

# Traffic Volume Thresholds for Identifying Driveway Turn Restrictions

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# Objective

Evaluate driver compliance and overall turn restriction effectiveness for turn restrictions located:

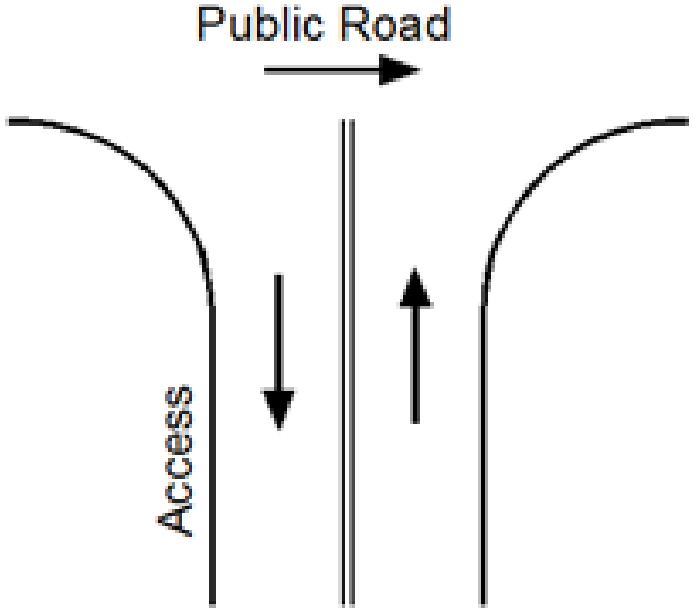
- Only at an access point location,
- As part of the roadway, and
- Combination of at the access point and road configuration options.



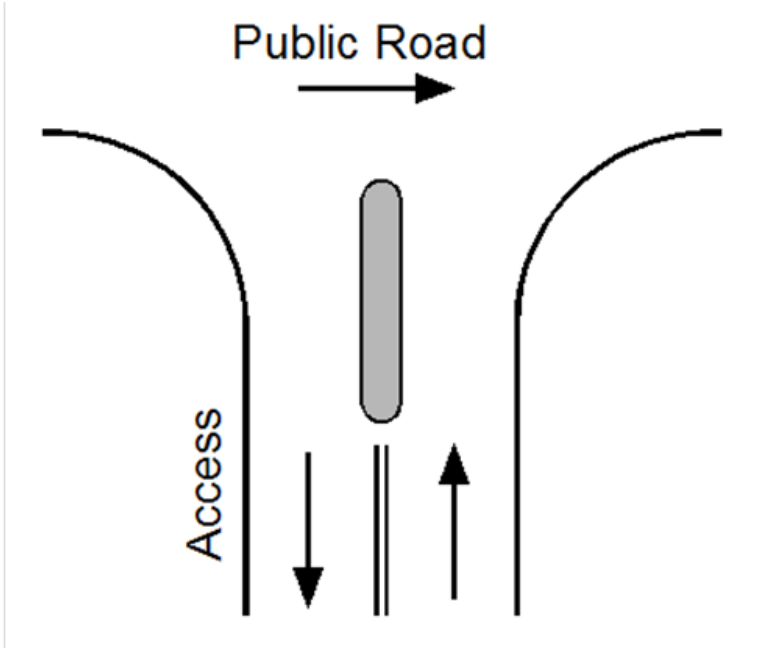
# Outline of Presentation

- Literature / state of practice review,
- Field observations,
- Companion safety assessments, and
- Micro-simulation analysis (to evaluate the various aspects of these turn restriction alternatives)

# No Turn Restriction or Signage Only

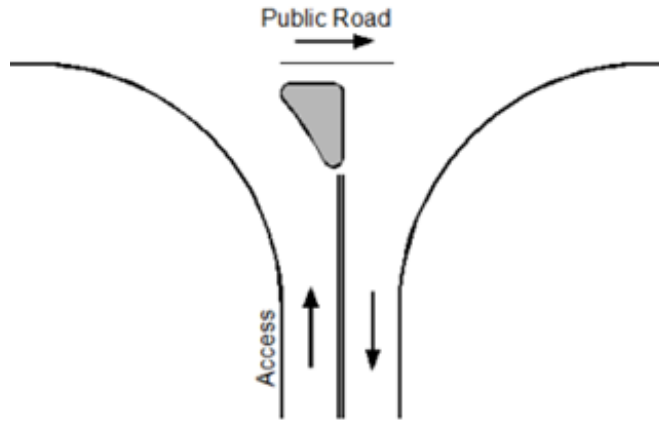


Unrestricted Access

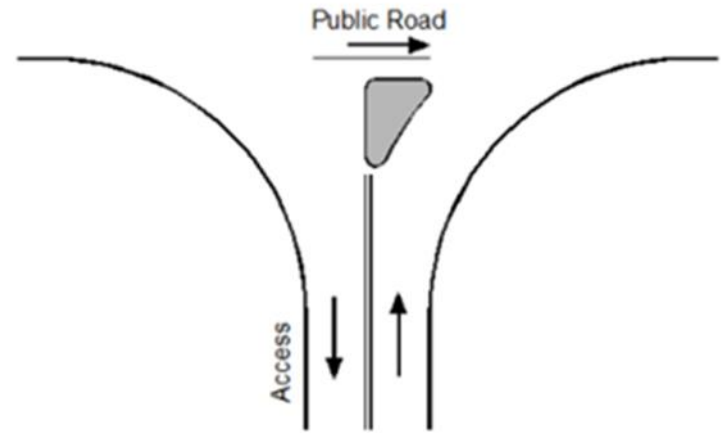


Access with Median Divider

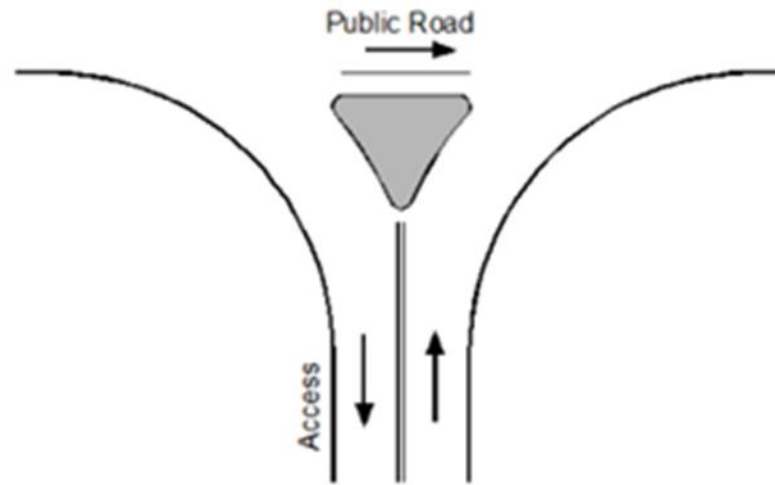
# Island Turn Restrictions



RIROLO Access



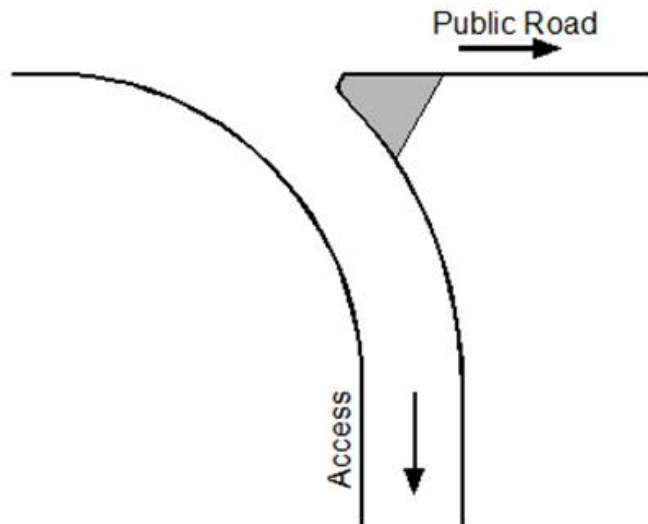
RIROLI Access



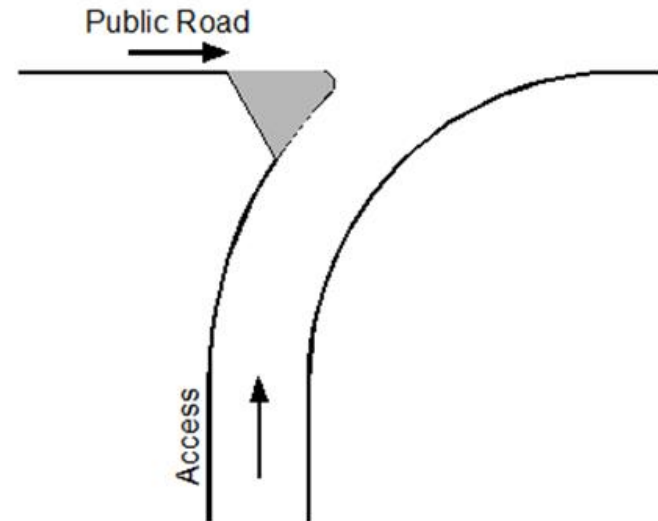
RIRO Access



# Island Turn Configurations

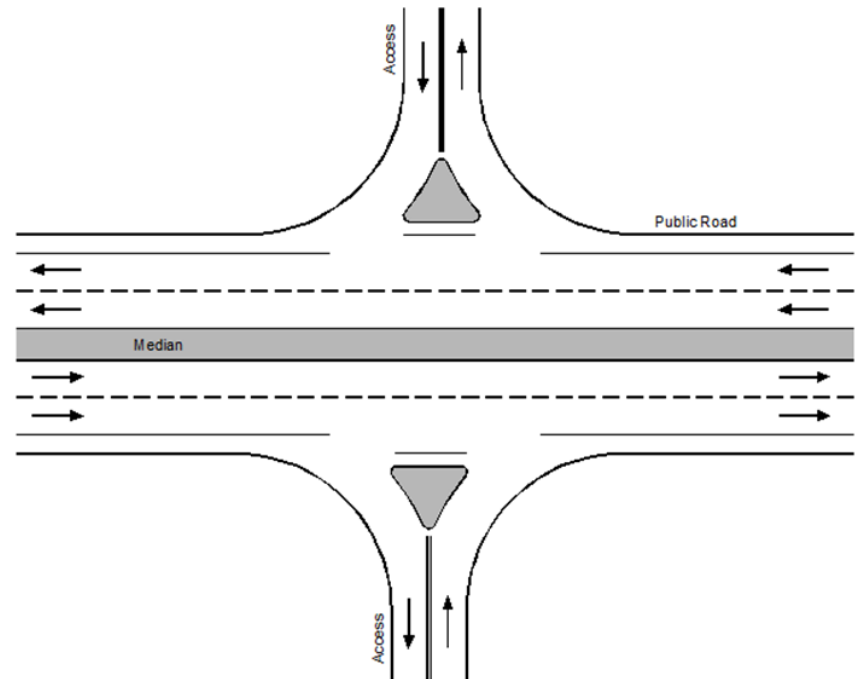
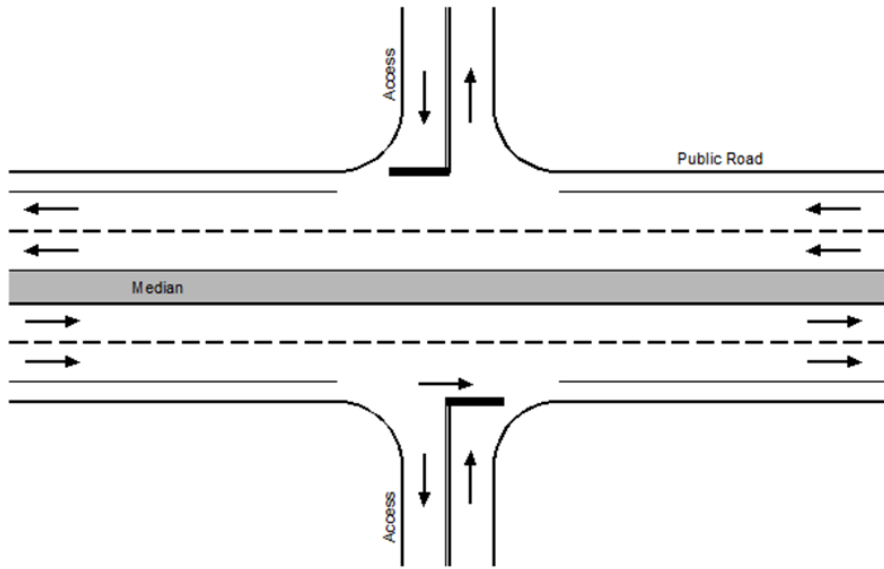


Right-In Only Access

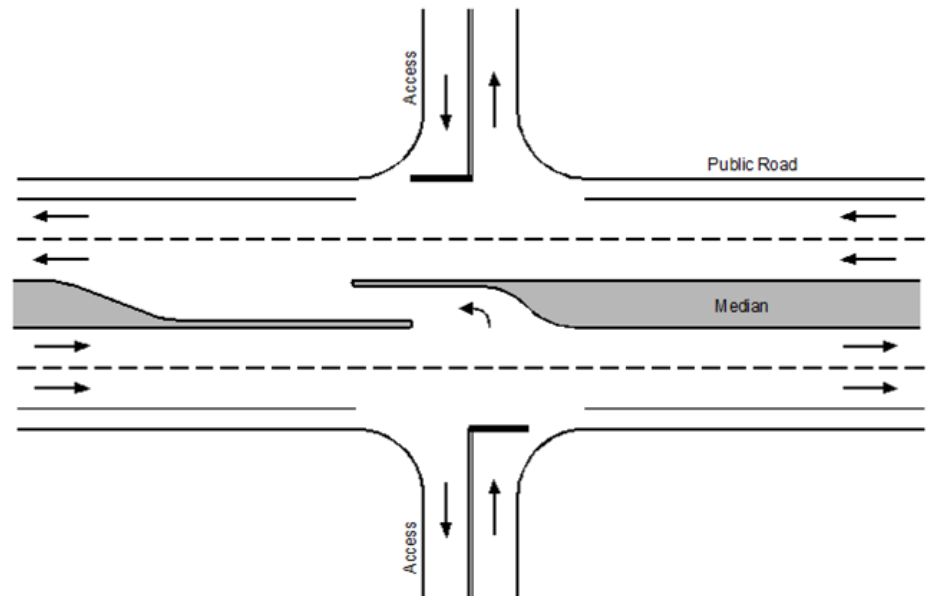
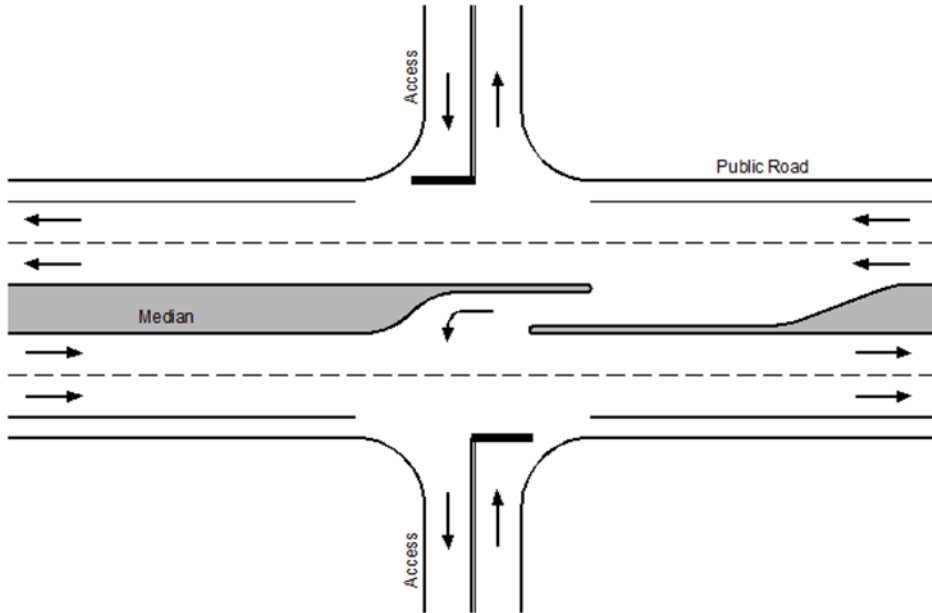


Right-Out Only Access


# Physical Median Constraints



# Median Directional Openings







# Traffic Volume Threshold to Install Non-traversable Median

State	Threshold	
	Average Daily Traffic Volume (vpd)	Number of Lanes
Georgia	24,000 (design year)	Multilane
Idaho	28,000	All State highways
Mississippi	25,000	N/A
Texas	20,000	N/A
Utah	20,000	Multilane limited access highways
Wyoming	24,000	Multilane urban arterials

NA = Not Applicable

# Design Speed Threshold to Install Non-traversable Median

State	Threshold	
	Design Speed (mph)	Roadway
Connecticut	50	Urban highways and streets
Florida	40	NA
Idaho	45	Multilane State highways
Indiana	45	Urban highways and streets
Kansas	45	In developed locations
Massachusetts	45	Arterials, collector and local roads in densely developed areas
Minnesota	45	NA
Montana	45	Urban and suburban highways and streets
New York	50	Highway
South Dakota	N/A	Low speed arterial roads

NA = Not Applicable

# Example Study Site – RIRO Median Constrained



# Example Turning Violation Field Data Summary

Turning Movement	Legally Permitted	Morning Off-Peak Volume (vph)		Percent of Turn-Restriction Violations
		Total	Trucks	All Vehicles
Right-in	Yes	31	1	NA
Right-out	Yes	5	0	
Left-in	No	0	0	
Left-out	No	0	0	
Total Into Driveway		31	1	0%
Total Out of Driveway		5	0	0%
Total Driveway Volume		36	0	0%

NA = Not Applicable



# Example Crash Summary for a Site

<b>Year</b>	<b>Number of PDO Crashes</b>	<b>Number of Injury Crashes</b>	<b>Comments</b>
2010	1	0	Angle crash
2011	1	0	Rear-end crash
2012	0	0	--
2013	2	1	All rear-end crashes, but the injury crash involved 6 vehicles
Total	4	1	Only 1 injury crash in vicinity of median treatment



# Summary of Field Study Observations

# RIRO Turn Restriction Compliance Summary

Site	Ingress Compliance (%)	Egress Compliance (%)	Adjacent Two-Way Traffic Volume (vph)	Corner Clearance (ft)
<b>Driveway-Only Constrained</b>				
OR-5	86	50	2419 (off-peak)	65
OR-6	100	85	1299 (off-peak), 1230 (peak)	65
OR-7	95	100	1897 (off-peak), 2218 (peak)	256
OR-9	100	100	2582 (peak)	84
OR-12	100	100	1424 (off-peak)	118
TX-15	97	95	1739 (peak)	152
TX-18	62	92	1407 (peak)	230
TX-20	98.5	97.5	854 (peak)	703

# RIROLI Turn Restriction Compliance Summary

<b>Site</b>	<b>Ingress Compliance (%)</b>	<b>Egress Compliance (%)</b>	<b>Adjacent Two-Way Traffic Volume (vph)</b>	<b>Corner Clearance (ft)</b>
<b>Driveway-Only Constrained</b>				
OR-8	--	80	1817 (off-peak)	184
OR-10	--	67	2505 (peak)	659
OR-11	--	98	2505 (peak)	659
OR-13	--	95	1618 (off-peak), 1684 (peak)	387
OR-14	--	100	1684 (peak)	387






# Turn Restriction Compliance at Field Sites

Site	Available Turning Maneuvers	Ingress Compliance (%)	Egress Compliance (%)	Adjacent Two-Way Traffic Volume (vph)	Corner Clearance (ft)
<b>Median-Only Constrained</b>					
OR-2	RIROLO	100	--	1882 (off-peak), 1962 (peak)	646
OR-3	RIRO	100	100	1877 (off-peak)	646
OR-4	RIROLI	--	100	1788 (off-peak), 2172 (peak)	294



# Turn Restriction Compliance at Field Sites

Site	Available Turning Maneuvers	Ingress Compliance (%)	Egress Compliance (%)	Adjacent Two-Way Traffic Volume (vph)	Corner Clearance (ft)
<b>Median and Driveway Constrained</b>					
OR-1	RIROLI	--	100	2253 (off-peak), 2549 (peak)	877
TX-16	RIRO	100	100	1127 (off-peak)	380
TX-17		91	100	1484 (peak)	267
TX-19		99	97	1423 (peak)	383



# Summary of Micro-Simulation Evaluation

(based on 3560 individual simulation runs)

# Land Use Descriptions

- **Light retail/commercial/residential** (access point volume  $\leq 60$  vph during peak conditions)  
– typically **5% or less** than adjacent road
- **Moderate retail/commercial/residential**  
(access point volume ranging from 61 to 139 vph during peak conditions)
- **Heavy retail/commercial/residential** (access point volume  $\geq 140$  vph during peak conditions) – typically **10% or more** of adjacent Road



# Speed Reduction (SR) Thresholds

- $\leq 10\%$  SR
- $20\% \leq SR < 10\%$
- $30\% \leq SR < 20\%$
- $> 30\%$

# Expected Performance for 4-Lane Light to Moderate Land Use Access

Test Scenario Description	1500 vph	2000 vph	2500 vph	3000 vph	3500 vph	4000 vph	4500 vph
No Access Points	$\leq 10\% \text{ SR}$						$20\% \leq \text{SR} < 10\%$
<b>20 Access Points per Mile</b>							
All	$\leq 10\% \text{ SR}$		$20\% \leq \text{SR} < 10\%$			$30\% \leq \text{SR} < 20\%$	$> 30\%$
RIROLI							
RIROLO			$\leq 10\% \text{ SR}$		$20\% \leq \text{SR} < 10\%$		
RIRO							
<b>40 Access Points per Mile</b>							
All	$20\% \leq \text{SR} < 10\%$				$30\% \leq \text{SR} < 20\%$		$> 30\%$
RIROLI	$\leq 10\% \text{ SR}$				$20\% \leq \text{SR} < 10\%$		
RIROLO							
RIRO							
Legend: SR = Speed Reduction (Simulated Speed Compared to Target Speed)							

# Expected Performance for 4-Lane Heavy Land Use Access

Test Scenario Description	1500 vph	2000 vph	2500 vph	3000 vph	3500 vph	4000 vph	4500 vph
No Access Points	$\leq 10\%$ SR						$20\% \leq \text{SR} < 10\%$
<b>20 Access Points per Mile</b>							
All		$20\% \leq \text{SR} < 10\%$			$30\% \leq \text{SR} < 20\%$		$> 30\%$
RIROLI		$\leq 10\%$ SR			$20\% \leq \text{SR} < 10\%$		
RIROLO							
RIRO							
<b>40 Access Points per Mile</b>							
All	$20\% \leq \text{SR} < 10\%$			$30\% \leq \text{SR} < 20\%$		$> 30\%$	
RIROLI	$\leq 10\%$ SR			$20\% \leq \text{SR} < 10\%$			
RIROLO							
RIRO							
Legend: SR = Speed Reduction (Simulated Speed Compared to Target Speed)							

# Expected Performance for 5-Lane Light to Moderate Land Use Access

Test Scenario Description	2000 vph	2500 vph	3000 vph	3500 vph	4000 vph	4500 vph	5000 vph	5500 vph	6000 vph
No Access Points	≤ 10% SR				20% ≤ SR < 10%				
<b>20 Access Points per Mile</b>									
All	≤ 10% SR	20% ≤ SR < 10%			30% ≤ SR < 20%		> 30%		
RIROLI									
<b>40 Access Points per Mile</b>									
All	20% ≤ SR < 10%			30% ≤ SR < 20%		> 30%			
RIROLI									
Legend: SR = Speed Reduction (Simulated Speed Compared to Target Speed)									



# Expected Performance for 5-Lane Heavy Land Use Access

Test Scenario Description	2000 vph	2500 vph	3000 vph	3500 vph	4000 vph	4500 vph	5000 vph	5500 vph	6000 vph
No Access Points	$\leq 10\%$ SR				$20\% \leq SR < 10\%$				
<b>20 Access Points per Mile</b>									
All	$20\% \leq SR < 10\%$			$30\% \leq SR < 20\%$		$> 30\%$			
RIROLI									
<b>40 Access Points per Mile</b>									
All	$20\% \leq SR < 10\%$		$30\% \leq SR < 20\%$			$> 30\%$			
RIROLI									
Legend: SR = Speed Reduction (Simulated Speed Compared to Target Speed)									

# Expected Performance for 6-Lane Light to Moderate Land Use Access

Test Scenario Description	4000 vph	4500 vph	5000 vph	5500 vph	6000 vph	6500 vph
No Access Points	$\leq 10\%$ SR					$20\% \leq \text{SR} < 10\%$
<b>20 Access Points per Mile</b>						
All	$20\% \leq \text{SR} < 10\%$		$30\% \leq \text{SR} < 20\%$		$> 30\%$	
RIROLI						
RIROLO	$\leq 10\%$ SR			$20\% \leq \text{SR} < 10\%$		
RIRO						
<b>40 Access Points per Mile</b>						
All	$20\% \leq \text{SR} < 10\%$		$30\% \leq \text{SR} < 20\%$		$> 30\%$	
RIROLI						
RIROLO	$\leq 10\%$ SR			$20\% \leq \text{SR} < 10\%$		
RIRO						
Legend: SR = Speed Reduction (Simulated Speed Compared to Target Speed)						

# Expected Performance for 6-Lane Heavy Land Use Access

Test Scenario Description	4000 vph	4500 vph	5000 vph	5500 vph	6000 vph	6500 vph
No Access Points	≤ 10% SR					20% ≤ SR < 10%
<b>20 Access Points per Mile</b>						
All	30% ≤ SR < 20%			> 30%		
RIROLI						
RIROLO	≤ 10% SR	20% ≤ SR < 10%			30% ≤ SR < 20%	
RIRO						
<b>40 Access Points per Mile</b>						
All	30% ≤ SR < 20%			> 30%		
RIROLI						
RIROLO	≤ 10% SR	20% ≤ SR < 10%			30% ≤ SR < 20%	
RIRO						
Legend: SR = Speed Reduction (Simulated Speed Compared to Target Speed)						

# Tips on Selecting Appropriate Treatment

- 1) Does the location provide adequate corner clearance?
- 2) Will any level of driver non-compliance be acceptable if turn restrictions are needed (for existing sites, do crash types include mid-block angle and head-on collisions)?
- 3) What additional speed reduction is acceptable if this and similar access points are constructed along the corridor?

# Example – 4 Lane Light to Moderate Land Use

- Driveway request located approximately 1000' from the nearest intersection
- Traffic volume along corridor approximately 4000 vph during the peak period
- Number of approximate access points per mile (both sides of the road) is 20.

**Problem to Consider:** Is it appropriate to permit construction of this driveway and are any supplemental turn restrictions recommended?

# Responses to Questions

- 1) A corner clearance of **1000 feet** should be adequate.
- 2) Safety is very important, but the agency does recognize that minor non-compliance could occur and accepts this potential risk.
- 3) The corridor is part of a larger network that must maintain good operations during the peak period. The total allowable reduction in speed (due to the increased peak hour traffic as well as friction due to turning maneuvers) is **15 percent**.

# Road 4000 vph, 20 access pts/mile, 15% SR

## RIROLO or RIRO Recommended

Test Scenario Description	1500 vph	2000 vph	2500 vph	3000 vph	3500 vph	4000 vph	4500 vph
No Access Points	$\leq 10\%$ SR						$20\% \leq \text{SR} < 10\%$
<b>20 Access Points per Mile</b>							
All	$\leq 10\%$ SR		$20\% \leq \text{SR} < 10\%$			$30\% \leq \text{SR} < 20\%$	$> 30\%$
RIROLI	$\leq 10\%$ SR		$20\% \leq \text{SR} < 10\%$			$30\% \leq \text{SR} < 20\%$	$> 30\%$
RIROLO	$\leq 10\%$ SR		$20\% \leq \text{SR} < 10\%$			$20\% \leq \text{SR} < 10\%$	$20\% \leq \text{SR} < 10\%$
RIRO	$\leq 10\%$ SR		$20\% \leq \text{SR} < 10\%$			$20\% \leq \text{SR} < 10\%$	$20\% \leq \text{SR} < 10\%$
<b>40 Access Points per Mile</b>							
All	$20\% \leq \text{SR} < 10\%$				$30\% \leq \text{SR} < 20\%$		$> 30\%$
RIROLI	$20\% \leq \text{SR} < 10\%$				$30\% \leq \text{SR} < 20\%$		$> 30\%$
RIROLO	$\leq 10\%$ SR				$20\% \leq \text{SR} < 10\%$		
RIRO	$\leq 10\%$ SR				$20\% \leq \text{SR} < 10\%$		
Legend: SR = Speed Reduction (Simulated Speed Compared to Target Speed)							



# Conclusions

- Driveway-specific and Roadway access treatments can provide practical options
- Number of crashes significantly reduced when median present
- Development of tool for selection of turn restriction type that considers land use, road volume, treatment type, and percentage of acceptable speed reduction





# Questions & Discussion