Complete Streets/Multi-modal Level of Service (CSLOS/MMLOS)

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SANDAG
October 11, 2012

CSLOS/MMLOS

Presentation Contents:

Overview of Approaches

CSLOS (HCM 2000/2010)

Sensitivity Examples

Other Evaluation Options

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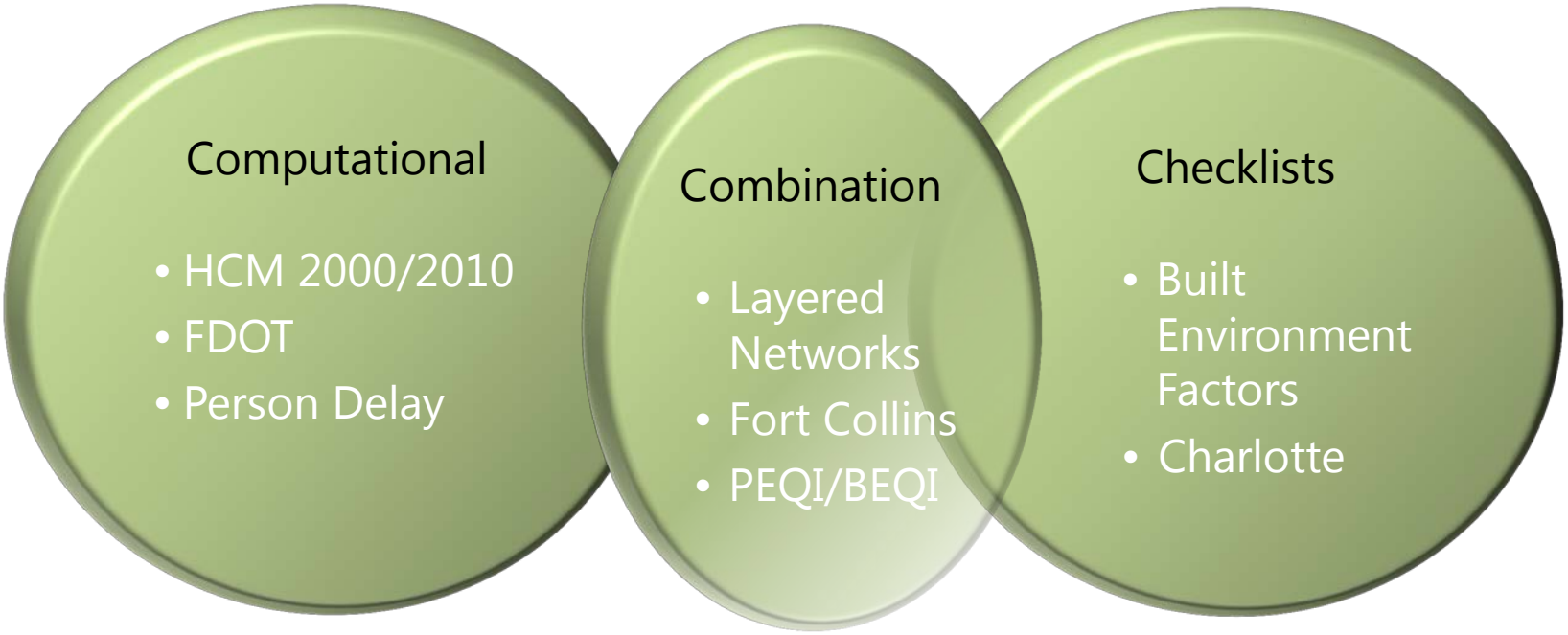

Other
- ATG

Some MM enhancements may degrade vehicular LOS

Benefits to pedestrians, relating to efficiency and safety, not fully accounted for with typical approaches

Multi-modal interaction and priority not uniform across roadway network

MMLOS Options

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Multimodal Level of Service

What are we getting at?

Is this a nice place to walk?

Is this a nice place to bike?

Is transit convenient?

Are tradeoffs considered?

Older methodologies:
pedestrian density, delay

Newer methodologies:
comfort, environment

Themes to consider:
Staying ahead of the curve
Embedded preferences in methodologies
Sensitivity to different considerations
Will results create desirable environments?
Linking analysis and toolkits

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Highway Capacity Manual 2000

Methodologies based on FHWA research

Chapter 18: Pedestrians

Research dates back to 1975

LOS based on density and delay

Chapter 19: Bicycles

Research dates back to 1975

LOS based on density and delay

Chapter 27: Transit

Research dates back to 1962

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HCM 2000

At signalized intersections

LOS depends on pedestrian delay:

Cycle length

Phase green time

On-street bike lane

LOS depends on vehicle passing events:

Bicycle flow rate

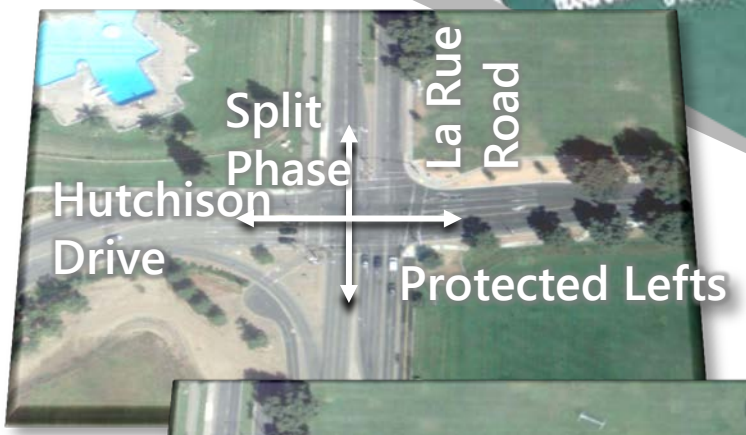
But not :

Lane width, speed limit, traffic volume

Transit

Focuses on service, not the roadway

Level of Service (LOS)	Headway (min)	Veh/h	Comments
A	<10	>6	Passengers don't need schedules
B	≥ 10-14	5-6	Frequent service; passengers consult schedules
C	>14-20	3-4	Maximum desirable time to wait if bus/train missed
D	>20-30	2	Service unattractive to choice riders
E	>30-60	1	Service available during hour
F	>60	<1	Service unattractive to all riders



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Highway Capacity Manual 2010

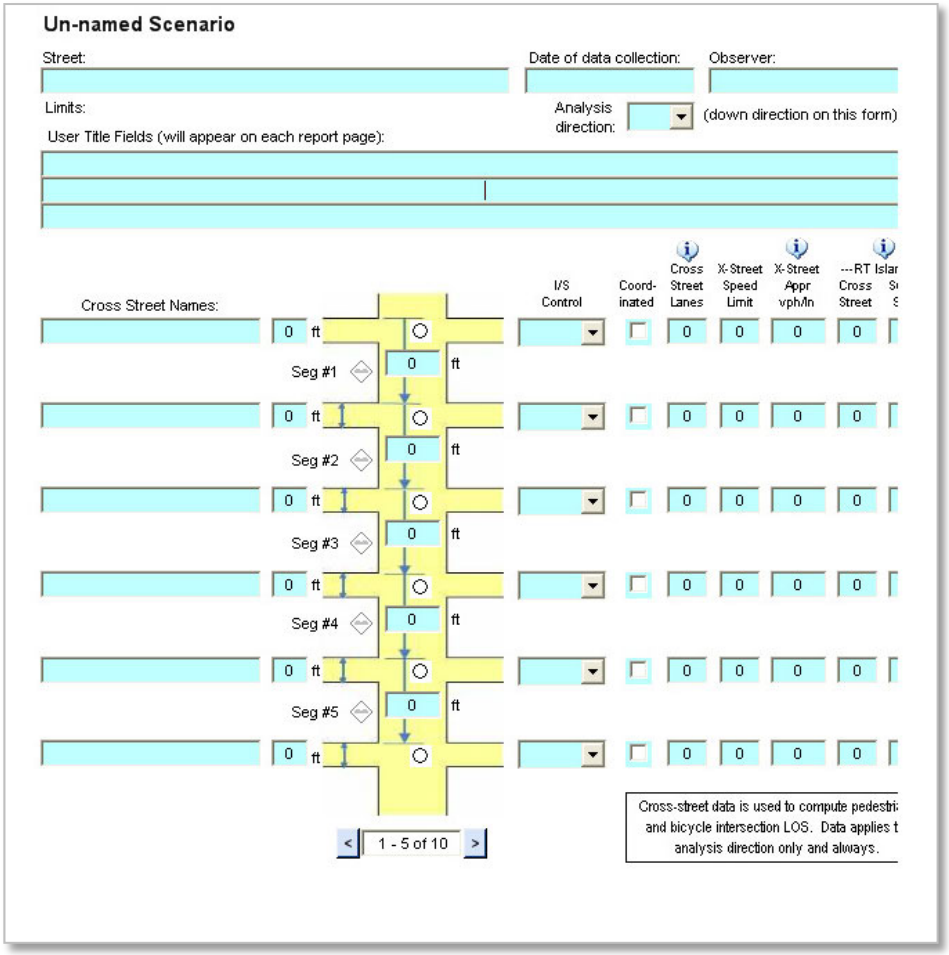
HCM 2010

- Developed from NCHRP 3-70
- Methodology applied through Complete Streets Level of Service (CSLOS, Kittleson)
- Produces LOS results for pedestrians, bicycles, transit, and autos
- Results available for segment, intersection, and facility
- LOS scores A – F

HCM 2010

Pedestrian LOS

Required Data Inputs
Intersection control type
Coordinated signal control
Link length
Traffic calming measures
Number of traffic lanes at cross-section
ADT 2-way (vpd) or Pk Hr 2-way (vph)
Cycle length (secs)
Speed limit
Through lanes at intersection
Left/Right turns percentage
Progression arrival type
On-Street parking occupancy
Striped [Parking]
Travel lane widths
Shoulder Parking width
Downstream cross street width
Lane widths
Median type
Median width
Percent with restrictive median
Bike lane width
Number of cross street lanes
Buffer width
Curb present
Street tree numbers/spacing
Mid-segment ped. crossing
Pk hr auto volumes: cross street
Ped. Volumes
Ped. cycle walk time (analysis)
Ped. cycle walk time (cross street)
RT islands
RTOR + permissive left (vph)
Sidewalk width
X-Street speed limit



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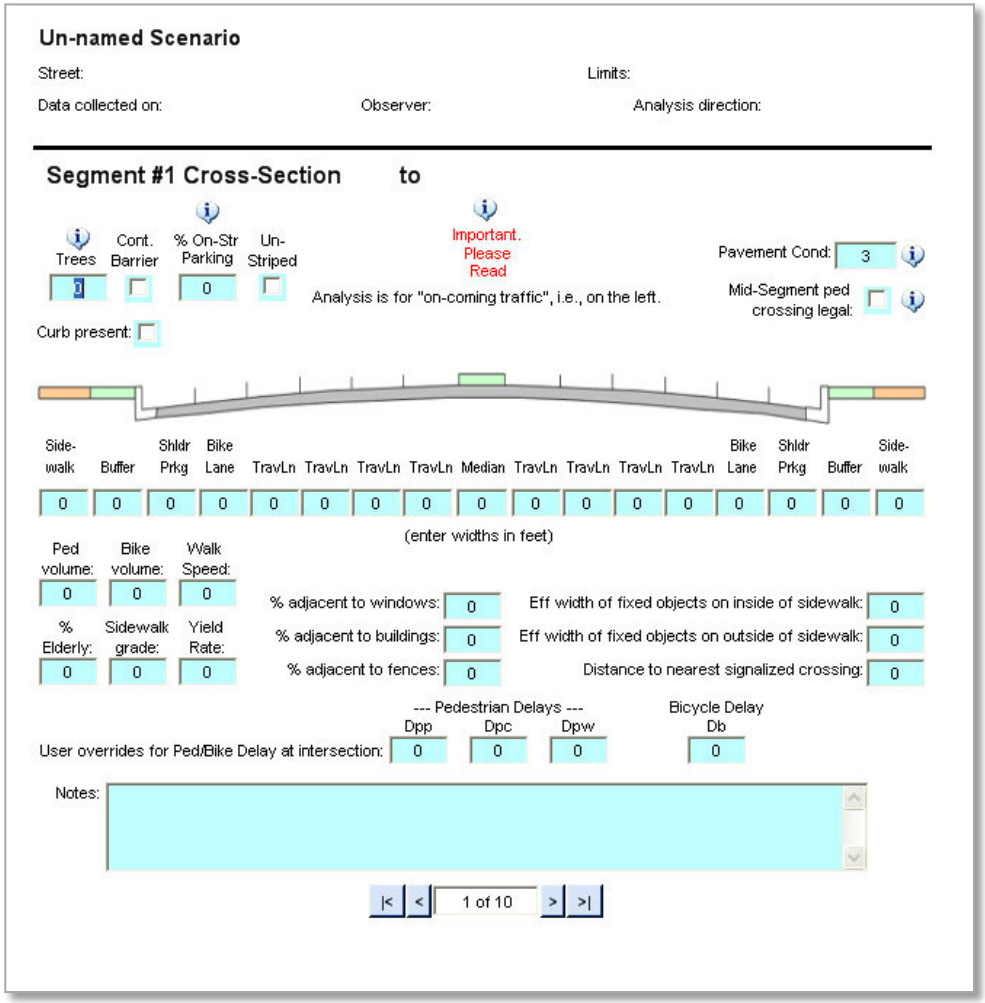
Bicycle LOS

Required Data Inputs
Intersection control type
Coordinated signal control
Link length
Traffic calming measures
Number of traffic lanes at cross-section
ADT 2-way (vpd) or Pk Hr 2-way (vph)
Cycle length (secs)
Speed limit
Through lanes at intersection
Left/Right turns percentage
Progression arrival type
On-Street parking occupancy
Striped [Parking]
Travel lane widths
Shoulder Parking width
Downstream cross street width
Lane widths
Median type
Median width
Percent with restrictive median
Bike lane width
Number of cross street lanes
Access points right side
Heavy vehicle percentage
Pavement condition



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HCM 2010

Transit LOS

Required Data Inputs
Intersection control type
Coordinated signal control
Link length
Traffic calming measures
Number of traffic lanes at cross-section
ADT 2-way (vpd) or Pk Hr 2-way (vph)
Cycle length (secs)
Speed limit
Progression arrival type
Bus stops
Stops with benches
Stops with shelters
Average dwell time
Avg. passenger trip length
CBD
Exclusive transit lane
Frequency
Load factor percent (pass/seat)
On-time performance
On-time window (minutes)
Reentry delay

Un-named Scenario

Street: Limits:

Data collected on: Observer: Analysis direction:

Field Survey

	Segment From	Segment To	Bus Stops (#)	Near-side Stops	Avg. Dwell Time	Re-Entry Delay	Shelters (% Stops)	Benches (% Stops)	In CBD	Exclusive Transit Lane	Traffic Condition
1			1	☐	0	0	0	0	☐	☐	No RTs
2			0	☐	0	0	0	0	☐	☐	No RTs
3			0	☐	0	0	0	0	☐	☐	No RTs
4			0	☐	0	0	0	0	☐	☐	No RTs
5			0	☐	0	0	0	0	☐	☐	No RTs

Bus is On-Time if arrives within: 0 mins. Average Passenger Trip Length: 0 miles ☐ Population S

Transit Performance Data

Segment #1 From	Segment #1 To	Route #'s	Frequency (bus/hr)	Load Factor % (pass/seat)	On-Time Perform. %	Schedule Speed (mph)
			0	0	0	0
			0	0	0	0
			0	0	0	0
			0	0	0	0
			0	0	0	0
			0	0	0	0
			0	0	0	0
			0	0	0	0
			0	0	0	0
			0	0	0	0

Wtd Avg Speed (mph)

Adjmnt Const (mph)

|< < 1 of 10 > >|

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Segment LOS: Autos

Required Data Inputs
Intersection control type
Coordinated signal control
Link length
Traffic calming measures
Number of traffic lanes at cross-section
ADT 2-way (vpd) or Pk Hr 2-way (vph)
Cycle length (secs)
Speed limit
Through lanes at intersection
Left/Right turns percentage
Access points opposite side
Cycle timing: # of phases
Cycle timing: Loss time
Cycle timing: Pretimed
D (percent of two-way flow in analysis direction)
K (percent of traffic in peak hr)
PHF (peak hour factor of downstream signal)
Through adjusted sat. flow (vphg/ln)
Urban street class

Un-named Scenario

Street: Limits:

Data collected on: Observer: Analysis direction:

ADT / Pk Hr K: D: 0

Field Survey / **Traffic Counts**

	Segment and Downstream Signal From	To	Speed Limit (mph)	Median Type	% with restictive median	Left Turn Pocket	Through Lanes at Intersection	Access Pts Rightside (#)	Access Pts Opp. side (#)	%LT Acc to Opp Side Access Pts	% I/S's with LT Lanes	Other Stop Rate	ADT 2-way (vpd)	Heavy Vehicle %	RTOR + PermLeft (vph)	Left/ Tur
1			0	0	0	☐	0	0	0	0	0	0	0	0	0	0
2			0	0	0	☐	0	0	0	0	0	0	0	0	0	0
3			0	0	0	☐	0	0	0	0	0	0	0	0	0	0
4			0	0	0	☐	0	0	0	0	0	0	0	0	0	0
5			0	0	0	☐	0	0	0	0	0	0	0	0	0	0
6			0	0	0	☐	0	0	0	0	0	0	0	0	0	0
7			0	0	0	☐	0	0	0	0	0	0	0	0	0	0
8			0	0	0	☐	0	0	0	0	0	0	0	0	0	0
9			0	0	0	☐	0	0	0	0	0	0	0	0	0	0
10			0	0	0	☐	0	0	0	0	0	0	0	0	0	0

Arterial Traffic Performance & Signal Timing

	Segment and Downstream Signal From	To	Cycle Length (secs)	% g/C for Thru Movmnt	Ped Walk (sec/cycle)	Xing Ped Walk (sec/cycle)	Urban Street Class	Progresn Arrival Type	Delay due to other sources (sec/veh)	Calc'd Mean Speed (mph)	Speed Adjmnt (mph) or	Observed Speed (mph)	Auto Calib Const (mph)	Use to calib auto speed	Calib-rated Speed (mph)
1			100	0	0	0			0	0.0	0.00	0	0.00	☐	0.0
2			100	0	0	0			0	0.0	0.00	0	0.00	☐	0.0
3			100	0	0	0			0	0.0	0.00	0	0.00	☐	0.0
4			100	0	0	0			0	0.0	0.00	0	0.00	☐	0.0
5			100	0	0	0			0	0.0	0.00	0	0.00	☐	0.0
6			100	0	0	0			0	0.0	0.00	0	0.00	☐	0.0
7			100	0	0	0			0	0.0	0.00	0	0.00	☐	0.0
8			100	0	0	0			0	0.0	0.00	0	0.00	☐	0.0
9			100	0	0	0			0	0.0	0.00	0	0.00	☐	0.0
10			100	0	0	0			0	0.0	0.00	0	0.00	☐	0.0

Unadjusted: 0.0

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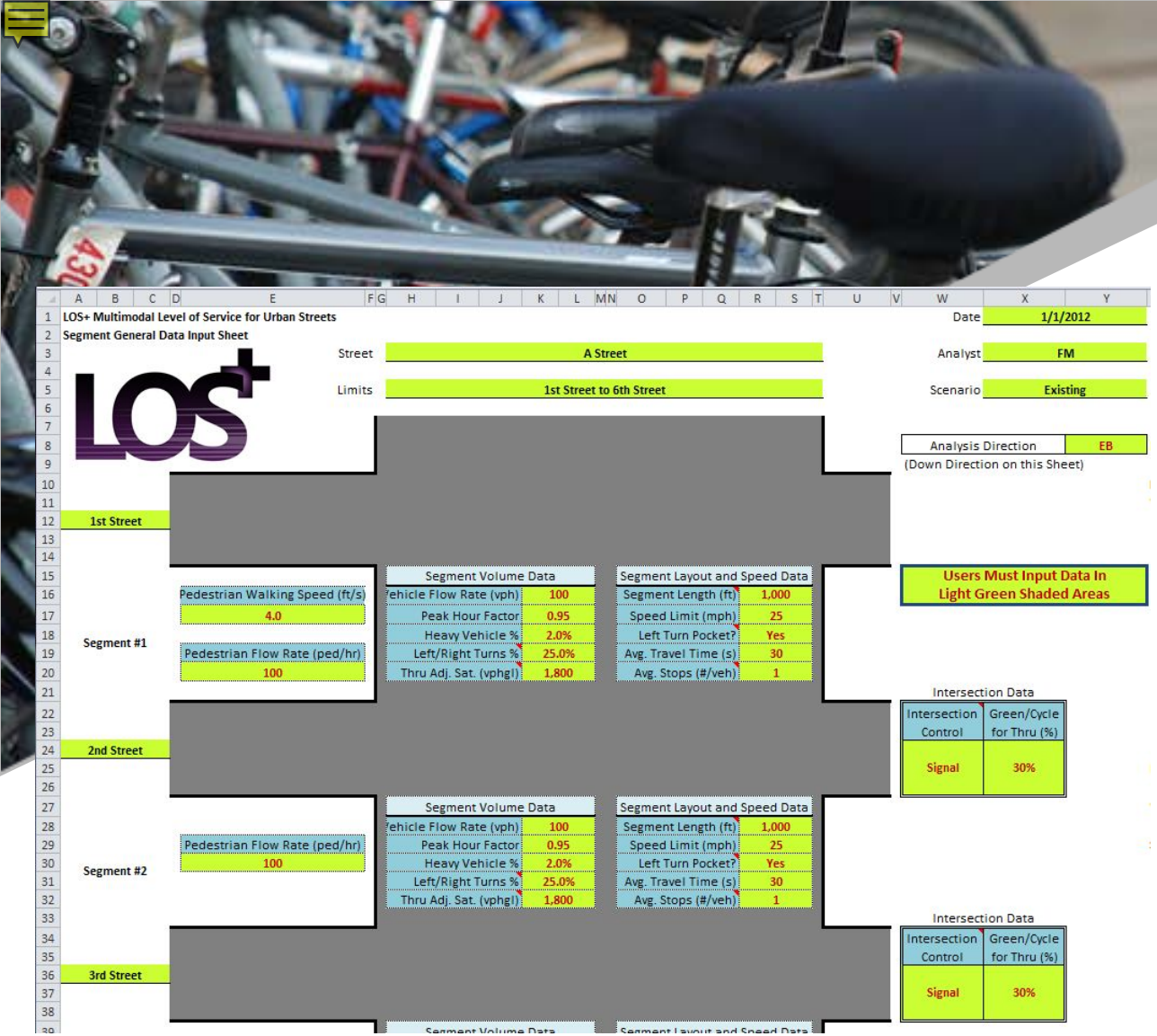

LOS+

Ped, bicycle, and transit components consistent with HCM 2010

Auto based on NCHRP 3-70

Segment LOS only

Less data-intensive but generally reflective of ped and bike experience

No cost to user

LOS+ part of the ASAP PLATFORM

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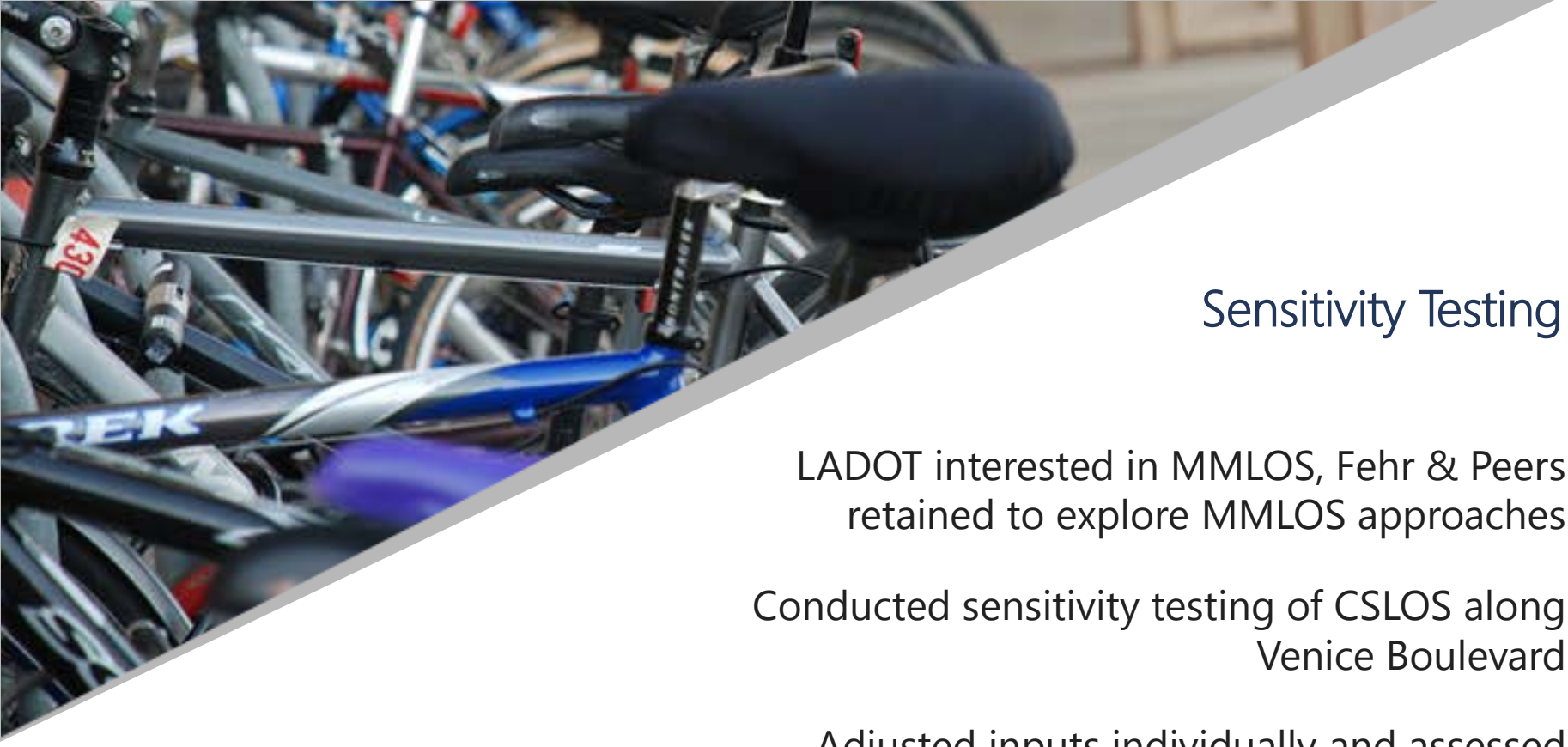

Sensitivity Testing

LADOT interested in MMLOS, Fehr & Peers retained to explore MMLOS approaches

Conducted sensitivity testing of CSLOS along Venice Boulevard

Adjusted inputs individually and assessed cumulative changes to pedestrian LOS

In several instances CSLOS lead to unexpected, counterintuitive, or insensitive results from the tool

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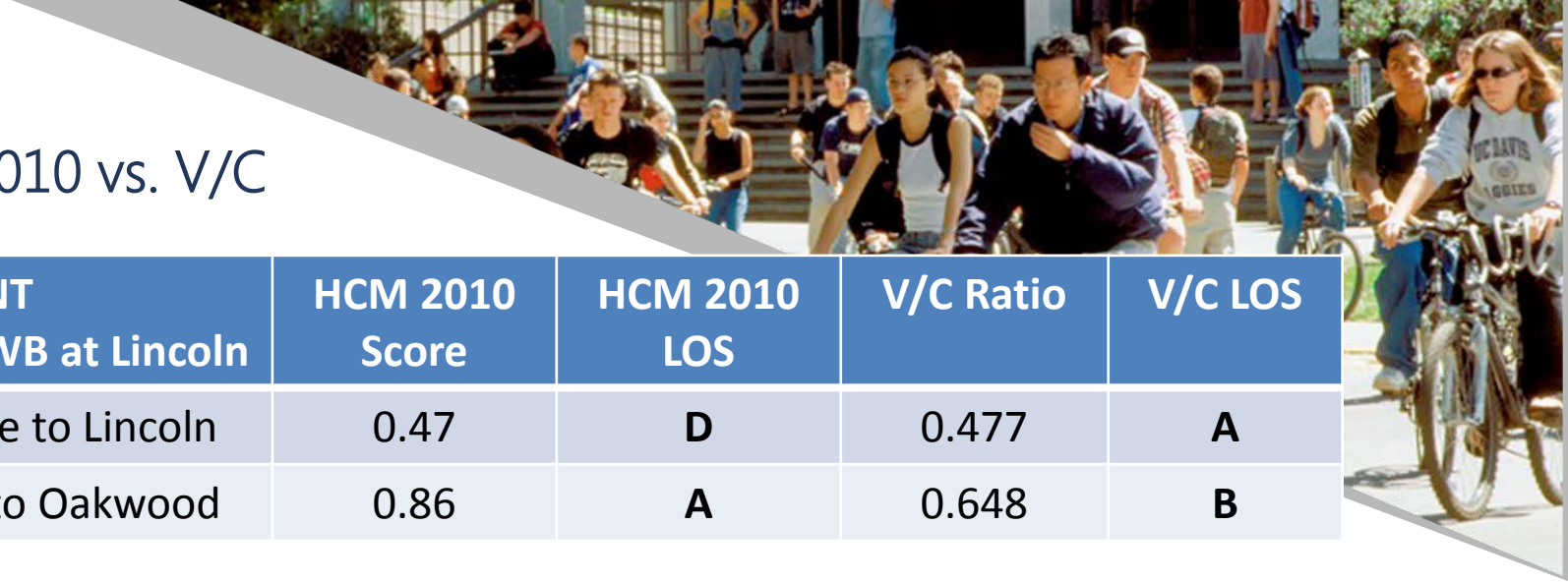

HCM 2010 vs. V/C

SEGMENT Venice WB at Lincoln	HCM 2010 Score	HCM 2010 LOS	V/C Ratio	V/C LOS
Walgrove to Lincoln	0.47	**D**	0.477	**A**
Lincoln to Oakwood	0.86	**A**	0.648	**B**

SEGMENT Venice EB at Lincoln	HCM 2010 Score	HCM 2010 LOS	V/C Ratio	V/C LOS
Oakwood to Lincoln	0.44	**D**	0.618	**B**
Lincoln to Walgrove	0.57	**C**	0.482	**A**

INTERSECTION Venice & Lincoln	HCM 2010 Score	HCM 2010 LOS	CMA V/C	CMA LOS
	71.3	**E**	0.925	**E**

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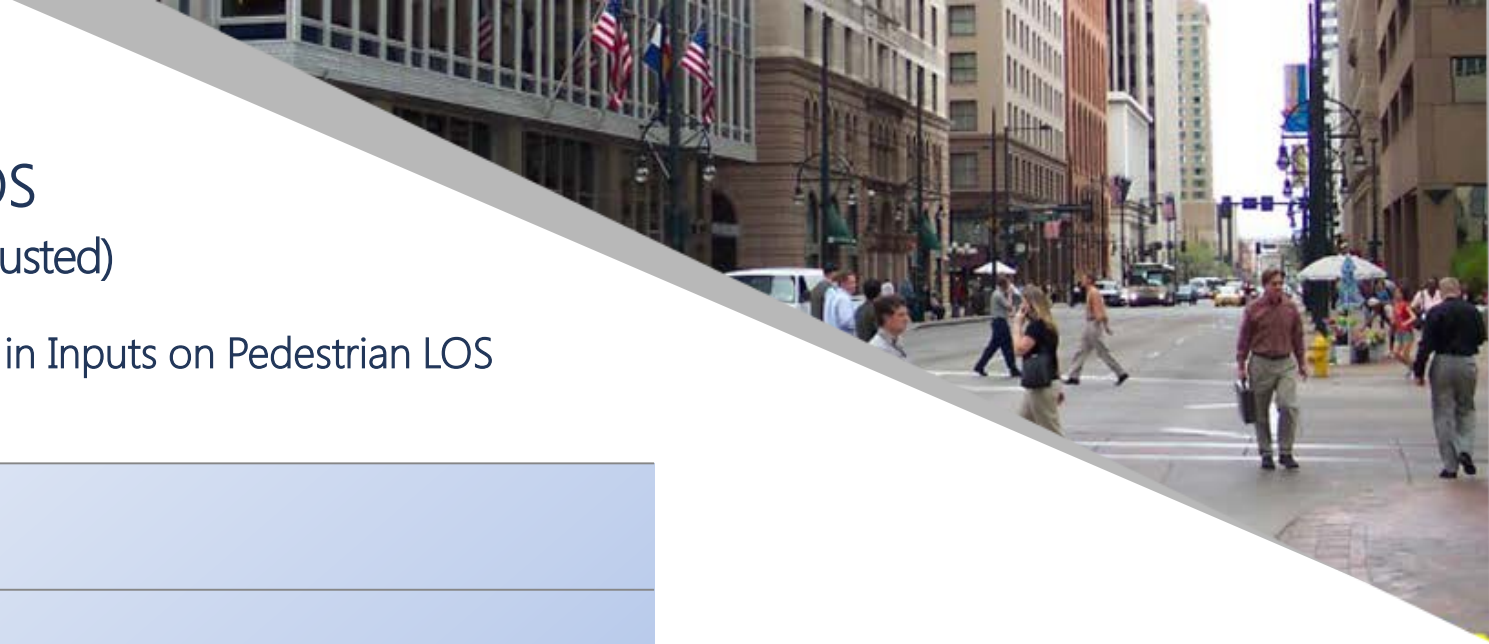
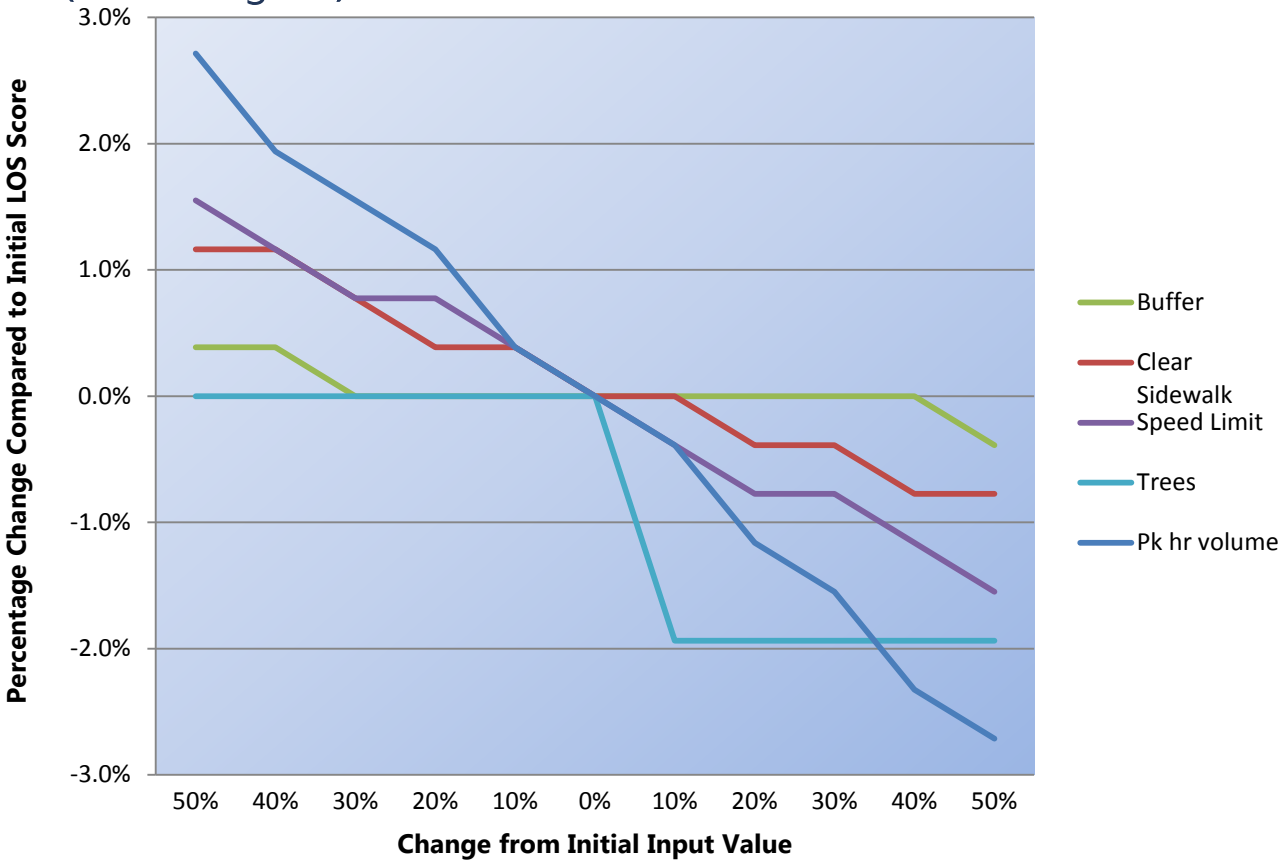
Pedestrian LOS Sensitivity (Adjusted)



Effect of Changes in Inputs on Pedestrian LOS (Trends Aligned)



LOS Score	LOS
x < 2.00	A
2.00 < x < 2.75	B
2.75 < x < 3.50	C
3.50 < x < 4.25	D
4.25 < x < 5.00	E
x > 5.00	F

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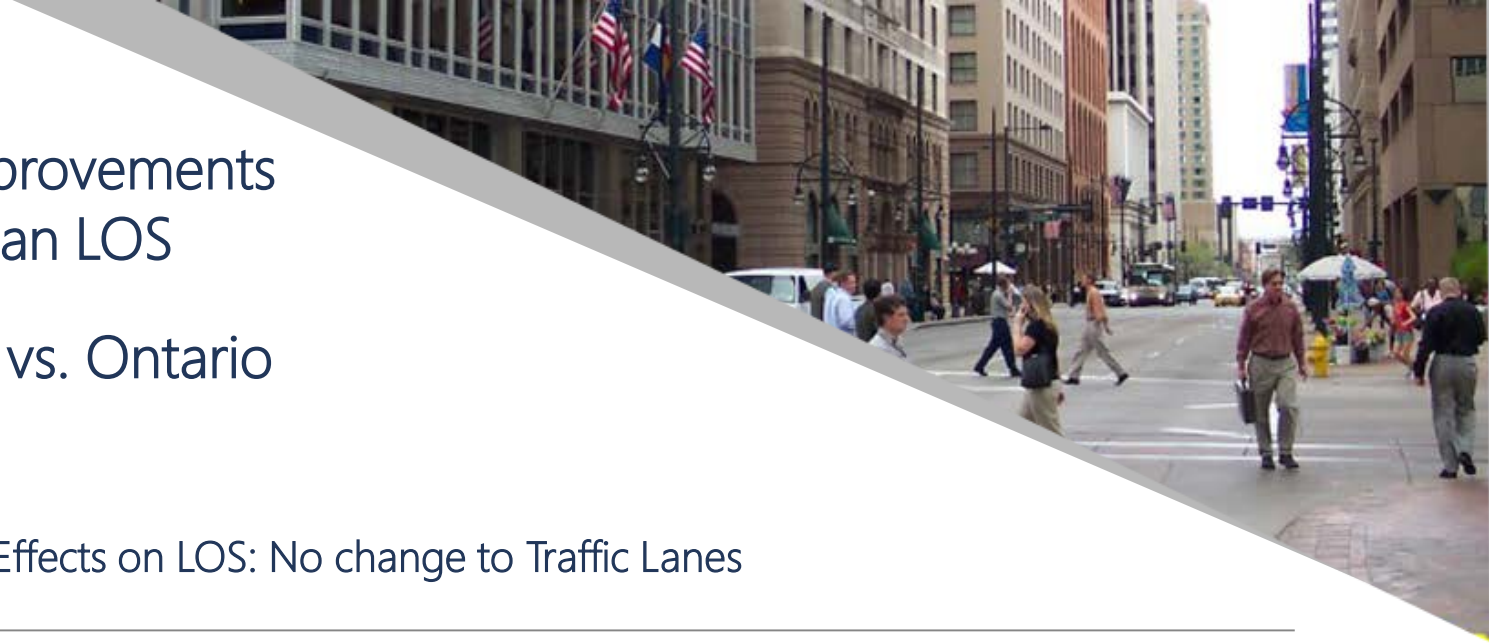
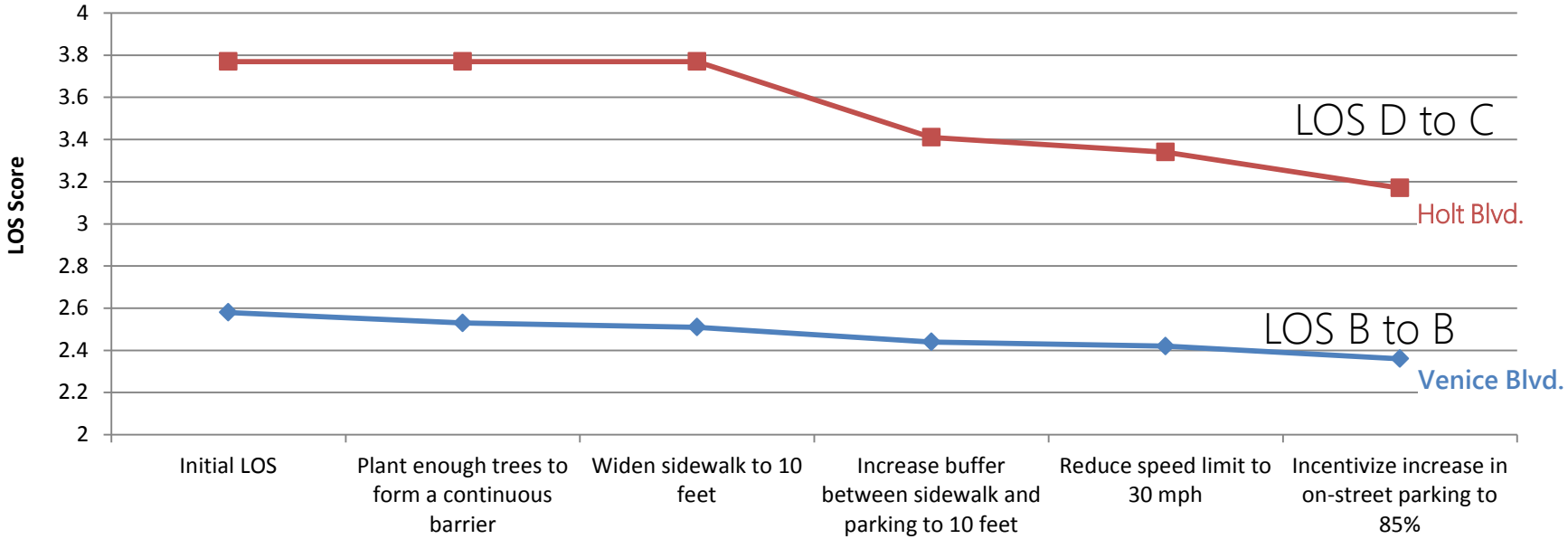
Sidewalk Improvements and Pedestrian LOS

Los Angeles vs. Ontario



Infrastructure Effects on LOS: No change to Traffic Lanes



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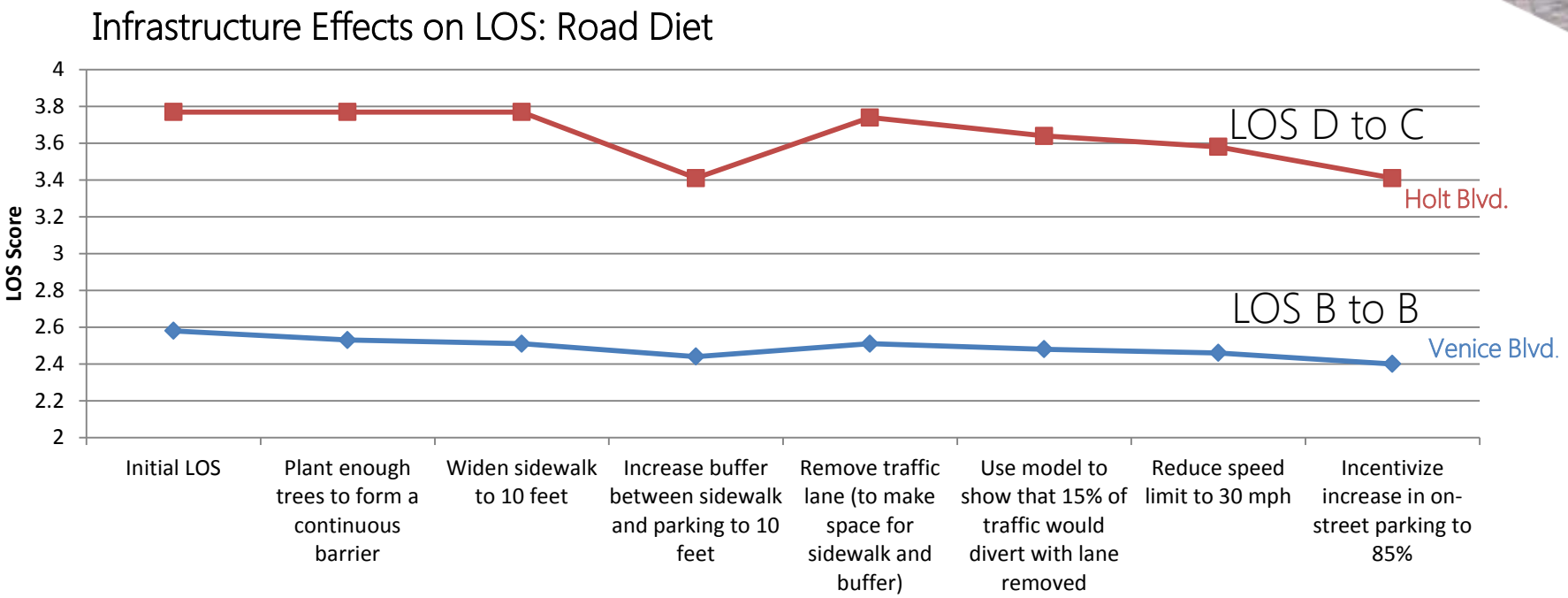
Road Diet Option and Pedestrian LOS

Los Angeles vs. Ontario



Sensitivity Testing - Local Example

Midway and Old Town Community Plan Updates

Comparison of CSLOS results with observed field conditions

In several instances, CSLOS lead to unexpected, counterintuitive, or insensitive results from the tool

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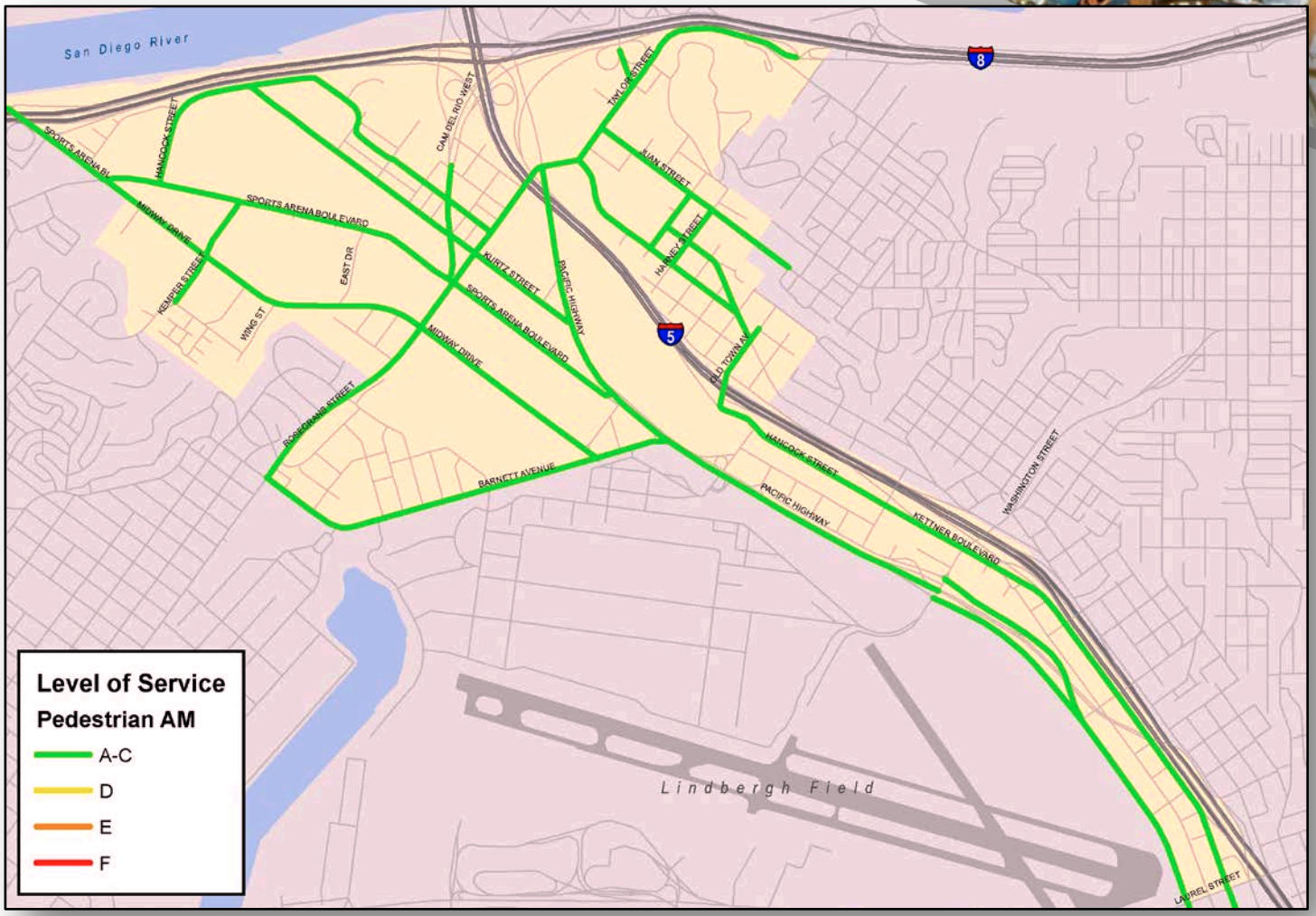
CSLOS Results – Ped LOS



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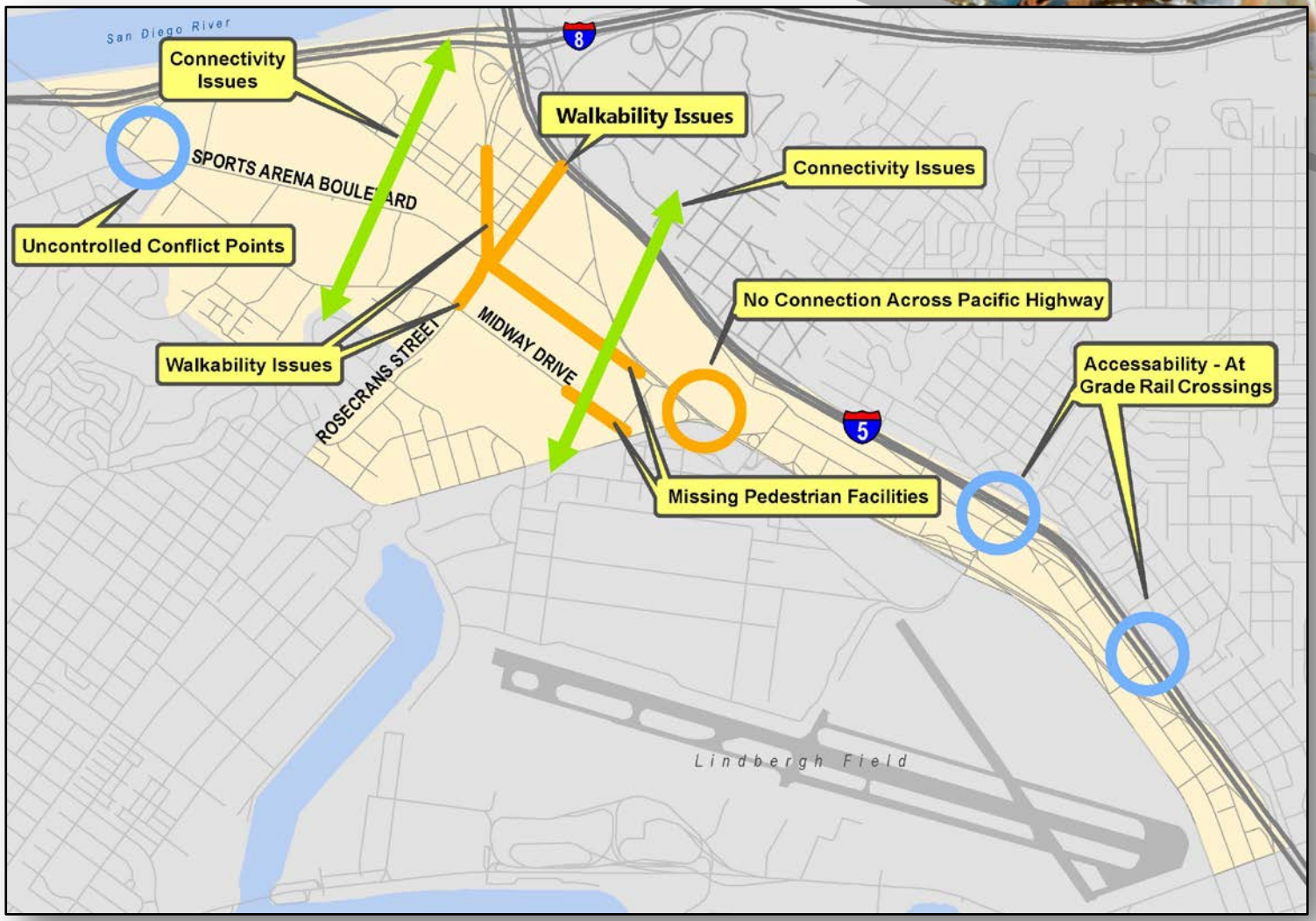
Actual Issues /Needs - Peds



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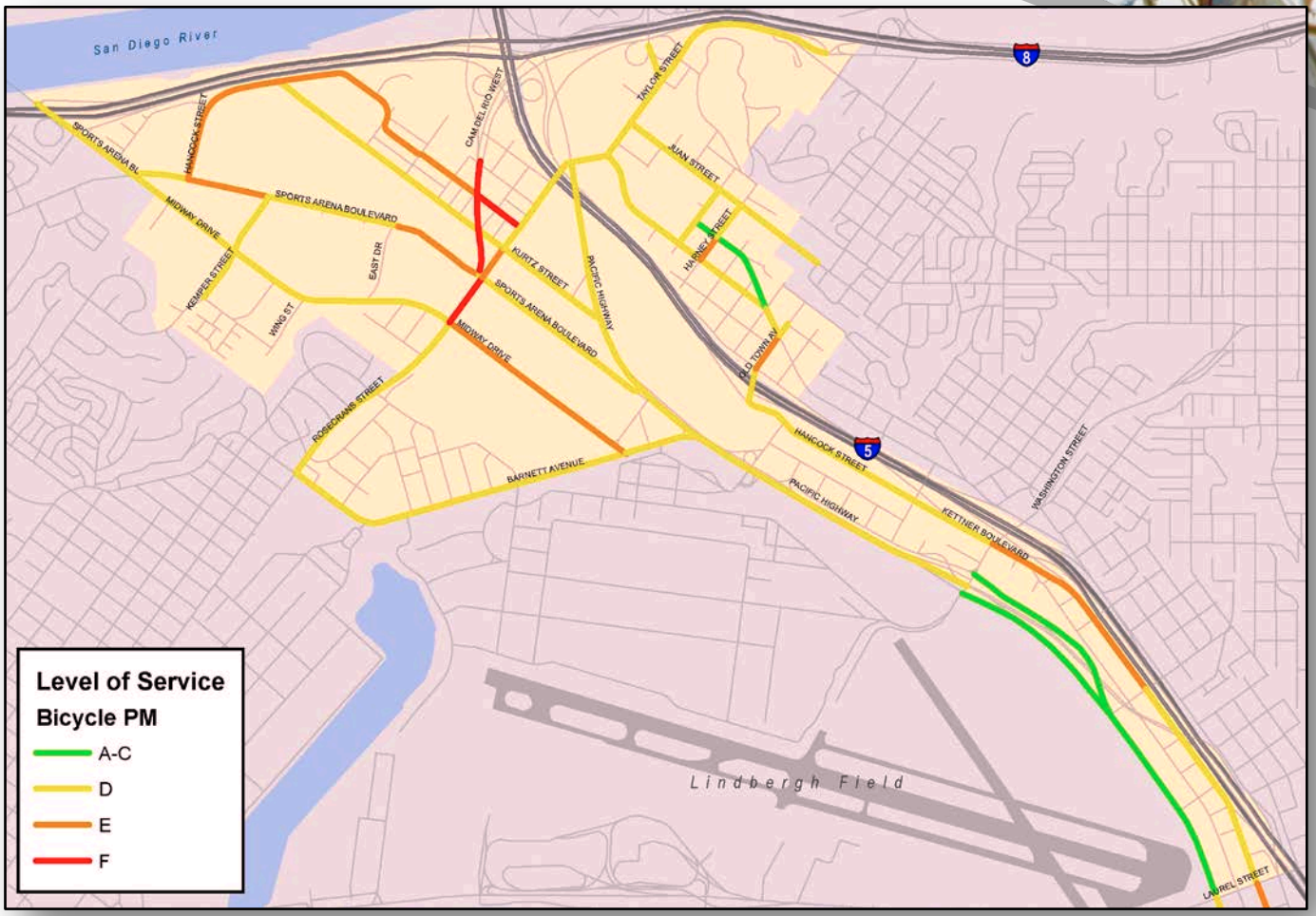
CSLOS Results – Bike LOS



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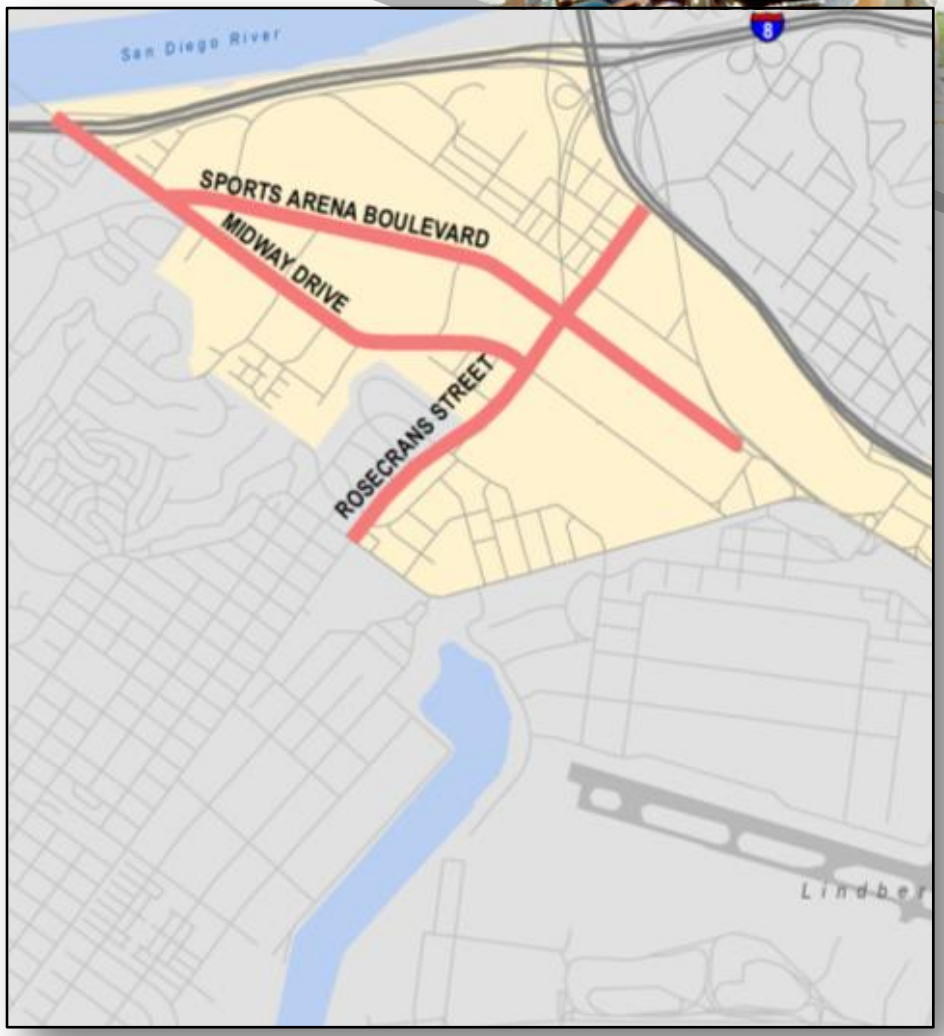
Actual Issues /Needs - Bikes

High bicycle demand

Lack of dedicated facilities and ROW

Numerous conflict points between vehicles and cyclists

High traffic volumes and speeds



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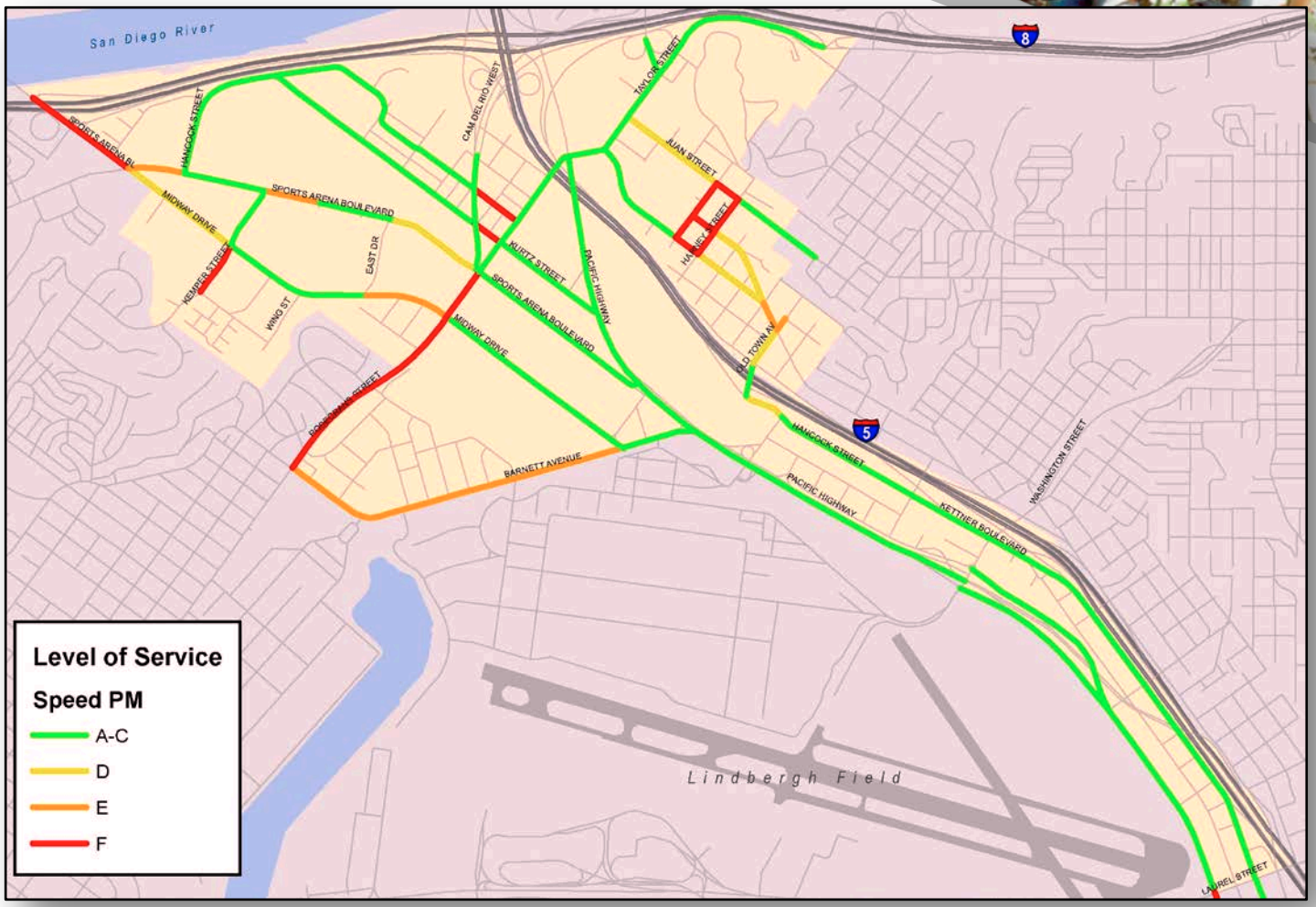
CSLOS Results – Vehicle LOS



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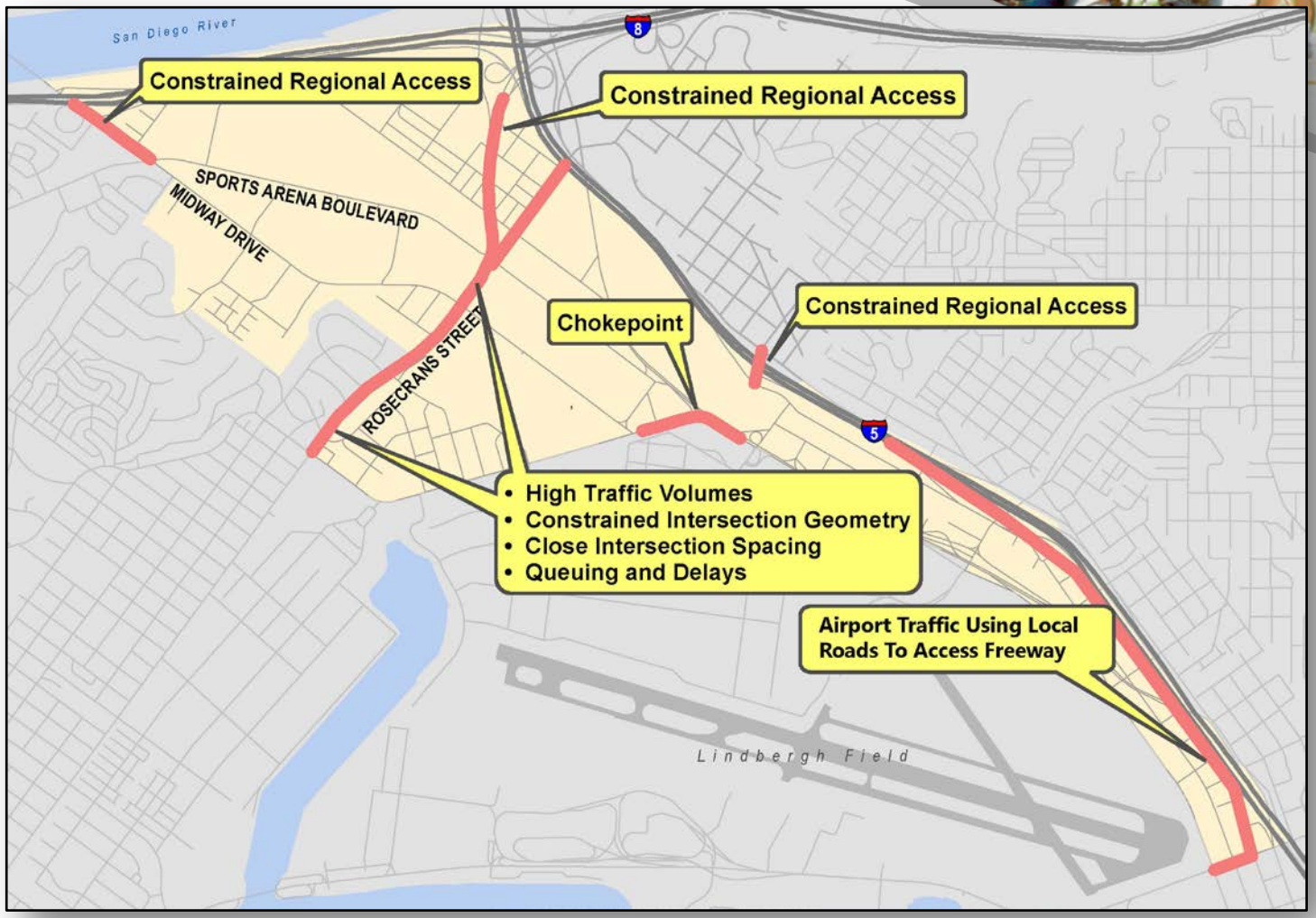
Actual Issues /Needs - Vehicles



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Other MMLOS Options

Person Delay

Fort Collins

PEQI/BEQI

Charlotte

LOS+

Auto Trips Generated

Layered Networks

Built Environment Factors

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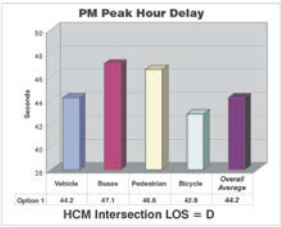
Person-Delay

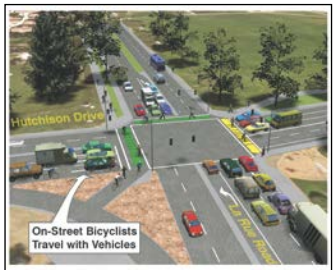
Using traffic simulation to evaluate automobile, transit, bicycle, and pedestrian delays in designing an intersection.

A case study from the University of California at Davis.

Option 1: Hutchison Drive/La Rue Road with All Bicycle/Pedestrian Phase

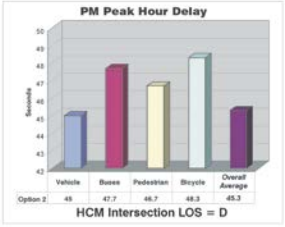
Under Option 1, the Hutchison Drive/La Rue Road intersection would have an exclusive bicycle/pedestrian phase. During this phase, all vehicles would stop and only bicyclists would travel through the intersection. The intersection would operate with a 120 second cycle length. Due to the California vehicle code, on-street bicyclists must use the exclusive bicycle/pedestrian phase and cannot use vehicle phases.





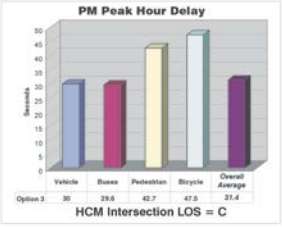
Option 2: Hutchison Drive/La Rue Road with Exclusive Bicycle Path Phase

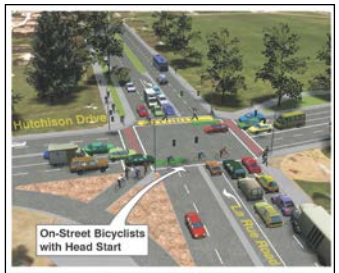
Under Option 2, the Hutchison Drive/La Rue Road intersection would have an exclusive bicycle/pedestrian phase only on the north side of Hutchison Drive or for the bicycle path on the west side of La Rue Road.



Option 3: Hutchison Drive/La Rue Road with Traditional Design (No Bike/Ped Phase)

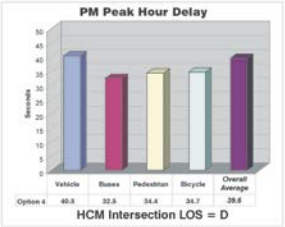
Under Option 3, bicyclists and pedestrians would travel with the flow of vehicles through the intersection as occurs at typical signalized intersections (e.g., current configuration). This option causes conflicts between east-west bicycle movements and the heavy westbound right-turn vehicle movement





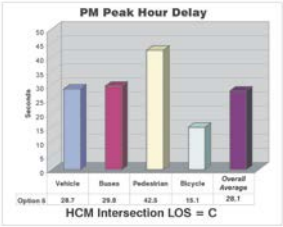
Option 4: Hutchison Drive/La Rue Road with Head Start for Bicyclists/Pedestrians

Option 4 is similar to Option 3, but would give bicyclists and pedestrians traveling on the southbound and westbound bicycle path approaches a five second head start before eastbound and westbound through vehicles receive a green light. This option would minimize right-turn conflicts during the start of the green phase when the highest vehicle flows occur.



Option 5: Hutchison Drive/La Rue Road with Grade Separated Bicycle Crossing

Under Option 5, a grade separated crossing would be provided for bicyclists and pedestrians traveling between the path on the north side of Hutchison Drive and the path on the west side of La Rue Road. This improvement has the lowest total delay and the least number of potential conflicts between modes.



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Fort Collins Methodology

Fort Collins created a city-specific MMLOS in their 1997 Transportation Master Plan; Pedestrian LOS updated in 2011

The Fort Collins methodology is based on a combination of quantitative and descriptive criteria

LOS is given in letter grades, but thresholds may differ by location or facility type

	Directness	Continuity	Street Crossings	Visual Interest & Amenities	Security
Pedestrian Districts	A	A	B	A	A
Activity Centers and Corridors	B	B	C	B	B
Transit Corridors	B	B	B	C	B
School Walking Areas	B	C	C	C	B
Other Areas within the City	C	C	C	C	C

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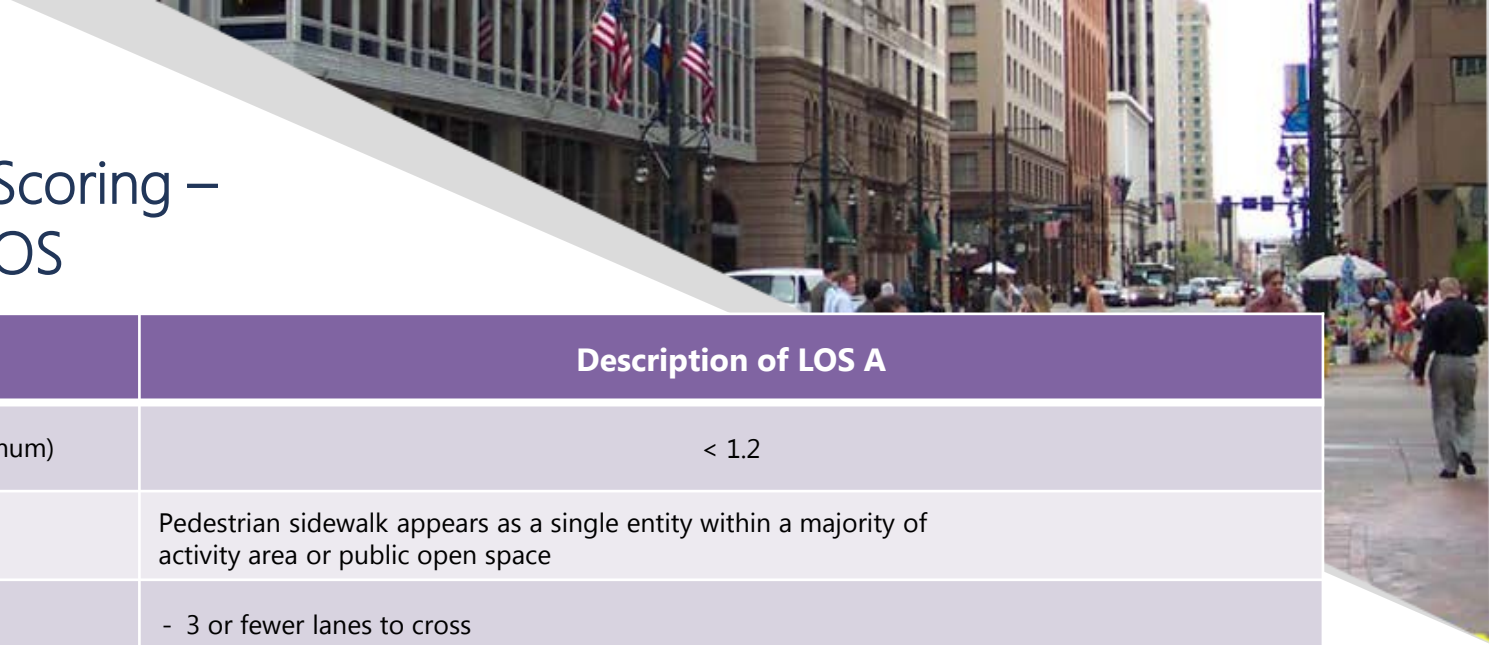
Fort Collins Scoring – Pedestrian LOS



Quality Indicators	Description of LOS A
Directness (Actual/Minimum)	< 1.2
Continuity	Pedestrian sidewalk appears as a single entity within a majority of activity area or public open space
Signalized Street Crossings	- 3 or fewer lanes to cross - Signal has clear vehicular pedestrian indicators - Well marked crosswalk - Good lighting levels - Standard curb ramps - Automatic pedestrian signal phase - Amenities, signing, and sidewalk and roadway character strongly suggest the of a pedestrian crossing - Drivers and pedestrians have unobstructed views
Visual Interest and Amenities	- Visually appealing and compatible with local architecture - Generous sidewalk width - Active building frontages - Pedestrian lighting - Street trees - Quality street furniture
Security	- Sense of security enhanced by presence of other people using sidewalks and overlooking them from adjacent buildings - Good lighting and clear sight lines

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PEQI / BEQI

- Pedestrian / Bicycle Environmental Quality Indexes created by the San Francisco Department of Public Health
- Used by others nationally, including UCLA Center for Occupational and Environmental Health and City of Pasadena
- Factors based on
  - Literature review
  - Existing indices
  - Level-of-service metrics
  - Empirical research
- Factors weighted based on national survey of
  - City planners
  - Transportation planners
  - Consultants
  - Advocates

Score	Interpretation
100 – 81	Highest quality, many important conditions present
80 – 61	High quality, some important conditions present
60 – 41	Average quality, conditions present but room for improvement
40 – 21	Low quality, minimal conditions
20 and below	Poor quality, conditions absent

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BEQI Inputs

INTERSECTION – Intersection Safety	STREET SEGMENT - Vehicle Traffic
Dashed Intersection Bicycle Lane	Number of Vehicle Lanes
No Turn on Red	Vehicle Speed
Bicycle Pavement Treatment	Traffic Calming Features
STREET SEGMENT - Street Design	Parallel Parking Adjacent to Bike Facility
Presence of a Marked Area for Bicycle Traffic	Traffic Volume
Width of Bike Lane	Percentage of Heavy Vehicles
Tree Lined Street	**STREET SEGMENT - Safety**
Connectivity of Marked Bicycle Network	Presence of Bicycle Lane Signs or Share Roadway Signs
Pavement Type/Condition	Bicycle/Pedestrian Scale Lighting
Driveway Cuts	**STREET SEGMENT - Land Use**
Street Grade	Bicycle Parking
	Retail Use
	Line of Sight

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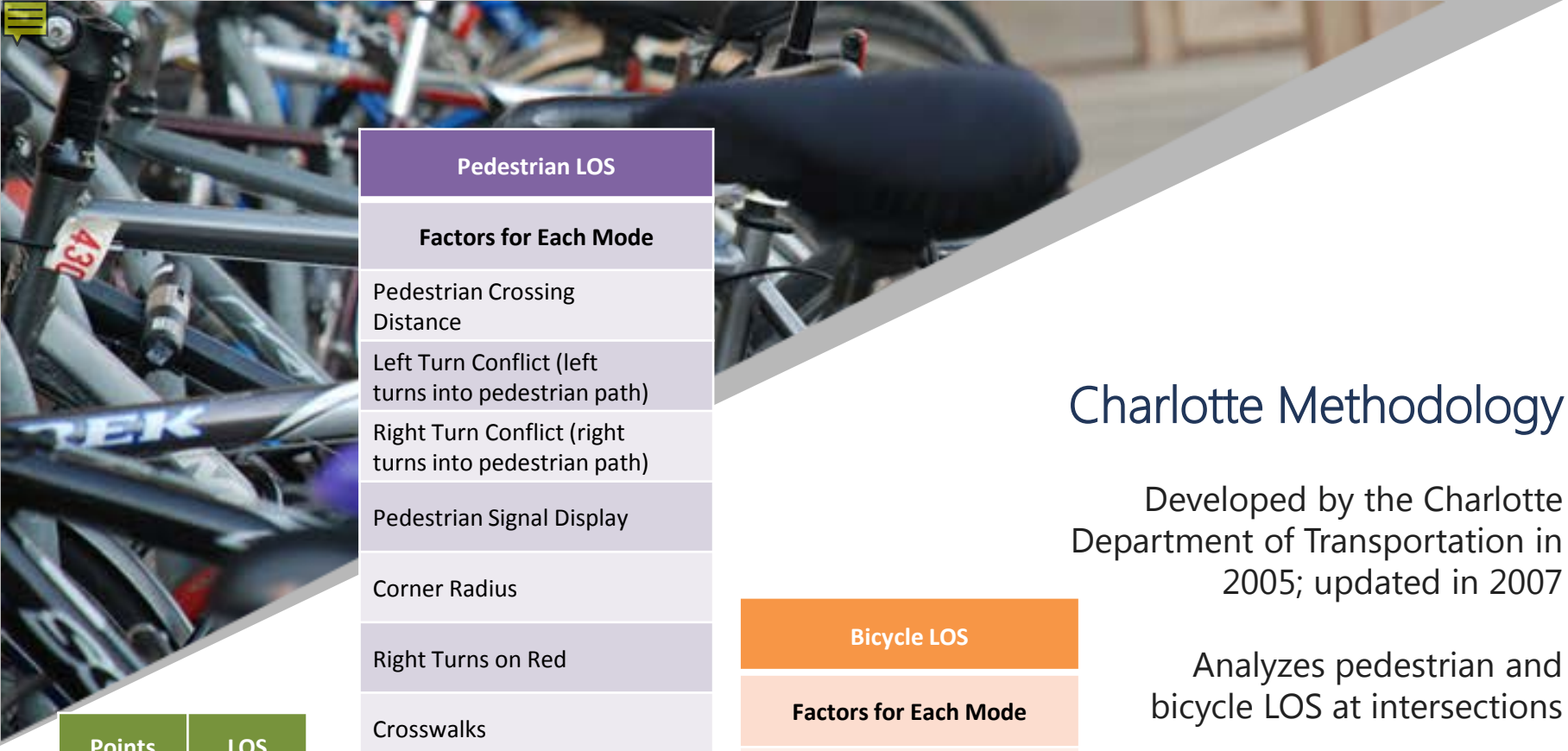

Charlotte Methodology

Developed by the Charlotte Department of Transportation in 2005; updated in 2007

Analyzes pedestrian and bicycle LOS at intersections

Points are assigned for input values

Points are tabulated to determine level of service

Pedestrian LOS
Factors for Each Mode
Pedestrian Crossing Distance
Left Turn Conflict (left turns into pedestrian path)
Right Turn Conflict (right turns into pedestrian path)
Pedestrian Signal Display
Corner Radius
Right Turns on Red
Crosswalks
Adjustment for One-Way Street Crossings

Bicycle LOS
Factors for Each Mode
Bike Travel Way & Speed of Adjacent Traffic
Opposing Vehicular Left Turn Phase & Stop Bar Location
Shared Traffic Lane/Separate Right Turn Traffic Lane
Right Turns on Red
Intersection Crossing Distance

Points	LOS
93+	A
74 – 92	B
55 – 73	C
37 – 54	D
19 – 36	E
0 – 18	F

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Auto Trips Generated

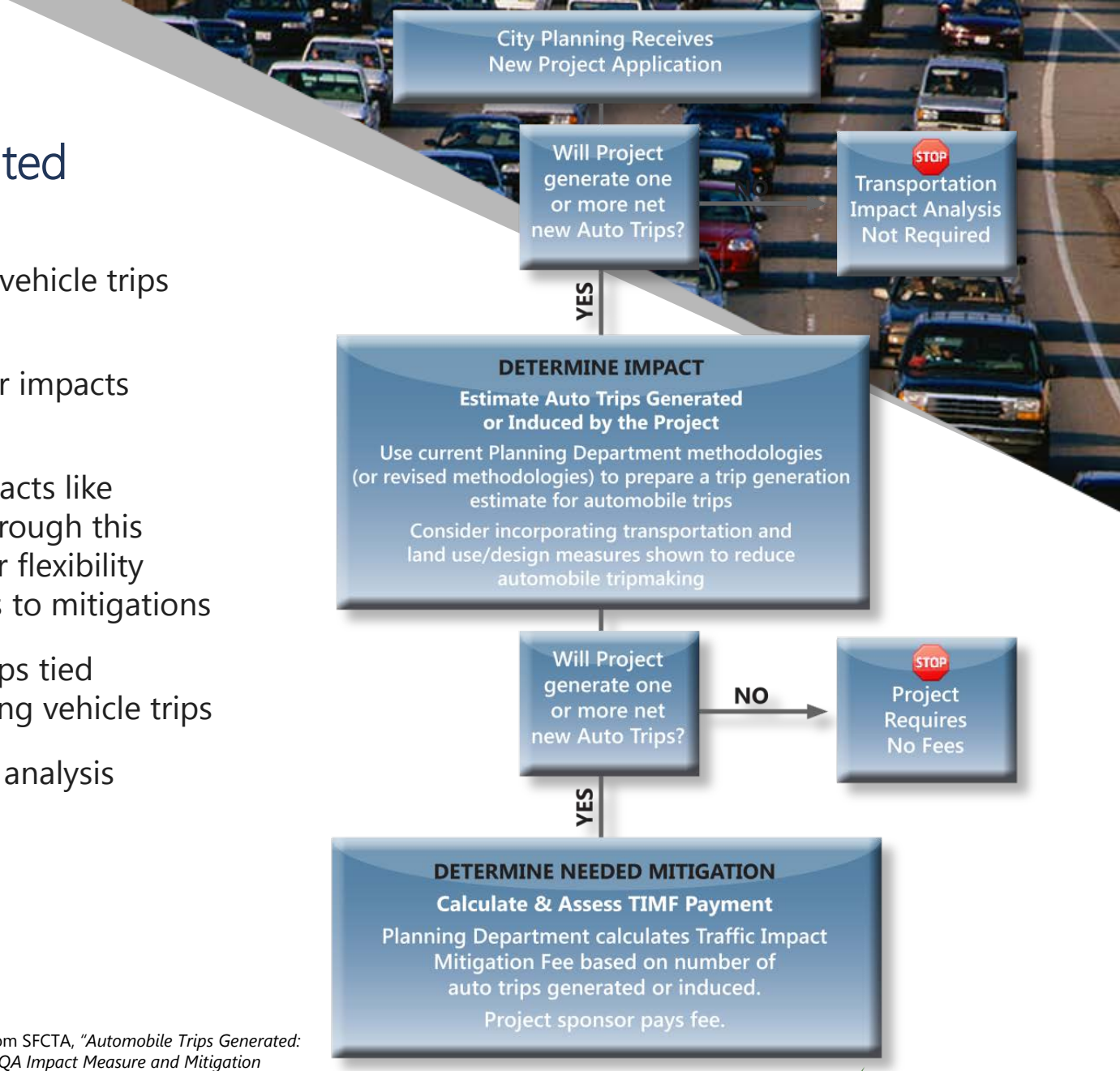
Unlike LOS standards, all vehicle trips impactful

Easy to measure proxy for impacts to modes

Some environmental impacts like GHG better addressed through this methodology and greater flexibility and multi-modal benefits to mitigations

Nexus - fee on vehicle trips tied to mitigating or eliminating vehicle trips

Based on trip generation analysis



From SFCTA, *"Automobile Trips Generated: CEQA Impact Measure and Mitigation Program, 2008*

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The MMLOS tool outlines a range of LOS tools and is structured to allow users (internal and external) to select the tools appropriate for their context.

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Multi-Modal Level of Service Toolkit

Built Environment Factors

Overview

The built environment is generally understood to have a strong influence on transportation choices and the quality of service for different modes. While the built environment includes both land uses and transportation infrastructure, most LOS applications focus on the latter, identifying elements of the built environment that fall within the public right-of-way and under public control. At the heart of this approach is the question, "To what extent do roadway features that include pedestrian and bicycle friendly designs impact a traveler's perception of that facility?"

Applying a Built Environment Approach

Through this approach at least two levels of physical features are identified: key or basic elements and enhancement elements. An inventory of each category of physical features would translate to a facility's perceived quality of service based on the built environment. For example, when assessing the pedestrian experience, key features might include:

- Travel lane and crossing lane widths
- Presence of sidewalks
- Presence of crosswalks

Enhancement features could include:

- Raised medians with pedestrian refuge
- Curb extensions/bulb-outs
- Pedestrian-oriented lighting

Based on a rating system that weighted the key features and enhancement features, a score would be tabulated for the pedestrian facility that translates to a rating system.

Built Environment factors: common in MMLOS

Every MMLOS calculation method involves some assessment of the built environment, although generally only for factors within the public-right-of-way itself. Most methods include built environment factors such as sidewalk widths, vehicle travel lane widths, medians, buffered pedestrian areas, crosswalks, etc. Some go further: the Fort Collins MMLOS evaluation method, for example, examines visual amenities (planters, pavement designs) and safety features (lighting, etc.). The 2010 Highway Capacity Manual allows the user to quantify the effect of sidewalk fixtures and adjacent buildings on the effective width of sidewalks.

Below: This picture of downtown Fort Collins, Colorado demonstrates several features that enhance pedestrian LOS: wide sidewalks, special paving, quality lighting and signage, street furniture and landscaping.

Incorporating Land Uses into LOS

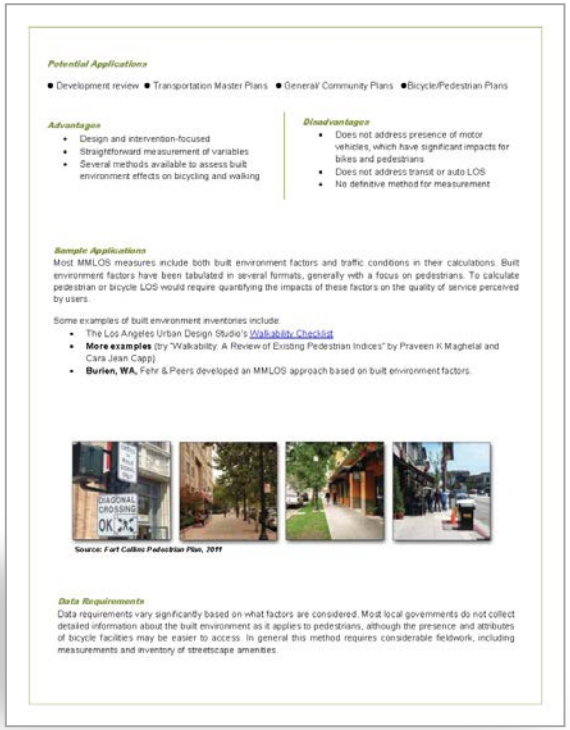
Adjacent land uses can have a powerful impact on pedestrians and cyclists. Elements to consider incorporating into a built-environment based LOS evaluation method include:

- Number of doorways adjacent to a sidewalk
- Number of frequently-used driveways
- Presence of retail store window displays
- "Eyes on the street" measures, such as businesses that are open late

A comprehensive evaluation of land use as it relates to pedestrian and bicycle LOS would include the number and types of businesses within a comfortable travel distance.

Source: Fort Collins Pedestrian Plan, 2011

Icons credit Nicolas Moilet, mapicons.com



Potential Applications

- Development review
- Transportation Master Plans
- General/ Community Plans
- Bicycle/Pedestrian Plans

Advantages

- Design and intervention-focused
- Straightforward measurement of variables
- Several methods available to assess built environment effects on bicycling and walking

Disadvantages

- Does not address presence of motor vehicles, which have significant impacts for bikes and pedestrians
- Does not address transit or auto LOS
- No definitive method for measurement

Sample Applications

Most MMLOS measures include both built environment factors and traffic conditions in their calculations. Built environment factors have been tabulated in several formats, generally with a focus on pedestrians. To calculate pedestrian or bicycle LOS would require quantifying the impacts of these factors on the quality of service perceived by users.

Some examples of built environment inventories include:

- The Los Angeles Urban Design Studio's Walkability Checklist
- **More examples** (try "Walkability: A Review of Existing Pedestrians Indices" by Praveen K Maghelal and Cara Jean Capp)
- **Burien, WA**, Fehr & Peers developed an MMLOS approach based on built environment factors.

Source: Fort Collins Pedestrian Plan, 2011

Data Requirements

Data requirements vary significantly based on what factors are considered. Most local governments do not collect detailed information about the built environment as it applies to pedestrians, although the presence and attributes of bicycle facilities may be easier to access. In general this method requires considerable fieldwork, including measurements and inventory of streetscape amenities.

http://www.fehrandpeers.com/mmlos-toolkit/

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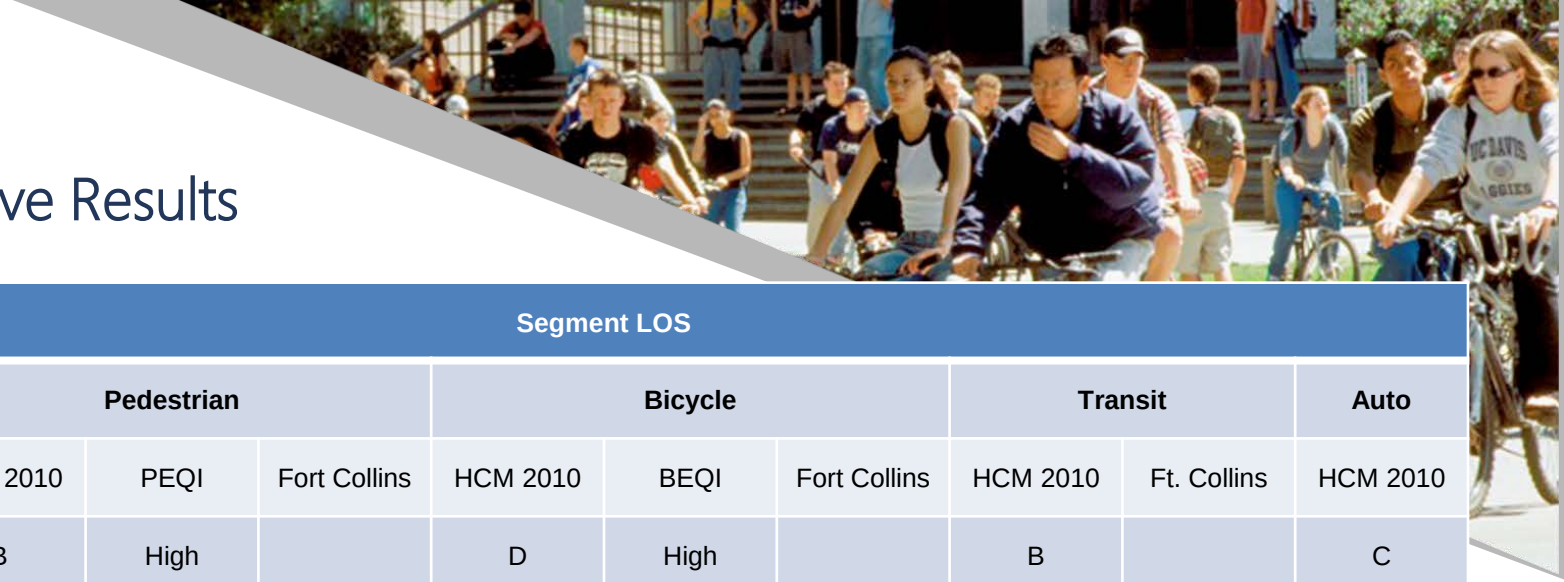

Comparative Results

Segment LOS									
	Pedestrian			Bicycle			Transit		Auto
	HCM 2010	PEQI	Fort Collins	HCM 2010	BEQI	Fort Collins	HCM 2010	Ft. Collins	HCM 2010
Venice EB e/o Lincoln	B	High	A/C/C/C/C	D	High	C	B	B	C
Venice WB e/o Lincoln	C	High		D	High		C		D
7th EB	C	Average	B/B/C/B/A	D	High	C *	A	A	F
7th WB	C	Average		E	Average		B		E

Intersection LOS							
	Pedestrian			Bicycle			Auto
	HCM 2010	PEQI	Charlotte	HCM 2010	BEQI	Charlotte	HCM 2010
Venice & Lincoln	A	Low	B	C	Low	C	E
7th & Figueroa	B	Average	A	D	Poor	C	F

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Consideration of Toolbox Elements

	HCM 2010		Person Delay		Fort Collins		Charlotte		Built Environment Factors	
OPERATIONAL IMPROVEMENTS	**AUTOS ***	**PEDS**	**AUTOS**	**PEDS**	**AUTOS**	**PEDS**	**AUTOS ***	**PEDS**	**AUTOS ***	**PEDS**
Pedestrian Countdown Signal	NO	NO	NO	NO	NO	YES	NO	YES	NO	YES
Reduced Walking Speed	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES
Pedestrian Recall	YES	NO	YES	YES	YES	YES	YES	NO	YES	YES
All Red Clearance	YES	NO	YES	NO	YES	NO	YES	YES	YES	YES
Leading Pedestrian Interval	YES	NO	YES	NO	YES	NO	YES	YES	YES	YES
Scramble Phase	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES
Flashing Yellow Arrow	YES	NO	YES	YES	YES	NO	YES	NO	YES	YES
Protected Left-Turn	YES	NO	YES	YES	YES	NO	YES	YES	YES	YES
Prohibited Right-Turn-on-Red	YES	YES	YES	NO	YES	NO	YES	YES	YES	YES
PHYSICAL IMPROVEMENTS	**AUTOS ***	**PEDS**	**AUTOS**	**PEDS**	**AUTOS**	**PEDS**	**AUTOS ***	**PEDS**	**AUTOS ***	**PEDS**
Directional Curb Ramps	NO	NO	NO	NO	NO	YES	NO	NO	NO	YES
Curb Extensions	YES/NO	NO	YES/NO	YES	YES/NO	NO	YES/NO	NO	YES/NO	YES
Stop Bar	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES
Median Island with Refuge	NO	YES	NO	NO	NO	YES	NO	YES	NO	YES

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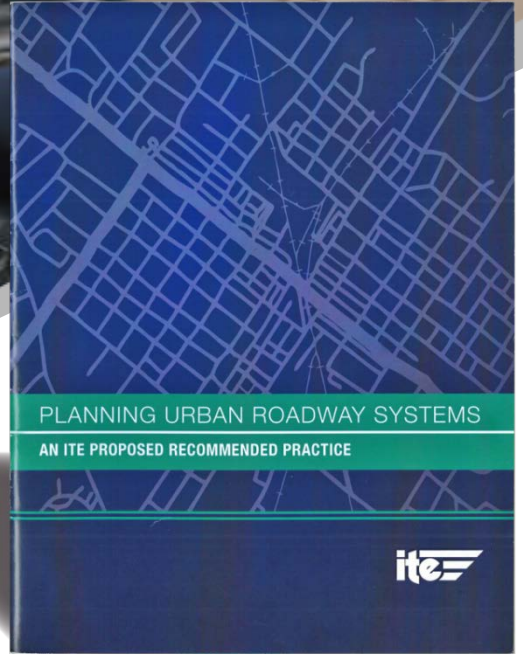
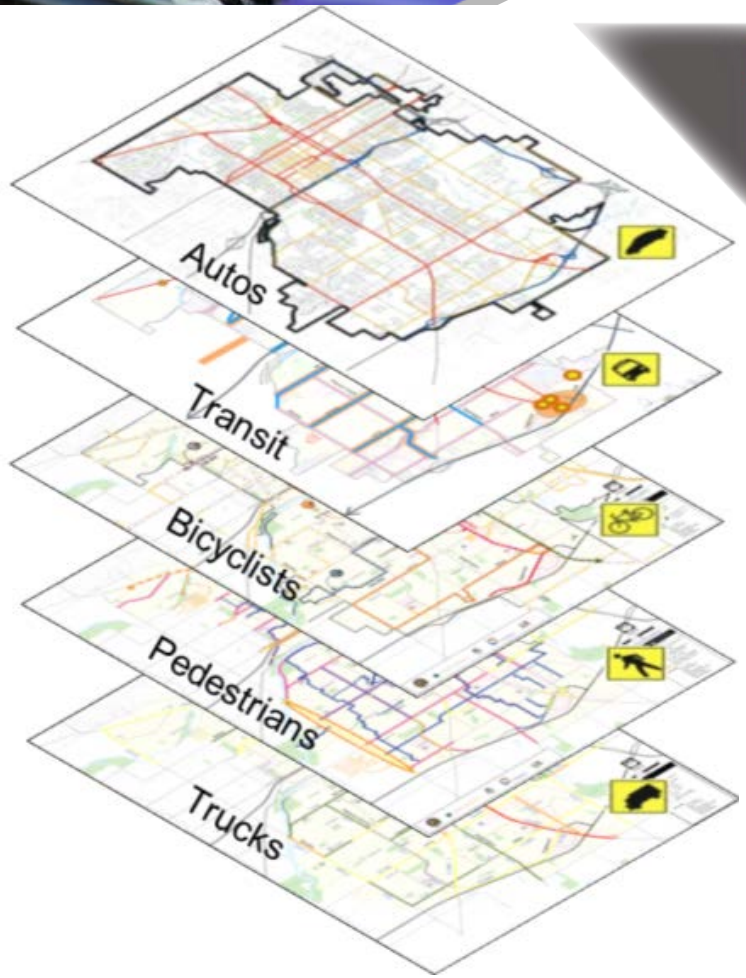


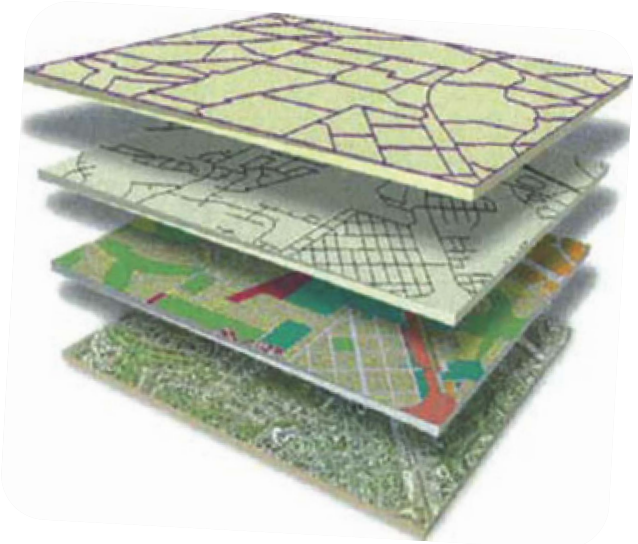
Layered Network

Street classification system: designate priority modes to specific streets

Each mode has its own set of design and operational features and performance standards

Use to prioritize improvements or evaluate trade-offs for mitigation





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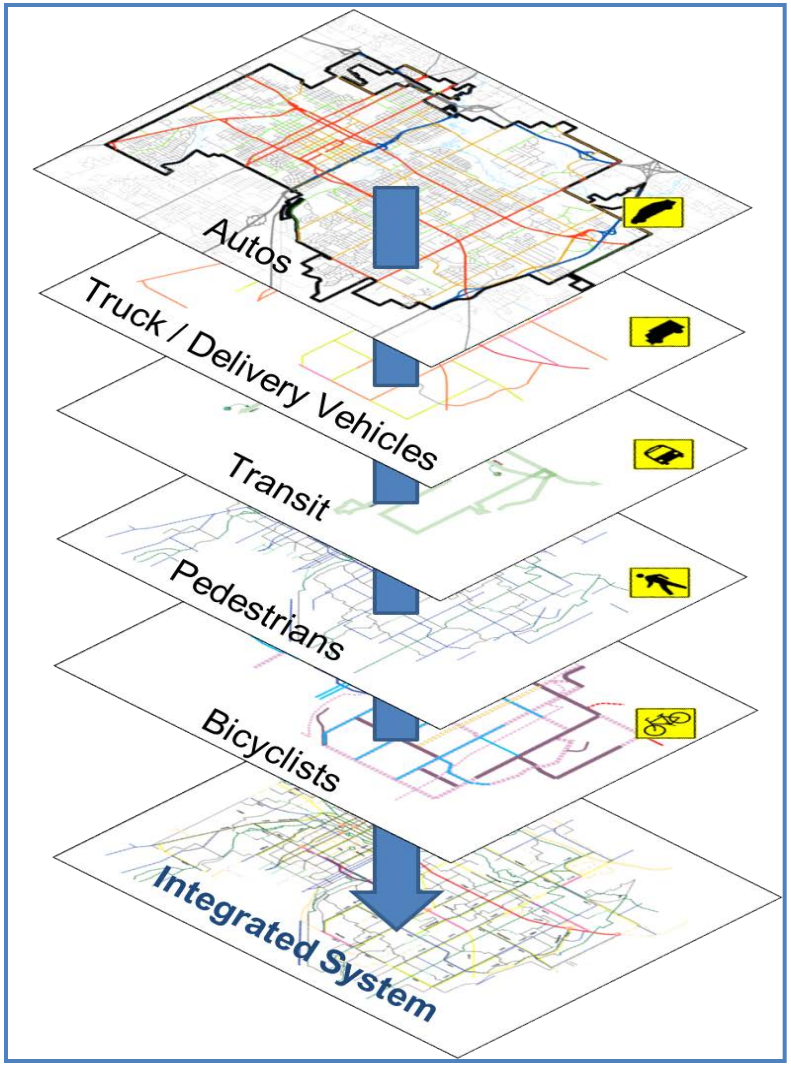
Multimodal Transportation System

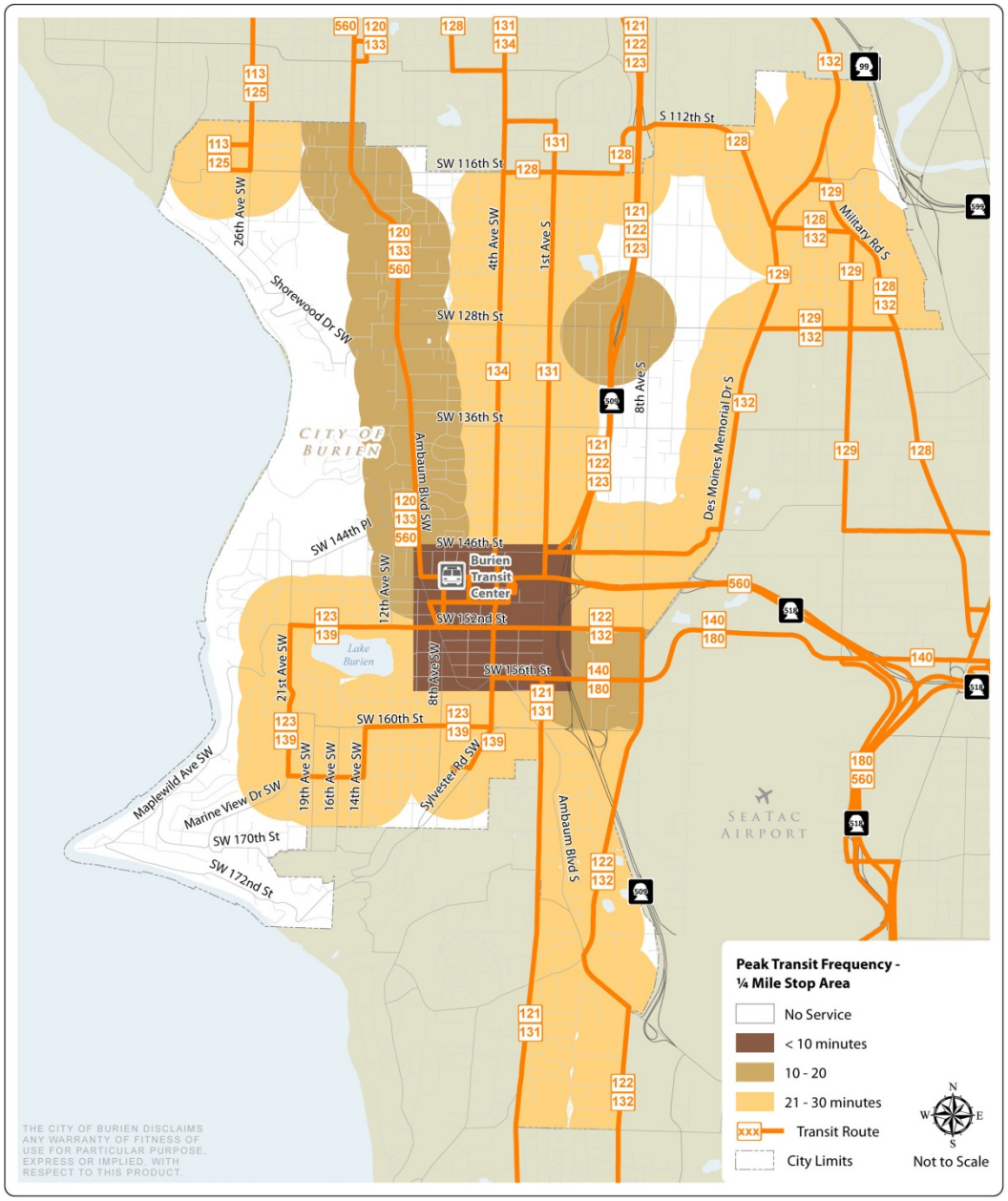


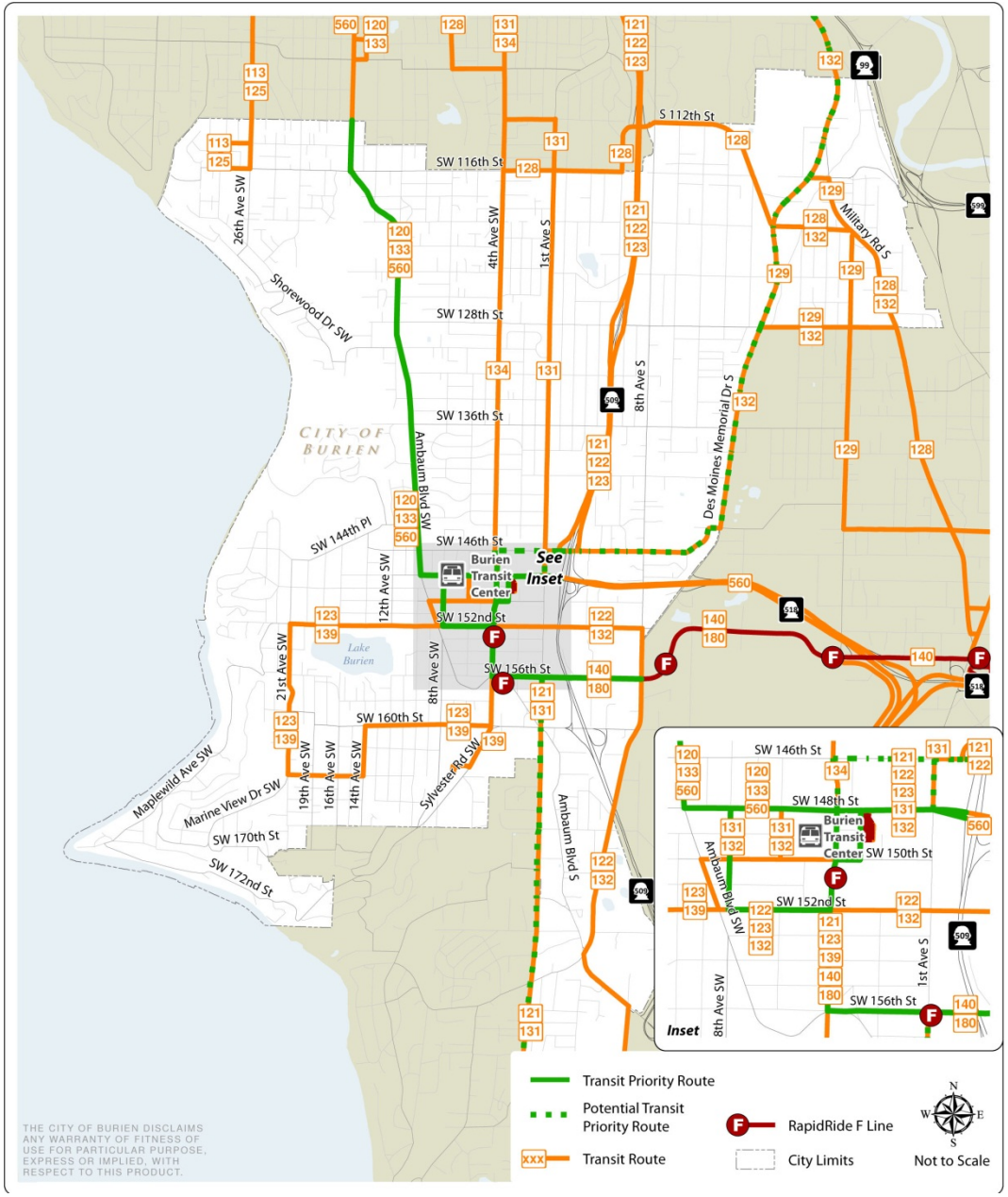
Layered Network

EERS

Bicycle Priority Overlay - Alameda Main Island
Bicycle Priority Streets
All Streets
Commercial Areas
Parks
Docks
Water
City Limit
0
0.25
0.5
1 Miles

Existing Transit Network





Transit Priority Routes

<u>Emphasis</u>

- All day, freq. service
- Transit stop amenities
- Minimal transit delay
- Good ped access

Transit Level of Service

Priority Corridors

Classification	Transit Stop Amenities (shelters, lighting, benches)	Transit Travel Speeds	Pedestrian Access	Frequency of Service
Green	High amenities	Minimal Roadway Delay	Sidewalks and marked crosswalks serving stops	All day service. Peak service 15 minutes or less, midday 30 minutes or less
Yellow	Some amenities	Moderate Roadway Delay	Sidewalks and marked crosswalks serving some stops	All day service. Peak service 30 minutes or less, midday service 60 minutes or less
Red	Little or no amenities	Congested Roadway	General lack of sidewalks and marked crosswalks	Low level of service

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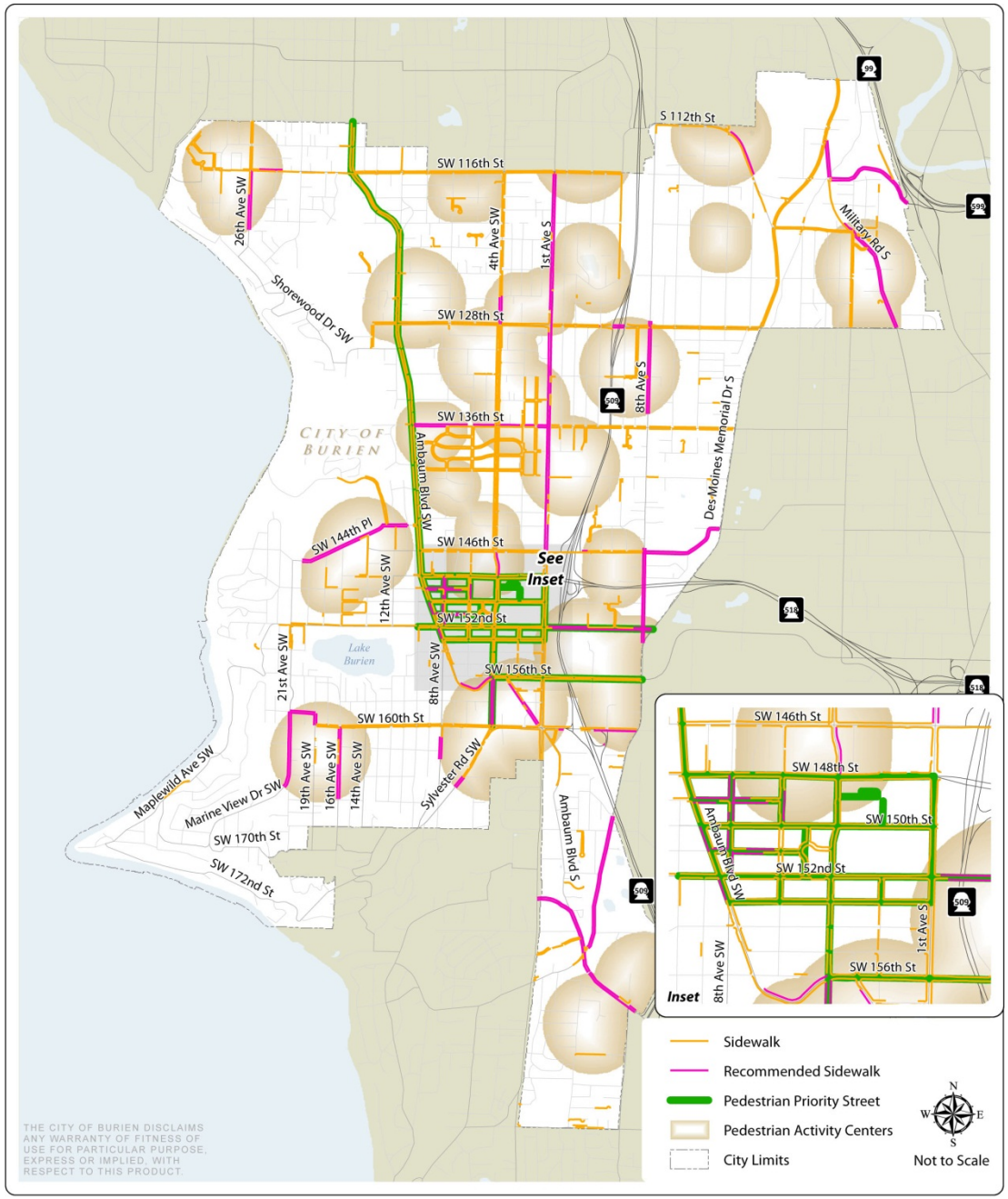
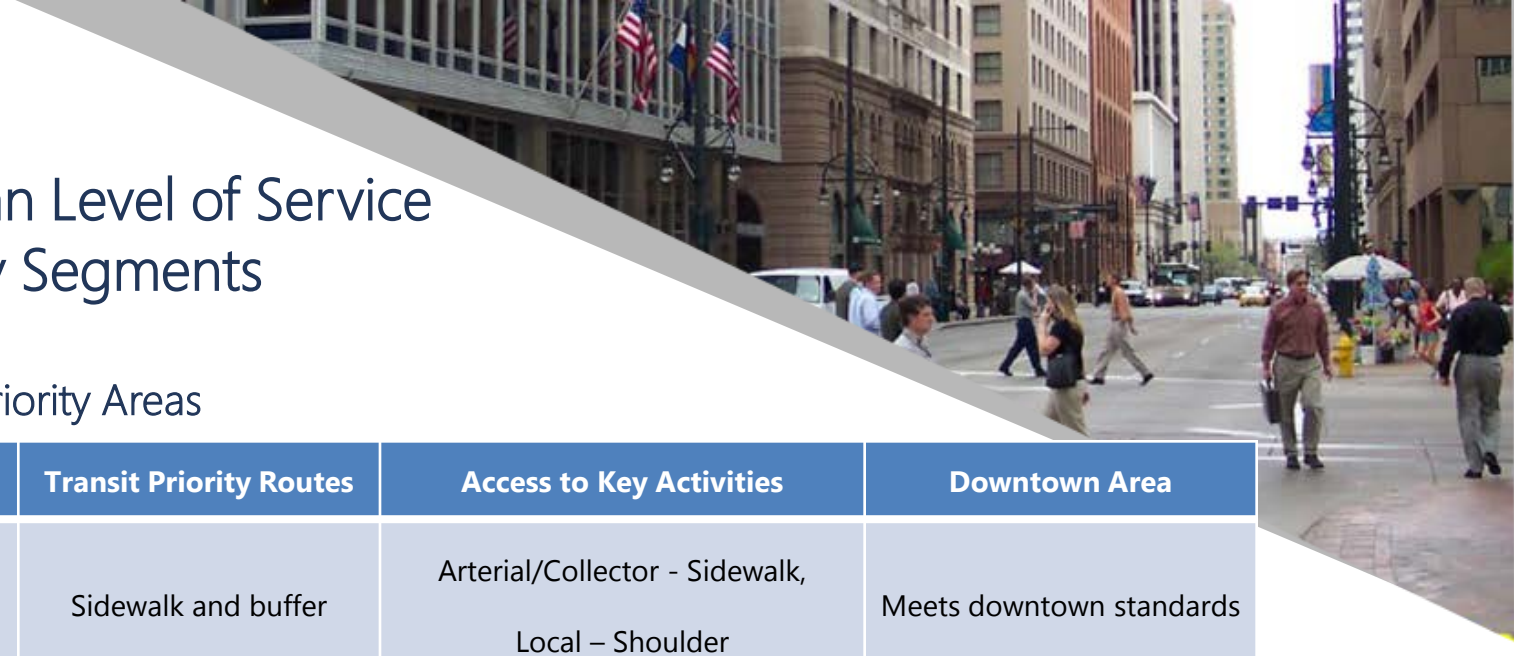


Pedestrian Priority Routes and Areas

Needs:

- 17-18 miles of new sidewalks on arterials and collectors
- Wide shoulders on local streets where possible



Pedestrian Level of Service Roadway Segments

Pedestrian Priority Areas

	Transit Priority Routes	Access to Key Activities	Downtown Area
Green	Sidewalk and buffer	Arterial/Collector - Sidewalk, Local – Shoulder	Meets downtown standards
Yellow	Sidewalk	Shoulder	Sub-standard sidewalk
Red	No Sidewalk	No sidewalk or shoulder	No sidewalk

Non-Pedestrian Priority Areas

	Non-Pedestrian Priority Area
Green	Arterial / Collector - Sidewalk both sides
Yellow	Arterial / Collector - Sidewalk one side
Red	Arterial / Collector - No sidewalk

Local Roads – No Standard

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Pedestrian Level of Service Intersections

Classification	Ped Priority Areas	Non-Pedestrian Priority Area
Green	Appropriately designed crossing within 300 feet of activity area or every 300 feet in downtown	Appropriately designed crossings at existing marked crosswalks
Yellow	Crosswalks present	Crosswalks present
Red	No crossings within 300 feet of activity area or not every 300 feet inside downtown	No crossings within 600 feet

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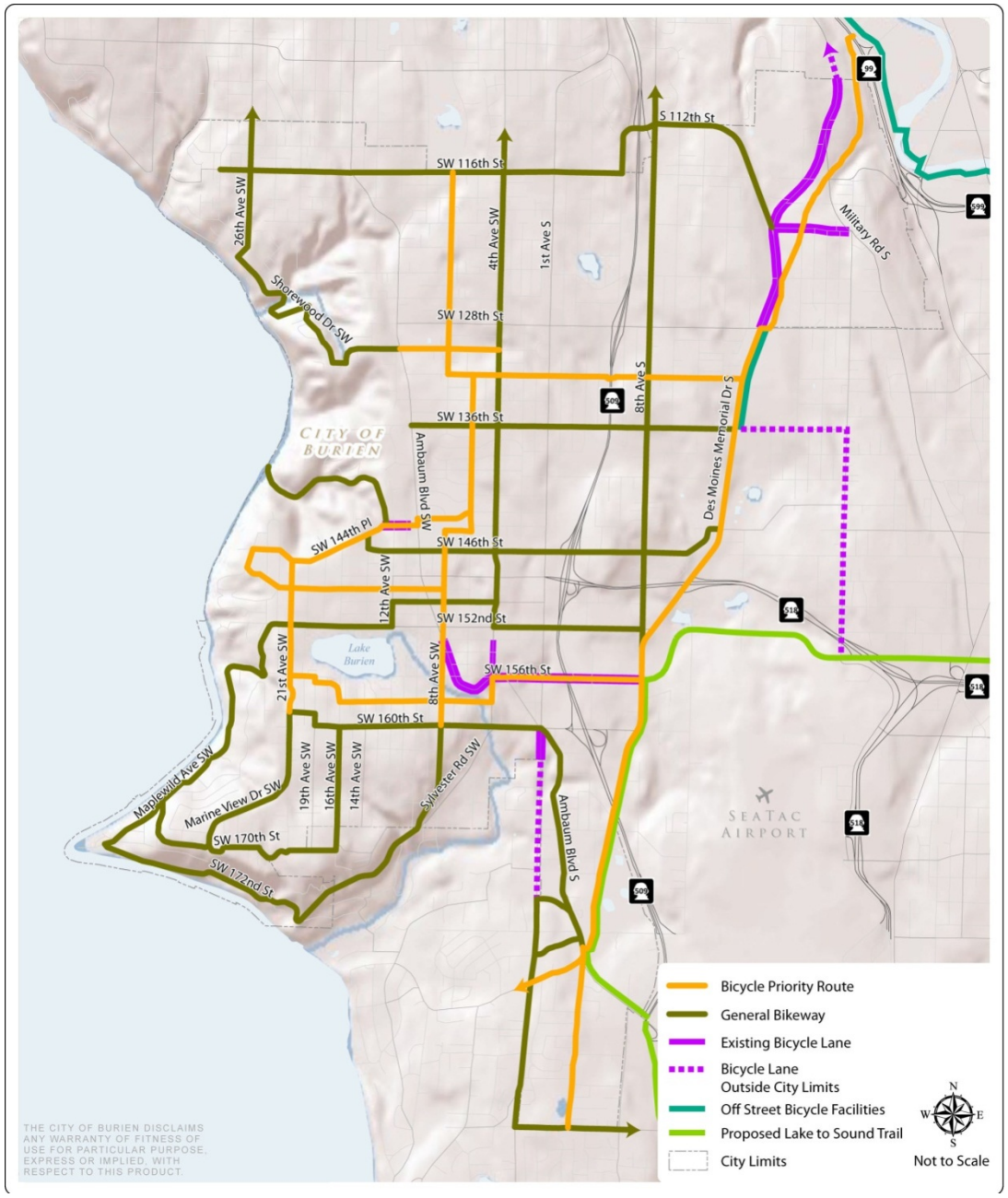


Bicycle Priority Routes

<u>Emphasis</u>

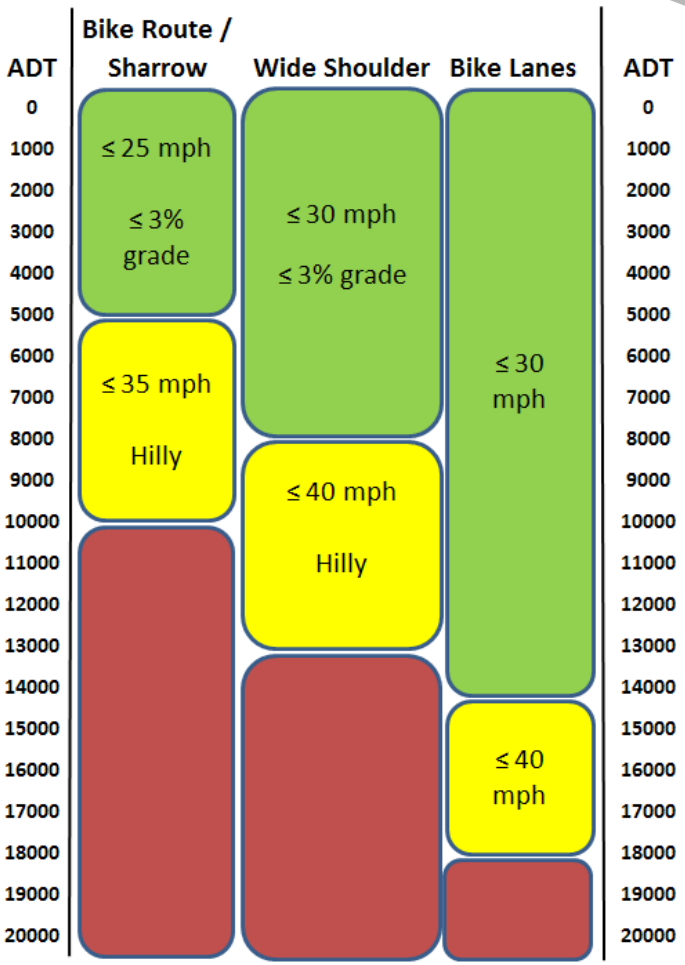
- Use of local streets and selected arterial corridors
- Adequate treatments at intersections
- Limited stop frequency

Bicycle Facility Level of Service

Volume and Speed Thresholds

Bicycle Priority Streets

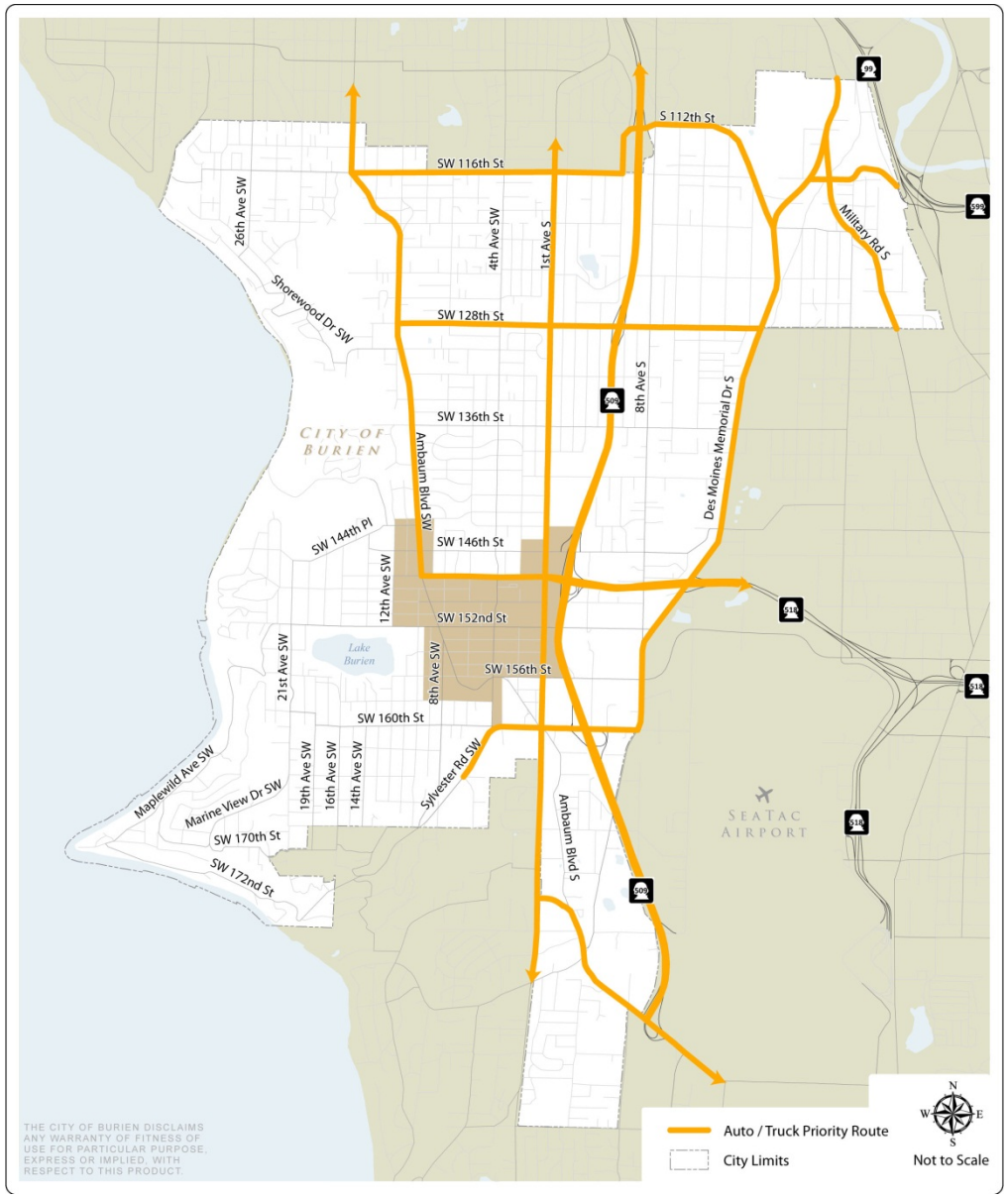
Other Streets with Bikeways



Bicycle Boulevards

A bicycle boulevard is a **shared roadway** optimized for bicycle traffic through the use of **traffic calming**, **traffic control measures**, and **directional signage**. Motor vehicle traffic on a bicycle boulevard is usually low and primarily local.

Bike Boulevards: Use of Street Ends
S 132nd St and 8th Ave SW



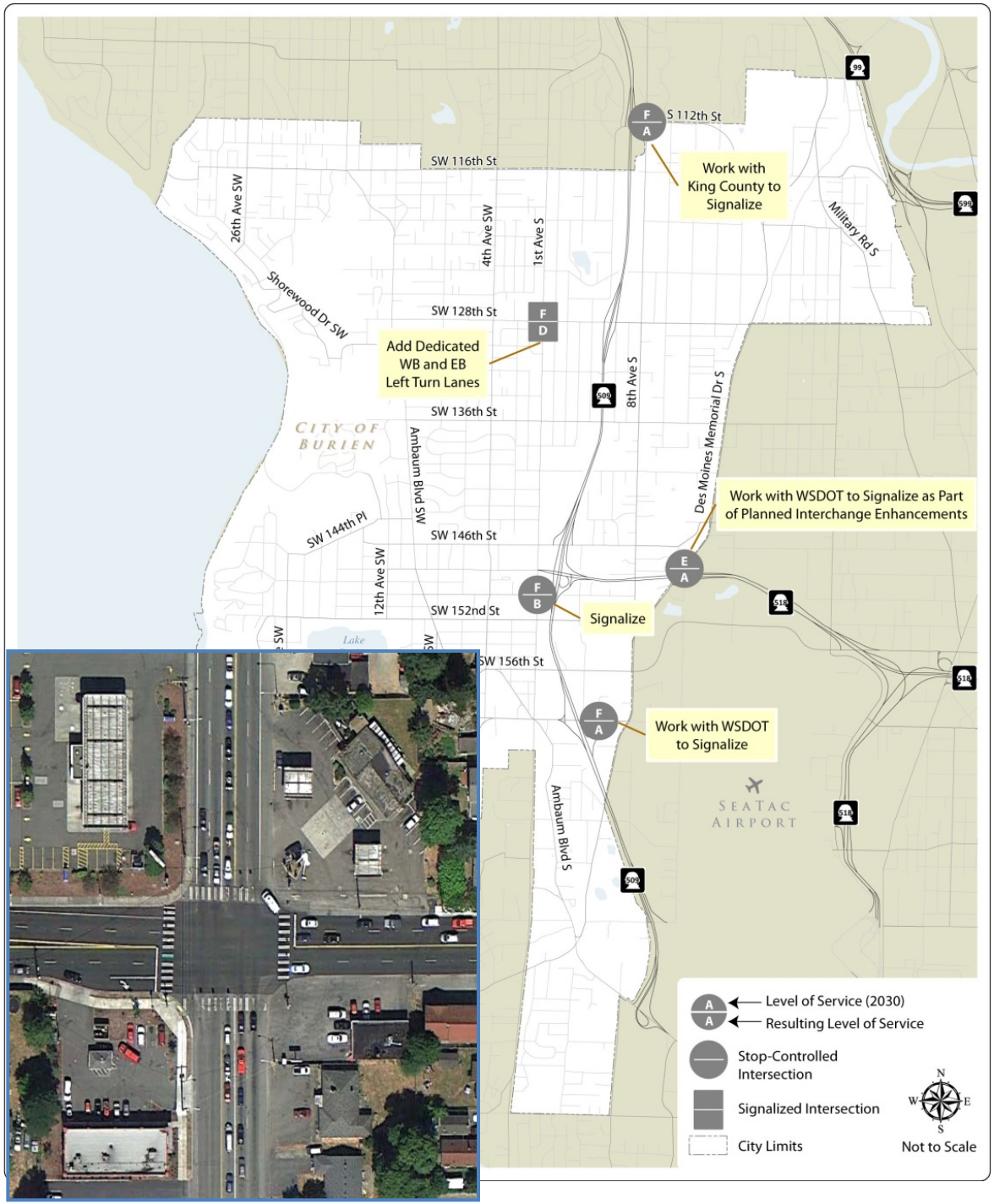
Auto / Truck Priority Routes

LOS E- Downtown Burien

LOS D- Vehicle Priority Roadways

LOS C- Other Roadways

Traffic Improvements



Implementing the Transportation Master Plan

Table 6. Costs of Burien Transportation Master Plan (20 Years)

Project Needs*	Description	Cost Range ($ Millions)
Auto/Truck Priority Projects	Traffic signals, intersection channelization	$5-10
Pedestrian Projects	Sidewalks, crossings	$30-35
Bicycle Projects	Bike boulevards, bike lanes, crossings	$5-10
Transit Projects	Shelters, Transit Signal Priority, other enhancements	$4-5
Pavement Maintenance	Overlay and pavement repair	$12-15
TOTAL		**$ 56-75**

* Does not include major regional or street reconstruction projects described in Table 7.

LA Layered Networks

Table 3-2
Complete Street Guide, Mode Preferences

Sample Street	Prioritized Modes	Non-Prioritized Modes	Prohibited Modes	Sample Street Typology
Category 1				
San Marcos Boulevard, Discovery to Grand				Multi-Way Boulevard
Rancho Santa Fe Road, Twin Oaks Valley Road				Arterial with Class II or Class III bike facility and sidewalks
Mission Road, Rural Parts of Twin Oaks Valley Road				Arterial with Enhanced Bike/Ped Facilities
Freeway State Route 78 (SR-78)				Highway
Collectors				Collector
Bicycle/Pedestrian Trails				Class I Bike/Ped Path
Neighborhood Streets				
Industrial Streets				
Main Street (University District)				
Priorities: Pedestrian				

Table 3-4 – LOS Parameters

Street	Mode Preference				Sample Street Typology
	Transit	Bicycle	Pedestrian	Vehicular	
San Marcos Boulevard, Discovery to Grand	LOS D	LOS D	LOS C	LOS E	Multi-Way Boulevard
Rancho Santa Fe Road, Twin Oaks Valley Road	LOS E	LOS E	LOS E	LOS D	Arterial with Class II or Class III bike facility and sidewalks
Mission Road	LOS D	LOS D	LOS C	LOS D	Arterial with Enhanced Bike/ Pedestrian Facilities
SR-78	LOS E	☒	☒	LOS D	Freeway
Collectors	LOS E	LOS D	LOS C	LOS E	Collectors
Bike/Pedestrian Trails	☒	LOS D	LOS C	☒	Class I Bike/Ped Paths
Neighborhood Streets	LOS E	LOS D	LOS C	LOS E	Neighborhood Streets
Industrial Streets	LOS E	LOS E	LOS E	LOS D	Industrial Streets
Main Street (University District)	LOS D	LOS D	LOS C	LOS E	Main Street Concept

Notes: Θ = Mode Prioritized Θ = Mode not Prioritized ☒ = Mode Prohibited

MMLOS Toolkit

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Multimodal Level of Service

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or Google “MMLOS”

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Safety

Table 2. Roadway Segments with a High Rate of Injury/Fatality Collisions

Segment	Collisions per Mile
S 128th St **(Occidental Ave S to 8th Ave S)**	10.6
Ambaum Blvd SW/12th Ave SW **(136th to 124th)**	6.8
S 128th St **(4th Ave SW in Burien to 22nd Ave S)**	6.2
4th Ave SW **(148th to 128th)**	4.8
Ambaum/12th/188th **(west of DMMD to 160th)**	2.8

WSDOT, 2011