Complete Streets
Multimodal Level of Service
NCTCOG-BPAC - February 18, 2015
Agenda

- Complete Streets Movement
- Application of Multimodal Level of Service (MMLOS)
- MMLOS Methodology and Tools
- Group Exercise
- Before and after pictures
- Take Away
Complete Streets Movement
Complete Street Policies and Initiatives

National Effort to Create Walkable and Livable Streets

- Context Sensitive Planning and Design
  - Regional Thoroughfare Plans
  - Cities Bicycle and Trail Master Plans
  - Transit Investment Plan

- Cities adopting Complete Streets Procedures
  - City of Tulsa

- Many States have adopted complete streets laws and/or policies for urban streets

- Secretary Fox - Mayor’s Challenge
  - Complete Street Approach
Application of MMLOS
Urban Street Facilities
Arterials and Collectors

- Planning for the Future Street
  - Transform the street and land uses
  - Different roadway concepts can be analyzed

- Design or Retrofit an Existing Street
  - Analyze different street alternatives
  - Quantifies the trade-offs between each road users

- Current Operations of an Existing Street
  - Identifies the deficiencies
MMLOS Methodology and Tools
Evolution of the Level of Service Methodology

Highway Capacity Manual 1950 to 2010

- Five editions with two major updates in 94’ and 97’
- 2010 Edition is a culmination of a multiagency effort (AASHTO, TRB, FHWA)
  - HCM needed to better address the bicycle, pedestrian, and transit level of service
HCM 2010 Multimodal Philosophy

Compare the Interaction for the different modes
HCM 2010 Multimodal Philosophy
Compare the Interaction for the Different Modes
Integrated Multimodal Evaluation Framework

Time and Space Resource Constraints

Auto LOS | Bicycle LOS

Auto

Bicycle

Right of Way

Auto Lanes

Bike Lanes

Sidewalk

Bus Lanes Pullouts

Signal Time

Thru & Left Turn Green

Thru Green

Ped. Walk, Min Green

Priority

Ped LOS

Transit LOS

Ped LOS

Transit

Auto

Bicycle

Pedestrian

Transit

Auto

Bicycle

Pedestrian

Transit

Auto

Bicycle

Pedestrian

Transit

Auto

Bicycle

Pedestrian

Transit

Auto

Bicycle

Pedestrian

Transit
Integrated Multimodal Evaluation Framework

Adverse Flow Interactions

- Auto
- Bicycle
- Pedestrian
- Transit
- Transit Stop Spacing

Running speed
Auto volume

Auto LOS
Bicycle LOS

Bicycle Int. Volume

Ped Int. Volume

Ped LOS
Transit LOS
MMLOS
Urban Street Analysis

- **Planning**
  - ADT (convert to peak hour volume)
    - Analyze each direction
  - Assumptions on turn percentages
  - Historical data

- **Design and Operations**
  - Turning movement counts
  - Peak hour volume
    - Analyze each direction

- **Facility LOS for all Modes**
  - Bicycle and Ped LOS is a combo of intersection and segment
### HCM Multimodal Level of Service Thresholds

<table>
<thead>
<tr>
<th>LOS Segment Score: Auto Mode</th>
<th>LOS Score: Bicycle, Transit, and Pedestrian*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Travel Speed Speed as a % of Base Free-Flow Speed</strong></td>
<td><strong>LOS Critical Volume to Capacity Ratio ≤ 1.00</strong></td>
</tr>
<tr>
<td>&gt; 85</td>
<td>A</td>
</tr>
<tr>
<td>&gt; 67-85</td>
<td>B</td>
</tr>
<tr>
<td>&gt; 50-67</td>
<td>C</td>
</tr>
<tr>
<td>&gt; 40-50</td>
<td>D</td>
</tr>
<tr>
<td>&gt; 30-40</td>
<td>E</td>
</tr>
<tr>
<td>≤ 30</td>
<td>F</td>
</tr>
</tbody>
</table>

- LOS F if Critical Volume to Capacity Ratio ≥ 1.00

* No Sidewalk
Multimodal Level of Service Tools

- **Complete Streets LOS Software**
  - Uses HCM methodology to calculate MMLOS

- **Shared Use Path Level of Service Calculator**
  - Analyzes off street shared-use paths (aka trails)
    - Existing or future trails
  - LOS calculated off user counts, mode split, geometrics, trail design (width, shoulders, & offsets), and physical setting.

- **Sidepath Safety Model**
  - Bicycle sidepath design factors affecting crash rates
    - Quantifies some of the concerns from the AASHTO Bike Guide
Case Study - Preliminary Planning Analysis
Pine Street – Tulsa, OK

- Sheridan Road to Memorial Drive
  - One-mile segment
  - Signalized intersections on each end
  - Four-lane undivided urban arterial
  - No sidewalk or bike lanes
  - Heavy truck traffic (10%)
  - Transit (Bus stops)
  - Existing 2014 ADT 12,400 vpd
  - Future 2034 ADT 18,500 vpd
  - 16 access points/driveways EB
  - 15 access points/driveways WB
Case Study - Preliminary Planning Analysis
Pine Street Land Uses
## Existing Multimodal Planning LOS
Pine St – Sheridan Rd. to Memorial Dr.

<table>
<thead>
<tr>
<th>EB</th>
<th>Vehicle LOS</th>
<th>Transit LOS</th>
<th>Bike LOS</th>
<th>Ped LOS</th>
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<tbody>
<tr>
<td>Score</td>
<td>0.83</td>
<td>4.83</td>
<td>5.01</td>
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<td>E</td>
<td>F</td>
<td>E</td>
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</table>

<table>
<thead>
<tr>
<th>WB</th>
<th>Vehicle LOS</th>
<th>Transit LOS</th>
<th>Bike LOS</th>
<th>Ped LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>0.85</td>
<td>4.59</td>
<td>4.85</td>
<td>4.34</td>
</tr>
<tr>
<td>LOS</td>
<td>B</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
</tbody>
</table>
Group Activity

1. Discuss the 3 Roadway Alternatives with a Group (5-10 people)

2. Recommend the preferred Alternative and discuss why??

3. Show the results and LOS for each Alternative

4. Discuss the trade-offs and LOS for each mode
Group Activity
Analyze 3 Different Alternatives

- Alt 1: Four-lane roadway with median island
  - 5’ bike lane, 3’ landscaped buffer, and 6’ sidewalk

- Alt 2: Three-lane roadway with TWLTL
  - Buffered bike lane, 6’ landscaped buffer, and 8’ sidewalk

- Alt 3: Four-lane roadway with median island
  - 14’ wide outside lane, 3.5’ landscaped buffer, and 10’ sidepath
# Pine Street – EB LOS Results

<table>
<thead>
<tr>
<th>Alt 1</th>
<th>Vehicle LOS</th>
<th>Transit LOS</th>
<th>Bike LOS</th>
<th>Ped LOS</th>
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</thead>
<tbody>
<tr>
<td>Score</td>
<td>0.65</td>
<td>4.59</td>
<td>4.28</td>
<td>2.91</td>
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<tr>
<td>LOS</td>
<td>C</td>
<td>E</td>
<td>E</td>
<td>C</td>
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</table>

<table>
<thead>
<tr>
<th>Alt 2</th>
<th>Vehicle LOS</th>
<th>Transit LOS</th>
<th>Bike LOS</th>
<th>Ped LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>0.62</td>
<td>4.66</td>
<td>4.10</td>
<td>2.56</td>
</tr>
<tr>
<td>LOS</td>
<td>C</td>
<td>E</td>
<td>D</td>
<td>B</td>
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</table>

<table>
<thead>
<tr>
<th>Alt 3</th>
<th>Vehicle LOS</th>
<th>Transit LOS</th>
<th>Bike LOS</th>
<th>Ped LOS</th>
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</thead>
<tbody>
<tr>
<td>Score</td>
<td>0.65</td>
<td>4.59</td>
<td>4.62</td>
<td>3.65</td>
</tr>
<tr>
<td>LOS</td>
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<td>E</td>
<td>E</td>
<td>D</td>
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# Pine Street – WB LOS Results

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<tr>
<th>Alt 1</th>
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<th>Transit LOS</th>
<th>Bike LOS</th>
<th>Ped LOS</th>
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<tbody>
<tr>
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<td>E</td>
<td>E</td>
<td>C</td>
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</table>

<table>
<thead>
<tr>
<th>Alt 2</th>
<th>Vehicle LOS</th>
<th>Transit LOS</th>
<th>Bike LOS</th>
<th>Ped LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
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<td>4.61</td>
<td>4.02</td>
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<tr>
<td>LOS</td>
<td>C</td>
<td>E</td>
<td>D</td>
<td>B</td>
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</table>

<table>
<thead>
<tr>
<th>Alt 3</th>
<th>Vehicle LOS</th>
<th>Transit LOS</th>
<th>Bike LOS</th>
<th>Ped LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>0.74</td>
<td>4.39</td>
<td>4.61</td>
<td>2.88</td>
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<tr>
<td>LOS</td>
<td>B</td>
<td>E</td>
<td>E</td>
<td>C</td>
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</table>
### Pine Street – Alt 2 Wins
Best LOS for all modes

<table>
<thead>
<tr>
<th></th>
<th>Vehicle LOS</th>
<th>Transit LOS</th>
<th>Bike LOS</th>
<th>Ped LOS</th>
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</thead>
<tbody>
<tr>
<td><strong>Alt 2 EB</strong></td>
<td></td>
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<tr>
<td>Score</td>
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<td>4.66</td>
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</tr>
<tr>
<td>LOS</td>
<td>C</td>
<td>E</td>
<td>D</td>
<td>B</td>
</tr>
<tr>
<td><strong>Alt 2 WB</strong></td>
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</tr>
<tr>
<td>Score</td>
<td>0.56</td>
<td>4.61</td>
<td>4.02</td>
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</table>

- Need to work with stakeholders and business owners
- Smallest ROW footprint
MMLOS Factors

- **Bicycle LOS**
  - Mainly effected by length of link between signalized intersections and number of access points the bicyclist must cross

- **Transit LOS**
  - There are 3-EB and 1-WB transit stops
  - Increasing the frequency (bus/hr) from every 45 min to 30 min
    - Improved the LOS from LOS E to LOS D

- **Pedestrian LOS**
  - Greatest factor is ADT and speed of traffic
    - For all alternatives the ADT and speed remained the same

- **Other Items to Consider**
  - Cost and impact to utilities
  - Traffic calming reduction (median islands, flashers, speed radar signs etc.)
Pine Street Overhead Utilities
Wrap Up
5th Street, S. of Main St., Frisco, TX
Multimodal Take Away

- Providing For All Users
  - No longer is vehicle delay our sole measure
  - Captures perception and comfort from the vulnerable road users

- Stakeholder Involvement Through the Process
  - Input throughout process from the City of Tulsa
  - Meetings with the business owners

- IF YOU BUILD IT THEY WILL COME
  - Transforms a street and land uses
    - Aesthetically pleasing
  - Can spur Economic Development
Questions

- Thank You For Your Time!!
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  Email: KSKleinschmidt@GarverUSA.com