

# Estimating the Impacts of Access Management with Micro-simulation: Lessons Learned

Bill Eisele

Bill Frawley

Casey Toycen, Roelof Engelbrecht, Kristin  
Turner, Anna Griffin Martin



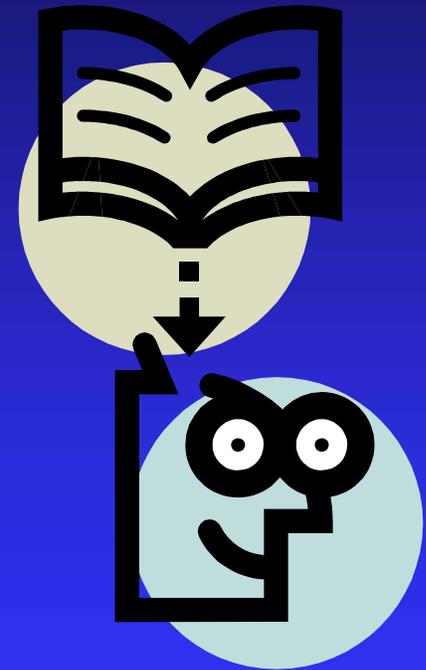
Sponsored by:



6<sup>th</sup> National Conference on Access Management  
8-30-2004

# Objectives

- Investigate the impacts of raised median installation and driveway density by traffic volume
  - ◆ 3 case studies
  - ◆ 3 theoretical corridors
- Investigate the use of a surrogate safety measure in micro-simulation
  - ◆ Time-to-collision
- Selecting a micro-simulation tool for access management alternatives analysis
  - ◆ Input and output characteristics
- Concluding thoughts and future work



# Methodology

- 3 case studies and 3 theoretical corridors
- Three simulation runs of each traffic volume
  - ◆ Each run provides a random estimate of the measure
  - ◆ Analyzed peak hour
  - ◆ Maintain O-D patterns
- Reduction in conflict points, travel time, speed and delay were analyzed
  - ◆ Travel time and speed of vehicles traversing the corridor
  - ◆ System delay
- Used VISSIM model
- Also ran time-to-collision analysis within VISSIM (1 run)
  - ◆ Proof-of-concept



# Three Case Studies (Characteristics)

<b>Location</b>	<b>Corridor Length (miles)</b>	<b>Signals per Mile / Access Points per Mile</b>	<b>Median Opening Spacing (feet)</b>	<b>Number of Lanes Each Direction</b>
Bryan, Texas	0.55	3.0 / 91	690 to 1,320	2
Temple, Texas	0.71	5.6 / 66	350 to 850	2
Tyler, Texas	1.47	4.1 / 46	500 to 1,500	3

- Median opening spacing for selected alternative

# Texas Case Study (Results)

Location	Percent Difference in Conflict Points	Estimated Existing ADT	Estimated Future ADT	Future Percent Difference in Travel Time	Future Actual Difference in Speed (mph)
Bryan, Texas	-60				
Temple, Texas	-56				
Tyler, Texas	-60				

- Large reduction in conflict points with raised median installation

# Texas Case Study (Results)

Location	Percent Difference in Conflict Points	Estimated Existing ADT	Estimated Future ADT	Future Percent Difference in Travel Time	Future Actual Difference in Speed (mph)
Bryan, Texas	-60	18,200	21,800		
			48,000		
Temple, Texas	-56	13,300	16,000		
Tyler, Texas	-60	24,400	29,300		
			48,000		

- Lower ADT is “existing +20%”
- Higher volume selected for further analysis

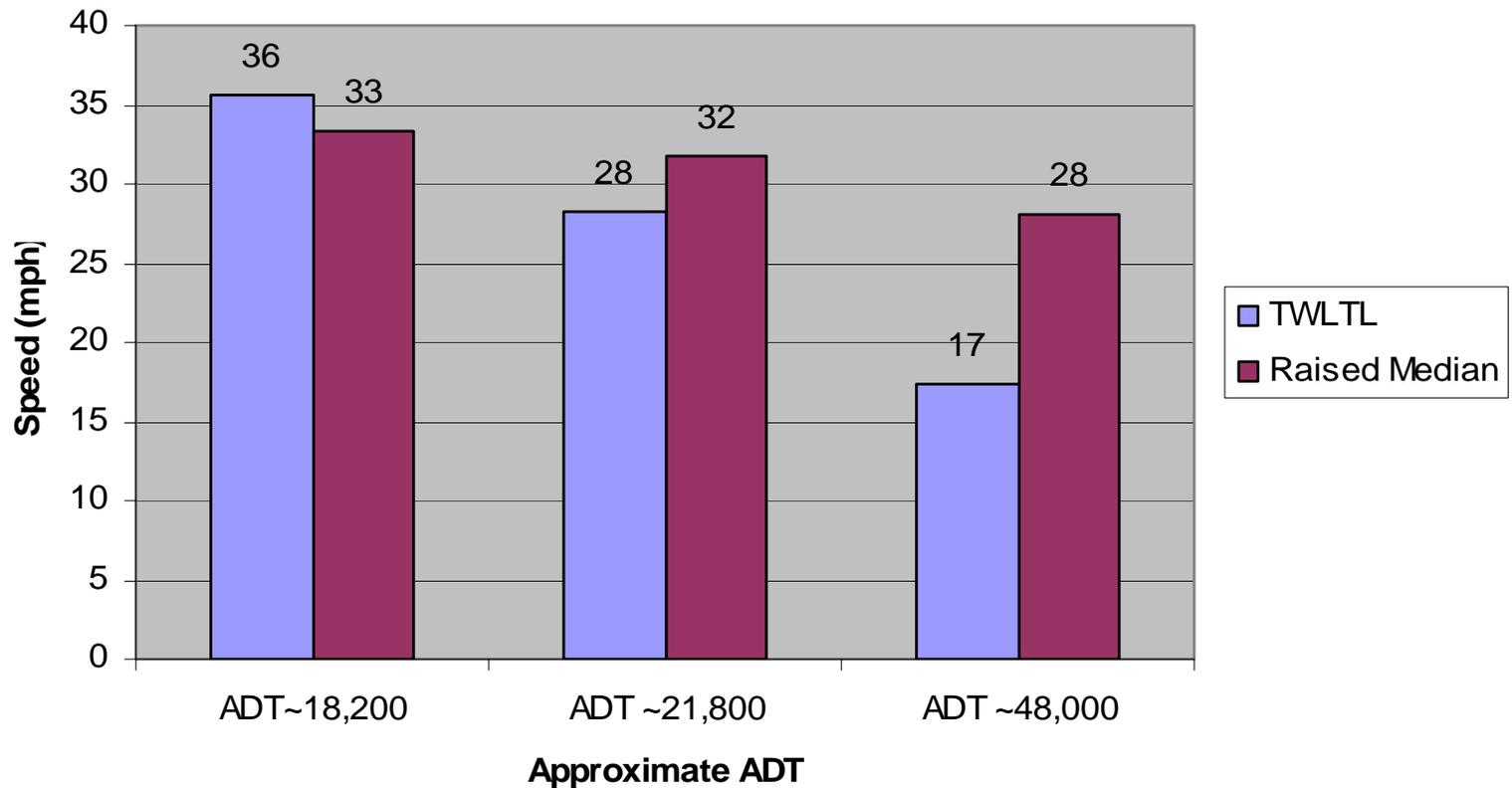
# Texas Case Study (Results)

Location	Percent Difference in Conflict Points	Estimated Existing ADT	Estimated Future ADT	Future Percent Difference in Travel Time	Future Actual Difference in Speed (mph)
Bryan, Texas	-60	18,200	21,800	-11	4 (increase)
			48,000	-38	11 (increase)
Temple, Texas	-56	13,300	16,000	3	1 (decrease)
Tyler, Texas	-60	24,400	29,300	2	<1 (decrease)
			48,000	57	4 (decrease)

- Case-specific results
- Function of traffic patterns, median opening locations, etc.

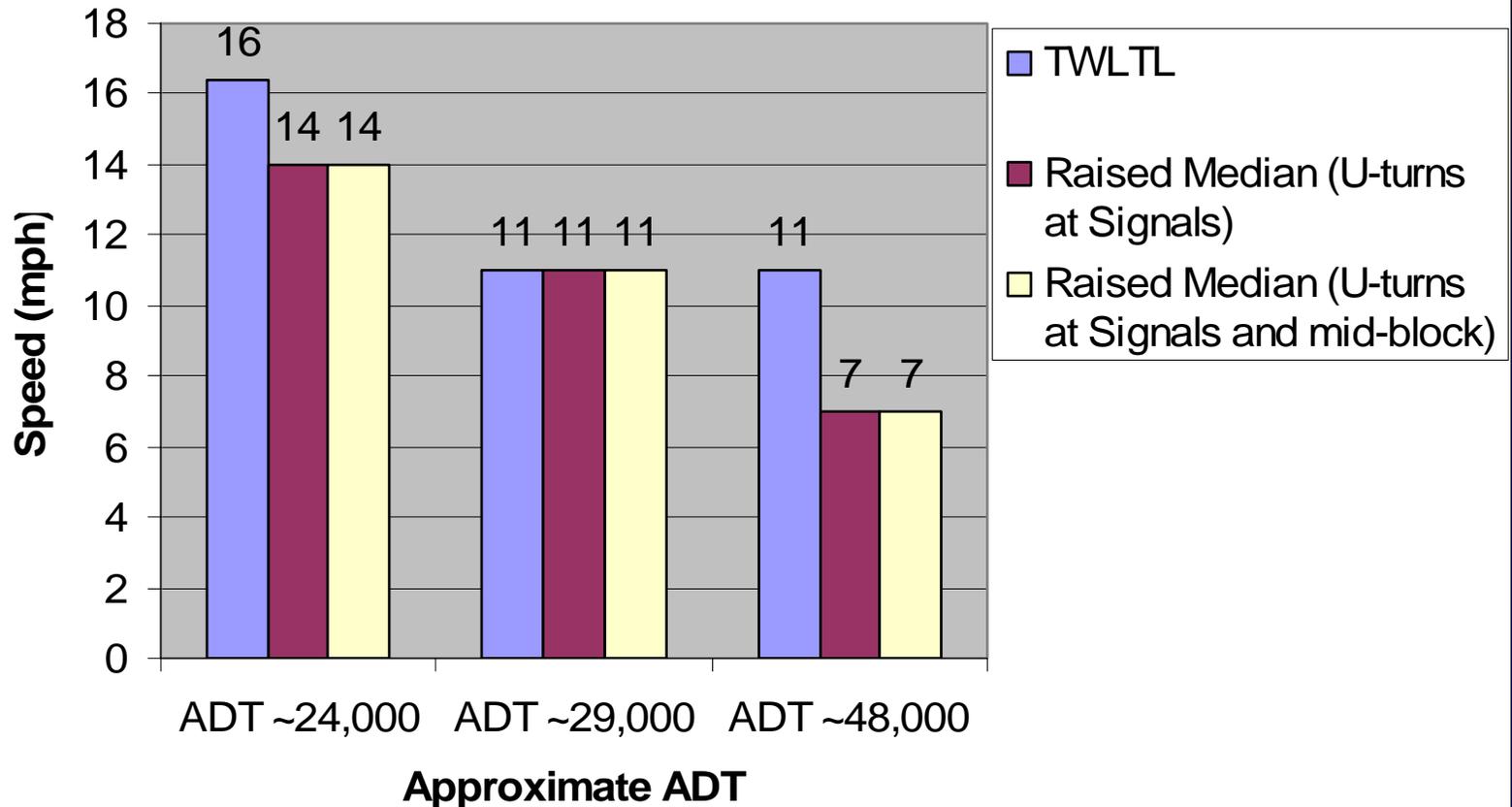
# Bryan, Texas Speed Results

Texas Avenue (Speed Results)



# Tyler, Texas Speed Results

## Broadway Avenue (Speed Results)



# Theoretical Scenarios (Characteristics)

Theoretical Corridor	Median Treatment	Number of Lanes in Each Direction	Number of Driveways	Driveway Spacing (feet)	Raised Median Opening Spacing (feet)
Scenario 1	TWLTL and Raised	2	18	660	660
Scenario 2	TWLTL	2	42	330	660
	Raised				
Scenario 2	TWLTL	3	42	330	660
	Raised				
Scenario 3	TWLTL	3	84	165	660
	Raised				

- ITE trip generation, driveways across from each other

<b>Theoretical Corridor</b>	<b>Estimated Future ADT</b>	<b>Future Percent Difference in Travel Time</b>	<b>Future Actual Difference in Speed (mph)</b>
Scenario 1	18,000 to 28,000		
Scenario 2 (2 lanes)	18,000		
	23,000		
	28,000		
Scenario 2 (3 lanes)	18,000		
	23,000		
	28,000		
	48,000		
Scenario 3 (3 lanes and higher driveway density)	18,000		
	23,000		
	28,000		
	33,000		
	38,000		
	48,000		

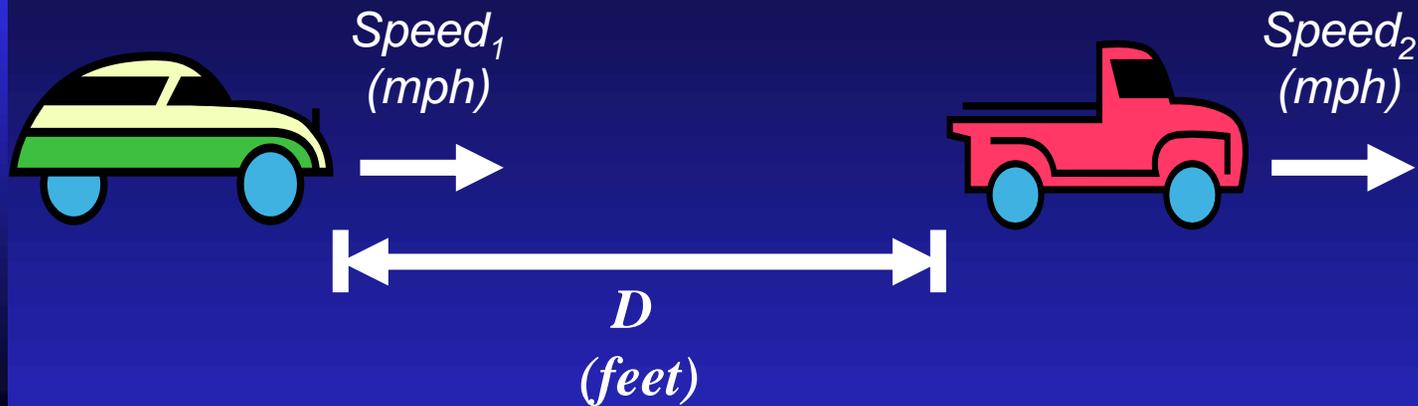
<b>Theoretical Corridor</b>	<b>Estimated Future ADT</b>	<b>Future Percent Difference in Travel Time</b>	<b>Future Actual Difference in Speed (mph)</b>
Scenario 1	18,000 to 28,000	Not Applicable	Not Applicable
Scenario 2 (2 lanes)	18,000	2	0 (same)
	23,000	6	2 (decrease)
	28,000	31	7 (decrease)
Scenario 2 (3 lanes)	18,000	7	2 (decrease)
	23,000	8	3 (decrease)
	28,000	11	3 (decrease)
	48,000	44	9 (decrease)
Scenario 3 (3 lanes and higher driveway density)	18,000	6	2 (decrease)
	23,000	1	1 (decrease)
	28,000	2	0 (same)
	33,000	6	2 (decrease)
	38,000	23	6 (decrease)
	48,000	10	2 (decrease)

# Conflict and Safety Analysis

- Crash data suspect, incomplete, or unavailable
- Micro-simulation as a tool
- Distance between vehicles divided by speed difference is time-to-collision (TTC)
- Rear-end only evaluated here (others later)
- TTC threshold of 4 and 10 seconds
- Number of assumptions—real drivers not “perfect”
- Relative safety performance of alternatives
  - ◆ Access, medians, signals....



# Time-to-collision Illustration

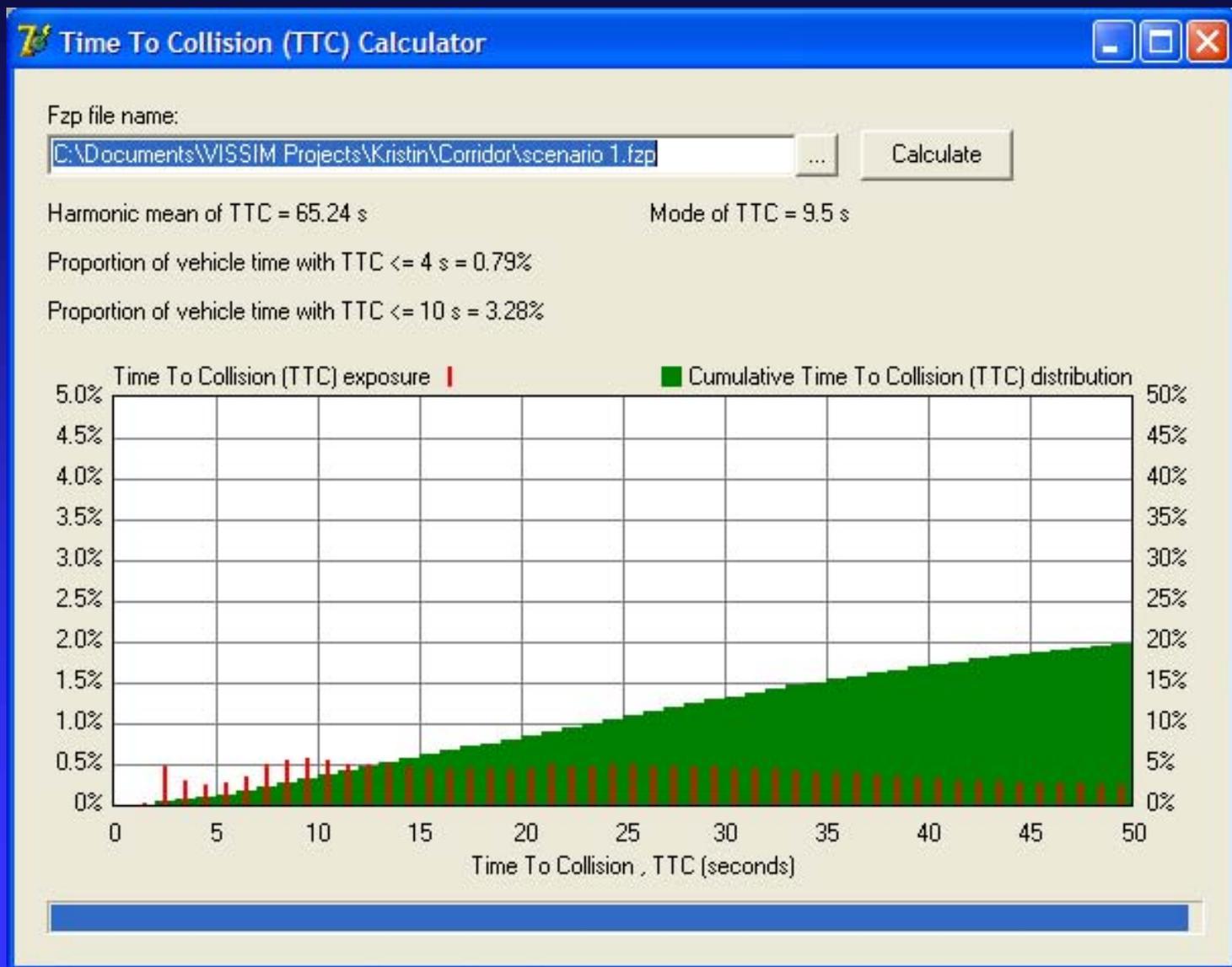


$$\text{Time-to-collision (seconds)} = \frac{D \times 3,600}{(Speed_1 - Speed_2) \times 5,280}$$

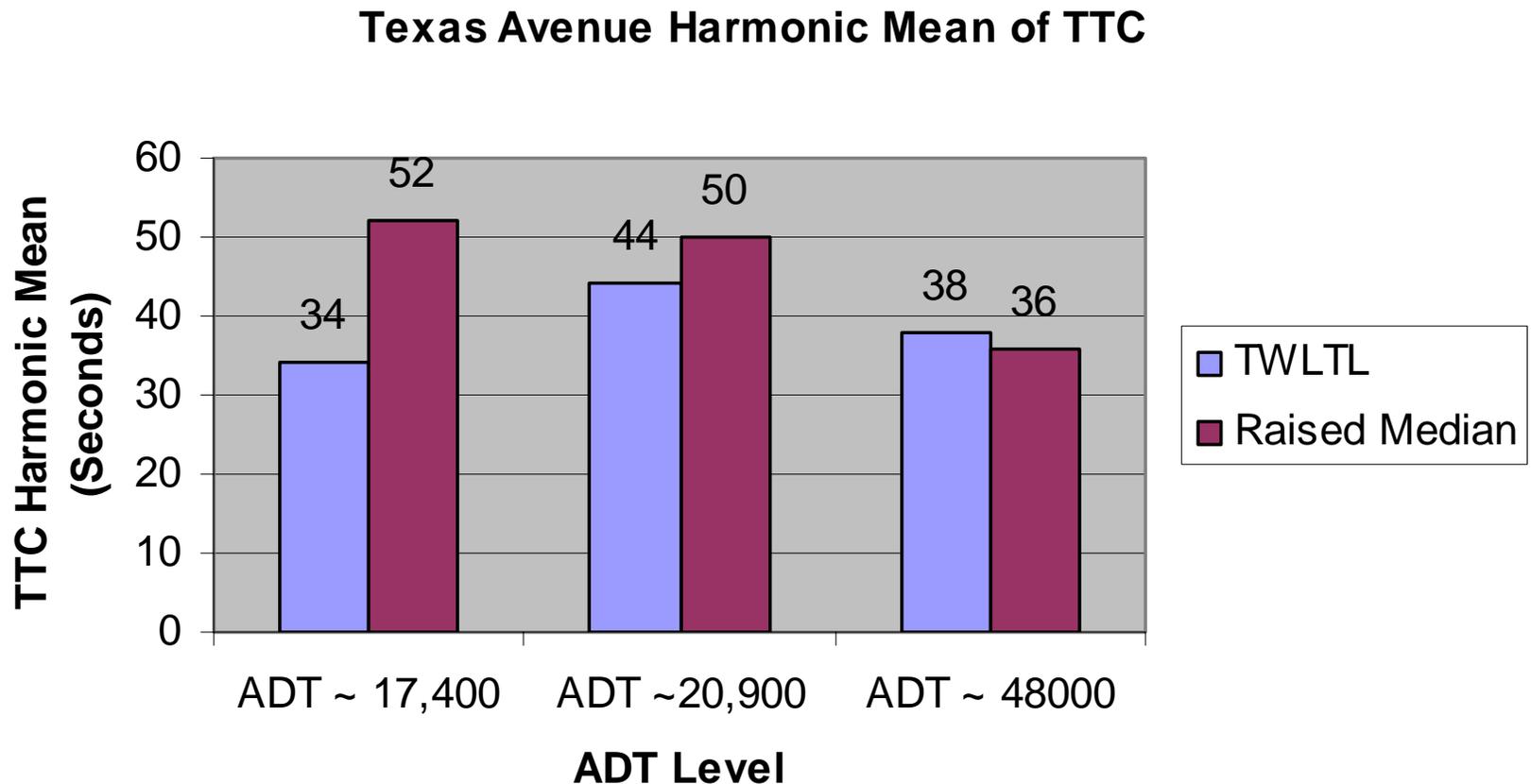
Example:

$$\text{Time-to-collision (seconds)} = \frac{100 \text{ feet} \times 3,600 \text{ seconds/hour}}{(30 \text{ mph} - 15 \text{ mph}) \times 5,280 \text{ feet/mile}} = 4.5 \text{ seconds}$$

# Conflict and Safety Analysis

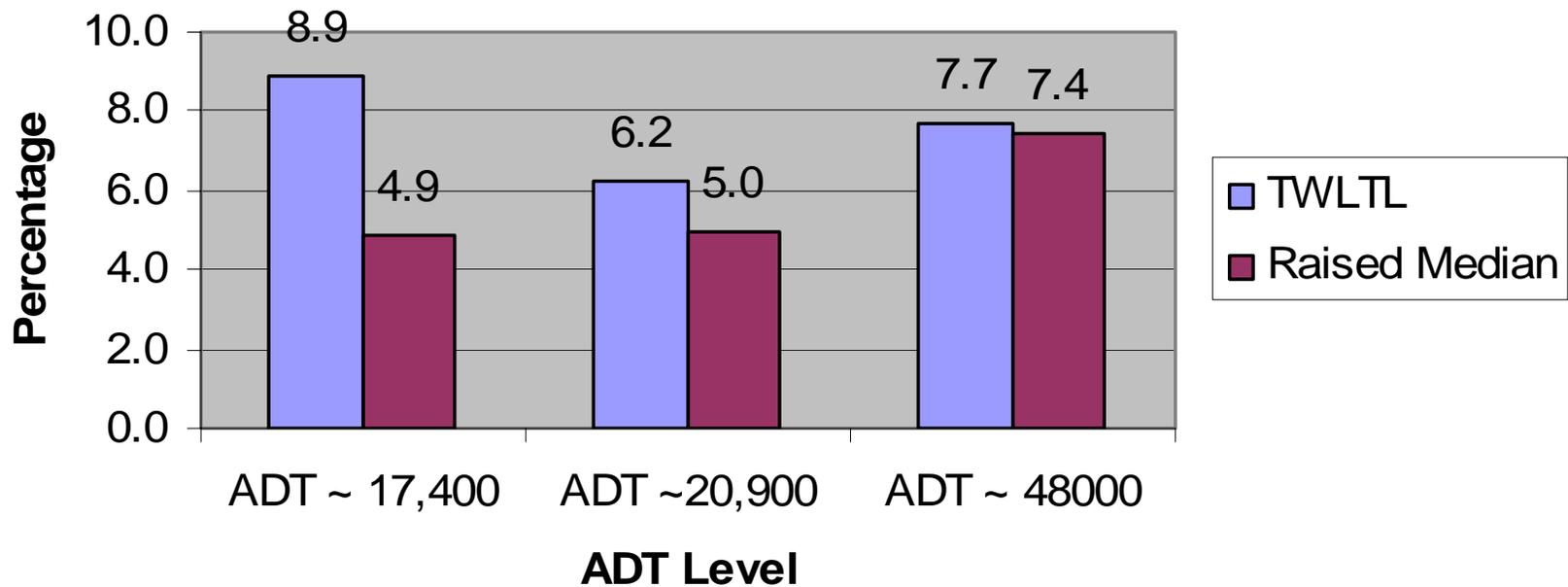


TWLTL generally lower harmonic mean  
(as expected for increased conflict  
points).....



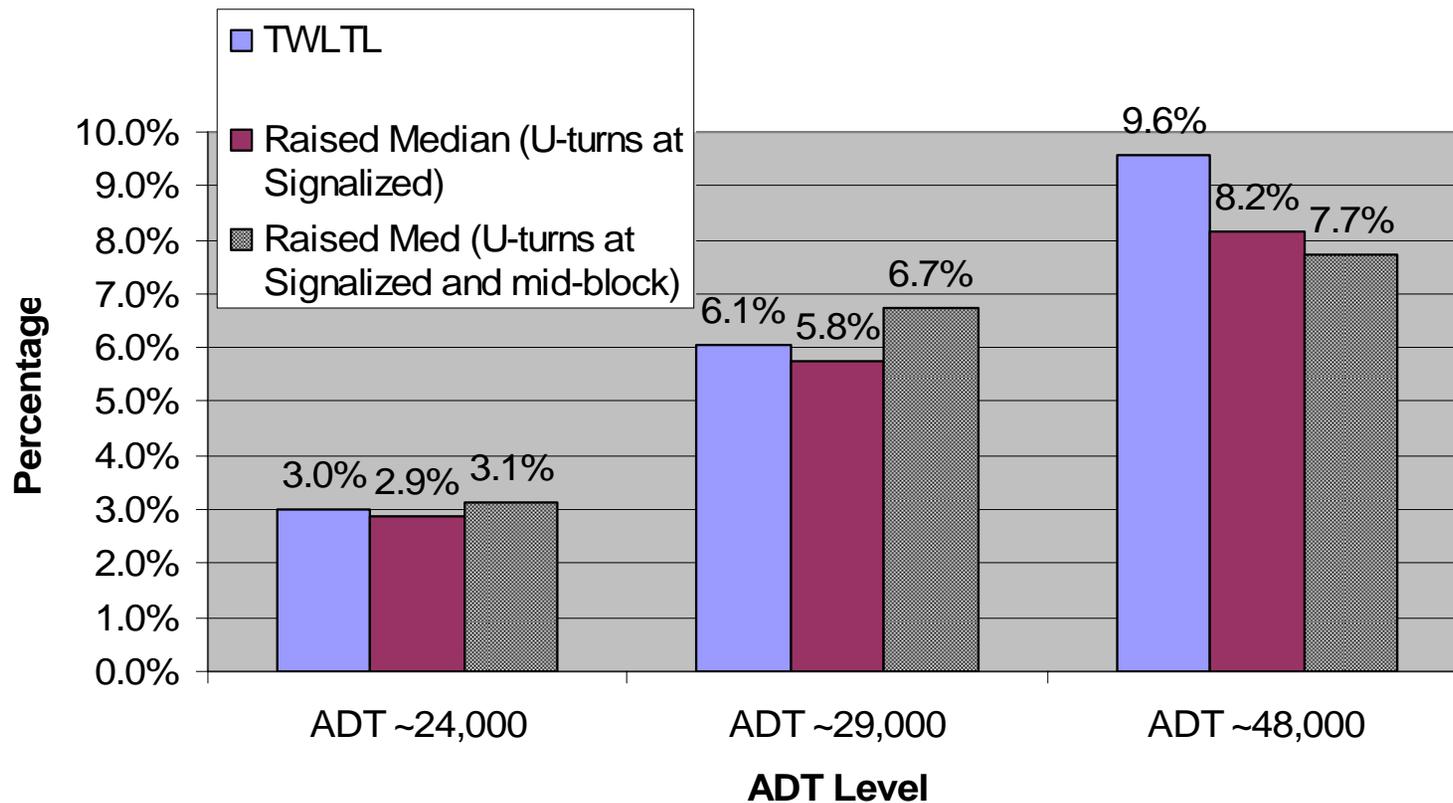
...which equates to higher proportion of vehicle time at  $\leq 10$  seconds for the TWLTL alternative.

### Texas Avenue Proportion of Vehicle Time with TTC $\leq 10$ Seconds



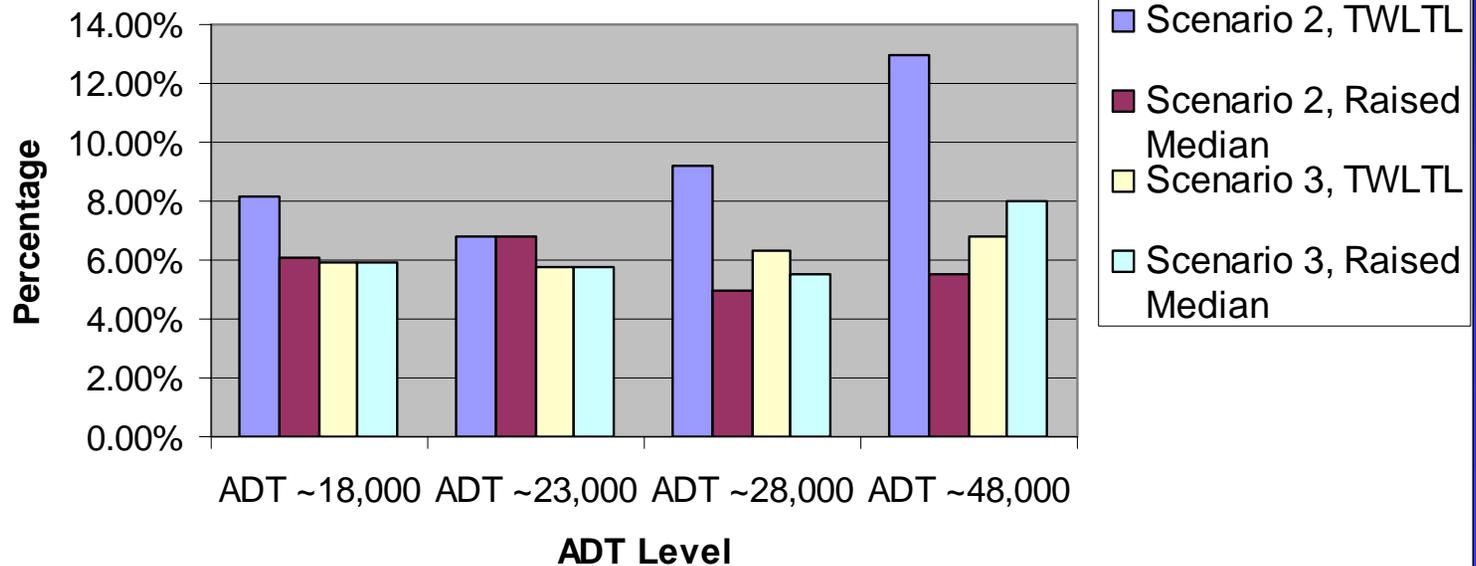
# Similar result on Tyler corridor...

**Broadway Avenue**  
**Proportion of Vehicle Time with TTC  $\leq$  10 Seconds**



...and on the theoretical corridors.

**Scenario 2 and Scenario 3  
(3 Lanes Each Direction)  
Proportion of Vehicle Time with  
TTC  $\leq$  10 Seconds**



# Selecting a Micro-simulation Tool

## ■ Input characteristics

- ◆ Complex situations, individual drivers
- ◆ Geometric inputs
  - ◆ Scale, auxiliary lanes, turning radii, lane width
- ◆ Operational inputs
  - ◆ Gap acceptance, speeds, accelerations
  - ◆ Signal optimization
- ◆ Calibration (evaluate default values)
- ◆ O-D, and other underlying theory

# Selecting a Micro-simulation Tool

## ■ Output characteristics

- ◆ Analysis at the individual vehicle level
- ◆ Spatial
  - ◆ By location—intersections, median openings
- ◆ Temporal
  - ◆ Over time—platooning, queuing
- ◆ Animation features
  - ◆ Visual consistency
  - ◆ 3-dimensions



# Concluding Thoughts

- Results from raised median installation are case-specific
- Caution should be used when generalizing AM impacts across corridors
- Function of traffic volumes, driveway density, weaving (o-d patterns), median opening location and density, decel lane length, signal coordination, speed distribution, driver behavior, etc.
- Micro-simulation allows detailed corridor analysis



# Concluding Thoughts

- Relatively small increases in travel time are likely offset by the well-documented increase in safety
  - ◆ NCHRP 395, NCHRP 420
  - ◆ Bill Frawley's talk tomorrow
- TTC appears to be a promising method for assessing safety in the micro-simulation environment
  - ◆ Indexed ranking of alternatives
- Must coordinate access management analysis needs with micro-simulation tool

# Future Work

- More runs that vary median opening number, median opening spacing and location, driveway density, traffic volume, decel lane length, etc. to populate larger matrix
- Expansion of TTC to angle crashes
- Additional TTC runs

# Contact Information

Bill Eisele, Ph.D., P.E.

979/845-8550

bill-eisele@tamu.edu

Bill Frawley, AICP

817/462-0533

w-frawley@tamu.edu

Can't get enough of this?!?....

See poster at the break!

Full paper on CD (or contact me)!