TRANSPORTATION Appendix

The transportation concepts and standards that follow are intended to provide further understanding of the content that has been included in the Transportation chapter of the Comprehensive Plan. The intent of this material is to offer further context for the recommendations contained within the chapter, and to broaden reader understanding of key design concepts, regulatory standards and academic research into multi-modal transportation planning. It should be used for informational purposes only and is not intended to comprehensively cover all aspects of multi-modal transportation planning or replace authoritative plans, manuals, standards or guides developed by public or private transportation planning entities. For further reading, consult the long-range transportation plans and other publications referenced in the chapter and within the text below.

Transportation Design Concepts and Standards - Roads

Capacity

The maximum hourly rate of persons or vehicles that can be expected to traverse a given road segment or point, such as signalized intersections, under prevailing road, traffic and control conditions is known as its capacity. A road facility's stated capacity defines a flow of traffic that can be achieved repeatedly for peak periods of demand. Thus, because transportation facilities operate poorly at full capacity, stated capacity is not the highest flow rate recorded at a facility. Instead, qualitative measures such as a roadway's level of service seek to better describe the facility's performance under prevailing conditions.

Level of Service

Level of service (LOS) measures operational conditions experienced by users within a flow of traffic or at an intersection. Quality levels are assigned based upon performance measures such as traffic volume compared to facility capacity, travel time, and user comfort derived from multiple variables like road conditions, safety hazards and travel distance. Publications such as the Federal Highway Administration's Highway Capacity Manual or the American Association of State Highway Transportation Officials Geometric Design of Highways and Streets ("Green Book") are the primary guidance documents used to grade the service of a facility.

Typical Level of Service systems assign a letter designation from A to F, with LOS A being the best operating conditions and LOS F the worst. These terms are defined below and on the following page:

- LOS A: Free Flow. Traffic flows at or above the posted speed limit and motorists have complete maneuverability between lanes

- LOS B: Reasonably Free Flow. LOS A speeds are maintained, maneuverability within the traffic stream is slightly restricted.

- LOS C: Stable Flow. Ability to maneuver through lanes is noticeably restricted and lane changes require more driver awareness. Declines in comfort and convenience.

- LOS D: Approaching Unstable Flow. Speeds slightly decrease as traffic volume slightly increases. Freedom to maneuver within the traffic stream is much more limited and driver comfort levels continue to decrease.

- LOS E: Unstable Flow, Operating at Capacity. Flow becomes irregular and speed varies rapidly because there are virtually no usable gaps to maneuver in the traffic stream and speeds rarely reach the posted limit. Comfort and convenience have reached poor levels.

- LOS F: Forced or Breakdown Flow. Every vehicle moves in lockstep with the vehicle in front of it with frequent slowing required. Travel time cannot be predicted, with generally more demand than capacity. Accident exposure increased significantly.

In addition to analyzing roadway segments, engineers also look at the level of service at roadway intersections. Intersections can cause a high level of disruption in traffic flow on individual segments of a road network. This disruption is measured in terms of time waiting for an opportunity to make a turn onto another road segment. Intersection level of service becomes extremely important in maintaining the safety of our local road network. The table below outlines the average wait times and their corresponding level of service.

Table A2-1: Level of Service Grades and Intersection Wait Times

LOS	Signalized Intersection	Unsignalized Intersection
A	</= 10 seconds	</= 10 seconds
B	10-20 seconds	10-15 seconds
C	20-35 seconds	15-25 seconds
D	35-55 seconds	25-35 seconds
E	55-80 seconds	35-50 seconds
F	>80 seconds	>50 seconds

Source: Highway Capacity Manual 5th Edition (2010)

Functional Classification

Functional classification is the process by which streets and highways are grouped into classes, or systems, according to the character of the service they intend to provide in moving the public through the transportation network.

Federal guidelines define three primary classification categories that are used: Arterial, Collector, and Local. Arterial and Collector roads also have sub-classifications that further define their mobility characteristics. These sub-categories have changed over the years. The most recent guidance provided by Federal Highway Administration is outlined in

Highway Functional Classification Concepts, Criteria and Procedures 2013 Edition. According to these new guidelines, the focus of road classification should be on the function of the road and not whether the road is located in an urban, rural or rural context. Table A2-2 below shows the changes to the Functional Classification System, followed by definitions for the current Federal Functional Classifications.

Table A2-2: 2008 Changes to Federal Functional Classification System

New Functional Classifications	Old Urban Functional Classifications	Old Rural Functional Classifications
Interstate	Urban Interstate	Rural Interstate
Other Freeways and Expressways	Urban Other Freeways and Expressways	
Other Principal Arterial	Urban Principal Arterial	Rural Other Principal Arterial
Minor Arterial	Urban Minor Arterial	Rural Minor Arterial
Major Collector	Urban Collector	Rural Major Collector
Minor Collector		Rural Minor Collector
Local	Urban Local	Rural Local

Source: FHWA Updated Guidance for the Functional Classification of Highways Memorandum, October 14, 2008

★ Arterial: Interstate/Expressway/Freeway

- Provide for the continuous and efficient routes for movement of high-volume traffic over long distances;
- Controlled roadway access points limit access to adjacent land uses;
- Higher posted speed limits;
- Multiple travel lanes separated by physical barrier;
- Usually funded and maintained by state government;
- Supports regional mobility;

★ Arterial: Other Principal Arterial

- Serve high-volume traffic in major centers of metropolitan areas;
- Adjacent land uses may be served directly through at grade intersections or driveways to specific parcels;
- Typically funded and maintained by a local government;
- Supports regional mobility;

★ Minor Arterial

- Serve moderate length trips and geographical areas;
- May serve local bus routes and include sidewalks, signalized intersections, or on-street parking;
- Typically maintained by local government, but capital costs may be the responsibility of state government;

★ Collector (Major and Minor)

- Gather traffic from local roads and funnel into arterial network;
- Major collectors usually have longer, fewer driveways, higher speed limits and traffic volumes and more travel lanes than minor collectors;
- Provide traffic circulation within residential neighborhoods as well as commercial, industrial or civic districts;
- Generally designed, constructed, and funded by local government;

★ Local

- Provide direct access to adjacent land uses over short travel distances;
- Lower posted speed limits;
- Designed to discourage through traffic;
- Not typically a part of transit routes;
- Usually funded by local government.

Transportation Demand Management

An alternative approach to addressing congestion related issues in transportation planning from expanding road capacity is demand management. Transportation demand management (TDM) looks at a range of strategies to reduce front end demand for road facilities, such as expanding transportation choices, financial incentives, land use management, and other policies and programs. At the State level, Commuter Choice Maryland is Maryland's TDM Program. This program includes programs and investments in transit facilities and services, carpool and rideshare information and facilities, bicycle and pedestrian facilities, teleworking assistance, Maryland Commuter Tax Credit, education and marketing to individuals and employers, and Guaranteed Ride Home for transit users or those carpooling. Additional strategies such as promoting compact development, toll or road pricing strategies, fuel taxes, and parking management all fall under the larger umbrella of TDM beyond what is promoted by the State's program.

The Hagerstown Eastern Panhandle Metropolitan Planning Organization (HEPMPO), in consultation with the State Highways Administration (SHA), completed a "Transportation Systems Management and Operations Plan" in 2020 for I-81 and I-70 in Washington County. Both I-81 and I-70 are priority freight corridors, experience on-going construction activities and have a history of weather-related travel impacts and severe accidents. This plan identifies non-capacity adding strategies to help optimize traffic flow during recurring and non-recurring congestion on existing facilities. The plan focuses on three different categories of strategies for implementation: (1) geometric and safety improvements, (2) traffic flow and signals and (3) intelligent transportation systems (ITS) expansion. Examples of demand management strategies for arterial roads include real-time traveler information, corridor management, ramp metering, the use of freeway shoulder for peak period travel, HOV lanes, reversible lanes, ramp metering and signalization, variable speed limits, park and ride facilities, connected and automated vehicle deployment, weather and traffic incident management, and more.

Traffic Calming


Source: Project for Public Spaces

Traffic calming uses a variety of street design and management techniques to improve the safety of roadways for multiple modes of transportation while enhancing the livability of adjacent communities. Traffic calming measures, which are typically installed in urbanized areas where current street conditions may present an unsafe or undesirable environment for non-motorized users, can encompass a wide range of design interventions. Examples include reducing lane widths and speed limits, managing traffic flows, creating roundabouts, speed bumps, pavement treatments, pinch points, landscaping in medians or along right-of-ways, refuge islands for pedestrians and many other techniques. Many communities in Washington County, by virtue of their historic settlement and development prior to the advent of automobile transportation, already possess some of these characteristics such as reduced lane widths in urban and town centers. Considering additional supportive design measures such as those described above, some of which have already been implemented in select locations, could further enhance the safety and livability of many urbanized areas in the County.

Network Resiliency

Accounting for variability and vulnerability in transportation planning, design and construction helps to improve the safety, reliability and sustainability of the transportation network as a whole. With weather and climate patterns becoming more unpredictable, creating a resilient transportation network that can adapt to rapidly changing conditions has become increasingly important. For example, severe flash flooding affected southern Washington County in May 2018 which damaged roadways in 73 different locations and necessitated the rescue of several local residents. Given the immense costs associated with cleaning up from these major events, planning for uncertainty in advance plays a large role in the ability of communities to recover in the aftermath of these unforeseen events.

Strategies for creating a resilient or adaptive transportation network can take many forms, including:

- Expanding network connectivity and access to multi-modal transportation options so that when one mode of transportation becomes gridlocked, other choices are available
- Identifying existing transportation infrastructure within the limits of floodplains or other natural hazards and considering new route alignments
- Improving associated drainage and stormwater management infrastructure
- Utilizing materials and techniques for paving which adapt to extremes in temperature and precipitation

Scenic Byways & Context Sensitive Design

Context sensitive design recognizes that mobility is not the only goal in transportation planning. Since the 1990s, federal, state and local governments have increasingly considered how transportation facilities impact an area's quality of life. This broader view of transportation development has sought to solicit greater input from a variety of stakeholder groups to achieve projects that positively impact communities in a manner that supports their desired pattern of development and protects sensitive resources.

One program that supports these larger objectives related to context sensitive design is the Scenic Byways program. Presently, both Federal and State roads can be given Scenic Byway designation. Roads given the National Scenic Byway designation possess one or more of six "intrinsic qualities": archeological, cultural, historic, natural, recreational, and scenic. The program was established by Congress in 1991 with the passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) to promote tourism and economic development while conserving heritage resources along these roadway corridors. The designation requires the preparation of corridor management plans, with public involvement, to conserve the roadways intrinsic qualities and aid in regional economic development.

The Maryland SHA, in partnership with the Maryland Department of Planning, has created its own program modeled on the Federal program. These entities work with local communities to develop corridor management plans and assist in their efforts to protect and enhance these desirable routes.

The Federal National Scenic Byway designation has been applied to two routes that pass-through Washington County, the Historic National Road (U.S.-40 and US ALT. 40) and "Journey Through Hallowed Ground." The former route commemorates the nation's first federally funded interstate highway which opened western lands for settlement and the transportation of goods. The latter route travels primarily through the Catoctin Mountains passing by notable Civil War sites and natural areas, including MD-77 to Smithsburg.

Portions of the State-designated "Antietam Campaign" Scenic Byway pass by places integral to the events of that pivotal Civil War battle in 1862, including several roads in southern Washington County. The "Chesapeake and Ohio Canal" State Scenic Byway follows 236 miles of country roads and state highways in the immediate vicinity of one of the first major transportation routes that moved goods and people into the Country's interior before the dawn of the age of Railroads. The Byway follows numerous State and County maintained roads in the proximity of the Canal. The C&O Canal is also a 184-mile National Historic Park overseen by the National Park Service.

The preservation of corridors for the protection of sensitive environmental or historic resources is touched upon in the Sensitive Areas and Historic Resources chapters of the Comprehensive Plan.

Transportation Design Concepts - Transit

Transit Oriented Development

Transit Oriented Development (TOD) is an urban planning tool which promotes a compact, mixed-use pattern of development by the clustering of residential, commercial and other complementary land uses within reasonable walking distances from transit hubs. The successful implementation of TOD depends on access and density around transit facilities. Typically, TOD areas are located within a ¼ to ½ mile radius of a central transit stop such as a train, light rail, or bus stop.

TOD can be difficult to achieve in a primarily rural area such as Washington County where there is no passenger train, light rail or bus rapid transit system in place and population density to foster higher transit ridership is reduced outside of the City of Hagerstown. The greatest potential for the implementation of TOD in Washington County outside of Hagerstown lies within portions of the Urban Growth Area where residential and business uses are clustered at a reasonably high density. As the County becomes more urbanized and transit services continue to expand incrementally with available funding, TOD may become more viable. Incorporating TOD principles, such as creating mixed-use communities at a pedestrian-scale clustered around activity centers, offers and alternate bridge strategy which is discussed further in the Housing chapter of the Comprehensive Plan.

Transportation Design Concepts - Bicycling, Pedestrian and Trails

Bicycle and Pedestrian Trail Facility Types

The appropriate type of bicycle, pedestrian or trail facility typically depends on a variety of factors, particularly the context in which the facility is being designed as well as the larger planning objectives such as user safety or modal switching. Modern road, street or trail design offers facility types which meet the full spectrum of transportation planning objectives.

- **Bicycle Facility Types**

SHA has produced the guidance document Bicycle Policy & Design Guidelines to provide uniform criteria for bicycle facilities along all State roads. The publication incorporates national guidelines, standards and best practices for use by State and local governments and is consistent with the manual produced by The American Association of State Highway Transportation Officials (AASHTO) Guide for the Development of Bicycle Facilities. Maryland's design guide contains definitions for each of the typical bicycle facilities deployed on roads throughout the State.

The figure on the following page shows the most common on-street and off-street bicycle facilities, arranging them according to the amount of separation from adjacent vehicle traffic, from least to most. This figure is followed by a brief glossary taken from the Maryland Bicycle Policy and Design Guidelines manual which defines each basic type and notes the corresponding image in the photo above in parentheses, where applicable.

Source: National Association of City Transportation Officials Urban Bikeway Design Guide (2011)

- **Bikeway -** General term denoting any trail, path, part of a highway, surfaced or smooth shoulder or any other travel way specifically signed, marked, or otherwise designated for bicycle travel. Bikeways include bike lanes, shared lanes, shared-use paths, trails, and bike routes.

- **Bike Route –** A system of bikeways connecting two or more points that is deemed most desirable for bicycling. A bike route is designated with guide signs, pavement markings, maps or other means. A bike route may include any of the various types of bikeways or a combination thereof.

- **Shared Lane (Image 2A) –** A roadway lane which is open to both bicycle and motor vehicle travel, without assigned space for each. Specific pavement markings and/or signs (such as that seen at left) may be used to provide positive guidance for drivers and bicyclists allowing them to share the same lane.

- **Bike Lane (Image 2B) –** Any portion of a roadway or shoulder which has been designated for single directional flow and includes pavement markings for the preferential or exclusive use of bicyclists.

- **Buffered Bike Lanes (Image 2C) –** Conventional bicycle lanes paired with a designated buffer space separating the bicycle lane from the adjacent motorized vehicle travel and/or parking lane. Separation is made by lane markings, not a physical barrier.

- **Cycle Tracks (Image 2D) –** Exclusive bikeways that are at street level and use a variety of methods for physical separation from motorized vehicle traffic and pedestrians. A one-way cycle track may be combined with a parking lane or other barrier (such as plastic bollards, a raised median or planters) between the cycle track and motor vehicle travel lane. Cycle tracks should be placed adjacent to the curb. Cycle tracks combine the user experience of a separated path with the on-street infrastructure of a bike lane.

★ **Shared-Use Path (Image 2E) –** A paved or unpaved bikeway outside the motor vehicle travel way and physically separated from motorized vehicular traffic by an open space, curb, curb and gutter, or barrier and either within the highway right-of-way or within an independent alignment. Shared-use paths are open to use by pedestrians and other authorized non-motorized users. A shared-use path typically allows two-way travel and is therefore wider than an on-road bikeway. Recreational trails and Greenways fall largely within this category of bike facility, differing only in the setting where they are constructed (rural or natural areas instead of urban) and sometimes in the materials used (unpaved instead of paved).

★ **Paved Shoulder –** Where a roadway right-of-way offers enough width, a paved shoulder accommodates bicycle traffic without the need to dedicate a portion of the vehicle travel lane to bicycles. These facilities are most commonly applied along roads traveling through rural areas.

The bicycle facilities described above represent some of the most common types in use, but others, such as bicycle boulevards and a variety of intersection or lane treatments and traffic signals exist to provide greater recognition of bicyclists as being equal users of road space. Metrics such as traffic volume, traffic speed, setting (urban or rural), cost, road width and other measures help to determine what type of bicycle facility can be accommodated on different roadway classifications. Table A-2-3 below gives a general idea of what facility may be appropriate under these varied travel conditions.

TableA2-3: Characteristics of Bicycle Facility Types

Facility Type	Traffic Volume	Traffic Speed	Setting	Cost	Preferred Width
Shared Lane	Low	Low	Urban/Rural	Low	14ft. +
Marked Shared Lane	Low	Low	Urban	Medium	14ft. +
Paved Shoulder	Low-High	Low-High	Rural	Medium	4ft. +
Bicycle Lane	Low-High	Low-High	Urban/Rural	Medium	6ft.
Bicycle Boulevard	Low	Low	Urban	High	Varies
Cycle Track	Low-High	Low-High	Urban	High	6ft. +
Shared Use Path	N/A	N/A	Urban/Rural	Medium-High	10ft. +

Source: Memphis MPO 2014 Regional Bicycle and Pedestrian Plan

★ **End-of-Trip Facilities –** These are amenities designed to remove additional barriers that prevent people from choosing to travel by bike. Bicycle parking is the most common end-of-trip facility, but additional facilities include locker rooms, showers, bicycle lockers, bike pump and repair stations and many others.

• Pedestrian Facility Types

In contrast to bicycle facility types, which tend to require a greater degree of context sensitive design to meet the needs of users, pedestrian facilities tend to be somewhat less specialized and are also more familiar to the general public.

★ **Sidewalk (photo 2a) –** Physically separated from travel lanes but within the public right-of-way, sidewalks can include a variety of paving materials such as concrete or brick that are appropriate to the neighborhood context. The buffer between the sidewalk and the travel lane is generally wider on roads with high traffic speeds or volumes.

★ **Crosswalk (photo 2b) –** Indicates the optimal or preferred location for pedestrians to safely cross the street while also correctly positioning motor vehicles at controlled intersections. A variety of striping patterns and pavement treatments are employed along busy roadways to provide enhanced pedestrian recognition. Crosswalks are often augmented by pedestrian signals at each end of the street crossing which provide visual and/or verbal instructions on when users can safely enter the street.

★ **Curb Ramps (photo 2c) –** To meet the needs of individuals with disabilities, mobility impairments or people pushing mobile objects (like strollers), curb ramps provide a seamless transition between the sidewalk and the road. Treatments on the ramp's surface provide warning and resistance to pedestrians entering the roadway to alert them that they are entering the vehicular lane. Curb ramps comply with the requirements of the Americans with Disabilities Act.

★ **Intersection Improvements (photo 2d) –** On roadways where marked crosswalks aren't adequate to the task of altering motorists to the presence of pedestrians (such as where there are high levels of pedestrian or vehicle traffic) other design measures may be taken. These may include median or island refuges, curb extensions and other strategies which reduce crossing distances and provide visual cues to drivers. Traffic calming measures such as roundabouts or traffic circles also fall under the general heading of intersection improvements which provide benefits to pedestrians.

★ **Amenities (photo 2e) –** Additional streetscape improvements such as benches, wayfinding signs, streetlights, trees and landscaping help to encourage increased pedestrian activity in similar fashion to end-of-trip bicycle facilities by providing comfort, convenience, and security.

2a

2b

2c

2d

2e

Bicycle Facility Design Considerations

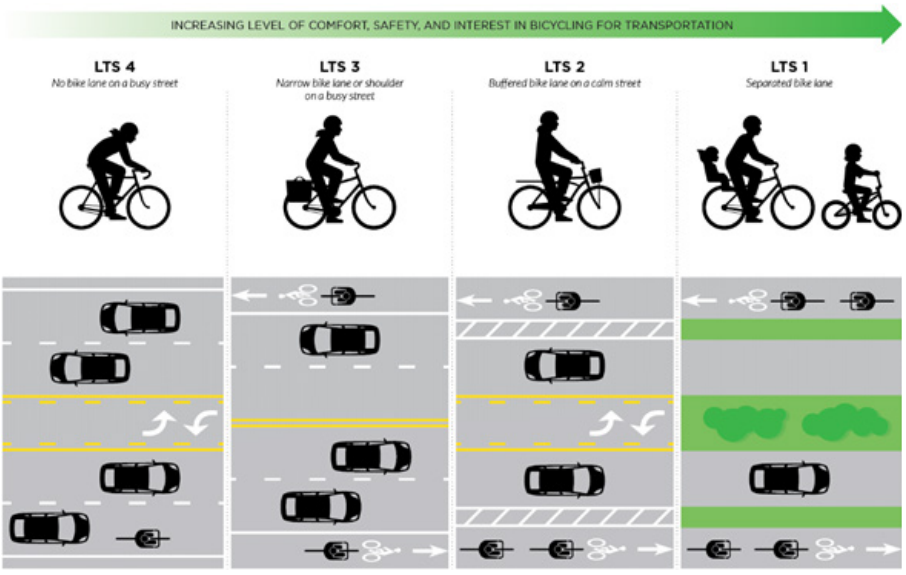
- **Rider Level of Comfort, Facility Level of Service and Level of Traffic Stress**

While the physical context is integral in planning the appropriate type of bicycle facility for a particular location, the comfort of an individual bicyclist can vary widely depending on his or her subjective perception of their traveling conditions. It therefore follows logically that measuring the adequacy of bicycle infrastructure to provide both safety and comfort, to bicyclists who possess widely different levels of experience cycling in different conditions, can be a significant challenge.

The traditional measure used nationally to quantify the adequacy of bicycle facilities is Bicycle Level of Comfort or Bicycle Level of Service (BLOC, BLOS). These measures are used by both MDOT and the MPO to assess bicycle conditions on State and local roadways in their planning efforts. BLOC assesses conditions on roadway segments based on roadway characteristics such as outside travel lane width, shoulder or bike lane width, speed limit, traffic volume, truck volume, pavement condition and the presence of medians or on-street parking. The segment is then assigned a letter grade of A-F, with A grade representing the highest level of comfort and F offering the lowest level of rider comfort.

The BLOC measure has limitations in offering a true assessment of bicycle facility adequacy in meeting the needs of users to feel safe and comfortable. Specifically, BLOC fails to adequately account for rider experience in assigning letter grades as it assumes cyclists are already comfortable riding on the street and doesn't account for conditions offered by off-street or separated facilities (e.g. – multi-use paths, cycle tracks, etc.) that may be preferred by less confident bicyclists.

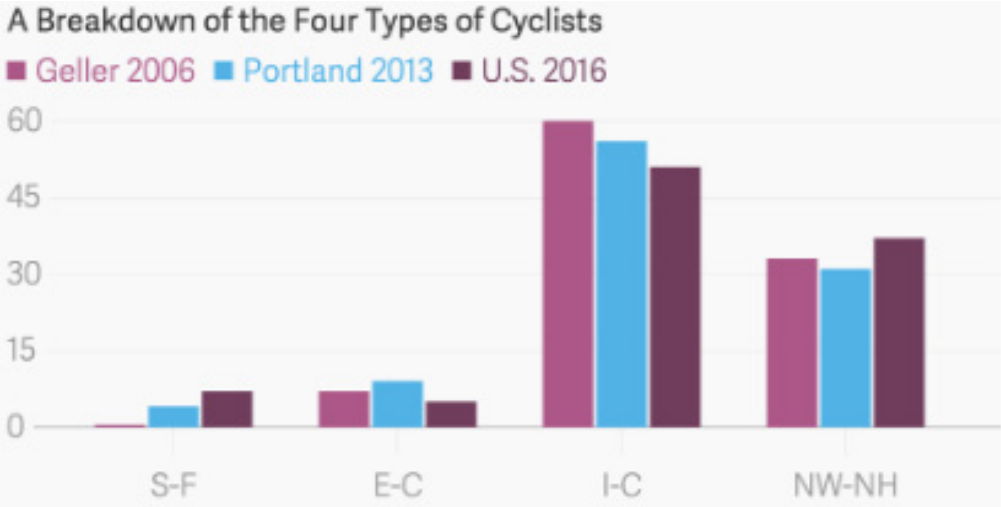
In order to better account for both the safety and comfort of bicyclists in the planning and design of bicycle infrastructure, BLOC is typically either replaced or supplemented by the Level of Traffic Stress (LTS) measure. LTS includes inputs that both overlap and expand upon BLOC, including posted or observed speed limit, presence and width of bikeways, intersection control, proximity to motor vehicle parking, blockage of the bikeway by motor vehicles, traffic volumes and truck route designation, and gaps in the bikeway network. Road segments are then given a rating between 1 and 4, with a segment graded 1 being the lowest stress and 4 as the most stressful bicycling environment. A sample depiction of the differing environments corresponding to these numerical grades is shown adjacent.



Source: Alta Planning + Design

The scoring system and philosophy embedded in LTS relates to academic research on bicyclist comfort, particularly the "Four Types of Cyclists" characterization developed by City of Portland, Oregon Bicycle Coordinator Roger Geller beginning in 2006. Geller came up with a typology that classifies cyclists into four categories depending on their comfort level bicycling in different environments and not necessarily just by their current bicycling behavior. These categories include "Strong and Fearless," "Enthused and Confident," "Interested but Concerned" and "No Way No How." As one might expect, "Strong and Fearless" represents the most confident group cycling in any conditions while "No Way No How" represents the least confident.

The value of these comfort measures lies in understanding what groups to target for their potential to switch some daily trips from motorized to active transportation modes such as bicycling or walking. Geller estimated that Portland cyclists fell into these four categories at the following percentages: Strong and Fearless (less than 1%), Enthused and Confident (7%), Interested but Concerned (60%), Now Way No How (33%). Subsequent research by Portland State University largely validated these figures nationally as can be seen in Chart A2-1 below:



The group within this typology of greatest interest to transportation planners is the "Interested but Concerned" group because they are both the most numerous and most amenable to potentially diverting some trips to non-motorized modes of transportation. "Interested but Concerned" cyclists already engage in some utilitarian bicycling but are often deterred from expanding their participation further by having to share the road with cars. Therefore, improvements in bicycle infrastructure that provides dedicated space to cyclists has the potential to attract significant numbers of new riders.

Transportation planning entities are aware of the academic research surrounding bicyclist comfort and have been integrating its principles into long range plans and regulatory standards for some time. MDOT, for example, is actively developing its own LTS system to better quantify cyclist comfort in planning and designing bicycle facilities. Pedestrian Level of Service and Pedestrian Level of Traffic Stress measures have also been developed using similar criteria as outlined above for bicycles

- **The Six "E's"**

  While brick and mortar efforts like improved bicycle infrastructure go a long way to encourage modal shifting, additional "soft" policies are also needed in the push to encourage wider participation in active transportation modes. A highly useful framework for understanding how to incorporate these soft policies into wider efforts to promote greater bicycle and pedestrian travel is the "6 E's." The League of American Bicyclists developed this multi-pronged strategy to advance safe bicycling and it awards a Bicycle Friendly designation to communities, businesses, and universities who have completed a certification program to validate improvements in these areas.

  - ★ **Engineering -** refers largely to the physical construction of bicycle or pedestrian specific infrastructure which alters the built environment to be more safe and friendly to these users, using the types of facilities previously described.

  - ★ **Education -** involves giving people of all ages and abilities the skills and confidence to ride through bicycle and pedestrian safety training and other methods.

  - ★ **Encouragement -** differs from education in that it is more event or program focused. Walk or Bike to School (or work) Days, bikeshare systems, and recreational or competitive events which generate enthusiasm around engaging in these modes of travel would be examples of encouragement activities.

  - ★ **Enforcement -** ensures safe roads for all users through the work of law enforcement, citizen safety groups (neighborhood watch, crossing guards) and others to ensure that traffic laws are obeyed, and community awareness is increased.

  - ★ **Evaluation -** refers to the efforts required to quantify existing conditions for bicyclists and pedestrians and then measure progress towards goal achievement. Efforts like bike or pedestrian counts, quantifying return on capital investments or identifying crash reduction trends are examples of evaluation methods.

  - ★ **Equity -** is the underlying objective of the framework as a whole. It involves providing transportation choices by removing barriers to entry and ensuring universal access to bicycling by focusing attention on providing transportation options where they are most needed.

Transportation Design Concepts - Freight

Estimating Truck Parking Demand

FHWA's Truck Parking Demand Estimation Tool, shown in Table A2-4, utilizes case studies to develop a planning level tool that allows local planners to estimate the demand for truck parking for freight-intensive land uses and developments at a high level. The Truck Parking Demand Estimation Tool allows practitioners to quickly estimate the peak number of trucks requiring parking. Estimates from this tool can help practitioners establish truck parking requirements at new industrial developments, assess a community's current ability to handle new truck parking demand, and plan for increased truck traffic in a community. The table summarizes the parking generation rate for every 100 employees for the NAICS industries with sufficient data. The tool also provides estimates for certain three-digit NAICS codes and estimates of spatial

distribution of truck parking demand. Manufacturing facilities should be evaluated using three-digit NAICS codes whenever possible due to significant variation in product types, sizes, and shipping needs.

Table A2-4: Truck Parking Demand Estimates by Industry per 1,000 Employees

Industry	Peak Parking per 1,000 Employees
Manufacturing: Facilities that process materials or assemble parts into finished goods (NAICS 31-33)	5.0
Wholesale Trade: Facilities that seel bulk goods to retailers (NAICS 42)	14.3
Retail Trade: Facilities that sell goods directly to consumers (NAICS 44-45)	11.5
Transportation: Facilities for storing, transloading, fulfilling or distributing products, materials or cargo (NAICS 49**)	34.7
Accommodation and Restaurants: Facilities proving lodging or food service (NAICS 72)	2.1

Source: FHWA Truck Parking Development Handbook (2022)

*NAICS 48-49: Transportation and Warehousing is typically presented as a single group. The values presented in this row apply predominantly to truck transportation facilities.
** NAICS 48-49: Transportation and Warehousing is typically presented as a single group. The values presented in this row apply to warehousing facilities only. The research supporting this did not develop a statistically significant value for estimating warehousing parking demand, and these values should be applied with caution.
Note: Variation within industries may be significant based on the size of operations and commodity types shipped to and from the facility.

The following options demonstrate how parking requirements can be based upon loading docks, building area and/or land use:

- ★ Option based on loading docks: One 10-foot by 80-foot (10' x 80') parking space for truck staging for every two (2) loading docks. Parking shall be maintained and available for truck parking prior to or after a scheduled delivery or pickup.
- ★ Option based on building square footage: One 10-foot by 80-foot (10’ x 80’) parking space for truck staging for the following building areas:

Table A2-5: Truck Parking Spaces by Land Use and Building Square Footage

Land Use	Gross Floor Area (Square Feet)	Minimum Number of Spaces
Retail, manufacturing, wholesaling, commercial, institutional, personal services, funeral homes, and similar uses.	Under 8,000	1
	8,000 to 40,000	2
	40,000 to 100,000	3
	100,000 to 250,000	4
	Each additional 200,000	1
Office buildings, hotels, motels, and similar uses	Under 100,000	1
	100,000 to 300,000	2
	Over 300,000	3
Warehouses, distribution, truck terminals, and similar uses	Per loading dock	1

Source: FHWA Truck Parking Development Handbook (2022)