Highway Occupancy Vehicle (HOV) System Analysis Tools – Statewide HOV Facility Performance Analysis

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UCI Team

Operational Performance Comparison of Limited-Access and Continuous-Access HOV Lane Facilities

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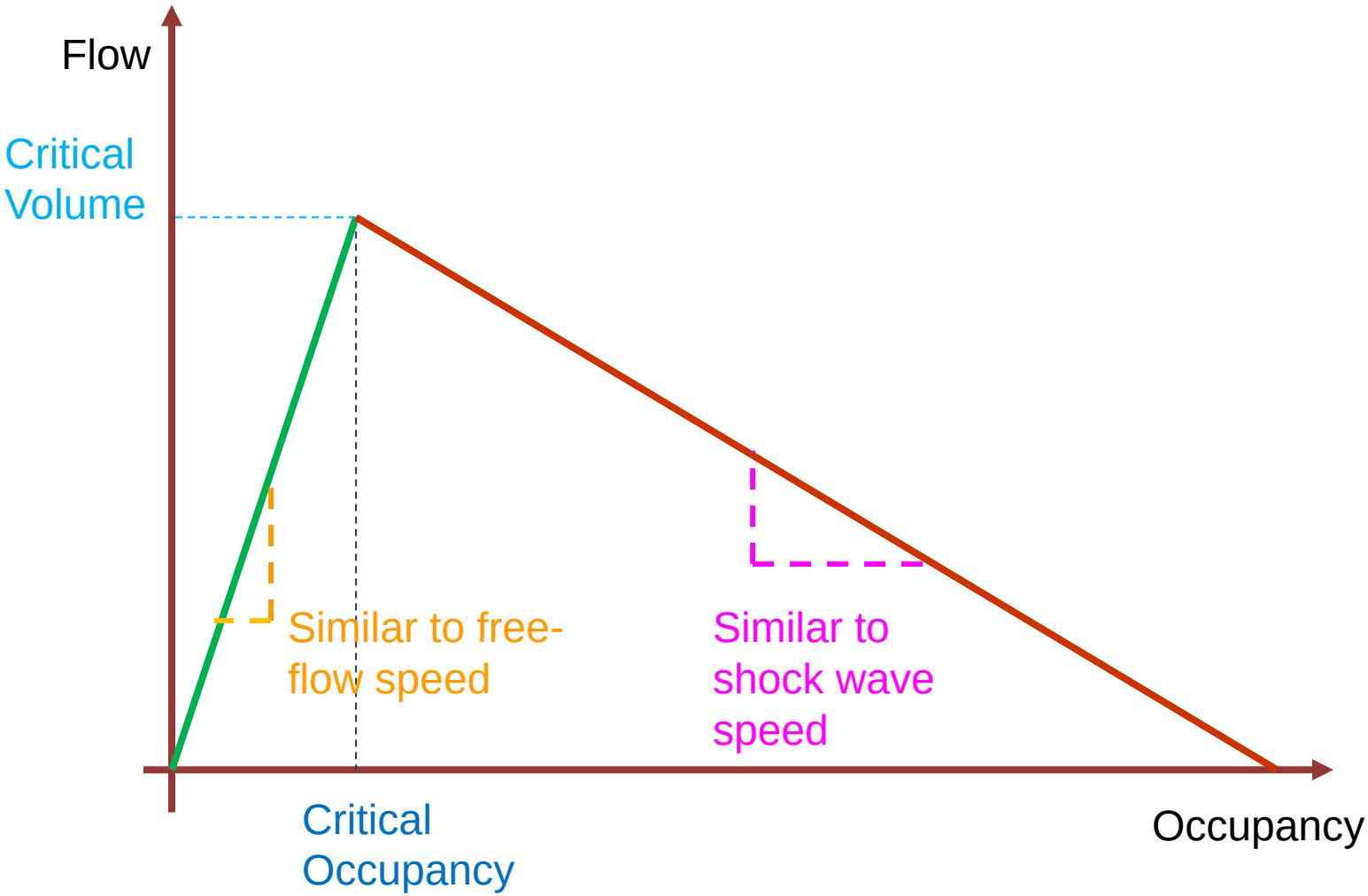
Study Approach

- Performance Measures
  - Speed contour (bottleneck and congestion review)
  - Speed differential
  - Vehicle-Miles Traveled (VMT) ratio
  - Number of lane changes
  - Violation rates

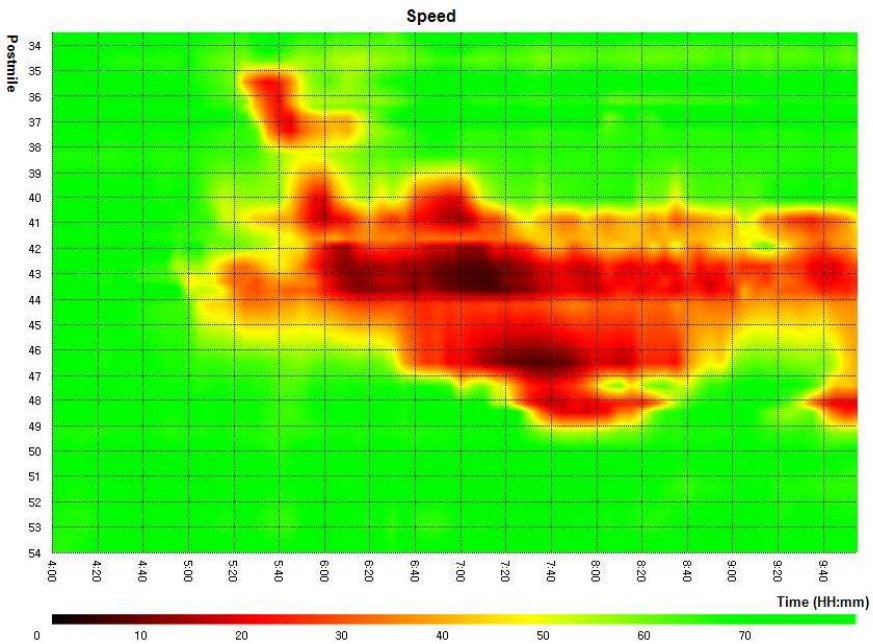
- Traffic flow fundamental diagram based method

Traffic Flow Fundamental Diagram

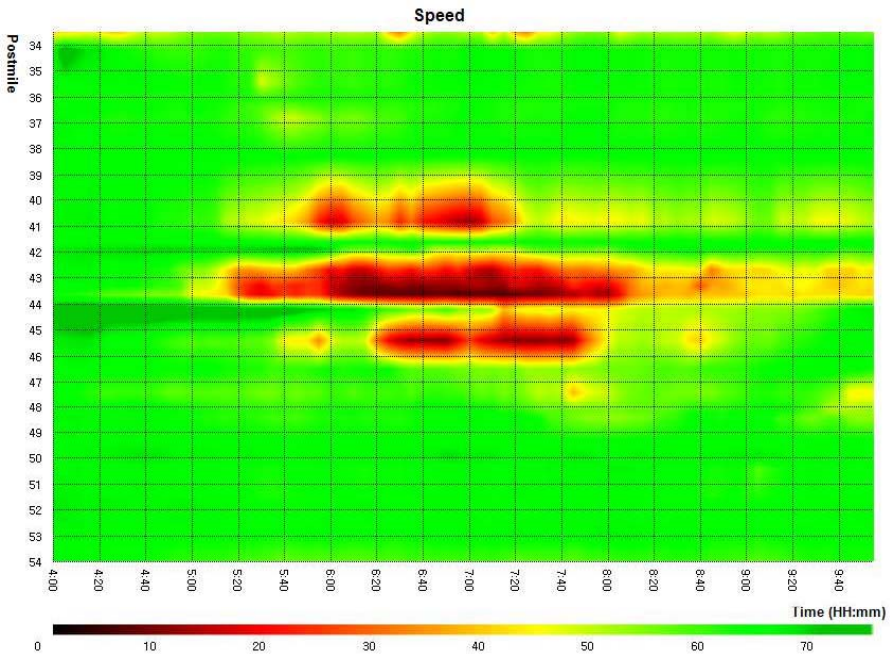


HOV vs GP congestion

- HOV lane is faster than GP lanes
- HOV drivers select HOV lane based on traffic condition along GP lanes



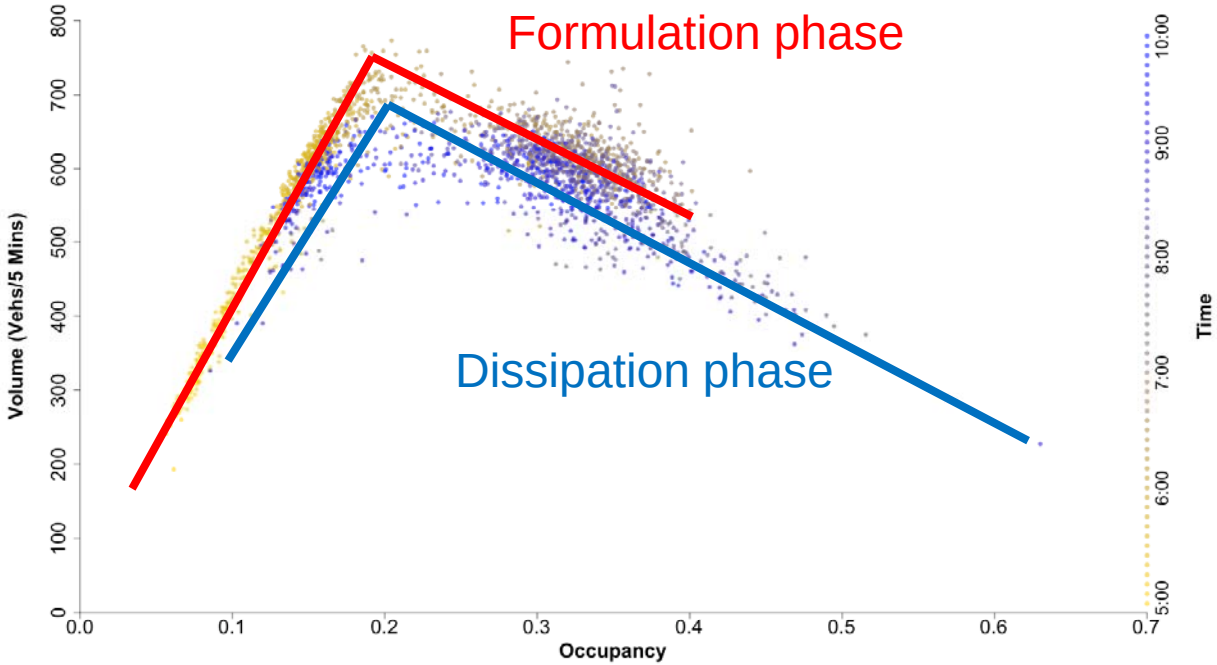
GP Lane



HOV Lane

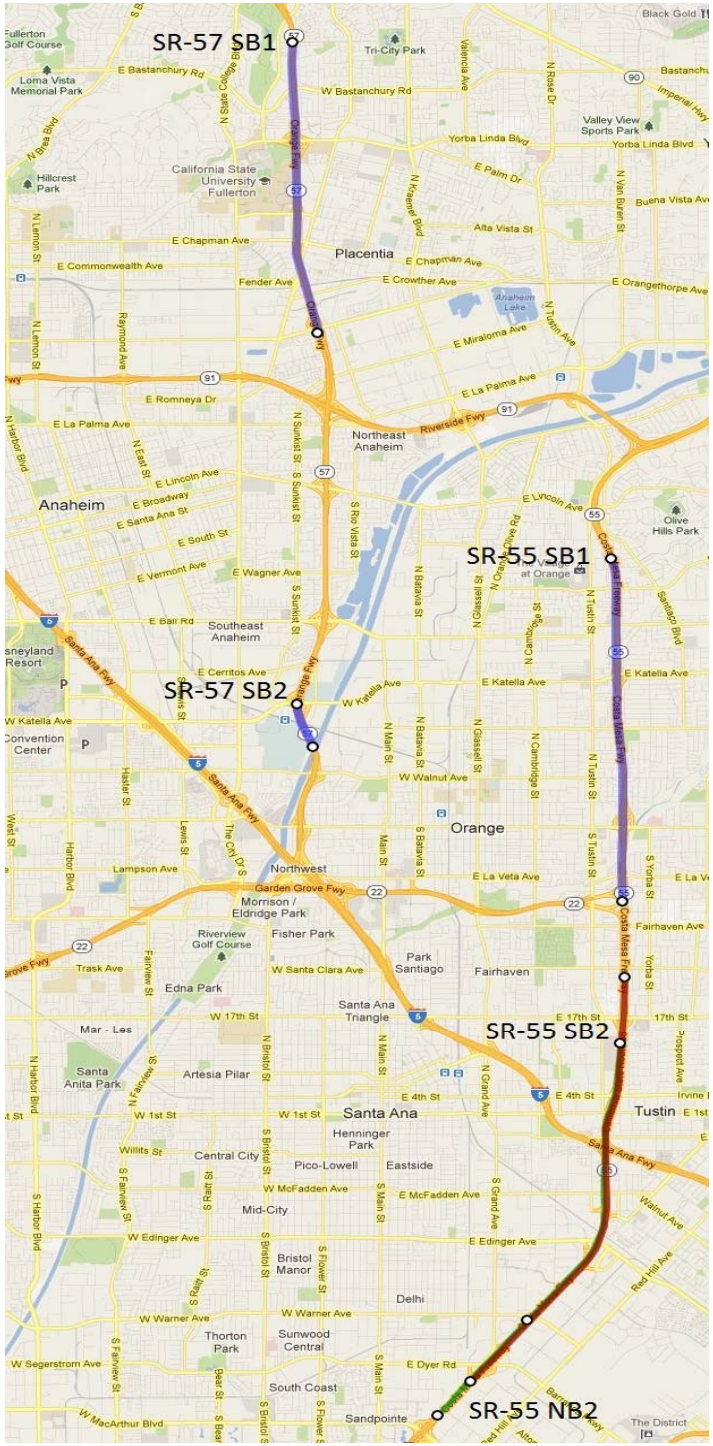
Proposed method

- Two phases: *Formulation* and *Dissipation* phases



Study Sites and Data Periods

Location (postmile range)	Conversion Date	"Before" dataset	"After" dataset	Study period
SR-55 SB1 (15.8 - 13.2)	Aug 2008	Jan 2, 2008 - Apr 1, 2008	Jan 6, 2009 - Apr 22, 2009	AM
SR55 SB2 (11.6 - 7)	4/1/2011	2010 Q3	2011 Q3	AM
SR-57 SB1 (8.5 - 5.8)	Sep 2009	Jan 6, 2009 - Apr 22, 2009	Jan 5, 2010 - Apr 13, 2010	AM
SR 57 SB2 (1.93 – 1.4)	12/1/2010	2010 Q2	2011 Q2	AM
SR55 NB2 (7.8 - 12)	4/1/2011	2010 Q4	2011 Q4	PM



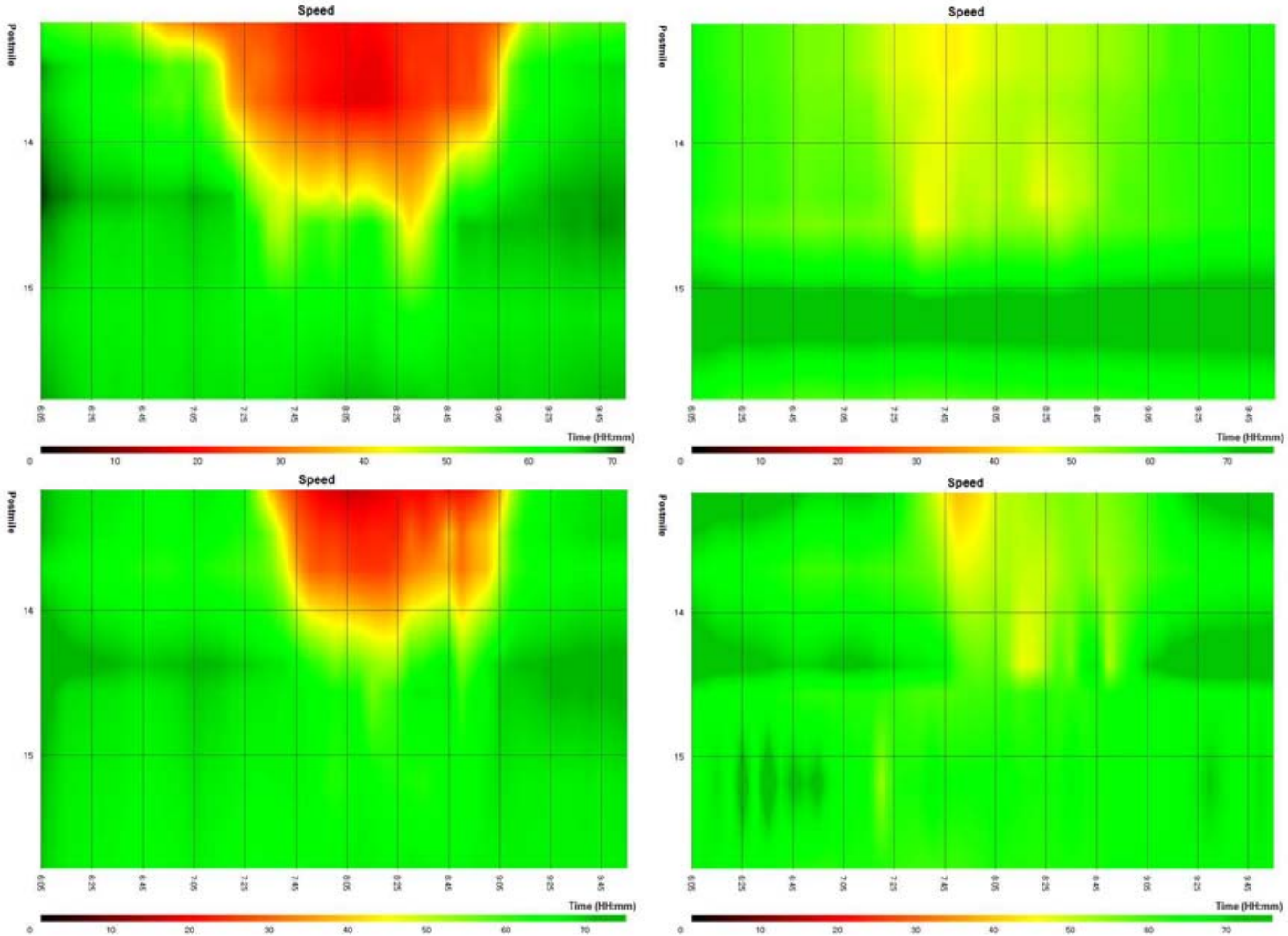
Data used

- PeMS
- Aerial Video
- District 12 HOV violation data
- District 12 detector data
- Micro-simulation modeling (SR-57 only)

SR-55 SB1 Site: Speed Contour

Before: Limited-access

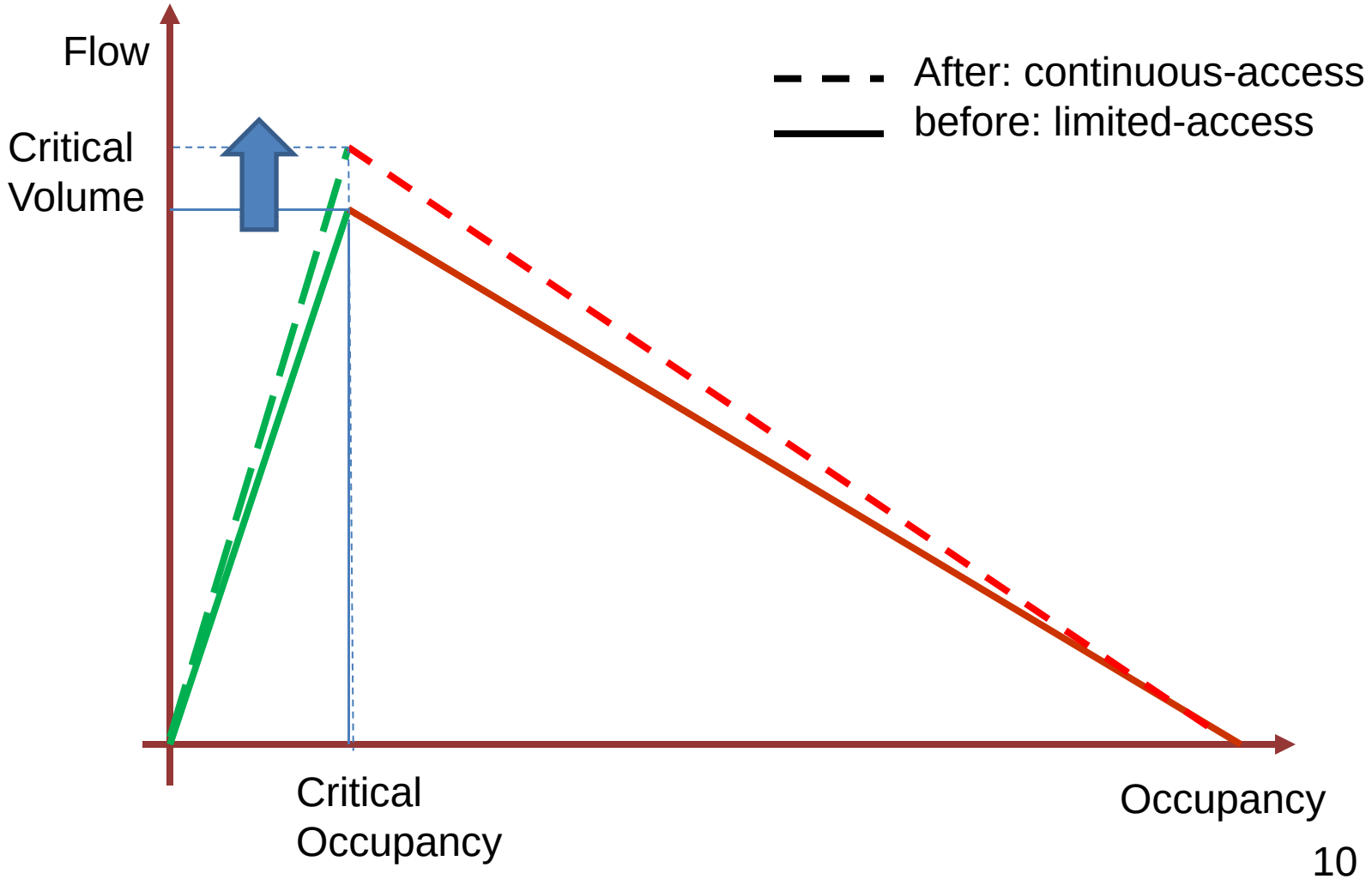
After: Continuous-access



GP Lane

HOV Lane

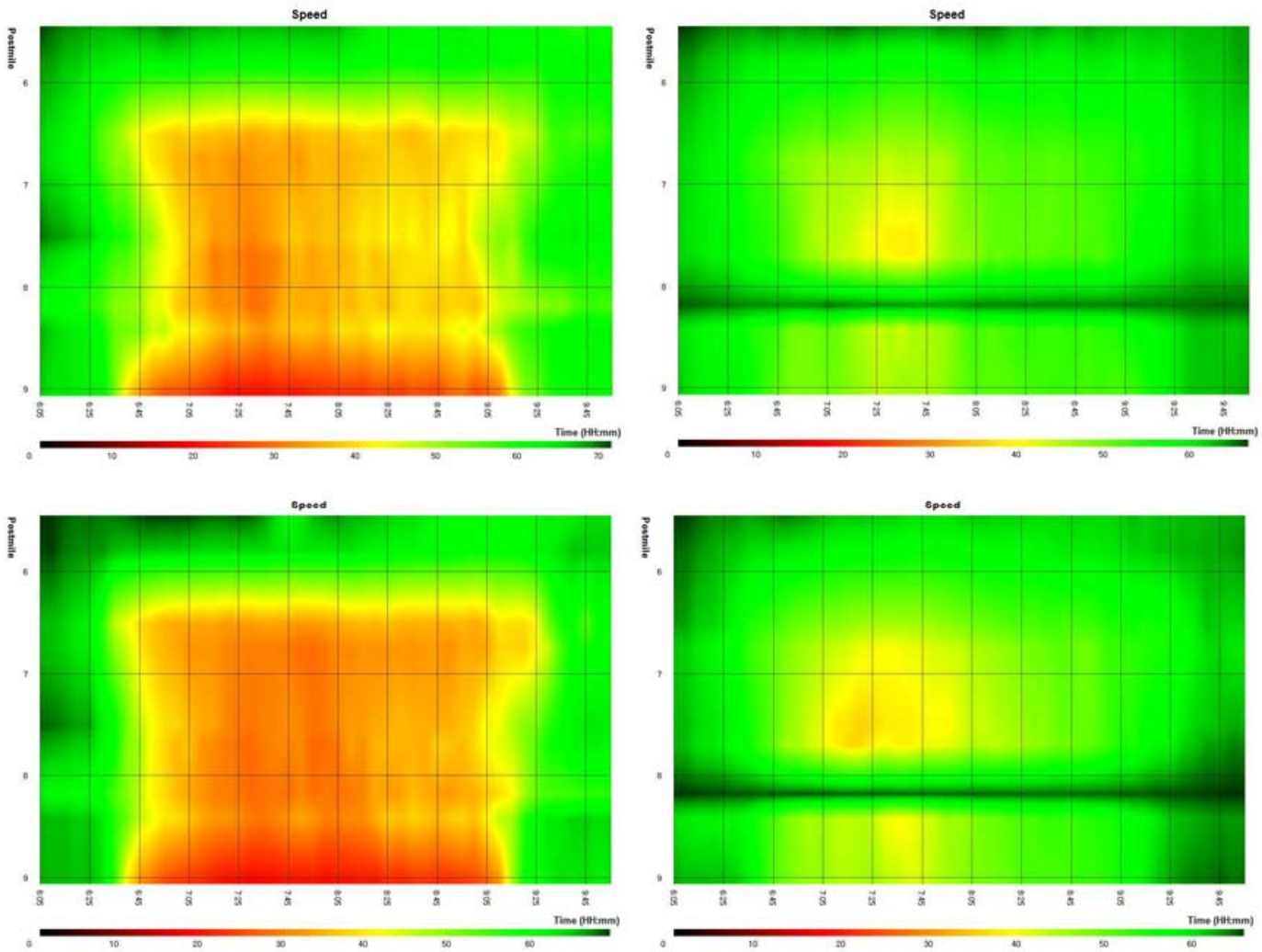
SR-55 SB1: Traffic Flow Diagram at Typical Location (both phases)



SR-57 SB1 Site: Speed Contour

Before: Limited-access

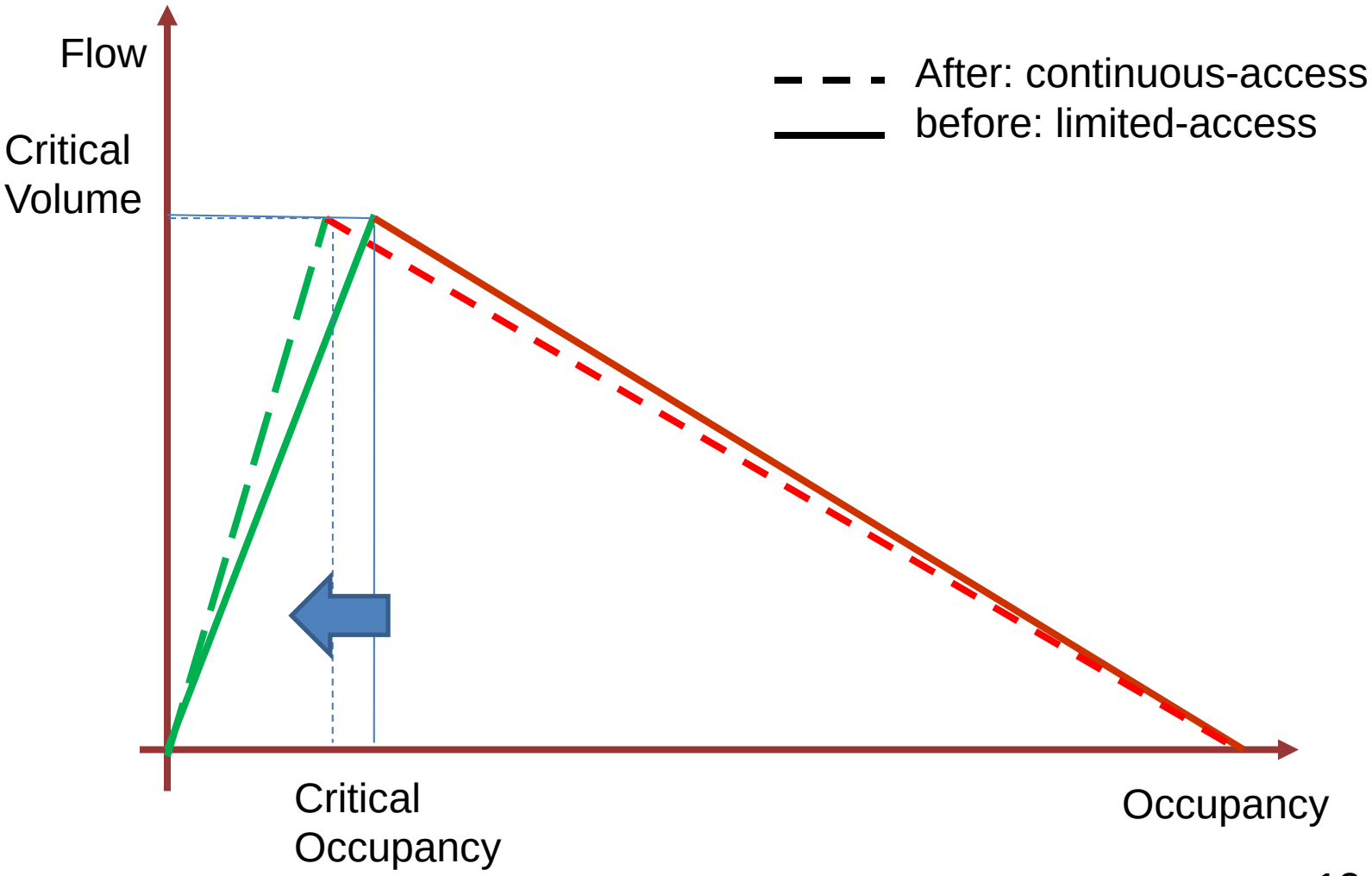
After: Continuous-access



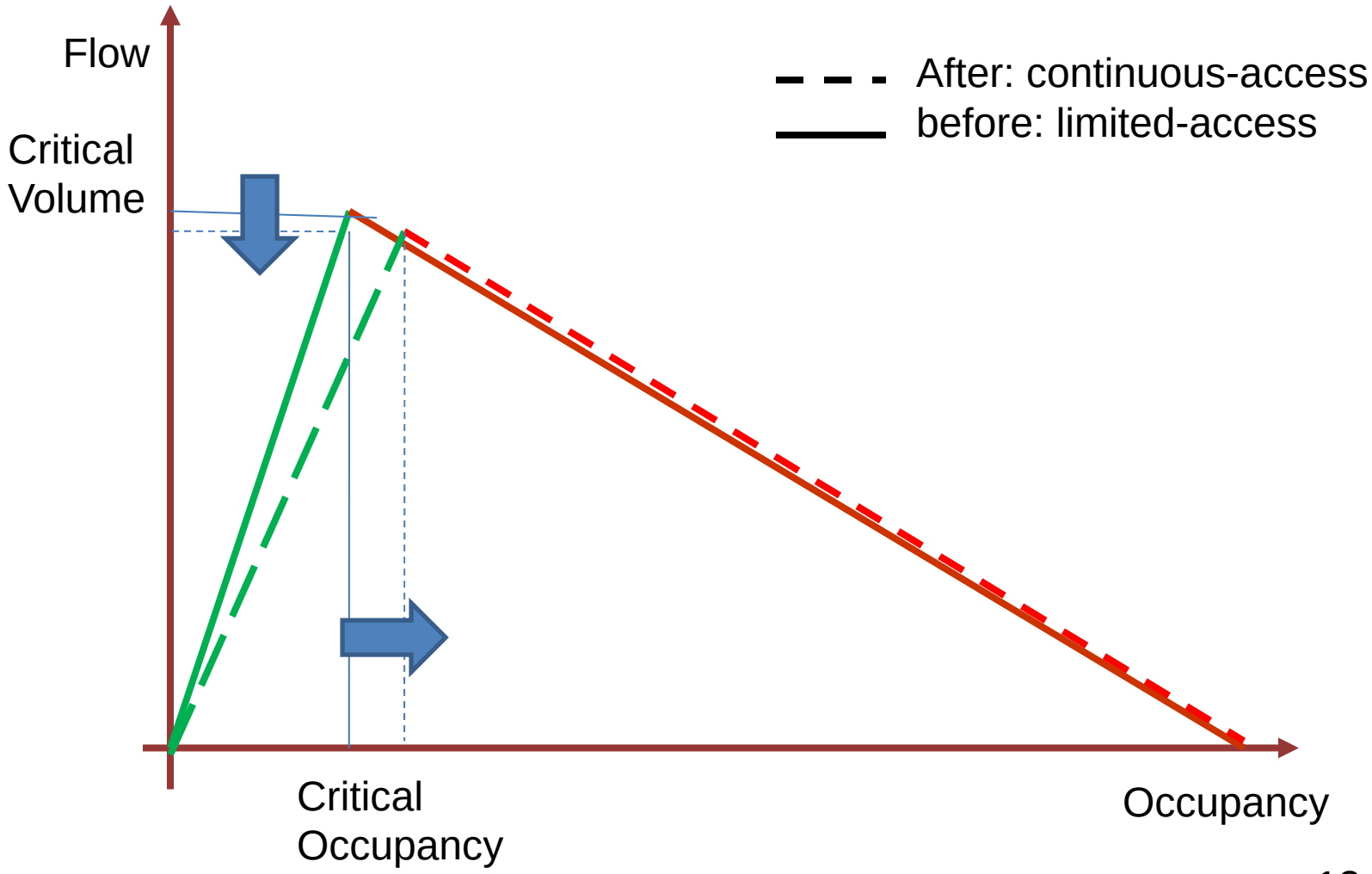
GP Lane

HOV Lane

SR-57 SB1: Traffic Flow Diagram at Typical Location (Formulation)



SR-57 SB1: Traffic Flow Diagram at Typical Location (Dissipation)



Before-after Performance Comparison

Site	Speed Contour	Demand Flows	Speed Differential	VMT Ratio
SR-55 SB1	Less congested	Higher	Higher	Similar
SR-55 SB2	More congested	Higher	Similar	Similar
SR-57 SB1	More congested	Lower	Similar	Similar
SR 57 SB2	Similar	Lower	Higher	Similar
SR55 NB2	More congested	Higher	Similar	Similar

Before-after Performance Comparison (contd.)

Site	Formulation			Dissipation	Perform-ance
	Cri. Occ.	Cri. Vol	Sho. Spd	Sho. Spd	
SR-55 SB1	Similar	Higher	Faster	Faster	Better
SR-55 SB2	Similar	Similar	Faster	Faster	Similar
SR-57 SB1	Lower	Similar	Slower	Faster	Worse
SR 57 SB2	Similar	Similar	Slower	Faster	Similar
SR55 NB2	Similar	Similar	Similar	Similar	Similar

Similar or lower critical occupancy in formulation phase

Similar or higher throughput in formulation phase

Faster shockwave speed in dissipation phase

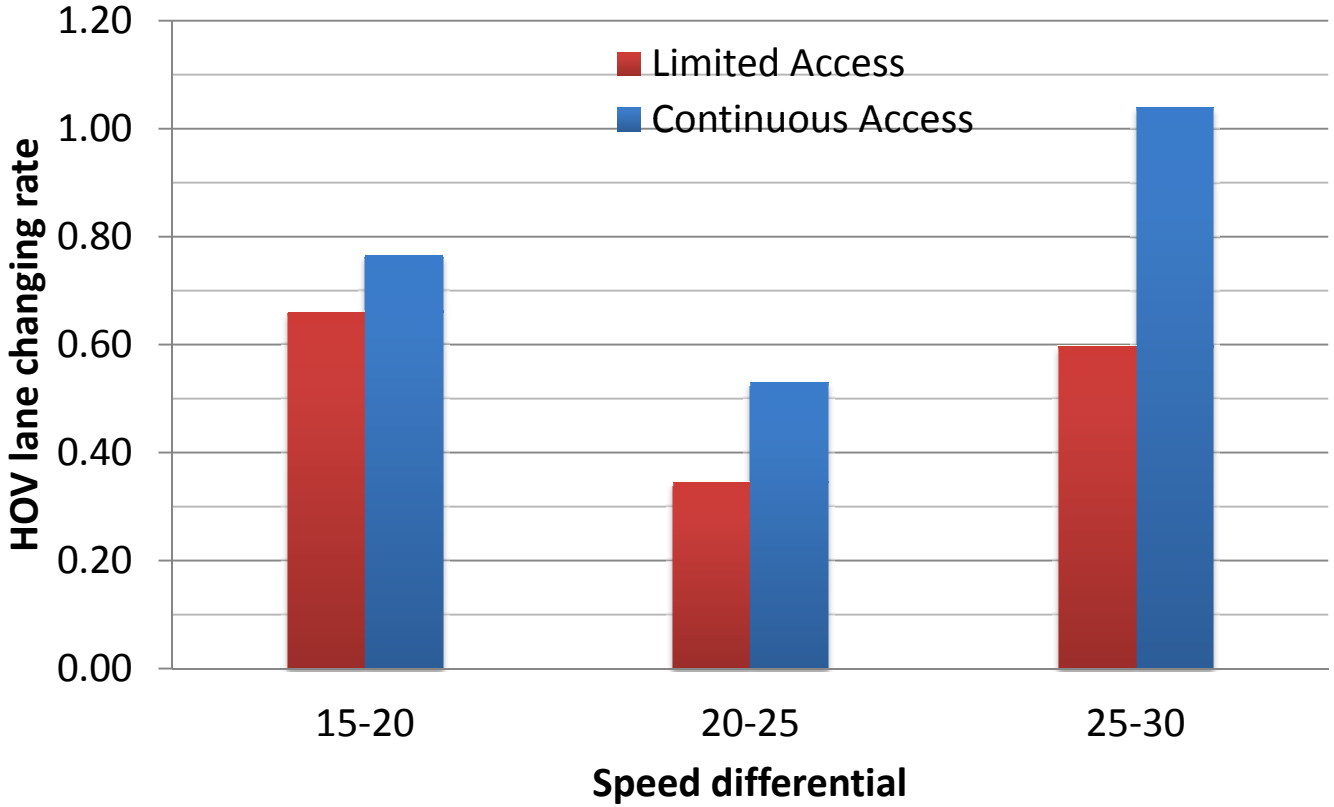
HOV Lane Violation

- SR-55 SB1:
  - Violators may help improve performance (collected at an location Walnut St. (postmile 14.382)).

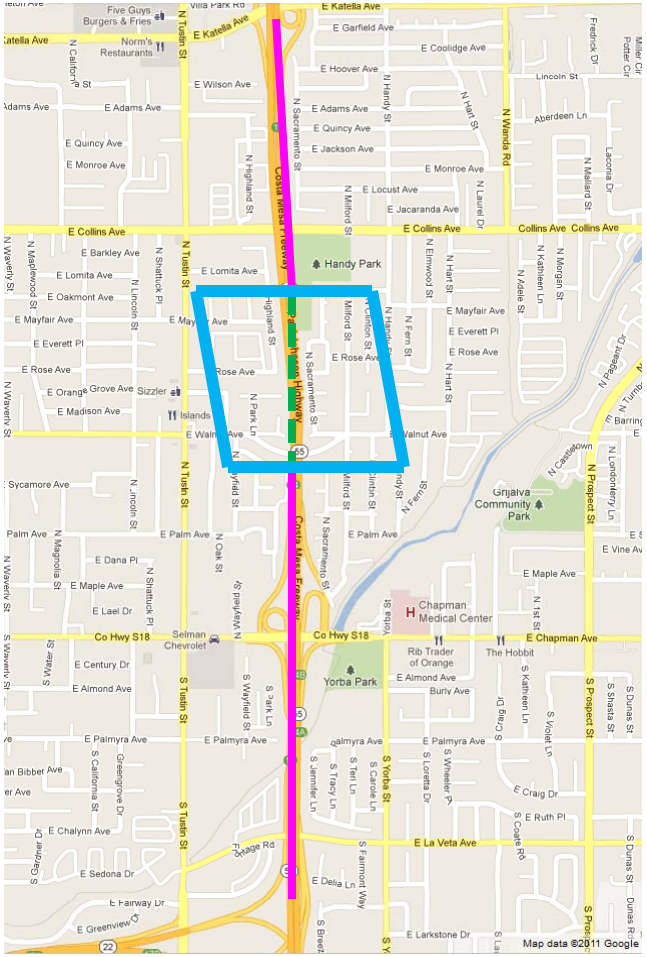
	Before: Limited-access (2007)			After: Continuous-access (2009)		
	# of Violators	Total HOV vehicles	Violation Rate	# of Violators	Total HOV vehicles	Violation Rate
SB AM	28.0	2530.5	1.11%	55.3	3089.3	1.79%
NB PM	1.5	2597.0	0.06%	55.0	2957.0	1.86%

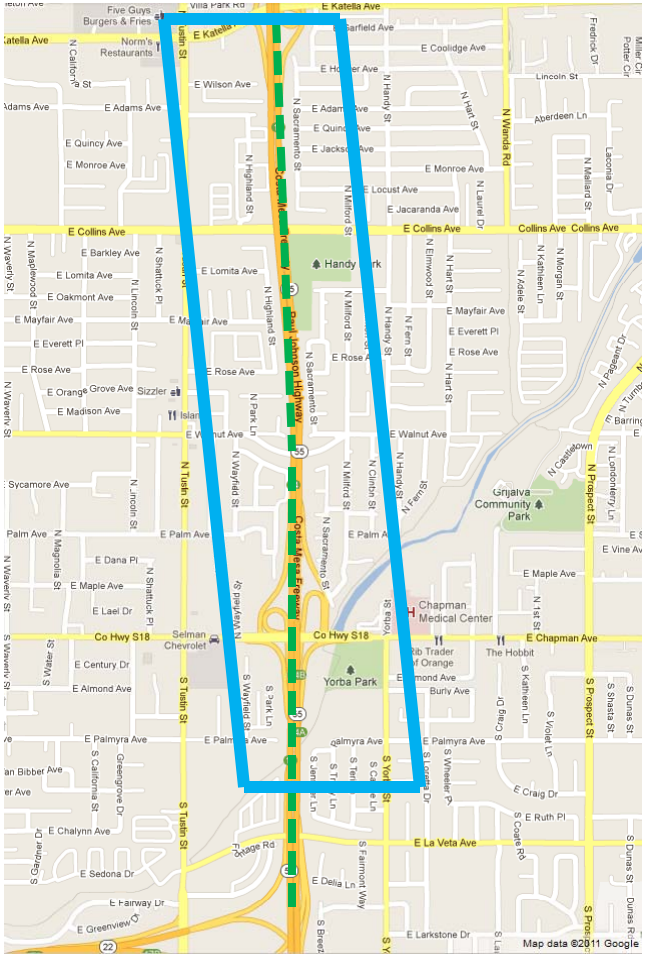
Comparison of HOV Lane Changing Rates

HOV lane changing rate = # of lane changes of HOV vehicles / HOV vehicles' VMT

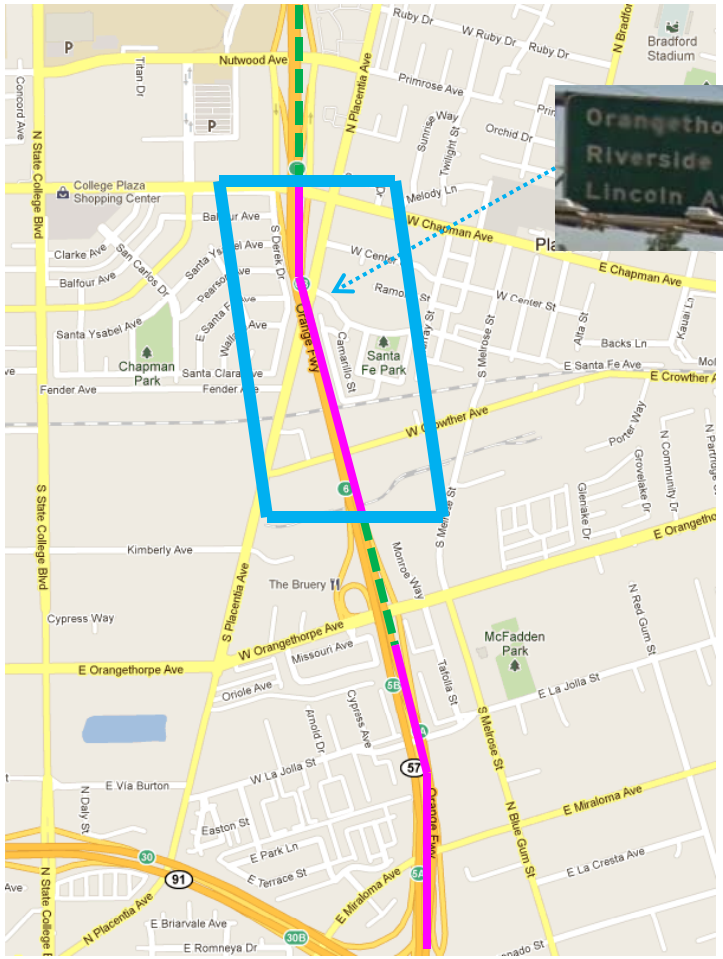


SB55 SB1 Site Performs Better

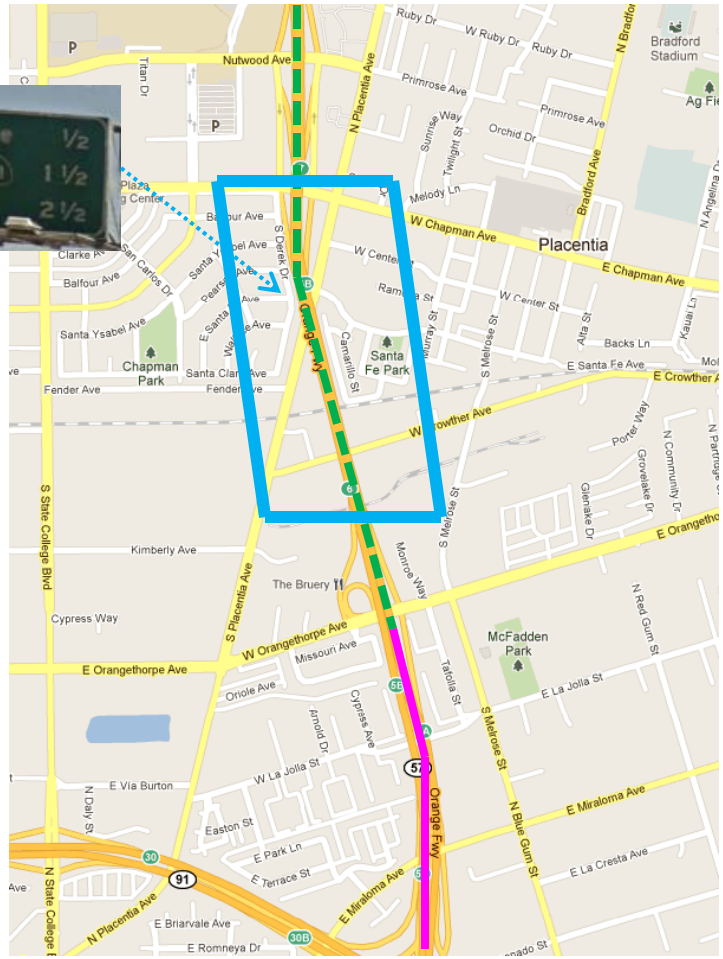




SR-57 SB1 Performs Worse



Before conversion



After conversion

SR-57 Key location: Chapman On-ramp

Chapman
On-ramp

750 veh/hr

500 veh/hr

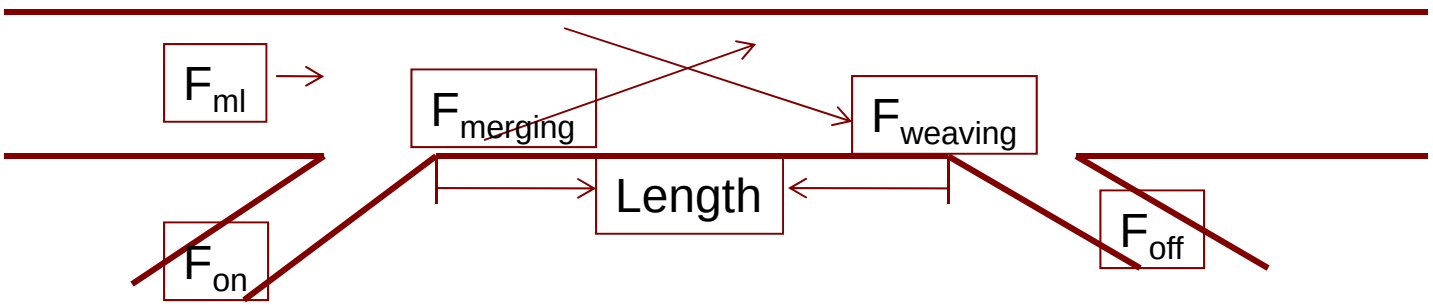
Nutwood
On-ramp

1 HOV lane:
1500 veh/hr

4 GP lane: 7000 veh/hr

Site Specific: Interchange Spacing

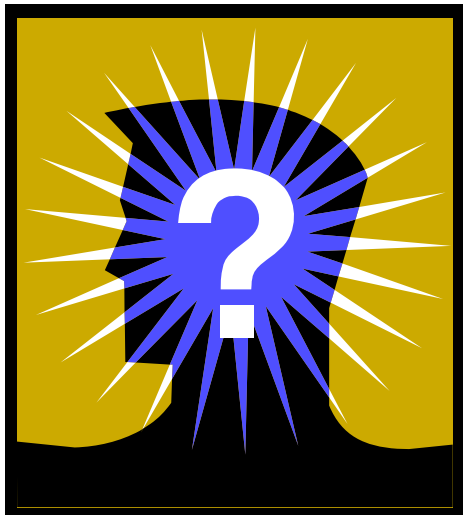
	SR-55 SB1		SR-57 SB1	
Section	Lincoln On – Katella Off	Katella On – Chapman Off	Yorba Linda On – Nutwood Off	Nutwood On – Orangethorpe Off
Length (mi)	1.11	1.09	0.57	0.72



Merging/Weaving Intensity:

$$Intensity(i) = (\sum F_{merging}(i) + \sum F_{weaving}(i)) / (F_{ml}(i) * Length)$$

Summary of Performance after Conversion to Continuous-access

- Site Specific
- Mixed performance during the formulation phase
  - Similar or higher throughput right before congestion
  - Similar or lower critical occupancy (easier to break down)
- Better performance during the dissipation phase
  - Fast shockwave speed (queue can dissipate at a faster speed at the end of the traffic congestion)
- More HOV lane changes
- More HOV violation

Questions?