

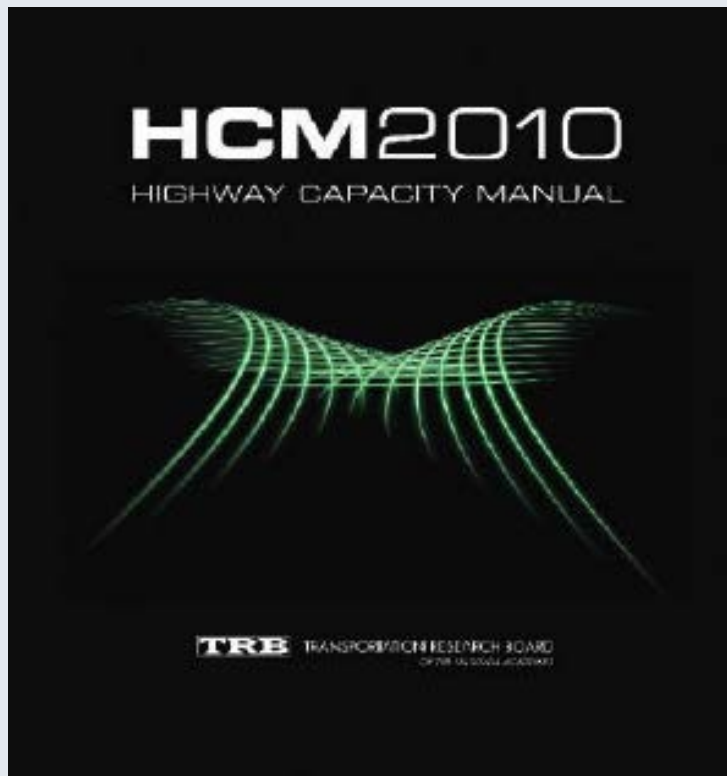


# DESIGNING IN CONTEXT OF COMPLETE STREETS

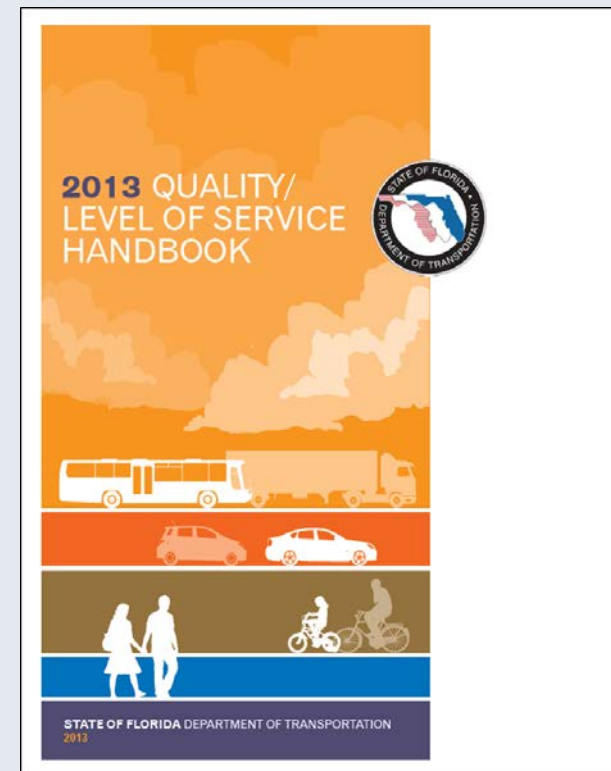
MULTIMODAL  
NETWORK –  
LEVEL OF  
SERVICE

# MULTIMODAL LEVEL OF SERVICE

Planning & Design  
HCM 2010 / HCS 7



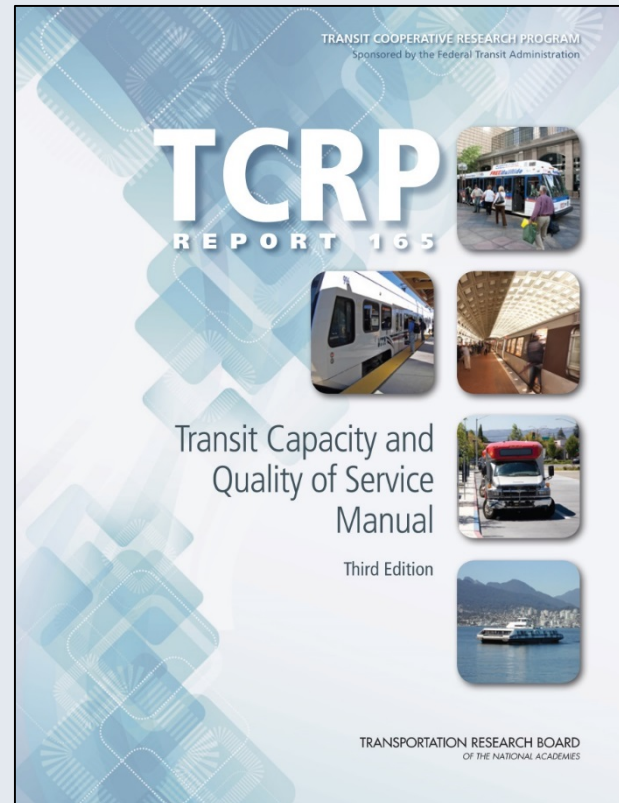
Planning  
FDOT 2013 QLOS  
ARTPLAN



# MULTIMODAL LEVEL OF SERVICE

## Planning & Design

### Transit Capacity and Quality of Service Manual (TCQSM)





# Key Differences Between Other Tools



# FDOT: QUALITY/LEVEL OF SERVICE HANDBOOK 2013

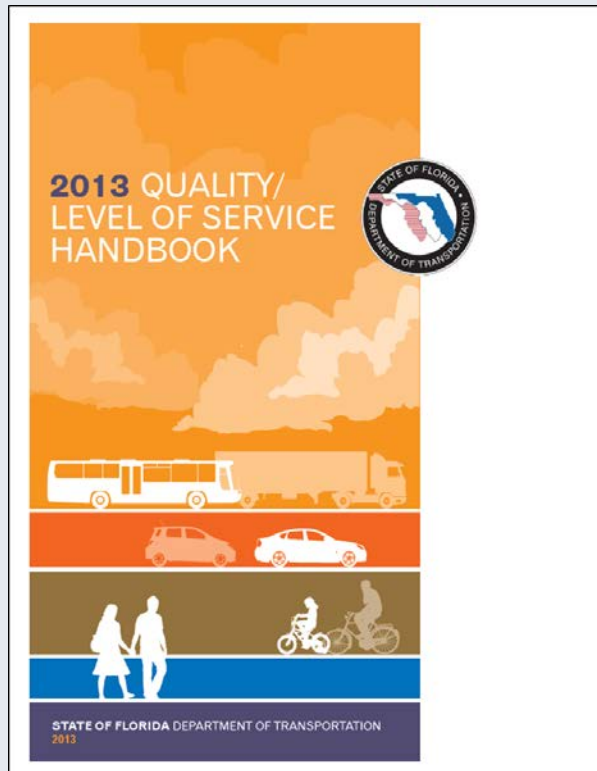
**Figure 3-1**  
**Examples of LOS By Mode for Urban Roadways**

LOS	Automobile	Bicycle	Pedestrian	Bus
A/B				
C/D				
E/F				

# PLANNING

## FDOT: QUALITY/LEVEL OF SERVICE HANDBOOK 2013

### FDOT 2013 Q/LOS ARTPLAN



[http://www.fdot.gov/planning/systems/programs/sm/los/los\\_sw2M2.shtm](http://www.fdot.gov/planning/systems/programs/sm/los/los_sw2M2.shtm)

# Key Differences Between Other Tools

## ARTPLAN

- Requires significantly fewer inputs than other tools such as HCS, TRANSYT-7F, and CORSIM
- Uses average travel speed rather than percent base free flow speed as the primary service measure

Number of inputs comparison:

Input	HCS Streets 2010	ARTPLAN
Turning Movements/Volume	12	3
Signal Timing Parameters	75+	5

# FDOT: QUALITY/LEVEL OF SERVICE HANDBOOK 2013

## ARTPLAN – Multimodal Analysis

### Pedestrian/Bicycle/Transit Inputs

Input	HCS Streets 2010	ARTPLAN
Pedestrian Parameters	76	16
Bicycle Parameters	42	6
Transit Parameters	24	4



# FDOT: QUALITY/LEVEL OF SERVICE HANDBOOK 2013

## Roadway Inputs

- **Roadway Class**
  - Class I: > 40 mph
  - Class II: < 35 mph
- **K Factor**
  - Urban – Rural Developed: 9.0
  - Rural Undeveloped: 9.5
- **% Heavy Vehicle**
  - Urbanized: 1.0
  - 2-lane to 6-lane: 2.0 – 3.0
  - Rural Developed: 3.0

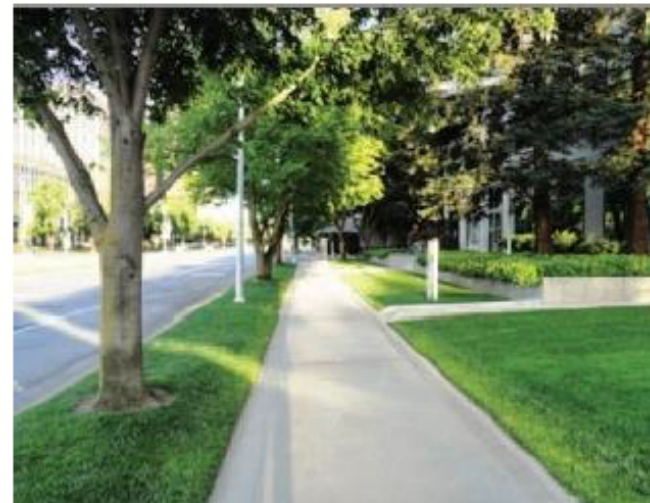
# FDOT: QUALITY/LEVEL OF SERVICE HANDBOOK 2013

## Intersection Inputs

- Cycle Length
- Through g/G
- Left g/G
- Arrival Type
- On-Street Parking
- Parking Activity
- Number of Left/Right Turn Lanes
- Percent Left/Right Turns
- Total Left Turn Storage

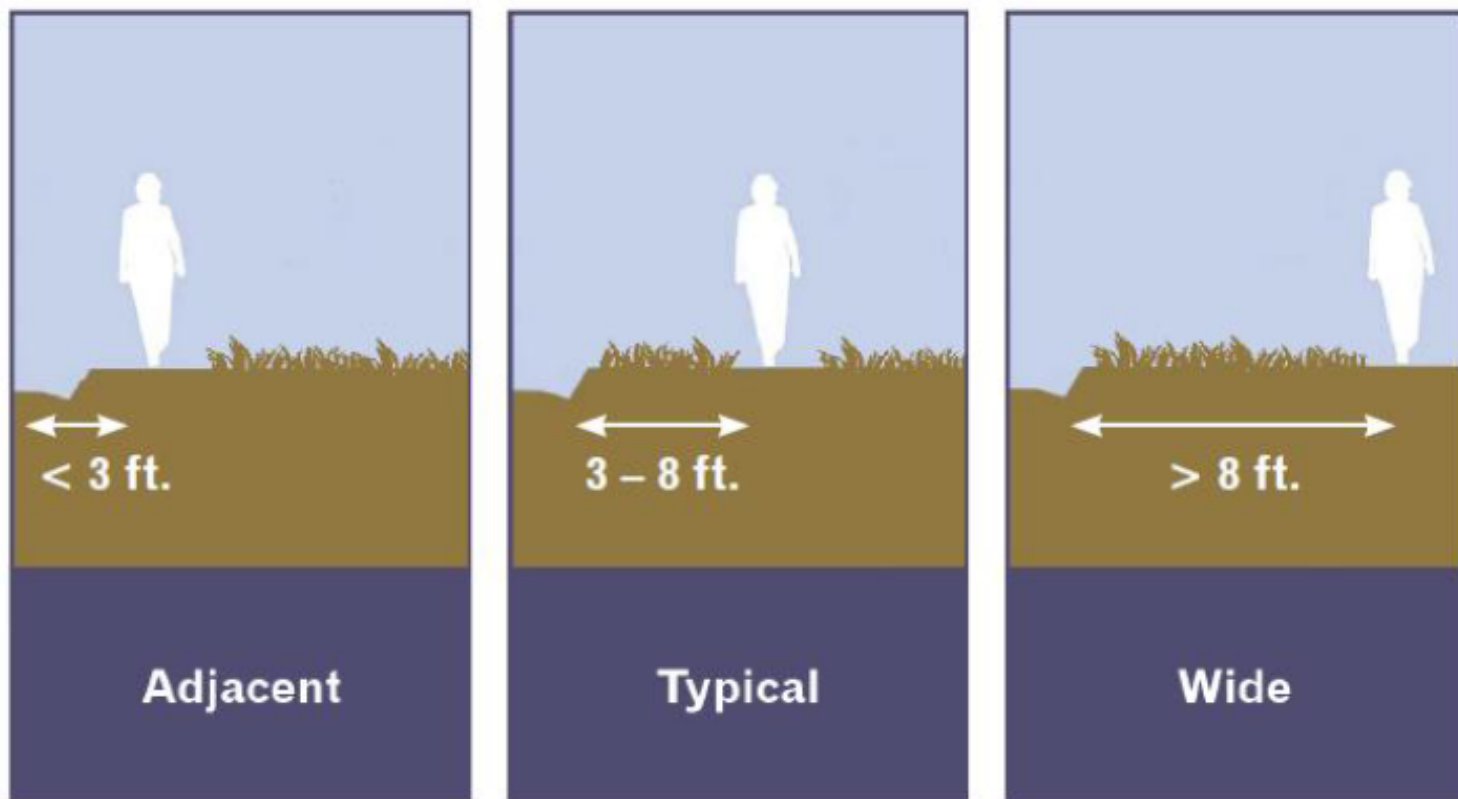
## Pedestrian Mode Variables

- **Sidewalk** - paved walkway at the side of a roadway, typically 5 feet in width (on the directional side of the arterial being analyzed)
- **Sidewalk Protective Barrier** - Physical barriers of at least 3' high and spacing of 20' or less that separate pedestrians from vehicles, such as planted trees and on-street parking.



# Pedestrian Mode Variables

- **Sidewalk/Roadway Separation** - lateral distance in feet from the outside edge of pavement to the inside edge of the sidewalk





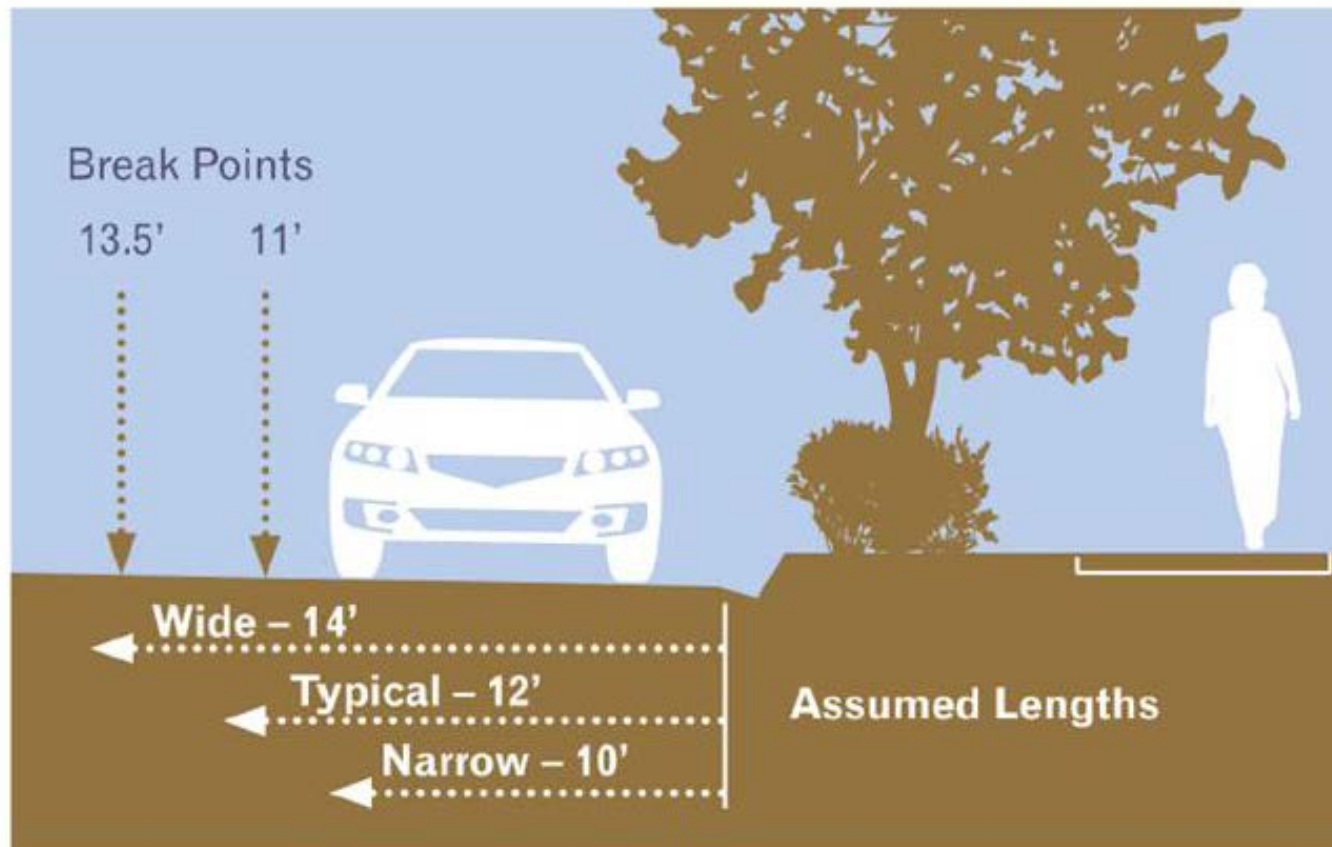
# Bicycle Mode Variables

- **Side Path** - Off-street dedicated bicycle and pedestrian path (ARTPLAN analyzes bicycles only)
- **Side Path Separation** - distance between the side path and the outside edge of the roadway



# Bicycle Mode Variables

- **Outside Lane Width** - Width, in feet, of a roadway's outside motorized vehicle through lane, not including the gutter



# Bicycle Mode Variables

- **Pavement Condition** - classification of the roadway surface where bicycling usually occurs
  - **Desirable** - new or recently resurfaced
  - **Typical** - light gray color, the surface appears worn, and may have some cracks; however, the ride for the bicyclist is fairly smooth
  - **Undesirable** - noticeable cracks, broken pavement, or ruts





# Bus Mode Variables

## ■ Bus Stop Amenities

- **Excellent** – Shelter and bench
- **Good** – Shelter, no bench
- **Fair** – Bench, no shelter
- **Poor** – No bench or shelter



## ■ Bus Stop Type

- **Typical** – Dwell time approximately 15 s
- **Major** – Dwell time approximately 35 s

## ■ Passenger Load Factor

- Passengers divided by seats (0 - 300%)



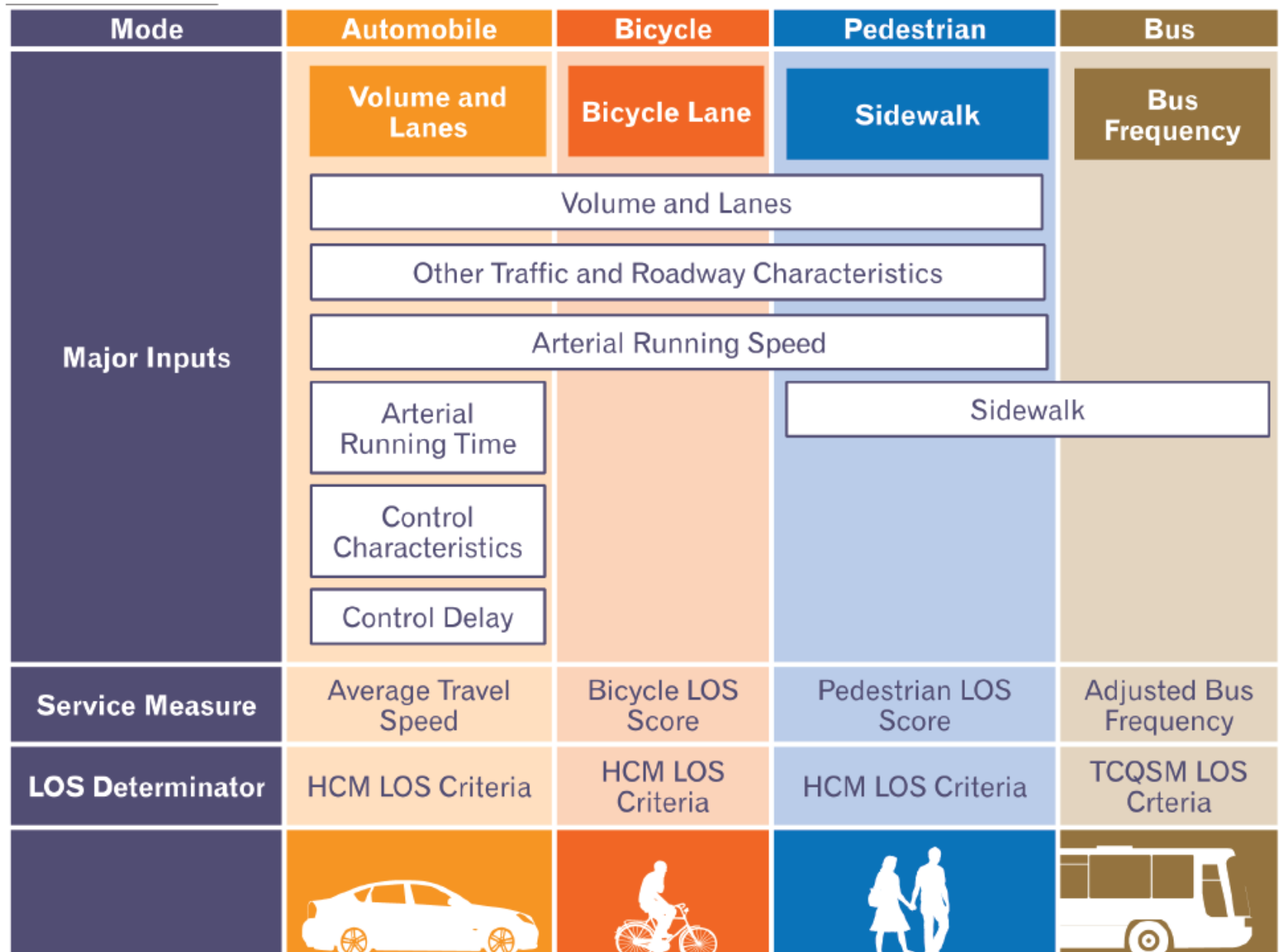


## Bus Mode

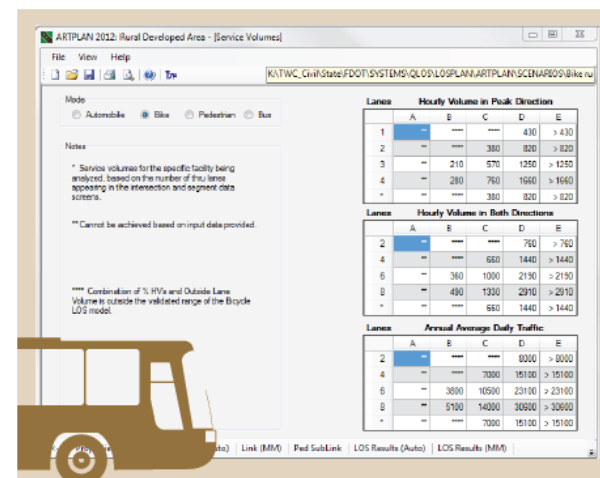
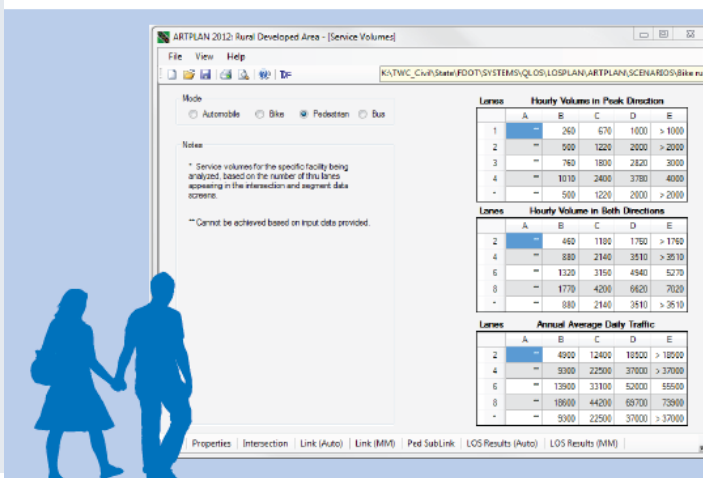
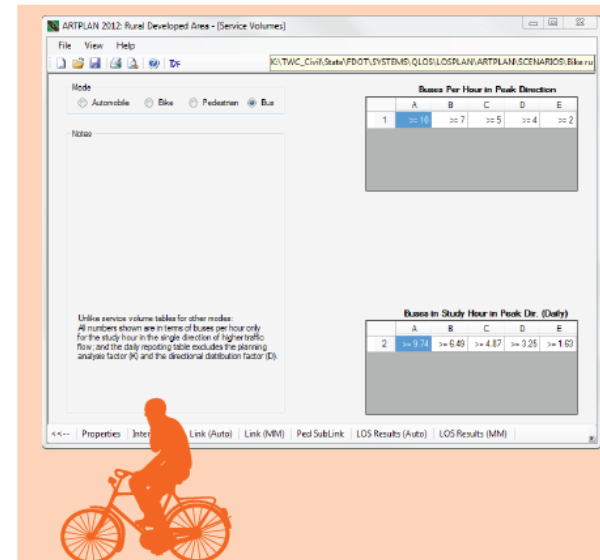
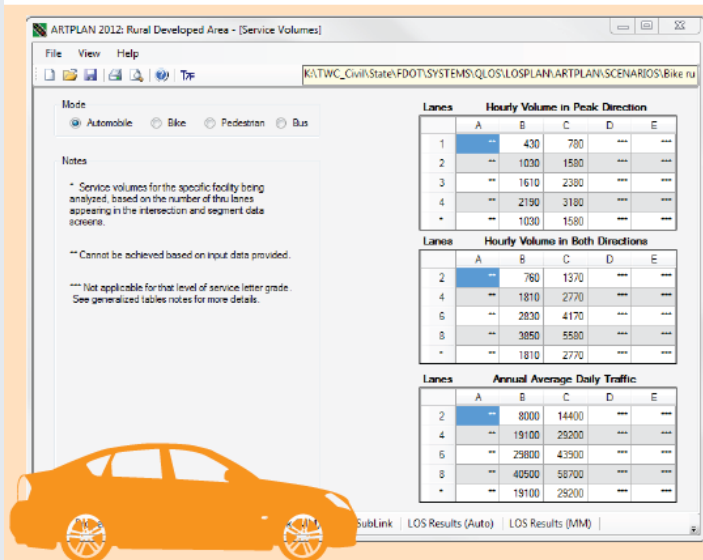
**Table 3-1**  
**Service Frequency LOS Thresholds**

Level of Service	Adjusted Service Frequency (Vehicles/hour)	Headway (minutes)	Comments
<b>A</b>	>6	<10	Passengers don't need schedules
<b>B</b>	>4	<15	Frequent service, passengers consult schedules
<b>C</b>	≥3	≤20	Maximum desirable time to wait if transit vehicle missed
<b>D</b>	≥2	≤30	Service unattractive to choice riders
<b>E</b>	≥1	≤60	Service available during hour
<b>F</b>	<1	>60	Service unattractive to all riders

**Figure 2-4**  
**Relationship of Inputs to Quality of Service Measures**



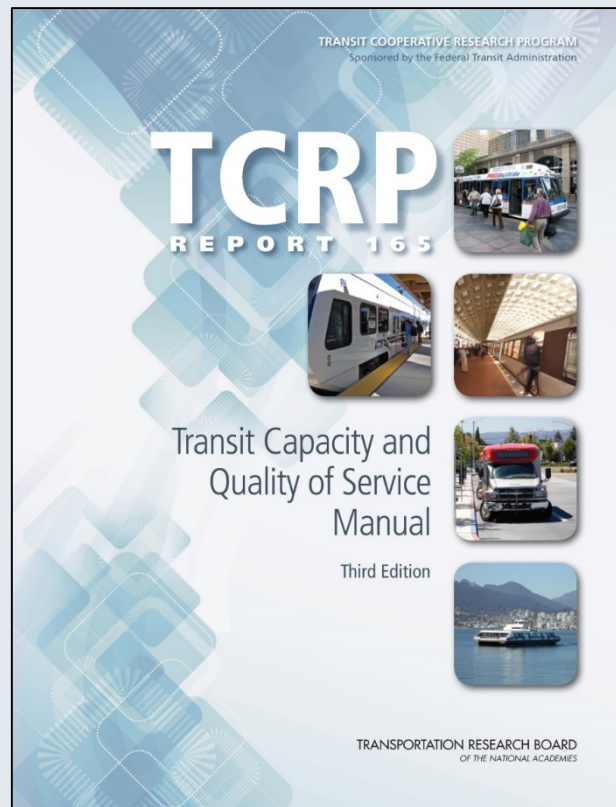
# FDOT: QUALITY/LEVEL OF SERVICE HANDBOOK 2013



# PLANNING & DESIGN

## TRANSIT LEVEL OF SERVICE

### Transit Capacity and Quality of Service Manual (TCQSM)



<http://www.trb.org/Main/Blurbs/169437.aspx>



# TRANSIT LEVEL OF SERVICE

## Different Stakeholder Viewpoints

Stakeholder Interest Areas		Performance Measure Examples	
Stakeholders	PASSENGER	TRAVEL TIME	<ul style="list-style-type: none"> <li>Transit-auto travel time</li> <li>Transfer time</li> </ul>
		AVAILABILITY	<ul style="list-style-type: none"> <li>Service coverage</li> <li>Service denials</li> <li>Frequency</li> <li>Hours of service</li> </ul>
		SERVICE DELIVERY	<ul style="list-style-type: none"> <li>Reliability</li> <li>Comfort</li> <li>Passenger environment</li> <li>Customer satisfaction</li> </ul>
		SAFETY AND SECURITY	<ul style="list-style-type: none"> <li>Vehicle accident rate</li> <li>Passenger accident rate</li> <li>Transit crime rate</li> <li>Safety device inventory</li> </ul>
	TRANSIT AGENCY	MAINTENANCE/CONSTRUCTION	<ul style="list-style-type: none"> <li>Road calls</li> <li>Fleet cleaning</li> <li>Spare ratio</li> <li>Construction impact</li> </ul>
		ECONOMIC	<ul style="list-style-type: none"> <li>Ridership</li> <li>Average fleet age</li> <li>Cost efficiency</li> <li>Cost effectiveness</li> </ul>
	MOTORIST	TRANSIT IMPACT	<ul style="list-style-type: none"> <li>Economic impact</li> <li>Employment impact</li> <li>Environmental impact</li> <li>Mobility</li> </ul>
		CAPACITY	<ul style="list-style-type: none"> <li>Vehicle capacity</li> <li>Person capacity</li> <li>Roadway capacity</li> <li>Volume-to-capacity ratio</li> </ul>
		TRAVEL TIME	<ul style="list-style-type: none"> <li>Delay</li> <li>Average system speed</li> </ul>

Quality of service focuses on the **passenger** point of view

# TRANSIT LEVEL OF SERVICE

## Typical Factors:

- Frequency, wait time, service span
- Reliability
- Service close to home, destination
- Crowding
- Fares, driver friendliness, safety/security

# TRANSIT LEVEL OF SERVICE

## Multimodal Transit LOS Calculation

Inputs		1	2	3	4
<b>TRANSIT OPERATIONS INFORMATION</b>					
	Number of local buses on street segment per hour (bus/h)	1	4	4	4
	Number of express buses stopping in segment per hour (bus/h)	0	0	0	0
$t_{ex}$	Average excess wait time (min)	0.0	2.8	2.8	2.8
$L_f$	Average passenger load factor (p/seat)	0.8	1.1	1.1	1.1
$S$	Average transit travel speed (mi/h)	12.0	6.9	6.9	7.4
$l_{pt}$	Average passenger trip length (mi)	3.7	3.7	3.7	3.7
	Is the segment in the CBD of a metro area of 5 million or more?	No	No	No	No
<b>TRANSIT AMENITY DATA</b>					
$p_{sh}$	Percent stops in segment with a shelter	0%	0%	0%	0%
$p_{be}$	Percent stops in segment with a bench	0%	0%	0%	0%
<b>PEDESTRIAN ENVIRONMENT DATA</b>					
$W_A$	Sidewalk width (ft) (Enter 0 if no sidewalk)	5.0	8.0	10.0	8.0
$W_{buf}$	Buffer width from sidewalk to street (ft)	0.0	0.0	0.0	0.0
	Does a continuous barrier exist between the street and sidewalk?	No	No	No	No
	Is the street divided?	No	No	No	Yes
	Are parking spaces striped?	No	No	No	Yes
$p_{pk}$	Proportion of on-street parking occupied	50%	80%	0%	100%
$W_{bl}$	Bicycle lane width (ft)	0.0	0.0	6.0	6.0
$W_{os}$	Shoulder/parking lane width (ft)	8.0	8.0	0.0	8.0
$W_{ol}$	Outside travel lane (closest to sidewalk) width (ft)	12.0	12.0	12.0	12.0
$v_m$	Outside lane demand flow rate at midsegment (veh/h)	400	400	400	800
$S_R$	Average vehicle running speed, including intersection delay (mi/h)	20.0	15.0	15.0	17.0

# TRANSIT LEVEL OF SERVICE

## Multimodal Transit LOS Calculation

### Calculations

f	Transit frequency (bus/h)	1	4	4	4
f <sub>h</sub>	Headway factor	0.95	2.80	2.80	2.80
f <sub>pl</sub>	Passenger load weighting factor	1.00	1.41	1.41	1.41
T <sub>at</sub>	Perceived amenity time rate (min/mi)	0.0	0.0	0.0	0.0
T <sub>ex</sub>	Excess wait time rate due to late arrivals (min/mi)	0.0	0.8	0.8	0.8
T <sub>ptt</sub>	Perceived travel time rate (min/mi)	5.0	13.8	13.8	13.0
T <sub>btt</sub>	Base travel time rate (min/mi)	4.0	4.0	4.0	4.0
f <sub>tt</sub>	Perceived travel time factor	0.91	0.64	0.64	0.65
s <sub>w-r</sub>	Transit wait-ride score	0.87	1.79	1.79	1.82
f <sub>s</sub>	Motorized vehicle speed adjustment factor	0.16	0.09	0.09	0.12
f <sub>v</sub>	Motorized vehicle volume adjustment factor	0.91	0.91	0.91	1.82
W <sub>aA</sub>	Adjusted available sidewalk width (ft)	5.0	8.0	10.0	8.0
f <sub>sw</sub>	Sidewalk width coefficient	4.50	3.60	3.00	3.60
f <sub>b</sub>	Buffer area coefficient	1.00	1.00	1.00	1.00
W <sub>t</sub>	Total width of outside lane, bike lane, and parking lane/shoulder (ft)	12.0	12.0	18.0	18.0
W <sub>v</sub>	Effective total width as a function of traffic volume (ft)	12.0	12.0	18.0	18.0
W <sub>1</sub>	Effective width of combined bike lane and shoulder (ft)	10.0	10.0	6.0	14.0
f <sub>w</sub>	Cross-section adjustment factor	-5.11	-5.47	-4.83	-5.70
I <sub>p</sub>	Pedestrian environment score	2.00	1.58	2.22	2.28
	Pedestrian LOS	B	A	B	B
I <sub>t</sub>	Transit LOS score	4.99	3.56	3.65	3.61

### Output

**Transit LOS**

**E**

**D**

**D**

**D**

# TRANSIT LEVEL OF SERVICE

**Transit LOS Score = Wait-Ride Score + Ped LOS Score**  
(adjusted to same scale as other modal LOS scores)

$$I_t = 6.0 - 1.50s_{w-r} + 0.15I_p$$

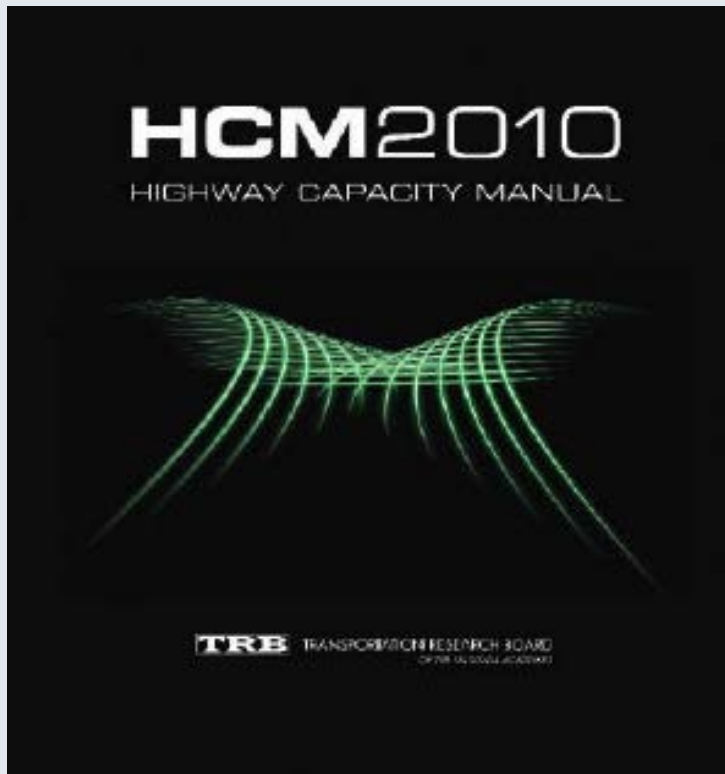
LOS	LOS Score
A	≤2.00
B	>2.00–2.75
C	>2.75–3.50
D	>3.50–4.25
E	>4.25–5.00
F	>5.00



# PLANNING & DESIGN

## HCM 2010/HCS7 MMLOS

HCM 2010/HCS7 . . . Very detailed



# PLANNING & DESIGN

## BICYCLE LEVELS OF TRAFFIC STRESS

### Mineta Transportation Institute of SJSU (MTI) Low-Stress Bicycling and Network Connectivity, 2012

**Table 1. Levels of Traffic Stress (LTS)**

LTS 1	Presenting little traffic stress and demanding little attention from cyclists, and attractive enough for a relaxing bike ride. Suitable for almost all cyclists, including children trained to safely cross intersections. On links, cyclists are either physically separated from traffic, or are in an exclusive bicycling zone next to a slow traffic stream with no more than one lane per direction, or are on a shared road where they interact with only occasional motor vehicles (as opposed to a stream of traffic) with a low speed differential. Where cyclists ride alongside a parking lane, they have ample operating space outside the zone into which car doors are opened. Intersections are easy to approach and cross.
LTS 2	Presenting little traffic stress and therefore suitable to most adult cyclists but demanding more attention than might be expected from children. On links, cyclists are either physically separated from traffic, or are in an exclusive bicycling zone next to a well-confined traffic stream with adequate clearance from a parking lane, or are on a shared road where they interact with only occasional motor vehicles (as opposed to a stream of traffic) with a low speed differential. Where a bike lane lies between a through lane and a right-turn lane, it is configured to give cyclists unambiguous priority where cars cross the bike lane and to keep car speed in the right-turn lane comparable to bicycling speeds. Crossings are not difficult for most adults.
LTS 3	More traffic stress than LTS 2, yet markedly less than the stress of integrating with multilane traffic, and therefore welcome to many people currently riding bikes in American cities. Offering cyclists either an exclusive riding zone (lane) next to moderate-speed traffic or shared lanes on streets that are not multilane and have moderately low speed. Crossings may be longer or across higher-speed roads than allowed by LTS 2, but are still considered acceptably safe to most adult pedestrians.
LTS 4	A level of stress beyond LTS3.

# PLANNING & DESIGN

## HCM 2010/HCS7 MMLOS

### HCS7

#### PRIMARY INPUT DATA

##### General

Urban Street

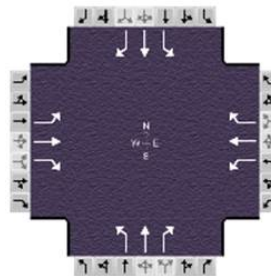
Intersection

Description

Forward Direction **EB** Area Type **Other**

Segment Length, ft  Duration 0.25

All Segment Lengths PHF 0.92



##### Traffic

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Demand, veh/h	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width, ft	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Storage Length, ft	0	0	0	0	0	0	0	0	0	0	0	0
Saturation, pc/h/ln	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Heavy Vehicles, %	0	0	0	0	0	0	0	0	0	0	0	0
Grade, %	0			0			0			0		
Buses, per h			0			0			0			0
Parking, per h	0	1	0	0	N	0	0	1	0	0	1	0
Bicycles, per h		0			0			0			0	
Pedestrians, per h		0			0			0			0	
Arrival Type	3	3	3	3	3	3	3	3	3	3	3	3
Upstream Filtering (I)	I-EB	1.00		I-WB	1.00		I-NB	1.00		I-SB	1.00	
Initial Queue, veh	0	0	0	0	0	0	0	0	0	0	0	0
Speed Limit, mi/h		35			35			35			35	
Detector, ft	40	40	40	40	40	40	40	40	40	40	40	40
RTOR, veh/h			0			0			0			0
Unsignalized Move...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Unsignalized Delay	0.0		0.0	0.0		0.0	0.0		0.0	0.0		0.0

##### Phasing

Cycle, s

Pre-Timed Signal ☐

Offset, s

Phase 2 Direction **EB**

Phase 4 Direction **SB**

Reference Phase **2**

Reference Point **End**

Force Mode **Fixed**

Side Street Split Phasing ☐

Uncoordinated Intersection ☐

Field-Measured Phase Times ☐

Phasing Wizard

##### Phase Duration

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Green	0.0	116.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Red	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

##### Timing

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	(5)	(2)	(1)	(6)	(3)	(8)	(7)	(4)
Phase Split, s	20.0	50.0	20.0	50.0	20.0	30.0	20.0	30.0
Yellow Change, s	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Red Clearance, s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Minimum Green, s	6	6	6	6	6	6	6	6
Lag Phase	<input type="checkbox"/> EL	<input type="checkbox"/> ET	<input type="checkbox"/> WL	<input type="checkbox"/> WT	<input type="checkbox"/> NL	<input type="checkbox"/> NT	<input type="checkbox"/> SL	<input type="checkbox"/> ST
Passage Time, s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Recall Mode	Off	Min	Off	Mir	Off	Off	Off	Off
Dual Entry	<input type="checkbox"/> EL	<input checked="" type="checkbox"/> ET	<input type="checkbox"/> WL	<input checked="" type="checkbox"/> WT	<input type="checkbox"/> NL	<input checked="" type="checkbox"/> NT	<input type="checkbox"/> SL	<input checked="" type="checkbox"/> ST
Dallas Phasing	<input type="checkbox"/> E/W	<input type="checkbox"/> N/S	Simultaneous Gap		<input checked="" type="checkbox"/> E/W	<input checked="" type="checkbox"/> N/S		

# PLANNING & DESIGN

## HCM 2010/HCS7 MMLOS

### HCS7

#### ☐ MULTIMODAL INPUT DATA

##### Pedestrian Mode - Signals

	EB	WB	NB	SB
Permitted Left-Turn Flow, veh/h	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Mid-Seg 85th % Speed, mi/h	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Number Right-Turn Islands	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Walkway Width, ft	<input type="text" value="9.0"/>	<input type="text" value="9.0"/>	<input type="text" value="9.0"/>	<input type="text" value="9.0"/>
Crosswalk Width, ft	<input type="text" value="12"/>	<input type="text" value="12"/>	<input type="text" value="12"/>	<input type="text" value="12"/>
Crosswalk Length, ft	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Corner Radius, ft	<input type="text" value="25"/>	<input type="text" value="25"/>	<input type="text" value="25"/>	<input type="text" value="25"/>
Outgoing Ped Volume, ped/h	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Incoming Ped Volume, ped/h	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Circulating Ped Volume, ped/h	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Rest-In-Walk Enabled	<input type="checkbox"/> EB	<input type="checkbox"/> WB	<input type="checkbox"/> NB	<input type="checkbox"/> SB
Pedestrian Signal Head	<input type="checkbox"/> EB	<input type="checkbox"/> WB	<input type="checkbox"/> NB	<input type="checkbox"/> SB
Crosswalk Closed	<input type="checkbox"/> EB	<input type="checkbox"/> WB	<input type="checkbox"/> NB	<input type="checkbox"/> SB

Hide Results ☐

##### Pedestrian Mode - Streets

	EB	WB
Two-Way Ped Volume, ped/h	<input type="text"/>	<input type="text"/>
Ped Waiting Delay, sec/ped	<input type="text"/>	<input type="text"/>
Pedestrian Free-Flow Speed, ft/s	<input type="text"/>	<input type="text"/>
Downstream Intersection Width, ft	<input type="text"/>	<input type="text"/>
Sidewalk Presence	<input type="checkbox"/> EB	<input type="checkbox"/> WB
Inside Object Effective Width, ft	<input type="text"/>	<input type="text"/>
Outside Object Effective Width, ft	<input type="text"/>	<input type="text"/>
Buffer Width, ft	<input type="text"/>	<input type="text"/>
Nearest Signal Distance, ft	<input type="text"/>	<input type="text"/>
Sidewalk Length Adjacent to Window, Prop	<input type="text"/>	<input type="text"/>
Sidewalk Length Adjacent to Building, Prop	<input type="text"/>	<input type="text"/>
Sidewalk Length Adjacent to Fence, Prop	<input type="text"/>	<input type="text"/>

Hide Results ☐



# PLANNING & DESIGN

## HCM 2010/HCS7 MMLOS

### HCS7

Streets		Transit Mode - Streets			
	EB	WB		EB	WB
On-Street Parking Occupied, Prop	<input type="text"/>	<input type="text"/>	Number of Transit Stops	<input type="text"/>	<input type="text"/>
Outside Thru Lane Width, ft	<input type="text"/>	<input type="text"/>	Dwell Time, s	<input type="text"/>	<input type="text"/>
Bicycle Lane Width, ft	<input type="text"/>	<input type="text"/>	Excess Wait Time, min	<input type="text"/>	<input type="text"/>
Paved Shoulder Width, ft	<input type="text"/>	<input type="text"/>	Average Passenger Trip Length, mi	<input type="text"/>	<input type="text"/>
Presence of Curb	<input type="checkbox"/> EB	<input type="checkbox"/> WB	Transit Frequency	<input type="text"/>	<input type="text"/>
Presence of Continuous Barrier	<input type="checkbox"/> EB	<input type="checkbox"/> WB	Passenger Load Factor	<input type="text"/>	<input type="text"/>
Total Walkway Width	<input type="text"/>	<input type="text"/>	Transit Stop Near Side	<input type="checkbox"/> EB	<input type="checkbox"/> WB
Median Type	<input type="text"/>	<input type="text"/>	Transit Stop On-Line	<input type="checkbox"/> EB	<input type="checkbox"/> WB
			Stops with Shelters, Prop	<input type="text"/>	<input type="text"/>
			Stops with Benches, Prop	<input type="text"/>	<input type="text"/>
			Re-Entry Delay, s	<input type="text"/>	<input type="text"/>
			Base Travel Time Rate, min/mi	<input type="text"/>	<input type="text"/>
			Hide Results <input type="checkbox"/>		



# PLANNING & DESIGN

## HCM 2010/HCS7 MMLOS

### HCS7

#### Bicycle Mode - Signals

	EB	WB	NB	SB
On-Street Parking Occupied, Prop	<input type="text" value="0.50"/>	<input type="text" value="0.50"/>	<input type="text" value="0.50"/>	<input type="text" value="0.50"/>
Curb-to-Curb Street Width, ft	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Outside Thru Lane Width, ft	<input type="text" value="12"/>	<input type="text" value="12"/>	<input type="text" value="12"/>	<input type="text" value="12"/>
Bicycle Lane Width, ft	<input type="text" value="5.0"/>	<input type="text" value="5.0"/>	<input type="text" value="5.0"/>	<input type="text" value="5.0"/>
Paved Shoulder Width, ft	<input type="text" value="2.0"/>	<input type="text" value="2.0"/>	<input type="text" value="2.0"/>	<input type="text" value="2.0"/>
Presence of Curb	<input type="checkbox"/> EB	<input type="checkbox"/> WB	<input type="checkbox"/> NB	<input type="checkbox"/> SB
Hide Results	<input type="checkbox"/>			

#### Bicycle Mode - Streets

	EB	WB
Bicycle Running Speed, mi/h	<input type="text"/>	<input type="text"/>
Percent Heavy Vehicles	<input type="text"/>	<input type="text"/>
Total Number of Access Points	<input type="text"/>	<input type="text"/>
Pavement Condition Rating	<input type="text"/>	<input type="text"/>
Hide Results	<input type="checkbox"/>	

# PLANNING & DESIGN

## HCM 2010/HCS7 MMLOS

### HCS7 - Output

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	2.2	B	2.2	B	2.5	B	2.5	B
Bicycle LOS Score / LOS	0.5	A	0.5	A	0.5	A	0.5	A

# MULTIMODAL LEVEL OF SERVICE

## Learning outcomes

### References

- Highway Capacity Manual 2010  
<https://www.mytrb.org/Store/Product.aspx?ID=1119>
- Transit Capacity and Quality of Service Manual (TCQSM), 3<sup>rd</sup> Ed. 2013  
<http://www.trb.org/Main/Blurbs/169437.aspx>

### Tools

- FDOT QLOS – Planning (all modes)  
<http://www.fdot.gov/planning/systems/programs/sm/los/>
- HCM – Planning & Design
  - HCS7 (Ped, Bike, Auto) <http://mctrans.ce.ufl.edu/mct/index.php/hcs/>
  - Spreadsheet (Ped, Bike)
- TCQSM – Planning & Design (Transit)

# MULTIMODAL LEVEL OF SERVICE

**QUESTIONS?**



# MULTIMODAL LEVEL OF SERVICE - EXERCISE

**EXERCISE**

# MULTIMODAL LEVEL OF SERVICE - EXERCISE

- Auto LOS
  - Results from traffic operations software
- Pedestrian and Bicycle LOS
  - Spreadsheet (provided), ARTPLAN, HCS7
- Transit LOS
  - TCQSM

# MULTIMODAL LEVEL OF SERVICE - EXERCISE

## Pedestrian and Bicycle LOS

- **Basic information**
- **Inputs**
- **Results**
- **Calculations**

# MULTIMODAL LEVEL OF SERVICE - EXERCISE

## Basic Information

Directional Segments				
ID	Facility	From	To	Direction
1	6th Ave S	8th St S	12th St S	North

# MULTIMODAL LEVEL OF SERVICE - EXERCISE

## Inputs

- $W_{ol}$  - Width of outside through lane (ft)
- $W_{os}$  - Width of paved outside shoulder (ft)
- $W_{bl}$  - Width of bicycle lane (ft)
- $W_{pk}$  - Width of striped parking lane (ft)
- $P_{pk}$  - Proportion of on-street parking occupied (%)
- $W_{buf}$  - Buffer width (ft) [distance between roadway and available sidewalk, 0 if sidewalk does not exist]
- $W_A$  - Available Sidewalk Width (ft) [0 if sidewalk does not exist]
- **Curb** - Curb present? (Y/N)



# MULTIMODAL LEVEL OF SERVICE - EXERCISE

## Inputs

- **Barrier** - Continuous barrier at least 3 feet high separating walkway from motor vehicle traffic? A discontinuous barrier (e.g. trees, bollards, etc.) can be considered a continuous barrier if they are at least 3 feet high and are spaced 20 feet on center or less.(Y/N)
- **Typical Section** - Street divided? (Y/N)
- $V_m$  - Directional volume of motorized vehicles in the subject direction of travel (vph)
- $N_{th}$  - Number of through lanes in the subject direction of travel (ln)
- $S_R$  - Running speed of motorized vehicle traffic (mph)
- $P_{HV}$  - Percent heavy vehicles in motorized vehicle volume (%)
- **PC** - FHWA's five point pavement surface condition rating (1-5)

# MULTIMODAL LEVEL OF SERVICE - EXERCISE

## Inputs

- Pavement Condition

RATING	PAVEMENT CONDITION
5.0 (Very Good)	Only new or nearly new pavements are likely to be smooth enough and free of cracks and patches to qualify for this category.
4.0 (Good)	Pavement, although not as smooth as described above, gives a first class ride and exhibits signs of surface deterioration
3.0 (Fair)	Riding qualities are noticeably inferior to those above; may be barely tolerable for high-speed traffic. Defects may include rutting, map cracking, and extensive patching.
2.0 (Poor)	Pavements have deteriorated to such an extent that they affect the speed of free-flow traffic. Flexible pavement has distress over 50 percent or more of the surface. Rigid pavement distress includes joint spalling, patching, etc.
1.0 (Very Poor)	Pavements that are in an extremely deteriorated condition. Distress occurs over 75 percent or more of the surface.

Source: U.S. Department of Transportation. Highway Performance Monitoring System-Field Manual. Federal Highway Administration. Washington, DC, 1987.

# MULTIMODAL LEVEL OF SERVICE - EXERCISE

## Inputs

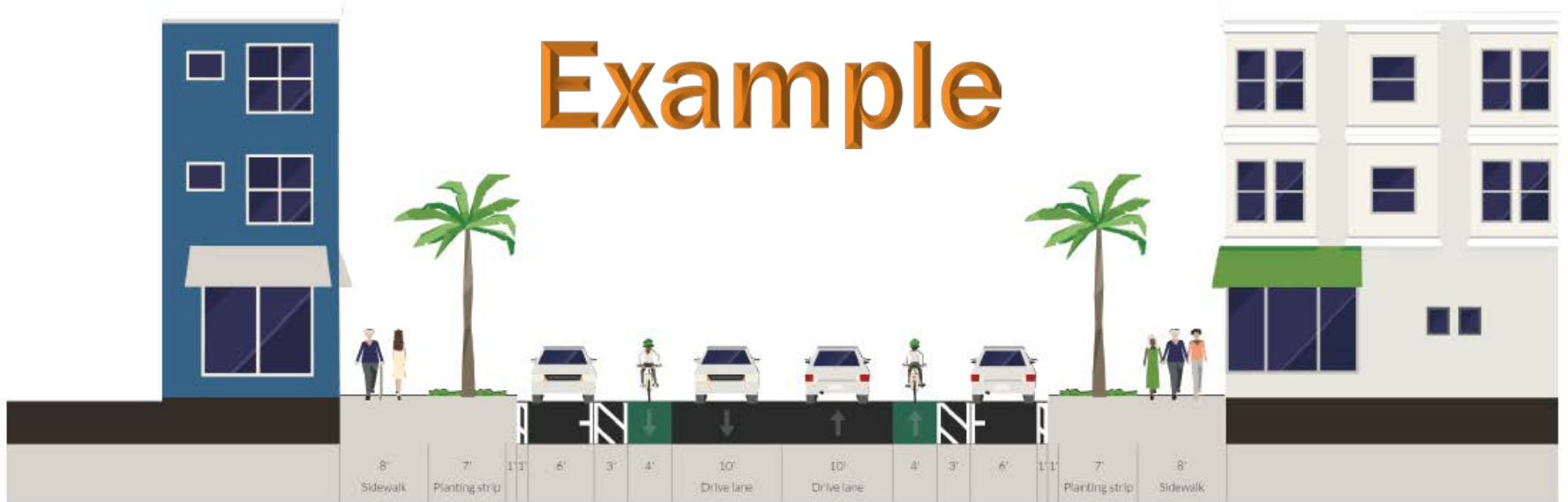
Inputs						
Continuous barrier at least 3 feet high separating walkway from motor vehicle traffic? A discontinuous barrier (e.g. trees, bollards, etc.) can be considered a continuous barrier if they are at least 3 feet high and are spaced 20 feet on center or less.(Y/N)	Street divided? (Y/N)	Directional volume of motorized vehicles in the subject direction of travel (vph)	Number of through lanes in the subject direction of travel (ln)	Running speed of motorized vehicle traffic (mph)	Percent heavy vehicles in motorized vehicle volume. (%)	FHWA's five point pavement surface condition rating (1-5)
		$v_m$	$N_{th}$	$S_R$	$P_{HV}$	PC
Y	Y	500	1	35	2	4

Get Started . . .

. . . Open the spreadsheet and enter data based on previous exercise, assumptions, or use one of the following typical sections.

# MULTIMODAL LEVEL OF SERVICE - EXERCISE

## Example



# MULTIMODAL LEVEL OF SERVICE - EXERCISE

## Example





# MULTIMODAL LEVEL OF SERVICE - EXERCISE

## Outputs

shown from previous spreadsheet inputs

Results			
PLOS Score	PLOS	BLOS Score	BLOS
1.70	A	2.76	C

- Report Out by Team

# MULTIMODAL LEVEL OF SERVICE

**QUESTIONS?**