)
  4. Extract Virginia's 90th percentile single-mode walk commute time (25 minutes based on U.S. Census ACS Table B08534)
  5. Calculate walk needs radius by multiplying the walk speed (2.4 mph) by the walk commute time (25 minutes) and rounding the result (1.0) to the nearest integer.
  6. Generate walk needs buffers of 1 mile around the Activity Centers, fixed-guideway transit stations, and BRT lines.
  7. Identify applicable roadway segments as those within the 1-mile buffer that are characterized as a non-limited access facility and are functionally classified above Local Streets.
  8. **Policy Threshold for Need for Pedestrian Access to Activity Centers:** Applicable roadway segments within one mile of Activity Centers, fixed-guideway transit stations, and BRT lines are identified as those with a VTrans Mid-term Need for Pedestrian Access to Activity Centers.

[1] US DOT Federal Highway Administration, Manual on Uniform Traffic Control Devices, 2009. https://mutcd.fhwa.dot.gov/index.htm

3.7 Need Category: Need for Bicycle Access to Activity Centers

Measure: Activity Centers Bike-sheds

What it means: Areas within biking distance of VTrans Activity Centers. VTrans Activity Centers are identified as "areas of regional importance that have a high density of economic and social activity" and are associated with the Regional Networks Travel Market. Activity Centers have been identified through stakeholder input.

Applicable VTrans Travel Market: RN

Identification of Needs

- Data Sources:
  - OIPI, Shapefile of Activity Centers by category (Knowledge-based, Industrial, Local-serving) (See Appendix C)
  - Existing, Planned and Under-Construction Fixed-Guideway and BRT lines: Northern Virginia and Fredericksburg Regional Networks, Dulles Corridor Metrorail Project, Hampton Roads Regional Network, Greater Richmond Transit Company, Washington Metropolitan Area Transit Authority
  - U.S. Census Bureau, American Community Survey (ACS) Five-year Estimates:
    i. Table B08534: Means of Transportation to Work by Travel Time to Work
  - U.S. Census Bureau, Shapefile of MPO boundaries in Virginia, 2014
  - U.S. Census Bureau (2014). *American Community Survey Reports, "Modes Less Traveled— Bicycling and Walking to Work in the United States: 2008-2012."* (Bike Commute Time)
  - Virginia DRPT, Shapefile of transit stops in Virginia, 2019

- Year of analysis: 2017

- Period of analysis: n/a

- Calculations:
  1. Retain only knowledge-based and local-serving Activity Centers inside of MPO boundaries.
  2. Create a shapefile of all fixed-guideway transit and commuter rail stations, and BRT lines inside of MPO boundaries
  3. Extract bike speed by averaging researched sources[1] (2019 sources noted under Secondary Data Sources. 2019 bike speed equal to 9.9 mph)
  4. Extract mean bike commute time (using the U.S. Census Modes Less Traveled Survey Report) and impute bike commute time that is equivalent to the walk commute using the following equation. 2019 figures resulted in a 42-minute bike commute time using the following equation:

     $$\left[\left(\frac{\textit{Mean bike commute-mean walk commute}}{\textit{mean walk commute}} + 1\right) * \textit{90th percentile walk commute}\right]$$

  5. Calculate bike needs radius by multiplying the bike speed (9.9 mph) by the bike commute time (42 minutes) and rounding the result (6.9) to the nearest integer.
  6. Generate bike needs buffers of 7 miles around the Activity Centers, fixed-guideway transit stations, and BRT lines.
  7. Identify applicable roadway segments as those within the 7-mile buffer that are characterized as a non-limited access facility and are functionally classified above Local Streets.
  8. **Threshold for Need for Bicycle Access to Activity Centers:** Roadway segments within 7 miles of Activity Centers, fixed-guideway transit stations, and BRT lines are identified as those with a Need for Bicycle Access to Activity Centers.

[1] Multiple sources
- McLeish, M. (2017). "How far is too far to bike to work?" Mobility Lab. Available at https://mobilitylab.org/2017/02/27/how-far-bike-work/
- Average cycling speed for new and experienced cyclists" Road Bike. Available at https://www.road-bike.co.uk/articles/average-speed.php.
- Tejvan (2017). Average speeds cycling. Available at https://cyclinguphill.com/average-speeds-cycling/
- "How fast does the average person ride a bike?" Reference. Available at https://www.reference.com/world-view/fast-average-person-ride-bike-cf053029272716e0

3.8 Need Category: Access to Industrial and Economic Development Areas (IEDAs)

Measure: Location and Readiness Status of Industrial and Economic Development Areas (IEDAs)

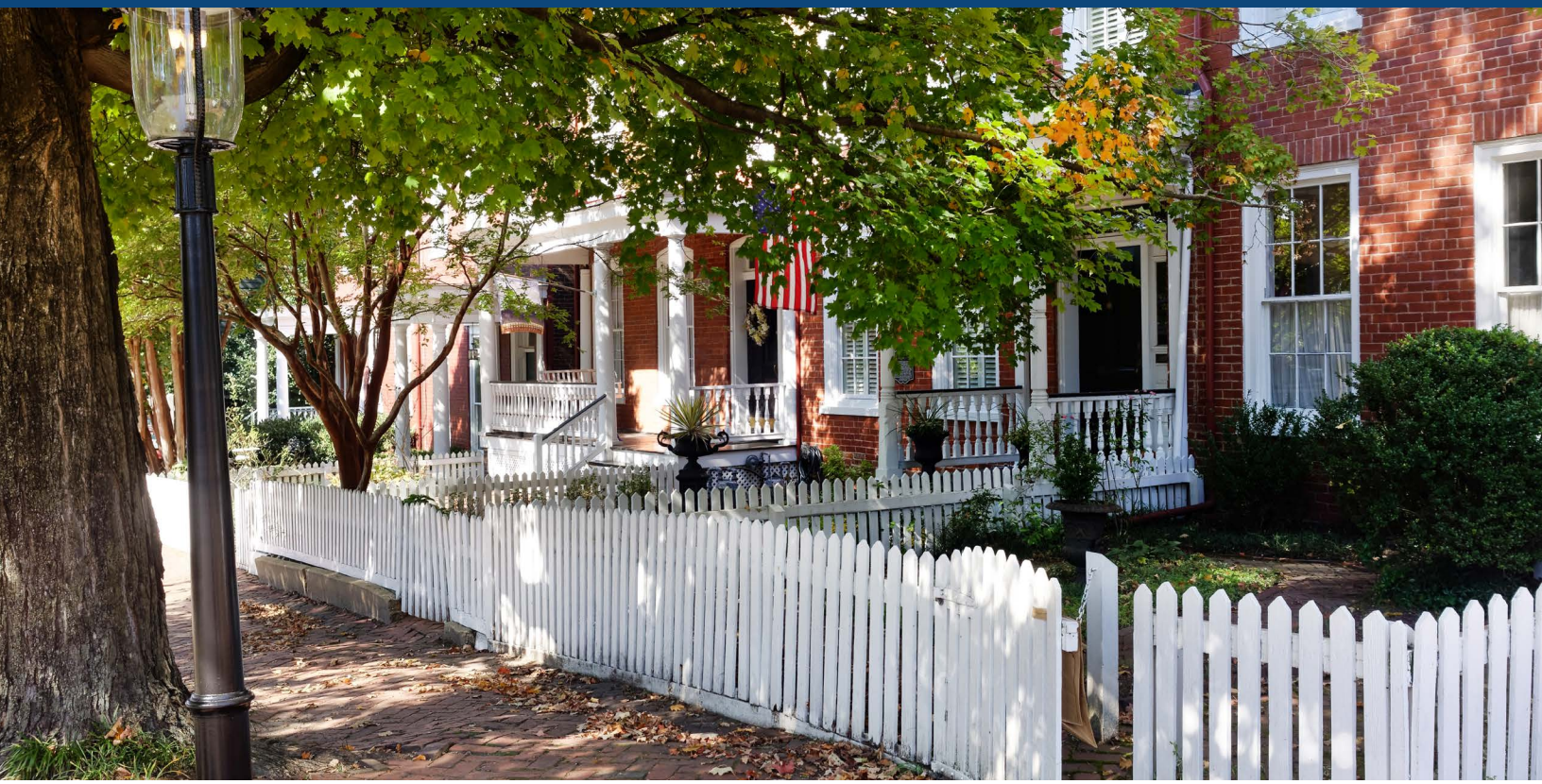
What it means: Sites selected for the Virginia Economic Development Partnership (VEDP) Virginia Business Ready Sites Program (VBRSP) that may require improved transportation access in the near future

Applicable VTrans Travel Market: Statewide

Identification of Needs

- Data Sources:
  - VEDP, VBRSP, Table of IEDA sites
- Year of analysis: 2019
- Period of analysis: n/a
- Calculations:
  1. Identify sites accepted in the VEDP Business Ready Sites Program
  2. Work with the VEDP to exclude office-only sites.
  3. Define Needs by VEDP readiness tiers.[1] Tiers include:
     - Tier 1 – Raw land with interested seller
     - Tier 2 – Site controlled and marketed for development
     - Tier 3 – Zoned industrial/commercial, due diligence complete
     - Tier 4 – Certified as "infrastructure ready"
     - Tier 5 – "Shovel Ready" – permits in place
  4. **Threshold for Need for Access to Industrial and Economic Development Areas:** IEDA sites, represented as nodes, that have achieved a readiness status of Tier 3 or higher in VEDP's Business Ready Sites Program, are identified as those with a VTrans Mid-term Need for Access to IEDA's.

[1] Virginia Economic Development Partnership, Business Ready Sites Program, https://www.vedp.org/vbrsp



3.9 Need Category: Urban Development Areas (UDAs)

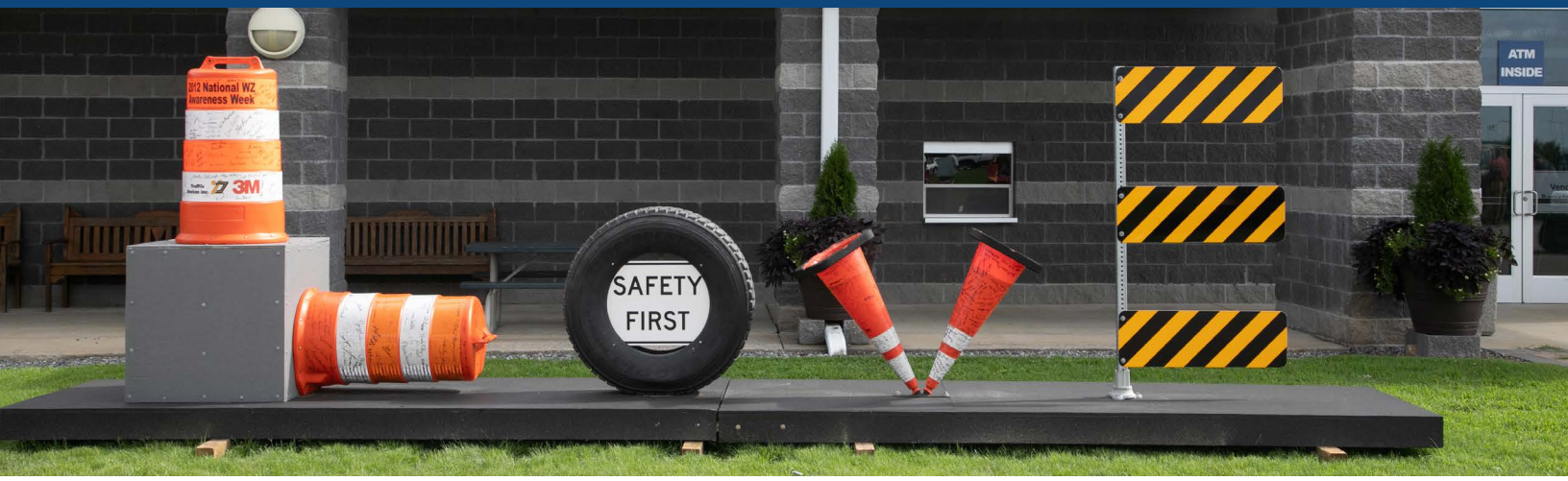
Measure: Locally-identified Need based on an online survey of sponsoring jurisdictions

What it means: Designated Urban Development Areas (UDAs) that are in need of transportation improvements to support walkability and local travel needs.

Applicable VTrans Travel Market: UDA

Identification of Needs

- Data Sources:
  - Localities with designated UDAs, UDA Needs via completed surveys
  - OIPI and Localities with designated UDAs, geospatial database of UDA boundaries
- Year of analysis: 2019
- Period of analysis: n/a
- Calculations:
  1. Collect, review and confirm locality UDA Needs survey responses.
  2. Review, and if necessary, revise boundaries of UDA borders in geospatial files to ensure internal roads are included.
  3. Code survey responses as "high," "moderate," "low," and "not applicable" as submitted by locality's designated respondent for the following survey question: "Please assess the types of transportation improvements that are most needed to promote the development of the UDA."
  4. Identify roadway segments falling within UDA boundaries and exclude limited access facilities and roadway segments designated as Local Streets from UDA Needs designation. Assign UDA Needs to remaining roadway segments. Distinguish between Needs within UDA and those adjacent to UDA (using a ¼-mile buffer).
  5. **Threshold for Needs for Urban Development Areas:** Roadway segments within and in close proximity to UDAs with Needs identified in the locality-completed surveys are identified as those with VTrans Mid-term Needs for UDAs.



3.10 Need Category: Roadway Safety

Measure: Potential for Safety Improvement (PSI)

What it means: Areas with a higher calculated risk of crashes based on roadway characteristics and observed crash data

Applicable VTrans Travel Market: Statewide

Identification of Needs

- Data Sources:
  - Virginia Department of Motor Vehicles, Five-year crash data by location and severity, including intersection and interchange-related crashes and segment-level crashes between intersections or interchanges on limited Access facilities
  - VDOT Traffic Engineering Division, PSI analysis
- Year of analysis: 2014–2018
- Period of analysis: all days, 24-hour days
- Calculations:
  1. Merge 2014–2018 crash database with PSI table data. With this information, the number of crashes by severity can be calculated and related to the PSI values by location.
  2. Create two sets of tables: One for crashes within 250 feet of an intersection and one for all crashes that occur along segments.
  3. Identify the following attributes:
     - Total crash aggregate five-year PSI
     - Fatal and injury crash aggregate five-year PSI
     - Number of years PSI analysis identifies a location as having crashes
     - Number of years PSI analysis identifies a location as having fatal and injury crashes
  4. Identify segments and intersections using the PSI ranking and crash thresholds as follows:
     - The top 100 (miles for segments, locations for intersections) of VDOT Potential for Safety Improvement (PSI) Intersections and Segments by PSI rank
     - Include additional intersections and segments meeting the following criteria:
       - Locations on PSI List 2+ years out of last five years
       - Locations on Fatal/Injury PSI List 2+ years out of last five years with at least 3+ Fatal or Injury crashes at the intersection or segment over the last five years
  5. **Threshold for Need for Roadway Safety:** Roadway segments and intersections (represented as nodes) meeting the thresholds in Step 4 above, are identified as those with a VTrans Mid-term Need for Roadway Safety.

3.11 Need Category: Pedestrian Safety

Measure: Utilization of roadway segments included in VDOT's Pedestrian Safety Action Plan (PSAP) Priority Corridors

What it means: Roadway areas that may require attention based on pedestrian safety factors

Applicable VTrans Travel Market: Statewide

Identification of Needs

- Data Sources:
  - VDOT Traffic Engineering, Geospatial database developed for PSAP
- Year of analysis: 2018, based on calendar year 2012–2016 crash data
- Period of analysis: all days, 24-hour days
- Calculations:
  1. Identify roadway segments included in VDOT PSAP Priority Corridors.
  2. **Threshold for VTrans Mid-term Need for Pedestrian Safety:** Roadway segments included in PSAP Priority Corridors are identified as those with a VTrans Mid-term Need for Pedestrian Safety.

3.12 Need Category: Capacity Preservation

Measure: VDOT Arterial Preservation Network, or the state-maintained portion of the National Highway System in Virginia and including some additional highways that facilitate connectivity.

What it means: This VTrans Need Category focuses on the need for proactive measures to strike a balance between access and mobility.

Applicable VTrans Travel Market: CoSS, RN

Identification of Needs

- Data Sources:
  - VDOT Transportation Mobility Planning Division, Geospatial database of VDOT's Arterial Preservation Network
- Year of analysis: 2019
- Period of analysis: n/a
- Calculations:
  1. Identify roadway segments included in VDOT's Arterial Preservation Network.
  2. **Threshold for Need for Capacity Preservation:** Roadway segments within RNs or along the CoSS, and included in VDOT's Arterial Preservation Network, are identified as those with a VTrans Mid-term Need for Capacity Preservation.

3.13 Need Category: Transportation Demand Management (TDM)

Measure: TDM Needs utilizing VTrans Travel Markets, Roadway Functional Classification, and Roadway Access Management.

What it means: Locations where Transportation Demand Management (TDM) strategies can be beneficial to reduce vehicle miles traveled.

Applicable VTrans Travel Market: CoSS, RN

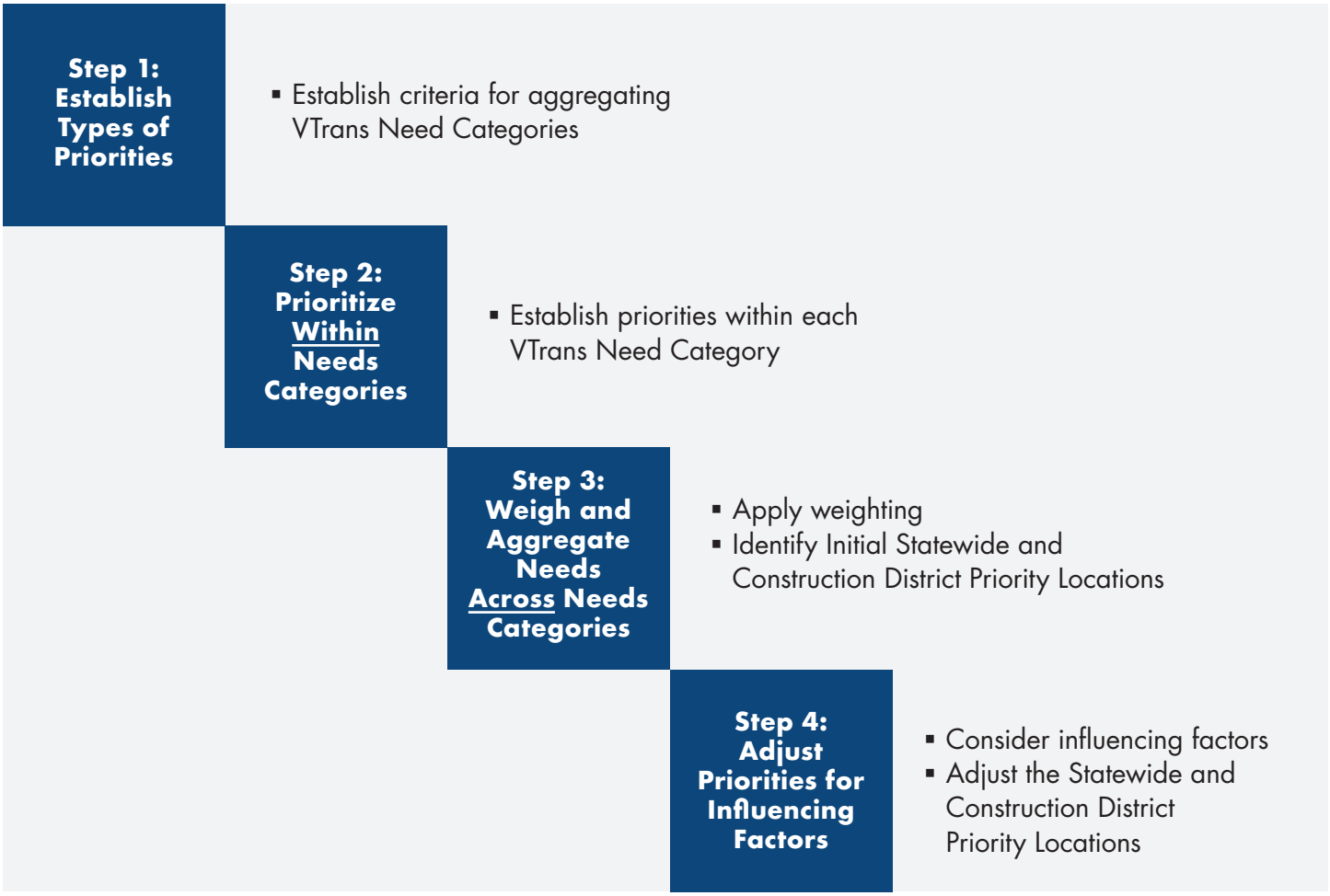
Identification of Needs

- Data Sources:
  - VDOT, LRS Geospatial database of Virginia's roadway system
- Year of analysis: 2019
- Period of Analysis: n/a
- Calculations:
  1. Identify roadway segments by VTrans Travel Markets and facility type
     - on a limited access or non-limited access facility
     - within Regional Networks or along CoSS
  2. Categorize the following roads as qualifying for designation as a TDM Need:
     - Limited access facilities on CoSS: These roads have a Need whose solution may be new or expanded park and ride facilities, rail and public transportation services and passenger facilities, bicycle and pedestrian facilities where permitted, and expansion and coordination of commuter assistance programs services.
     - Non-limited access facilities on CoSS: These roads have a Need whose solution may be new or expanded park and ride facilities, rail and public transportation services and facilities, bicycle and pedestrian facilities, and expansion and coordination of commuter assistance programs services.
     - Limited access facilities within Regional Networks: These roads have a Need whose solution may be new or expanded park and ride facilities, rail and public transportation services and facilities, bicycle and pedestrian facilities, and expansion and coordination of commuter assistance programs services.
     - Non-limited access and non-local roads within MPO Areas: These roads have a Need whose solution may be new or expanded public transportation services and facilities, bicycle and pedestrian facilities, expansion and coordination of commuter assistance programs, and Shared Mobility solutions.
  3. **Threshold for VTrans Mid-term Need for Transportation Demand Management:**
     - Roadway segments along limited access facilities along CoSS are identified as those with a VTrans Mid-term Need for Transportation Demand Management for new or expanded park and ride facilities, rail and public transportation services and passenger facilities, bicycle and pedestrian facilities where permitted, and expansion and coordination of commuter assistance programs services.
     - Roadway segments along non-limited access facilities along CoSS are identified as those with a VTrans Mid-term Need for Transportation Demand Management for new or expanded park and ride facilities, rail and public transportation services and facilities, bicycle and pedestrian facilities, and expansion and coordination of commuter assistance programs services.
     - Roadway segments along limited access facilities within Regional Networks are identified as those with a VTrans Mid-term Need for Transportation Demand Management for new or expanded park and ride facilities, rail and public transportation services and passenger facilities, bicycle and pedestrian facilities where permitted, and expansion and coordination of commuter assistance programs services.
     - Roadway segments along non-limited access facilities within Regional Networks (but not also along CoSS) are identified as those with a VTrans Mid-term Need for Transportation Demand Management for new or expanded public transportation services and facilities, bicycle and pedestrian facilities, coordination of commuter assistance programs, and Shared Mobility.

4. PRIORITIZATION OF NEEDS[1]

The Draft Policy for the Prioritization of the VTrans Mid-term Needs is conducted in four steps shown in Figure 2 and described in greater detail below.

Figure 3: Steps for Prioritization of the VTrans Mid-term Needs

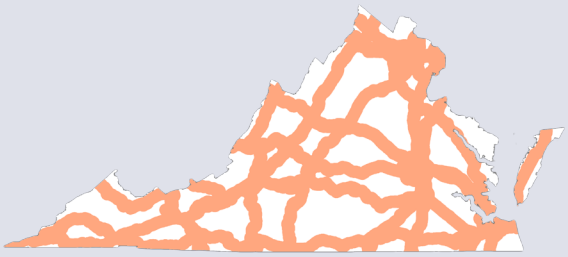
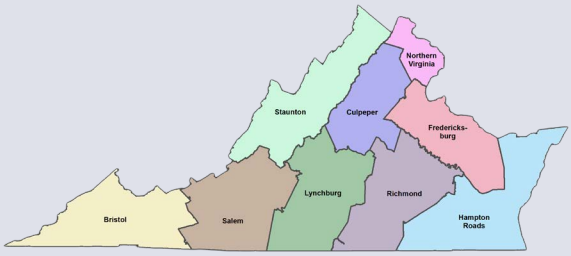


[1] Accepting comments in preparation for review by the Board

4.1 Step 1: Establish Types of Priorities

The first step organizes various VTrans Travel Markets and Need categories into two groups: Statewide Priority Locations and Construction District Priority Locations.

Table 2: Step 1 Levels of Prioritization

Levels of Prioritization	Statewide Priority Locations	Construction District Priority Locations
Aggregation Level	Statewide: Corridors of Statewide Significance (CoSS) 	The Nine VDOT Construction Districts 
Applicable VTrans Travel Markets	▪ Corridors of Statewide Significance (CoSS) ▪ Safety Needs along CoSS	▪ Regional Networks (RN) ▪ Safety ▪ Urban Development Area (UDA) Need - Access to Industrial and Economic Development Areas (IEDA)
Examples of Aggregation Level and Travel Markets	To establish Statewide Priority Locations, Needs along I-66 in Northern Virginia will be compared against Route 29 in the Lynchburg area or against Route 13 in Hampton Roads. All these roadways are part of the VTrans CoSS Travel Market.	To establish Construction District Priority Locations, Needs along Laburnum Avenue in the City of Richmond will be compared against Washington Street in the City of Petersburg. Both the City of Richmond and the City of Petersburg are in the Richmond Construction District. Laburnum Avenue, for example, will not be compared against any street outside of the Richmond Construction District.
Applicable Need Categories	1. Congestion Mitigation (CoSS) 2. Improved Reliability (Roadway) (CoSS) 3. Improved Reliability (Intercity and Commuter Rail) (CoSS) 4. Roadway Safety (along CoSS) 5. Capacity Preservation (CoSS) 6. Transportation Demand Management (CoSS)	1. Congestion Mitigation (RN) 2. Improved Reliability (Roadway) (RN) 3. Transit Access for Equity Emphasis Areas (RN) 4. Transit Access to Activity Centers (RN) 5. Pedestrian Access to Activity Centers (RN) 6. Bicycle Access to Activity Centers (RN) 7. Access to Industrial and Economic Development Areas (IEDAs) (UDA) 8. Roadway Safety 9. Pedestrian Safety 10. Capacity Preservation (RN) 11. Transportation Demand Management (RN)

4.2 Step 2: Prioritize Within Need Categories

The second step utilizes the following two criteria to categorize VTrans Mid-term Needs as *Very High, High, Medium, and Low.*

1. Severity of the Need: This criterion takes into account the intensity or extremity of the Need. For example, roadway segments where vehicles spend the greatest number of hours in traffic are categorized as a *Very High* Need compared to roadway segments where vehicles spend fewer hours in traffic.
2. Magnitude of the Need: This criterion takes into account the number of residents, vehicles, or persons impacted by the Severity of the need.

These criteria are explained in more detail below for both Statewide Priority Locations and the Construction District Priority Locations.

As a note, only areas where a need was identified in the Identification of the Mid-term Needs are included in the calculations for the Prioritization of the Mid-term Needs. No new needs were identified as part of the prioritization process, but some needs identified as a node-based representation were transferred to a roadway segment-based representation for the purposes of aggregation and weighting.

4.2.1 Prioritization within Congestion Mitigation Need Category

Applicable VTrans Travel Market: CoSS, RN

Utilized for: Establishing Statewide Priority Locations (based on CoSS Needs) and Construction District Priority Locations (based on RN Needs)

VTrans Mid-term Needs for Congestion Mitigation are identified through two performance measures:

- Percent Person-Miles Traveled in Excessively Congested Conditions (PECC): PECC is used to identify Need for Congestion Mitigation for: (1) Interstate roadway segments within CoSS; and, (2) Other select limited access facilities (LAF) included in Appendix B.
- Travel Time Index (TTI). TTI is used to identify Need for Congestion Mitigation for: (1) non-limited access facilities within CoSS; and, (2) all other roadway segments within RNs.

Two criteria, Severity and Magnitude, are utilized to categorize VTrans Mid-term Needs for Congestion Mitigation as *Very High, High, Medium, and Low*, in the following manner.

Severity of VTrans Mid-term Need for Congestion Mitigation

- Source data
  - Interstate roadway segments within CoSS and other select limited access facilities (LAFs): PECC values used to identify VTrans Mid-term Needs for Congestion Mitigation
  - For non-limited access facilities within CoSS and all other roadway segments within RNs: TTI values used to identify VTrans Mid-term Needs for Congestion Mitigation

- Calculations
  - Interstate roadway segments within CoSS and other select LAFs: PECC values used to establish VTrans Mid-term Needs for Congestion Mitigation
  - For non-limited access roadway segments within CoSS and all other roadway segments within RNs:
  - Calculate cumulative total value of all average hourly TTI values greater than 1.3 over the period from 6 AM – 8 PM using the following equation:

  - *TTI = 5/7 × (sum of weekday TTI > 1.3) + 2/7 × (sum of weekend TTI > 1.3)*

  - And set any outliers with an equation value > 8 (90th percentile), to 8.

Magnitude of VTrans Mid-term Needs for Congestion Mitigation

- Source data
  - Interstate roadway segments within CoSS and other select LAFs: PECC values used to establish VTrans Mid-term Needs for Congestion Mitigation reflect PMTs and therefore no additional criteria are used for Magnitude.
  - For non-limited access roadway segments within CoSS and all other roadway segments within RNs:
    - VDOT Traffic Engineering Division, VMT for TMCs
    - Highway Capacity Manual[1] guidance: If VMT for a segment is null or 0, populate VMT with (segment length * 7,100)

Consideration of Severity and Magnitude Criteria

- The first step is to normalize PECC values to be able to compare PECC against TTI values.
- PECC is normalized using the following equation. Scores are normalized separately for CoSS to establish Statewide Priority Locations and normalized separately within each VDOT Construction District to establish Construction District Priority Locations. A ceiling of 100% is set for PECC.

$$PECC\ normalized = \frac{PECC\text{-}minimum\ PECC}{maximum\ PECC\text{-}minimum\ PECC}$$

- For TTI, the product resulting from the multiplication of the Severity criterion and Magnitude criterion is normalized utilizing the following equation for CoSS to establish Statewide Priority Locations and normalized separately within each VDOT Construction district to establish Construction District Priority Locations.

$$TTI\_VMT\ normalized = \frac{TTI\_VMT\text{-}minimum\ TTI\_VMT}{maximum\ TTI\_VMT\text{-}minimum\ TTI\_VMT}$$

- Assign the PECC normalized score to limited access facilities and the TTI normalized score to non-limited access roadway segments. If a roadway segment was not given a value using this method, the maximum of the two normalized scores is used.

Prioritizing within Congestion Mitigation Needs Category

Prioritization within this VTrans Mid-term Needs Category occurs in the following manner:

- Sort the *PECC _normalized* and *TTI_VMT_normalized* in descending order and assign the following values based on mileage to develop statewide and for each VDOT Construction District *Very High, High, Medium,* and *Low* categorizations for Need for Congestion Mitigation:[2]
  - *Very High* (Score 7): Top 5% of the total mileage
  - *High* (Score 6): 5.001%–10%
  - *High* (Score 5): 10.001%–15%
  - *Medium* (Score 4): 15.001%–20%
  - Medium (Score 3): 20.001%–25%
  - *Low* (Score 2): 25.001%–50%
  - *Low* (Score 1): Bottom 50.001%–100%

If RN Need for Congestion Mitigation has fewer than 20 total miles of Congestion Needs in a VDOT Construction District, the following method is used:

- Sort *PECC _normalized* and *TTI_VMT_normalized* in descending order and assign the following values based on mileage:
  - *Very High* (Score 7): Top 0–5 miles
  - *High* (Score 6): 5.001–10 miles
  - *High* (Score 5): 10.001–15 miles
  - *Medium* (Score 4): 15.001–20 miles

[1] Transportation Research Board, Highway Capacity Manual, Sixth Edition: A Guide for Multimodal Mobility Analysis, 2016.

[2] Where prioritization values do not break exactly at the percentile categories, assign all values to the higher category until there is a new prioritization value. For example, if the top 7% of roadway miles all have the same score, then 7% of miles would be classified as *Very High*.

4.2.2 Prioritization within Improved Reliability (Roadway) Need Category

Applicable VTrans Travel Market: CoSS, RN

Utilized for: Establishing Statewide Priority Locations (based on CoSS Needs) and Construction District Priority Locations (based on RN Needs)

Two criteria, Severity and Magnitude, are utilized to categorize VTrans Mid-term Needs for Improved Reliability (Roadway) as *Very High, High, Medium,* and *Low* in the following manner.

Severity of VTrans Mid-term Need for Improved Reliability (Roadway)

- Source data: Hourly weekday and weekend level of travel time reliability (LOTTR) values used to establish VTrans CoSS and RN needs for reliability improvements
- Calculations
  - Calculate the weighted sum of LOTTR, which is the cumulative total of all average LOTTR values > 1.5 over the period from 6AM – 8PM, weighted by day of the week.
  - *weighted sum = 5/7 × (sum of weekday LOTTR > 1.5) + 2/7 × (sum of weekend LOTTR > 1.5)*

Magnitude of VTrans Mid-term Need for Improved Reliability (Roadway)

- Source data:
  - VDOT Traffic Engineering Division, VMT for TMCs
- Calculations
  - If VMT for a segment is null or 0, populate VMT with (segment length * 7,100) (Highway Capacity Manual[1] guidance).

Consideration of Severity and Magnitude Criteria

- Severity (LOTTR values) x Magnitude (VMT)

Prioritizing within Improved Reliability (Roadway) Need Category

Prioritization within this VTrans Mid-term Needs Category occurs in the following manner:

- Sort the product of the multiplication in descending order and assign the following values based on mileage to develop statewide and for each VDOT Construction District *Very High, High, Medium,* and *Low* categorizations for Need for Improved Reliability.
  - *Very High* (Score 7): Top 5% of the total mileage
  - *High* (Score 6): 5.001%–10%
  - *High* (Scores 5): 10.001%–15%
  - *Medium* (Score 4): 15.001%–20%
  - *Medium* (Score 3): 20.001%–25%
  - *Low* (Score 2): 25.001%–50%
  - *Low* (Score 1): Bottom 50.001%–100%

If RN Need for Improved Reliability has fewer than 20 total miles of Needs in a VDOT Construction District, the following method is used:

- Sort the multiplication in descending order and assign the following values based on mileage:
  - *Very High* (Score 7): Top 0–5 miles
  - *High* (Score 6): 5.001–10 miles
  - *High* (Scores 5): 10.001–15 miles
  - *Medium* (Score 4): 15.001–20 miles

4.2.3 Prioritization within Improved Reliability (Intercity and Commuter Rail) Need Category

Applicable VTrans Travel Market: CoSS

Utilized for: Establishing Statewide Priority Locations (based on CoSS Needs)

Two criteria, Severity and Magnitude, are utilized to categorize VTrans Mid-term Needs for Improved Reliability (Intercity and Commuter Rail) as *Very High, High, Medium,* and *Low* in the following manner.

Severity of VTrans Mid-term Need for Improved Reliability (Intercity and Commuter Rail)

- Source data: Station-level (Amtrak) & line-level (VRE) directional rail on-time performance used to Identify Need for Improved Reliability (Intercity and Commuter Rail).
- Calculations
  - Identify service by railroad corridor per CoSS definition (Appendix A).
  - Assign station-level (Amtrak) & line-level (VRE) directional rail on-time performance values to the Primary CoSS component.
  - Assign the minimum directional performance value to roadway segments.

Magnitude of VTrans Mid-term Need for Improved Reliability (Intercity and Commuter Rail)

- Source data:
  - Virginia DRPT, station-level boardings and alightings data for Amtrak and VRE.
- Calculations
  - Assign the sum of average daily boarding and alighting (based on applicable service days determined as 365 service days for Amtrak and 248 service days for VRE) to the roadway segments along Primary CoSS components. If a road has no direction listed, the average of the two directional numbers is applied.
  - Northbound and eastbound roadway directions are considered Inbound rail travel for all CoSS's except the East-West CoSS Corridor. Within the East-West CoSS Corridor, within Hampton Roads and Richmond Districts, northbound and westbound rail travel is considered Inbound, and within Staunton and Culpeper Districts, northbound and eastbound rail travel is considered Inbound.

Consideration of Severity and Magnitude Criteria

- Severity (on-time performance) x Magnitude (daily boardings and alightings)

Prioritizing within Improved Reliability (Intercity and Commuter Rail) Need Category

Prioritization within this VTrans Mid-term Needs Category occurs in the following manner:

- For the entire state, sort the product of Severity and Magnitude measures in descending order and assign the following values based on mileage[1] to develop statewide *Very High, High, Medium,* and *Low* categorizations for Need for Improved Reliability (Intercity and Commuter Rail).
  - *Very High* (Score 7): Top 5% of the total mileage
  - *High* (Score 6): 5.001%–10%
  - *High* (Score 5): 10.001%–15%
  - *Medium* (Score 4): 15.001%–20%
  - *Medium* (Score 3): 20.001%–25%
  - *Low* (Score 2): 25.001%–50%
  - *Low* (Score 1): Bottom 50.001%–100%

[1] Where prioritization values do not break exactly at the percentile categories, assign all values to the higher category until there is a new prioritization value. For example, if the top 7% of roadway miles all have the same score, then 7% of miles would be classified as *Very High*.

4.2.4 Prioritization within Transit Access for Equity Emphasis Areas Need Category

Applicable VTrans Travel Market: RN

Utilized for: Establishing Construction District Priority Locations

One criterion, Severity, is utilized to categorize VTrans Mid-term Needs for Transit Access for Equity Emphasis Areas (EEAs) as *Very High, High, Medium,* and *Low* in the following manner.

Severity of VTrans Mid-term Need for Transit Access to EEAs

- Source data: Census Block Groups and associated EEA Index values used to identify VTrans Mid-term Need for Transit Access for Equity Emphasis Areas
- Calculations
  - Assign Block Groups' EEA index values to the road segments within their boundaries with Need for Transit Access to EEA

Magnitude of VTrans Mid-term Need for Transit Access to EEAs

- None. EEA Index accounts for relative density in Census Block Group areas which are already controlled for population.

Prioritizing within Transit Access to EEAs Need Category

Prioritization within this VTrans Mid-term Needs Category occurs in the following manner:

- For each VDOT Construction District, sort EEA Index in descending order and assign the following values based on mileage[1] to develop VDOT Construction District-specific *Very High, High, Medium,* and *Low* categorization for VTrans Mid-term Need for Transit Access for Equity Emphasis Areas.
  - *Very High* (Score 7): Top 5% of the total mileage
  - *High* (Score 6): 5.001%–10%
  - *High* (Score 5): 10.001%–15%
  - *Medium* (Score 4): 15.001%–20%
  - *Medium* (Score 3): 20.001%–25%
  - *Low* (Score 2): 25.001%–50%
  - *Low* (Score 1): Bottom 50.001%–100%

[1] Where prioritization values do not break exactly at the percentile categories, assign all values to the higher category until there is a new prioritization value. For example, if the top 7% of roadway miles all have the same score, then 7% of miles would be classified as *Very High*.

4.2.5 Prioritization within Transit Access to Activity Centers Need Category

Applicable VTrans Travel Market: RN

Utilized for: Establishing Construction District Priority Locations

Two criteria, Severity and Magnitude, are utilized to categorize VTrans Mid-term Needs for Transit Access to Activity Centers as *Very High, High, Medium,* and *Low* in the following manner.

Severity of Need for VTrans Mid-term Transit Access to Activity Centers

- Source data: Transit deficit (difference in number of workers who can reach an Activity Center by transit within 45 minutes as compared to by automobile) used to identify VTrans Mid-term Need for Transit Access to Activity Centers.
- Calculations
  - Assign node-specific VTrans Mid-term Needs to roadway segments using the following method:
  - Determine the median transit commute time for each RN, spatially joining RNs to the county-level Census data on Means of Transportation to Work.
  - Sum the number of people in a RN taking transit and the number in each travel time category: <10 minutes, 10–14 minutes, 15–19 minutes, 20–24 minutes, 25–29 minutes, 30–44 minutes, 35–44 minutes, 45–59 minutes, 60+ minutes.
  - Identify the median transit commute time as the midpoint of the travel time bin containing the 50th percentile transit commuter.
  - Convert the value to a distance by multiplying it by the average travel speed of a bus (12 mph).[1]
  - Draw a buffer equal in radius to the median transit commute distance for each RN around Activity Centers in that RN. For Activity Centers not inside a RN, draw a buffer whose size is the distance between an RN boundary and the Activity Centers that is furthest outside it (5.4 miles).
  - Assign the maximum transit deficit of any Activity Center whose buffer intersects a road segment centroid to that segment.

[1] American Public Transit Association (APTA), "2020 Public Transportation Fact Book", 2020.

Magnitude of VTrans Mid-term Need for Transit Access to Activity Centers

- Source data:
  - U.S. Census Bureau, LEHD Origin-Destination Employment Statistics (LODES) Residence Area Characteristics (RAC) employment data by Census block
  - InfoUSA, business location data aggregated at the Census Block Group level
  - VDOT, Roadway Functional Classification
- Calculations
  - Assign the maximum Activity Center employment of any Activity Center whose buffer intersects a road segment centroid.
  - Only consider segments whose function class is not "error", "Local", or any ramp. Assign the remaining segments a temporary functional class score ('FC Score'):
    - 7 points: Interstate, Other Freeways & Expressways, Other Principal Arterial
    - 5 points: Minor Arterial
    - 3 points: Major Collector
    - 1 point: Minor Collector

Consideration of Severity and Magnitude Criteria

- Calculate a scoring metric based on Severity and Magnitude in the following manner:

$$Score = \frac{transit\ deficit \times AC\ employment}{maximum\ AC\ employment\ in district} \times FC\ Score$$

Prioritizing within Transit Access to Activity Centers Need Category

Prioritization within this VTrans Mid-term Needs Category occurs in the following manner:

- For each VDOT Construction District, sort the scores in descending order and assign the following values based on mileage[1] to develop VDOT Construction District-specific *Very High, High, Medium,* and *Low* categorizations for VTrans Mid-term Need for Transit Access to Activity Centers.
  - *Very High* (Score 7): Top 5% of the total mileage
  - *High* (Score 6): 5.001%–10%
  - *High* (Score 5): 10.001%–15%
  - *Medium* (Score 4): 15.001%–20%
  - *Medium* (Score 3): 20.001%–25%
  - *Low* (Score 2): 25.001%–50%
  - *Low* (Score 1): Bottom 50.001%–100%

[1] Where prioritization values do not break exactly at the percentile categories, assign all values to the higher category until there is a new prioritization value. For example, if the top 7% of roadway miles all have the same score, then 7% of miles would be classified as *Very High*.

4.2.6 Prioritization within Pedestrian Access to Activity Centers Need Category

Applicable VTrans Travel Market: RN

Utilized for: Establishing Construction District Priority Locations

Two criteria, Severity and Magnitude, are utilized to categorize VTrans Mid-term Needs for Pedestrian Access to Activity Centers as *Very High, High, Medium,* and *Low* in the following manner.

Severity of VTrans Mid-term Need for Pedestrian Access to Activity Centers

- Source data:
  - Walk Score®[1]
  - VDOT Transportation Mobility Planning Division, Existing documented pedestrian infrastructure
- Calculations
  - Access Walk Score® for Census Block centroids and assign to road segments based on the share of each Census Block area within a 200-foot buffer around the road segment.
  - The resulting area-weighted averages are the pedestrian Severity measure.

Magnitude of VTrans Mid-term Need for Pedestrian Access to Activity Centers

- Source data:
  - U.S. Census Bureau, American Community Survey 2018 5-Year Estimates "Total Population" by Block Group
  - U.S. Census Bureau, LEHD Origin-Destination Employment Statistics (LODES) Workplace Area Characteristics (WAC) employment data by Census Block
  - VDOT, Roadway Functional Classification
- Calculations
  - Aggregate Census Block-level employment data to the Block Group-level.
  - Calculate employment and population densities using each Census Block Group's total employment, population, and area in square miles.
  - Sum the resulting employment and population densities.
  - Assign a road segment the summed density value of the Block Group that its centroid intersects.

[1]Redfin Real Estate (2020). walkscore.com/VA

Consideration of Severity and Magnitude Criteria

- For roadway segments with no documented pedestrian infrastructure, or documented pedestrian infrastructure with deficiencies in observed infrastructure, and with an area-weighted average Walk Score® below 70, multiply Severity (Walk Score®) and Magnitude (population and employment densities, roadway functional classification) to develop a score.
- Multiply the output of the above calculation based on points assigned by a roadway segment's roadway functional classification as follows:
  - 7 points: Other Principal Arterial
  - 3 points: Minor Arterial
  - 1 point: All other functional classes

Prioritizing within Pedestrian Access to Activity Centers Need Category

Prioritization within this VTrans Mid-term Needs Category occurs in the following manner:

- For each VDOT Construction District, sort the score in descending order and assign the following values based on mileage[1] to develop VDOT Construction District-specific *Very High, High, Medium,* and *Low* categorizations for VTrans Mid-term Need for Pedestrian Access to Activity Centers.
  - *Very High* (Score 7): Top 5% of the total mileage
  - *High* (Score 6): 5.001%–10%
  - *High* (Score 5): 10.001%–15%
  - *Medium* (Score 4): 15.001%–20%
  - *Medium* (Score 3): 20.001%–25%
  - *Low* (Score 2): 25.001%–50%
  - *Low* (Score 1): Bottom 50.001%–100%
  - Assign other roadway segments with VTrans Mid-term Need for Pedestrian Access to Activity Centers a priority score of 1 *(Low)*.

[1] Where prioritization values do not break exactly at the percentile categories, assign all values to the higher category until there is a new prioritization value. For example, if the top 7% of roadway miles all have the same score, then 7% of miles would be classified as *Very High*.

4.2.7 Prioritization within Bicycle Access to Activity Centers Need Category

Applicable VTrans Travel Market: RN

Utilized for: Establishing Construction District Priority Locations

Two criteria, Severity and Magnitude, are utilized to categorize VTrans Mid-term Need for Bicycle Access to Activity Centers as *Very High, High, Medium,* and *Low* in the following manner.

Severity of VTrans Mid-term Need for Bicycle Access to Activity Centers

- Source data:
  - Virginia Department of Rail and Public Transportation's Route and Stop shapefiles, used to identify BRT lines, fixed-guideway transit stops, and all other transit stops.
  - VDOT Transportation Mobility Planning Division, Virginia Bicycle Facility Inventory; Existing documented bicycle infrastructure, which includes shared use paths, bicycle lanes, shared lanes designated with signs or pavement markings, and four-foot paved shoulders.[1]
- Calculations
  - Draw 3-, 5-, and 7-mile buffers around VTrans Activity Centers. Repeat the same for BRT lines and fixed-guideway transit stops.
  - Intersect the buffers with road segment centroids and assign a road segment the smallest intersecting bike buffer.
  - Assign the following bike Severity values to segments:
    - 3.0 points: Bike buffer of 3 miles and within 200-ft of a transit stop
    - 2.5 points: Bike buffer of 3 miles and outside of 200-ft of a transit stop
    - 2.0 points: Bike buffer of 5 miles and within 200-ft of a transit stop
    - 1.5 points: Bike buffer of 5 miles and outside of 200-ft of a transit stop
    - 1.0 point: Bike buffer of 7 miles and within 200-ft of a transit stop
    - 0.5 points: Bike buffer of 7 miles and outside of 200-ft of a transit stop

[1] https://www.virginiaroads.org/datasets/bicycle-facility-inventory-view

Magnitude of VTrans Mid-term Need for Bicycle Access to Activity Centers

- Source data:
  - U.S. Census Bureau, American Community Survey 2018 5-Year Estimates, "Total Population" by Block Group
  - U.S. Census Bureau, LEHD Origin-Destination Employment Statistics (LODES) Workplace Area Characteristics (WAC) employment data by Census Block
  - VDOT, Roadway Functional Classification
- Calculations
  - Aggregate Census Block-level employment data to the Block Group level.
  - Calculate employment and population densities using each Census Block Group's total employment, population, and area in square miles.
  - Sum the resulting employment and population densities.
  - Assign a road segment the summed density value of the Block Group that its centroid intersects.
  - For roadway functional classification, assign the following values:
    - 7 points: Other Principal Arterial
    - 3 points: Minor Arterial
    - 1 point: All other functional classes

Consideration of Severity and Magnitude Criteria

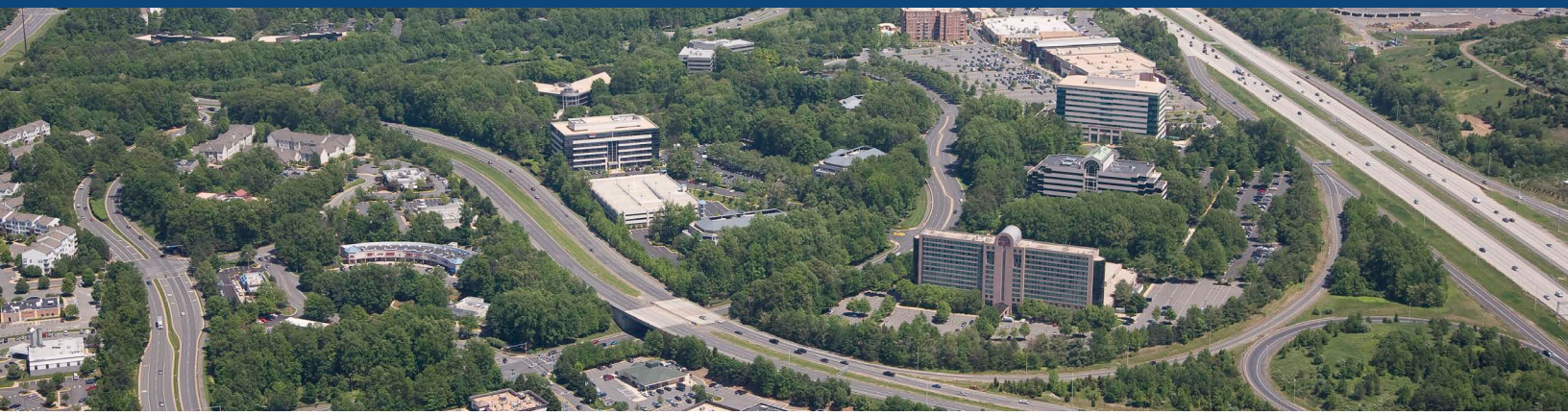
- For roadway segments with no documented bicycle infrastructure, multiply Severity (proximity to VTrans Activity Centers) and Magnitude (population and employment densities, roadway functional classification) to develop a score.

Prioritizing within Bicycle Access to Activity Centers Need Category

Prioritization within this VTrans Mid-term Needs Category occurs in the following manner:

- For each VDOT Construction District, sort the score in descending order and assign the following values based on mileage[1] to develop VDOT Construction District-specific *Very High, High, Medium,* and *Low* categorizations for VTrans Mid-term Need for Bicycle Access to Activity Centers.
  - *Very High* (Score 7): Top 5% of the total mileage
  - *High* (Score 6): 5.001%–10%
  - *High* (Score 5): 10.001%–15%
  - *Medium* (Score 4): 15.001%–20%
  - *Medium* (Score 3): 20.001%–25%
  - *Low* (Score 2): 25.001%–50%
  - *Low* (Score 1): Bottom 50.001%–100%
  - Assign other roadway segments with VTrans Mid-term Needs for Bicycle Access to Activity Centers a priority score of 1 *(Low)*.

[1] Where prioritization values do not break exactly at the percentile categories, assign all values to the higher category until there is a new prioritization value. For example, if the top 7% of roadway miles all have the same score, then 7% of miles would be classified as *Very High*.



4.2.8 Prioritization within Access to Industrial and Economic Development Areas (IEDAs) Need Category

Applicable VTrans Travel Market: Statewide

Utilized for: Establishing Construction District Priority Locations

Severity of VTrans Mid-term Need for Access to Industrial and Economic Development Areas (IEDAs)

- Source data:
  - Established priorities for CoSS and RN Need for Congestion Mitigation
  - Established priorities for CoSS and RN Need for Improved Reliability
  - IEDA locations (polygons)
- Calculations
  - Node-specific VTrans Mid-term Need for Access to Industrial and Economic Development Areas (IEDAs) are assigned to roadway segments using the following method:
    - Identify roadway segments with a Functional Classification above Local Streets
    - Establish a two-mile buffer around IEDA sites
    - Manually select roadway segments that connect an IEDA parcel to the nearest CoSS roadways and along CoSS roadway segments within a two-mile buffer of the site, or if there is no CoSS roadway within two miles, select segments that connect to the nearest CoSS.
  - Calculate the distance in miles from a road segment midpoint to the centroid of the IEDA to which the road segment provides access.
  - For each segment, find the maximum value (noted as X below) from the following priorities previously assigned to the identified roadway segments: (1) CoSS Need for Congestion Mitigation; (2) RN Need for Congestion Mitigation; (3) CoSS Need for Improved Reliability; and (4) RN Need for Improved Reliability.

Magnitude of VTrans Mid-term Access to Industrial and Economic Development Areas (IEDAs)

- None since Need for Congestion Mitigation and Need for Improved Reliability include Magnitude components

Prioritizing within Industrial and Economic Development Areas (IEDAs) Need Category

For each VDOT Construction District, assign the following values based on mileage[1] to develop VDOT Construction District-specific *Very High, High, Medium,* and *Low* categorizations for VTrans Mid-term Need for Access to Industrial and Economic Development Areas (IEDAs).

- *Very High* (Score 7): 2.5 miles ≥ IEDA distance, and value X > 1
- *High* (Score 6): 5 miles ≥ IEDA distance > 2.5 miles, and value X > 1
- *High* (Score 5): IEDA distance > 5 miles or IEDA distance is null, and value X > 1
- *Medium* (Score 4): 2.5 miles ≥ IEDA distance, and value X = 1
- *Medium* (Score 3): 5 miles ≥ IEDA distance > 2.5 miles, and value X = 1
- *Low* (Score 2): IEDA distance > 5 miles or IEDA distance is null, and value X = 1
- *Low* (Score 1): Max Congestion or Reliability priority is null (no Congestion or Reliability needs)

[1] Where prioritization values do not break exactly at the percentile categories, assign all values to the higher category until there is a new prioritization value. For example, if the top 7% of roadway miles all have the same score, then 7% of miles would be classified as *Very High*.

4.2.9 Prioritization within Roadway Safety Need Category

Applicable VTrans Travel Market: Statewide

Utilized for: Establishing Construction District Priority Locations

Severity of VTrans Mid-term Need for Roadway Safety

- Source data:
  - VDOT Construction District-specific Potential for Safety Improvement (PSI) rankings used to establish VTrans Mid-term Needs for Roadway Safety
- Calculations
  - Assign node-specific PSI rank to roadway segments using 150-ft buffers around the intersections with Need for Roadway Safety.
  - Use unique intersection numbers to differentiate roadway segments where the Need for Roadway Safety was assigned based on an adjacent intersection versus segments that had a stand-alone Need for Roadway Safety. For road segments with an intersection rank and a segment rank, retain the highest rank. For instance, for a road with an intersection rank of 4 and a segment rank of 23, retain the rank of 4.
  - For VTrans Mid-term Needs for Roadway Safety along CoSS: a Severity criterion is not used since VDOT Construction District-specific PSI rankings skew the results.
  - For VTrans Mid-term Needs for Roadway Safety within RN, assign the following values
    - Score 7: PSI rank score: 20 ≥ PSI rank
    - Score 6: PSI rank score: 40 ≥ PSI rank > 20
    - Score 5: PSI rank score: 60 ≥ PSI rank > 40
    - Score 4: PSI rank score: 80 ≥ PSI rank > 60
    - Score 3: PSI rank score: 100 ≥ PSI rank > 80
    - Score 2: PSI rank score: 150 ≥ PSI rank > 100
    - Score 1: PSI rank score: PSI rank > 150

Magnitude of VTrans Mid-term Need for Roadway Safety

- Source data
  - VDOT Traffic Engineering Division, Intersection and roadway segment-specific number of crashes involving serious injuries and fatalities.
- Calculations
  - Assign node-specific counts for crashes involving fatalities or serious injuries to roadway segments using 150-ft buffers around the intersections with Need for Roadway Safety.
  - Use unique intersection numbers to differentiate roadway segments where the VTrans Mid-term Need for Roadway Safety was assigned based on an adjacent intersection versus segments that had stand-alone Need for Roadway Safety.
  - Assign intersection- and segment-specific crashes involving fatalities or serious injuries to roadway segments with VTrans Mid-term Need for Roadway Safety. Sum the resulting intersection- and segment-specific crashes for each road segment.
  - For VTrans Mid-term Needs for Roadway Safety within RN, sort the combined number of crashes involving serious injuries and fatalities for roadway segment-specific needs and intersection-specific needs assigned to roadway segments in descending order and assign the following values as the Magnitude score Mid-term Needs for Roadway Safety within the RN.
    - Score 7: Top 5% of the total mileage
    - Score 6: 5%–10%
    - Score 5: 10.001%–15%
    - Score 4: 15.001%–20%
    - Score 3: 20.001%–25%
    - Score 2: 25.001%–50%
    - Score 1: Bottom 50.001%–100%
  - For Needs for Roadway Safety along CoSS, the combined number of crashes is the Magnitude component.

Consideration of Severity and Magnitude Criteria

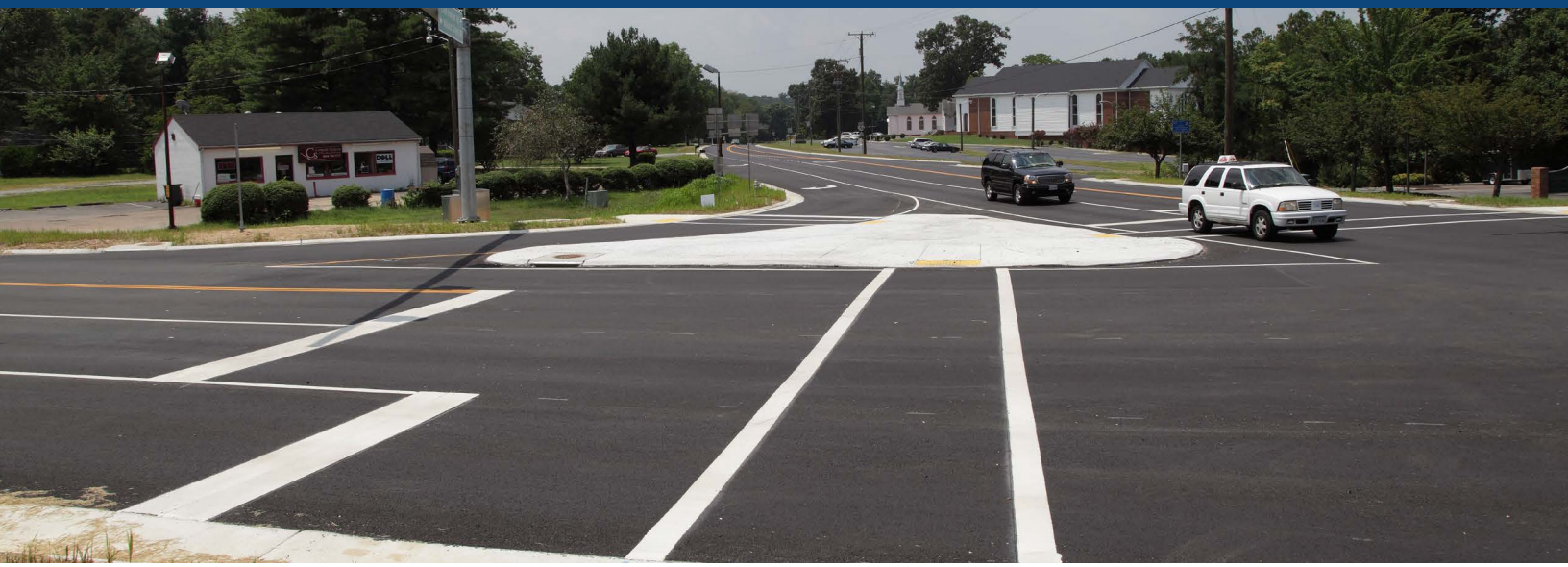
- For VTrans Mid-term Needs for Roadway Safety within RN, for both types of roadway segments (segments where the values were assigned based on intersections and those where the values were segment-specific), average the Severity (PSI rank) and Magnitude (number of crashes involving serious injuries and fatalities).

Prioritizing within Roadway Need Category

Prioritization within this VTrans Mid-term Needs Category occurs in the following manner:

- For CoSS, sort the Magnitude in descending order and assign the following values based on mileage[1] to develop statewide *Very High, High, Medium,* and *Low* categorizations for VTrans Mid-term Need for Roadway Safety.
  - *Very High* (Score 7): Top 5% of the total mileage
  - *High* (Score 6): 5.001%–10%
  - *High* (Score 5): 10.001%–15%
  - *Medium* (Score 4): 15.001%–20%
  - *Medium* (Score 3): 20.001%–25%
  - *Low* (Score 2): 25.001%–50%
  - *Low* (Score 1): Bottom 50.001%–100%
- For each VDOT Construction District, sort the average of Severity and Magnitude in descending order and assign the following values based on mileage[1] to develop VDOT Construction District-specific *Very High, High, Medium,* and *Low* categorizations for VTrans Mid-term Need for Roadway Safety within the RN.
  - *Very High* (Score 7): Top 5% of the total mileage
  - *High* (Score 6): 5.001%–10%
  - *High* (Score 5): 10.001%–15%
  - *Medium* (Score 4): 15.001%–20%
  - *Medium* (Score 3): 20.001%–25%
  - *Low* (Score 2): 25.001%–50%
  - *Low* (Score 1): Bottom 50.001%–100%

[1] Where prioritization values do not break exactly at the percentile categories, assign all values to the higher category until there is a new prioritization value. For example, if the top 7% of roadway miles all have the same score, then 7% of miles would be classified as *Very High*.



4.2.10 Prioritization within Pedestrian Safety Need Category

Applicable VTrans Travel Market: Statewide

Utilized for: Establishing Construction District Priority Locations

Severity of VTrans Mid-term Need for Roadway Safety

- Source data:
  - Scores used to establish priority corridors within VDOT Pedestrian Safety Action Plan (PSAP)
- Calculations
  - Assign PSAP scores to roadway segments. If a segment has more than one PSAP score assigned, retain the maximum score.

Magnitude of VTrans Mid-term Need for Pedestrian Safety

- The PSAP score takes into account magnitude.

Prioritizing within Pedestrian Safety Need Category

Prioritization within this VTrans Mid-term Needs Category occurs in the following manner:

- Sort the Severity values in descending order and assign the following scores based on mileage[1] to develop VDOT Construction District-specific *Very High, High, Medium,* and *Low* categorizations for VTrans Mid-term Need for Pedestrian Safety.
  - *Very High* (Score 7): Top 5% of the total mileage
  - *High* (Score 6): 5.001%–10%
  - *High* (Score 5): 10.001%–15%
  - *Medium* (Score 4): 15.001%–20%
  - *Medium* (Score 3): 20.001%–25%
  - *Low* (Score 2): 25.001%–50%
  - *Low* (Score 1): Bottom 50.001%–100%

If VTrans Mid-term Need for Pedestrian Safety has fewer than 20 total miles of Needs in a VDOT Construction District, the following method is used:

- Sort the Severity values in descending order and assign the following values based on mileage:
  - *Very High* (Score 7): Top 0–5 miles
  - *High* (Score 6): 5.001–10 miles
  - *High* (Score 5): 10.001–15 miles
  - *Medium* (Score 4): 15.001–20 miles

[1] Where prioritization values do not break exactly at the percentile categories, assign all values to the higher category until there is a new prioritization value. For example, if the top 7% of roadway miles all have the same score, then 7% of miles would be classified as *Very High*.

4.2.11 Prioritization within Capacity Preservation Need Category

Applicable VTrans Travel Market: CoSS, RN

Utilized for: Establishing Statewide and Construction District Priority Locations

Severity of VTrans Mid-term Need for Capacity Preservation

- Source data:
  - RITIS, Hourly average 2018 Travel Time Index (TTI) for each TMC for weekdays and weekends
- Calculations
  - Calculate TTILT13, which is the cumulative total of all TTI less than 1.3 from 6 AM to 8 PM using the following equation:
  - *TTILT13 = 5/7 × (sum of weekday TTI < 1.3) + 2/7 × (sum of weekend TTI < 1.3)*
  - Set outliers with an equation value greater than the 15, (90th percentile) to 15.
  - For CoSS Need for Capacity Preservation, sort TTILT in descending order for the entire state and assign the following scores (referred to as CoSS Capacity):
    - Score 7: Top 5% of the total mileage
    - Score 6: 5.001%–10%
    - Score 5: 10.001%–15%
    - Score 4: 15.001%–20%
    - Score 3: 20.001%–25%
    - Score 2: 25.001%–50%
    - Score 1: Bottom 50.001%–100%
  - For RN Need for Capacity Preservation, sort TTILT in descending order for each VDOT Construction District and assign the following scores (referred to as RN Capacity):
    - Score 7: Top 5% of the total mileage
    - Score 6: 5.001%–10%
    - Score 5: 10.001%–15%
    - Score 4: 15.001%–20%
    - Score 3: 20.001%–25%
    - Score 2: 25.001%–50%
    - Score 1: Bottom 50.001%–100%

Magnitude of VTrans Mid-term Need for Capacity Preservation

- Source data:
  - VDOT Traffic Engineering Division, VMT for TMCs.
- Calculations:
  - If VMT for a segment is null or 0, populate VMT with (segment length * 7,100) (Highway Capacity Manual).

Consideration of Severity and Magnitude Criteria

- Utilize established priorities within Need for Roadway Safety along CoSS (referred to below as Safety *Statewide Priority*) and established priorities within Need for Roadway Safety within RN (referred to below as *Safety District Priority*)
- For CoSS Need for Capacity Preservation, derive a scoring metric using the following equation, which relies on the Capacity Preservation Severity, Safety Statewide Priority, and VMT.
  CoSS Capacity Score = AVG (CoSS Capacity, Safety Statewide Priority) x VMT
- For RN Need for Capacity Preservation, derive a scoring metric using the following equation, which relies on RN Capacity Preservation Severity, Safety District Priority, and VMT.
  RN Capacity Score = AVG (RN Capacity, Safety District Priority) x VMT

Prioritizing within CoSS and RN Capacity Preservation Need Category

Prioritization within this VTrans Mid-term Needs Category occurs in the following manner:

- Sort the CoSS Capacity Scores in descending order and assign the following scores based on mileage[1] to develop statewide *Very High, High, Medium,* and *Low* categorizations for VTrans Mid-term Need for Capacity Preservation.
  - *Very High* (Score 7): Top 5% of the total mileage
  - *High* (Score 6): 5.001%–10%
  - *High* (Score 5): 10.001%–15%
  - *Medium* (Score 4): 15.001%–20%
  - *Medium* (Score 3): 20.001%–25%
  - *Low* (Score 2): 25.001%–50%
  - *Low* (Score 1): Bottom 50.001%–100%
- Sort the *RN Capacity Scores* in descending order and assign the following scores based on mileage[1] to develop VDOT Construction District-specific *Very High, High, Medium,* and *Low* categorizations for VTrans Mid-term Need for Capacity Preservation.
  - *Very High* (Score 7): Top 5% of the total mileage
  - *High* (Score 6): 5.001%–10%
  - *High* (Score 5): 10.001%–15%
  - *Medium* (Score 4): 15.001%–20%
  - *Medium* (Score 3): 20.001%–25%
  - *Low* (Score 2): 25.001%–50%
  - *Low* (Score 1): Bottom 50.001%–100%

[1] Where prioritization values do not break exactly at the percentile categories, assign all values to the higher category until there is a new prioritization value. For example, if the top 7% of roadway miles all have the same score, then 7% of miles would be classified as *Very High*.

4.2.12 Prioritization within Transportation Demand Management Need Category

Applicable VTrans Travel Market: CoSS, RN

Utilized for: Establishing Statewide and Construction District Priority Locations

Severity of VTrans Mid-term Need for Transportation Demand Management

- Source data:
  - StreetLight Data, CoSS Severity: Total number of inter-RN trips during a typical three weekdays.
  - RN Severity: PECC and TTI values developed for Need for Congestion Mitigation
- Calculations
  - CoSS Severity:
    - Total number of inter-RN trips during a typical three weekday period were assigned to Primary CoSS facilities and, if required, CoSS Major Component facilities (Appendix A) that provide connection between CoSS Primary Facilities. Trips were assigned from the centroid of the RN and adjusted as needed to match the RN's urban core. In most cases, this corresponded with a roadway junction on the CoSS near the downtown of the largest city in the RN.
    - Trips were assigned to the network to achieve the fastest travel times.
  - RN Severity:
    - Normalize PECC scores within each VDOT Construction District using the following equations. Use District-normalized PECC for limited access facilities or those without a TTI score, and District-normalized TTI_VMT for non-limited access roads or roads without a PECC value.
    - *PECC District Normalized* = $\frac{\textit{PECC-minimum district PECC}}{\textit{maximum district PECC-minimum district PECC}}$
    - Set a ceiling of 100% for PECC.
    - *TTI_VMT District Normalized* = $\frac{\textit{TTI\_VMT-minimum district TTI\_VMT}}{\textit{maximum district TTI\_VMT-minimum district TTI\_VMT}}$

Magnitude of VTrans Mid-term Need for Transportation Demand Management

- Source data:
  - StreetLight Data, CoSS Magnitude: total number of inter-RN trips during a typical three weekdays (captures Severity as well as Magnitude)
  - RN Magnitude: VMT for TMCs: VDOT Traffic Engineering Division
  - Calculations:
    - CoSS Magnitude: No additional calculations are performed.
    - RN Magnitude: If VMT for a segment is null or 0, populate VMT with (segment length * 7,100) (Highway Capacity Manual).

Consideration of Severity and Magnitude Criteria

- RN
  - Assign the *PECC District Normalized* score[1] to limited access facilities and the *TTI_VMT District Normalized* score to non-limited access roadway segments. If a road was not given a value using this method, the maximum normalized score of the two is used.

Prioritizing within CoSS and RN Transportation Demand Management Need Category

Prioritization within this VTrans Mid-term Needs Category occurs in the following manner:

- Sort CoSS severity in descending order and assign the following scores based on mileage[2] to develop statewide *Very High, High, Medium,* and *Low* categorizations for VTrans Mid-term Need for Transportation Demand Management.
  - *Very High* (Score 7): Top 5% of the total mileage
  - *High* (Score 6): 5.001%–10%
  - *High* (Score 5): 10.001%–15%
  - *Medium* (Score 4): 15.001%–20%
  - *Medium* (Score 3): 20.001%–25%
  - *Low* (Score 2): 25.001%–50%
  - *Low* (Score 1): Bottom 50.001%–100%
- Sort *PECC District Normalized* score and *TTI_VMT District Normalized* score in descending order and assign the following scores based on mileage[2] to develop VDOT Construction District-specific *Very High, High, Medium,* and *Low* categorizations for VTrans Mid-term Need for Capacity Preservation.
  - *Very High* (Score 7): Top 5% of the total mileage
  - *High* (Score 6): 5.001%–10%
  - *High* (Score 5): 10.001%–15%
  - *Medium* (Score 4): 15.001%–20%
  - *Medium* (Score 3): 20.001%–25%
  - *Low* (Score 2): 25.001%–50%
  - *Low* (Score 1): Bottom 50.001%–100%

[1] See Needs Category: Congestion Mitigation (PECC) for details on this normalized score.

[2] Where prioritization values do not break exactly at the percentile categories, assign all values to the higher category until there is a new prioritization value. For example, if the top 7% of roadway miles all have the same score, then 7% of miles would be classified as *Very High*.

4.3 Step 3: Weight and Aggregate VTrans Mid-term Needs Across Need Categories

The third step takes the VTrans Mid-term Needs as categorized above, weighs them and aggregates them to form a location- or roadway segment-specific score between 1 and 7.

Table 3: Weighting to Establish Statewide and Construction District Priority Locations:

Travel Market	Board-adopted VTrans Need Category	Weighting– Statewide Priority	Weighting – Construction District Priority[1]			
			Area Type A	Area Type B	Area Type C	Area Type D
CoSS	Congestion Mitigation	25.00%	These Need Categories are not utilized for establishing Construction District Priority Locations.			
CoSS	Improved Reliability (Highway)	15.00%				
CoSS	Improved Reliability (Intercity and Commuter Rail)	10.00%				
Safety	Roadway Safety (along CoSS)	25.00%				
CoSS	Capacity Preservation	10.00%				
CoSS	Transportation Demand Management	15.00%				
RN	Congestion Mitigation	These Need Categories are not utilized for establishing Statewide Priority Locations.	25.00%	15.00%	10.00%	5.00%
RN	Improved Reliability (Highway)		20.00%	10.00%	5.00%	5.00%
RN	Transit Access for Equity Emphasis Areas		5.00%	6.25%	6.25%	3.75%
RN	Transit Access to Activity Centers		5.00%	6.25%	6.25%	3.75%
RN	Pedestrian Access to Activity Centers		5.00%	6.25%	6.25%	3.75%
RN	Bicycle Access to Activity Centers		5.00%	6.25%	6.25%	3.75%
UDA	Access to Industrial and Economic Development Areas		2.50%	10.00%	10.00%	15.00%
Safety	Roadway Safety		15.00%	15.00%	20.00%	25.00%
Safety	Pedestrian Safety		5.00%	5.00%	5.00%	5.00%
RN	Capacity Preservation		2.50%	10.00%	15.00%	20.00%
RN	Transportation Demand Management		10.00%	10.00%	10.00%	10.00%
	Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

4.4 Step 4: Adjust Priorities for Influencing Factors

- For road segments with a Congestion and/or Reliability Need, or a Safety Need present, the aggregate score from Step 3 is adjusted based on the following:
  - Co-located pavement repair, rehabilitation, or replacement needs;
  - Co-located bridge repair, rehabilitation, or replacement needs; and,
  - Exposure to project sea level rise, storm surge, or historical or project inland/riverine flooding.

A roadway segment can receive additional points for each of the above-listed influencing factors based on the following logic:

Adjustment for co-located pavement repair, rehabilitation, or replacement needs

- If a Need for Reliability Improvement (Roadway) or a Need for Congestion Mitigation is present, add additional points to the cumulative score from Step 3 per the following:
  - Additional 5.0%: co-located pavement needs in 2024, 2025, or 2026
  - Additional 3.5%: co-located pavement needs in 2027, 2028, or 2029
  - Additional 2.0%: co-located pavement needs in 2030, 2031, or 2032

Adjustment for co-located bridge repair, rehabilitation, or replacement needs

- If a Need for Reliability Improvement (Roadway) or a Need for Congestion Mitigation is present, add additional points to the cumulative score from Step 3 per the following:
  - Additional 5.0%: co-located bridge that is in the top 25% locations based on Bridge Importance Factor[1] in the applicable VDOT Construction District
  - Additional 3.5%: co-located bridge that is in the top 25%–50% locations based on Bridge Importance Factor in the applicable VDOT Construction District
  - Additional 2.0%: co-located bridge that is in the bottom 50%–100% locations based on Bridge Importance Factor in the applicable VDOT Construction District

Adjustment for exposure to projected sea level rise, storm surge, or historical inland/riverine flooding

- If a Need for Reliability Improvement (Roadway) or a Need for Congestion Mitigation is present, add additional points to the cumulative score from Step 3 per the following:
  - Additional 5.0%: if roadway segment has exposure to, (a) inundation of 2 ft or higher under Intermediate-High sea level rise scenario in Year 2040; (b) inundation of 2 ft or higher from Category 2 Hurricane; or, (c) history of flooding and in a 100-year flood zone and
  - Additional 3.5%: if roadway segment has exposure to, (a) inundation of 1 to 2 ft under Intermediate-High sea level rise scenario in Year 2040; or (b) inundation of 1 to 2 ft from Category 2 Hurricane.
  - Additional 2.0%: if roadway segment has exposure to, (a) inundation of up to 1 ft under Intermediate-High sea level rise scenario in Year 2040; or (b) inundation of up to 1 ft from Category 2 Hurricane.

Or,

- If a Need for Roadway Safety is present and no Need for Reliability Improvement (Roadway) or for Congestion Mitigation is present, add additional points to the cumulative score from Step 3 per the following:
  - Additional 5.0%: if the roadway segment has a history of flooding and in a 100-year flood zone.

[1] Moruza, A. K., Mateo, A. D., et al. (2019). *Methodology for Ranking Relative Importance of Structures to Virginia's Roadway Network*. Retrieved from http://www.virginiadot.org/vtrc/main/online_reports/pdf/16-r19.pdf.

4.5 Establishment of Statewide and Construction District Priority Locations

The final adjusted Statewide Priority Locations and Construction District Priority Locations are then established as follows:

Statewide Priority Locations are assigned levels 1–4 based on their relative statewide rank by roadway segment mileage in the following manner:

- Priority 1 Locations: Top 0%–1% of the total mileage
- Priority 2 Locations: 1.001%–5% of the total mileage
- Priority 3 Locations: 5.001%–15% of the total mileage
- Priority 4 Locations: Bottom 15.001%–100% of the total mileage

Construction District Priority Locations are assigned levels 1-4 based on their relative rank for each VDOT Construction District by roadway segment mileage in the following manner:

- Priority 1 Locations: Top 0%–1% of the total mileage
- Priority 2 Locations: 1.001%–5% of the total mileage
- Priority 3 Locations: 5.001%–15% of the total mileage
- Priority 4 Locations: Bottom 15.001%–100% of the total mileage

APPENDIX A: DEFINITION OF VTRANS TRAVEL MARKETS

Corridor of Statewide Significance/Primary Facility and Major Components

Name	Primary Facility	Major Components – Roadway	Major Components - Multimodal
Coastal Corridor	US 17		Port of Virginia, Norfolk Southern Heartland Corridor, Norfolk Southern Coal Corridor, CSX National Gateway Corridor, CSX Coal Corridor, Amtrak, Norfolk International Airport, Newport News/Williamsburg International Airport, Rappahannock River
Crescent Corridor	I-81	I-381, I-581, US-11	Norfolk Southern Crescent Corridor, Short Line Railroads, Roanoke Regional Airport, Virginia Inland Port, Shenandoah Valley Regional Airport
East-West Corridor	I-64	I-264, I-464, I-564, I-664, US-60, US-11, US-250	CSX Coal Corridor, Norfolk Southern Coal Corridor, Amtrak, Charlottesville-Albemarle Airport, Richmond International Airport, Norfolk International Airport, Newport News/Williamsburg International Airport, Port of Virginia, Port of Richmond, James River, York River
Eastern Shore Corridor	US-13		Norfolk Southern, CSX, Amtrak, Bay Coast Railroad and Barge, Port of Virginia, Norfolk International Airport, Newport News/ Williamsburg International Airport
Heartland Corridor	US-460	Coalfields Expressway	Norfolk Southern Heartland Corridor, Amtrak, Roanoke Regional Airport, Lynchburg Regional Airport, Norfolk International Airport, Newport News/Williamsburg International Airport, Richmond International Airport, Port of Virginia, James River
North Carolina to West Virginia Corridor	US-220		Norfolk Southern, Roanoke Regional Airport
North-South Corridor	RT-234	Prince William County Parkway, RT659, Bi-County Parkway, Northstar Boulevard	Washington Dulles International
Northern Virginia Corridor	I-66	US-50, RT-55	Norfolk Southern Crescent Corridor, Amtrak, Virginia Railway Express, WMATA Orange Line, Washington Dulles International, Ronald Reagan Washington National Airport, Virginia Inland Port
Seminole Corridor	US-29	US-50, RT-28	Norfolk Southern Crescent Corridor, Amtrak, Virginia Railway Express, WMATA Orange Line, Lynchburg Regional Airport, Charlottesville Albemarle Airport, Washington Dulles International
Southside Corridor	US-58		CSX National Gateway, Norfolk International Airport, Newport News/Williamsburg International Airport, Port of Virginia
Washington to North Carolina Corridor	I-95	I-85, I-195, I-295, I-395, I-495, US-1, US-301, RT-288	CSX National Gateway, Amtrak, Virginia Railway Express, WMATA Blue Line, WMATA Yellow Line, Ronald Reagan Washington National Airport, Richmond International Airport, Port of Richmond, James River
Western Mountain Corridor	I-77	US-11, US-52	

APPENDIX A: DEFINITION OF VTRANS TRAVEL MARKETS

Regional Networks/Counties and Cities

Regional Network	Counties and Cities Included
New River Valley Region	Montgomery County, Pulaski County, City of Radford
Richmond Region	Charles City County, Chesterfield County, Goochland County, Hanover County, Henrico County, New Kent County, Powhatan County, City Richmond
Staunton/Augusta/ Waynesboro Region	Augusta County, City of Staunton, City of Waynesboro
Tri-Cities Region	Chesterfield County, Dinwiddie County, Prince George County, City of Colonial Heights, City of Hopewell, City of Petersburg
Northern Virginia Region	Arlington County, Fairfax County, Loudoun County, Prince William County, City of Alexandria, City of Falls Church, City of Fairfax, City of Manassas, City of Manassas Park
Harrisonburg Region	Rockingham County, City of Harrisonburg
Charlottesville Region	Albemarle County, City of Charlottesville
Roanoke Region	Botetourt County, Roanoke County, City of Roanoke, City of Salem
Bristol Region	Washington County, City of Bristol
Winchester Region	Frederick County, City of Winchester
Fredericksburg Region	Spotsylvania County, Stafford County, City of Fredericksburg
Danville Region	Pittsylvania County, City of Danville
Central VA MPO Region (Lynchburg)	Amherst County, Bedford County, Campbell County, City of Lynchburg
Kingsport Region	Scott County
Hampton Roads Region	Gloucester County, Isle of Wight County, James City County, Suffolk County, Southampton County, York County, City of Chesapeake, City of Franklin, City of Hampton, City of Newport News, City of Norfolk, City of Portsmouth, City of Poquoson, City of Virginia Beach, City of Williamsburg

APPENDIX B: LISTING OF LIMITED ACCESS FACILITIES FOR NEEDS IDENTIFICATION

For the purposes of the Identification and Prioritization of the Mid-term Needs, roadway segments were assigned as limited access facilities (LAF) or non-limited access facilities. All Interstate highways were considered as limited access facilities, along with select segments of the following roadways:

- US Rt 13
- US Rt 220
- US Rt 29
- US Rt 460
- US Rt 58
- State Rt 28
- State Rt 37
- State Rt 76
- State Rt 146
- State Rt 150
- State Rt 164
- State Rt 168
- State Rt 195
- State Rt 199
- State Rt 262
- State Rt 267
- State Rt 288
- State Rt 90004
- State Rt 90005

APPENDIX C: DEFINITION OF VTRANS ACTIVITY CENTERS

Activity Centers are locations of concentrated employment or other clusters of economic or social activity that are primary attractors of travel trips within Regional Networks (RNs).

Activity Center Designation

Working collaboratively with local and regional planners and stakeholders, OIPI identified locations of concentrated employment and economic activity, and sorted them into three broad categories based on predominant economic generators and associated types of Accessibility Needs.

- **Local-serving:** Primarily serve customers in the local community or region with retail shopping, real estate services, healthcare, recreation, or pre-K through 12 education among other local-serving activities.
- **Knowledge-based:** Export knowledge-based services and products to the rest of the state, country, or world through activities like corporate management, information-based industries, and higher education.
- **Freight-dependent:** Contain enterprises that rely upon good freight access in order to create, process, and/or transport goods and materials such as agriculture, mining, utilities, construction, logistics, and other goods and materials that depend on freight transportation.

Activity Center Types by Industry and NAICS Code

As part of the 2019 Update of VTrans Mid-term Needs development process, Activity Centers were assigned to the economic category that contains the plurality of their employment using the alignment between employment classified by North American Industry Classification System (NAICS) codes and the economic categories listed below.

- **Freight-dependent**
  - 11 – Agriculture, Forestry, Fishing and Hunting
  - 21 – Mining, Quarrying, and Oil and Gas Extraction
  - 22 – Utilities
  - 23 – Construction
  - 31 – Manufacturing
  - 32 – Manufacturing
  - 33 – Manufacturing
  - 42 – Wholesale Trade
  - 48 – Transportation and Warehousing
  - 49 – Transportation and Warehousing
- **Knowledge-based**
  - 51 – Information
  - 54 – Professional, Scientific and Technical Services
  - 55 – Management of Companies and Enterprises
  - 56 – Administrative and Support and Waste Management and Remediation Services
- **Local-serving**
  - 44 – Retail Trade
  - 45 – Retail Trade
  - 52 – Finance and Insurance
  - 53 – Real Estate and Rental and Leasing
  - 61 – Educational Services
  - 62 – Health Care and Social Assistance
  - 71 – Arts, Entertainment, and Recreation
  - 72 – Accommodation and Food Services
  - 81 – Other Services, except Public Administration
  - 92 – Public Administration

Employment at the level of U.S. Census Blocks was assigned to an Activity Center if the Block's centroid is within one mile of the point representing an Activity Center. In cases where the Block centroid is within one mile of two or more Activity Centers, it is assigned to the closest Activity Center.

PREPARED BY THE OFFICE OF INTERMODAL
PLANNING AND INVESTMENT FOR THE
COMMONWEALTH TRANSPORTATION BOARD