The Impact of Access: How Signals, Intersections, and Driveways Impact Our Safety, Mobility, and Economy!

COMPASS
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TRB Access Mgmt Conference, Natchez Mississippi, October 2010

Why we need access management in today's economic situation

- Helps preserve capacity
- Significantly reduces the human carnage on the roadway
- Thereby helping prevent the costs and suffering associated with accidents
- Preserving roadway function to reduce the need to re-construct.

Why Access Mgmt Important Today?

- It supports sustainability
- It is cost effective
- It preserves the function of roadways
- It reduces accidents
- It improves capacity

What is Access Management

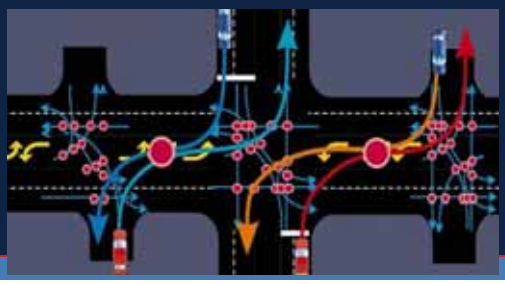
- Managing each point of access to a road.
- Driveways and intersections
- Interchanges and interchange crossroads

- Goals: Smoother traffic flow
- Better travel times
- Less stressful drive
- Fewer accidents

SAFETY is a big component of Access Management

In its simplest form, Access Management is Conflict Management

- If you reduce the rate and severity of conflicts the motorist encounters, you will reduce the crash rate, the injury rate and increase the smooth flow of traffic.



Roadways are the Most Dangerous Public Facilities on the Face of the Earth

- In the US, about 800 people are killed each **week**
- 16,000 Crashes each **day**
- 6,500 Injuries each **day**

- The leading cause of death of a child, age 3 to 14 is a traffic crash.
- 32 fatal week, >3,000 inj.

At the current U.S. crash rate, one child of every 90 born today will die violently in a motor vehicle crash. 70 out of every 100 will be injured at some point in their lives.

AASHTO Strategic Highway Safety Plan, December 2004

Idaho Fatal Rates Higher

Year		Fatalities	Total Vehicle Miles Traveled (Millions)	Fatalities Per 100 Million Vehicle Miles Traveled	Total Population	Fatalities Per 100,000 Population
2007	Idaho	252	15,782	1.60	1,496,145	16.84
	US	41,259	3,032,399	1.36	301,290,332	13.69
	Best State*			0.79		6.55
2008	Idaho	232	15,251	1.52	1,523,816	15.22
	US	37,261	2,973,509	1.25	304,059,724	12.25
	Best State*			0.67		5.59

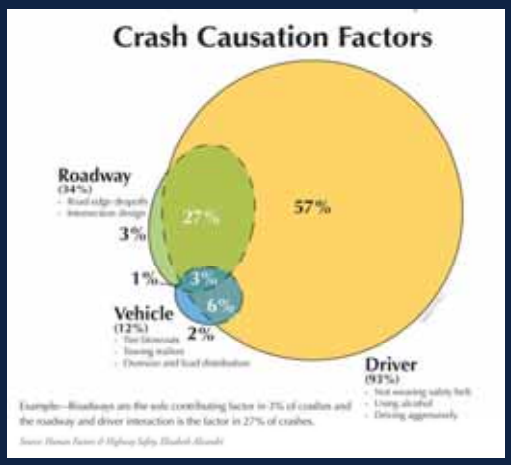
Per population: OR = 10.98 WA = 7.96 Utah = 10.05

Fatal Rates, International Comparison

- UK, 6.1 per 100,000 population.
- Japan, 7.0 per 100,000
- Australia, 8.2 per 100,000
- US, 13.69 in 2007

Managing road design

- Do we design for the vehicle?
  - Size, stopping distance
- Or for the driver?
  - Reaction time, speeding, inattentiveness
  - Work load, conflict frequency
- "6,000 people died last year (2008) in accidents that involved someone texting or talking on their phone. Another 500,000 were injured." (Dec 2009) Victor Mendez, Administrator, Federal Highway Administration



Minnesota DOT

- If no human errors, there should only be 7% of the current crash history
- human error contributes to the other 93%
-
- Each Year
- Idaho crashes drop from 26,000 to 1,800
- Injuries drop from 13,000 to 900.
- This will not happen.

Again

- Do we design for the vehicle?
  - Size, stopping distance
- Or for the driver?
  - Reaction time, speeding, inattentiveness
- Conflict management is designing for the driver

Driver Work-Load is a Rate

- Speed = increases work load rate
- Conflict frequency = increases work load rate
- High work load = higher crash rate

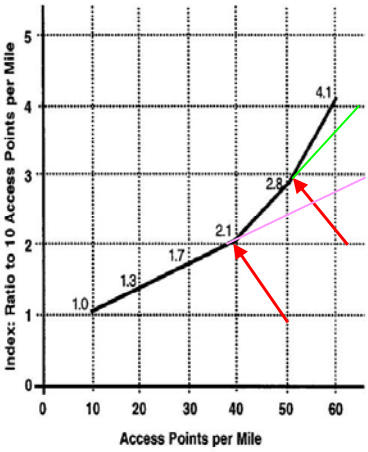
AM Strategy: Driver Work-Load can be modified by good planning and design

- Access Related crashes at driveways and intersections represent over **55** percent of all traffic crashes. 65% to 75% in urban areas
- More than 3.5 million access related crashes annually.
- Over 3,500 access related injuries each day.

There is no such thing as a Safe Access.

As the number of access points per mile increase, so does the frequency of total highway collisions.

The crash rate also increases.
Each access = 4%



Source: Estimated from Various Sources

Figure 15. Composite accident rate indices.

NCHRP 420

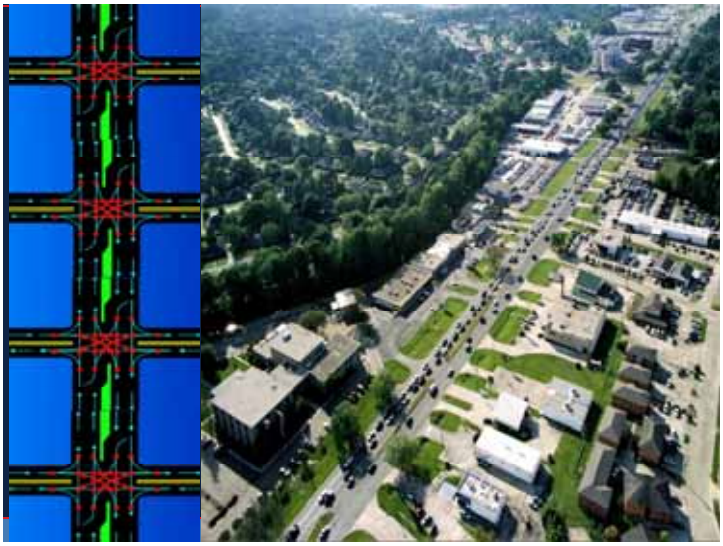
Every Access Point is Fundamentally a Safety Problem

- Issuing an access permit is a decision to diminish public safety and roadway function.

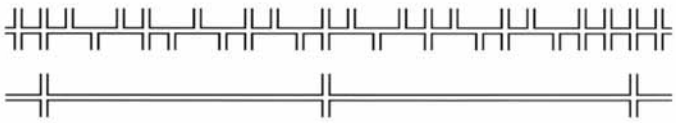
When access principles are applied to a specific Corridor

- Crashes reduced by 30 to 60 percent
- Capacity increased by 20 to 40 percent

Fairview



If a roadway program or project can reduce the crash rate from 12.5 to 3.5 per MVM



For a Typical 3 Mile Section of 4 Lanes at 37,000 daily traffic	Top Highway	Bottom Highway
Number of Conflict points	1,641	324
Number of Crashes Expected in 5 years	2,435	680
Cost of Crashes in 5 years	$ 26.5 M	$ 7.5 M
Average Speed	25 MPH	44 MPH

3.5 vs 12.5 mvm

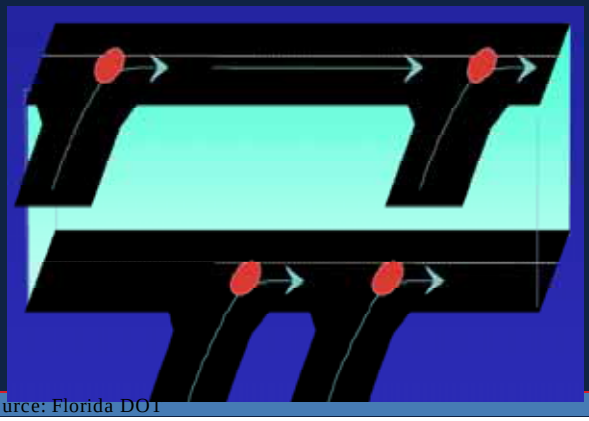
Goals of Access Management

- Separate Turning Vehicles from through traffic

Source: Florida DOT

Goals of Access Management

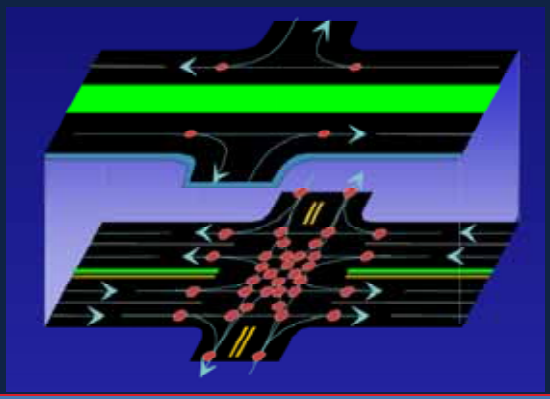
- Separate conflict points



Source: Florida DOT

Goals of Access Management

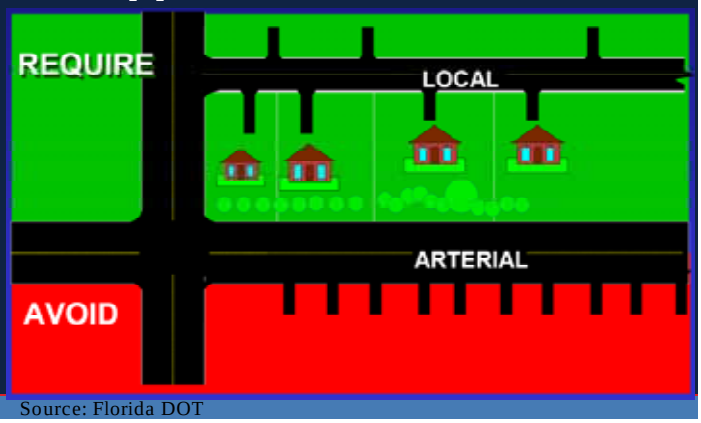
- Limit access conflicts



Source: Florida DOT

Goals of Access Management

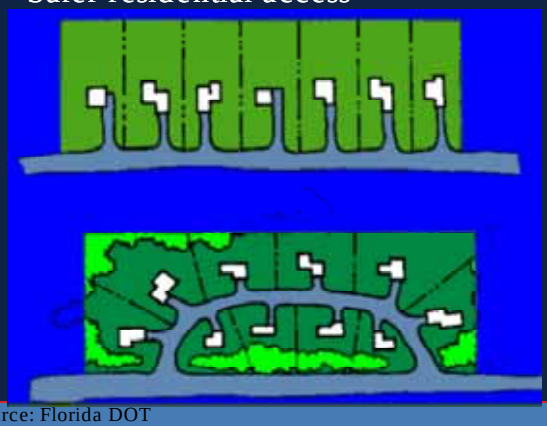
- Keep private access off arterials



Source: Florida DOT

Goals of Access Management

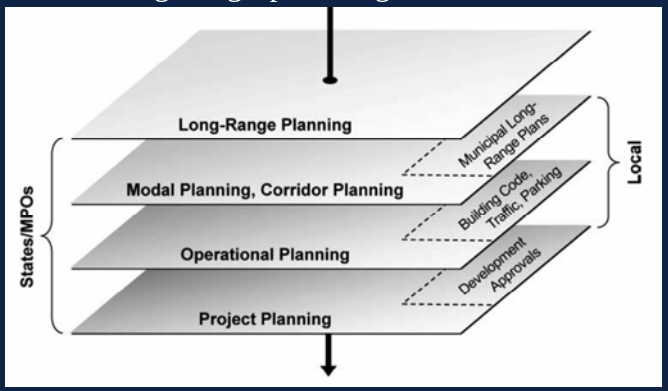
- Safer residential access



Source: Florida DOT

New Flag lots in Virginia

AM is not just access permits, ideally, it starts with long range planning

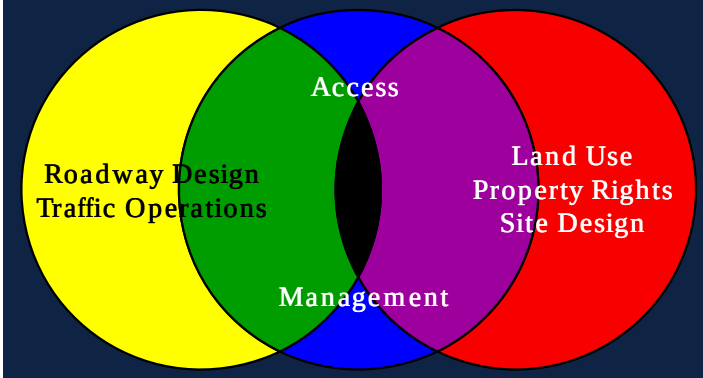


A Guidebook for Including Access Management In Transportation Planning. NCHRP 548

Why is Access Management Difficult to Execute

- Legal considerations – Property rights
- Crosses professional and agency organizational lines
- Reluctance of highway agencies to deal with land side issues
- Failure of elected officials to put into practice what is necessary for safety

Different agencies & different professions



Successful Programs have Three Major Elements

1) A hierarchical access classification system for all roadways to align the level of access control with the intended function of the road.
2) Specific design and engineering criteria to determine access location and design.
3) Procedures that guide the application, evaluation and decision process for a permitting program.

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System Wide Access Classification System

- Sets the system hierarchy
- The access classification determines the answer to the question:
- May I have access to the roadway?

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Decision Flow Chart For Permit Decision:

1. Qualify?
2. Location
3. Mitigate

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Access Categories to Manage by Function

Arizona State Highway Access Management Categories	
FW (freeway)	
MR (major regional)	
R1 (rural principal)	U1 (urban principal)
R2 (rural secondary)	U2 (urban mixed)
	U3 (urban secondary)
SF (service and frontage roads)	

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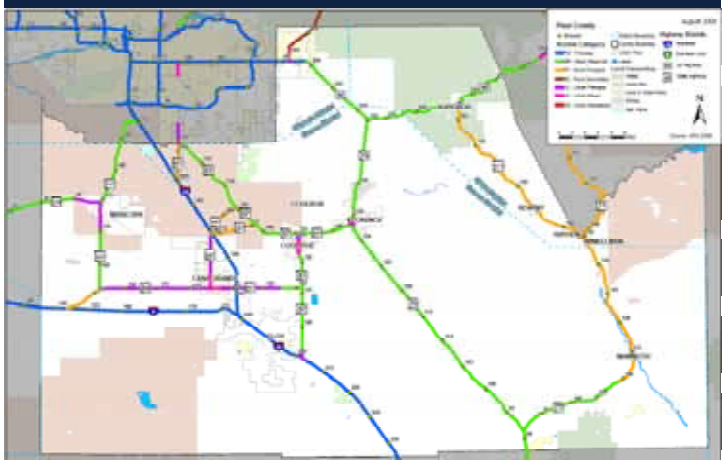
Pinal County



Decision Flow Chart For Permit Decision:

1. Qualify
2. Location?
3. Mitigate

Location Determination

- First – Decision Sight Distance (AASHTO)

Posted speed in MPH	25	30	35	40	45	50	55	60	65	70
Distance in feet	625	715	800	890	980	1125	1220	1275	1365	1455

- Second – Spacing from other accesses

Posted speed in MPH	25	30	35	40	45	50	55	60	65	70
Approach Spacing	200	250	360	425	495	570	645	730	820	910

- Bottom line – stopping sight distance (adj for design speed)

Posted speed in MPH	25	30	35	40	45	50	55	60	65	70
Sight distance (in ft.)	160	210	265	320	385	455	530	610	695	785

Decision Flow Chart For Permit Decision:

1. Qualify
2. Location
3. Mitigate

Arizona Turn Lane Warrants
(2008 draft)

Access Category	Left-turn Decel		Right-turn Decel Lane	
	At/Above 45 MPH	Below 45 MPH	At/Above 45 MPH	Below 45 MPH
MR	10 AADT	10 AADT	5 VPH	10 VPH
U1	10 VPH	10 VPH	10 VPH	10 VPH
U2	10 VPH	15 VPH	15 VPH	15 VPH
U3	10 VPH	25 VPH	15 VPH	25 VPH
R1	10 VPH	10 VPH	10 VPH	10 VPH
R2	10 VPH	15 VPH	10 VPH	15 VPH
SF	10 VPH	25 VPH	15 VPH	25 VPH

Deceleration Lane Length Options

Speed in MPH	35	45	55	65
Deceleration Length, Ft.	215	345	510	710

10 mph speed differential for normal arterial

Speed in MPH	35	45	55	65
Deceleration Length, Ft.	350	630	810	1060

Zero mph speed differential For major arterial, expressway

Deceleration turn-lane length by access category

Posted Speed Limit	25	30	35	40	45	50	55	60	65	70	75
MR	210	280	350	490	630	700	810	930	1060	1100	1350
R1 or U1,	110	160	215	275	345	425	510	605	710	820	950
R2, U2, U3, & SF	105	145	190	245	300	365	435	510	590	680	800
Transition Taper length	50	50	50	50	75	75	75	75	75	100	100

- Values above are taper and decel length
- Storage length is added to above values

Minimum Design

- Minimum design means
  - minimum capacity
  - minimum safety
  - minimum costs.
- Permits should act to minimize the impacts of the new access
- Don't allow a minimum design.

Legal Issues in Access Management

- Property rights do not include the right to create safety problems on public facilities

Legal Issues in Access Management

- Owners have a right to access their property.
- They have a right to demand clear and concise requirements and procedures.

Legal Issues in Access Management

- Less of a problem if you have a prepared program with clearly defined and reasonable standards.
- You are managing access rights, not managing traffic.

Police Power

- The power of the government to act in furtherance of the public good to promote the public health, safety, morals and general welfare, **without incurring liability** for the resulting injury to private individuals.

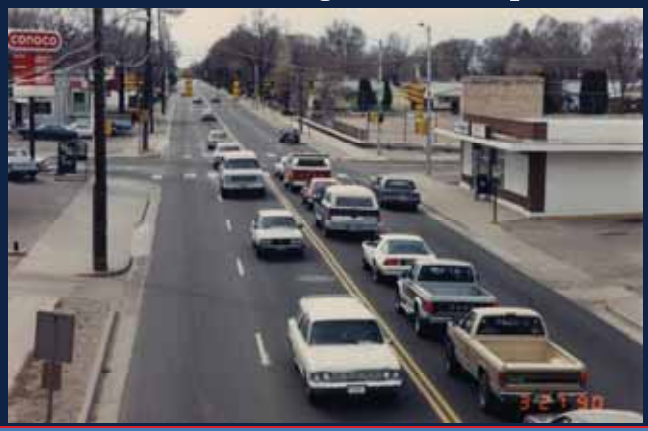
Can We Manage Access without Compensation?

- Allowing uncontrolled access would not be a concern if there no safety or operational problems.
- What do we know about the need manage access and justify standards?

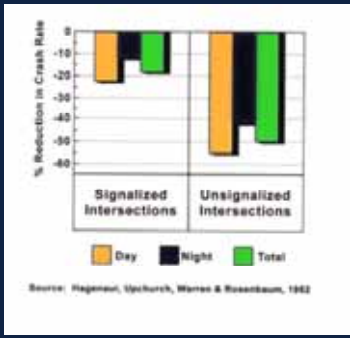
TURN LANES

- Are critical for both capacity and public safety

No left turn has greatest impact

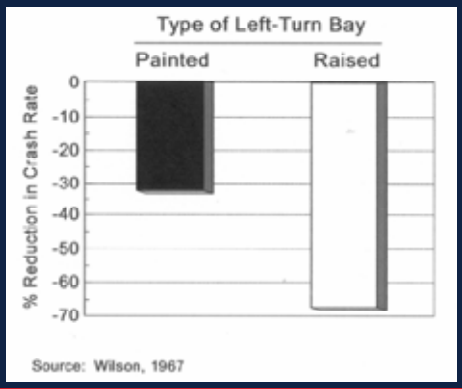


Adding left turn bays reduced the crash rate (Vancouver BC)



Vancouver, B.C.
Left-Turn Bays • Increase Capacity 20% or more • Decrease Crash Rates 25% to 50%

Adding painted left turn compared to raised left turn

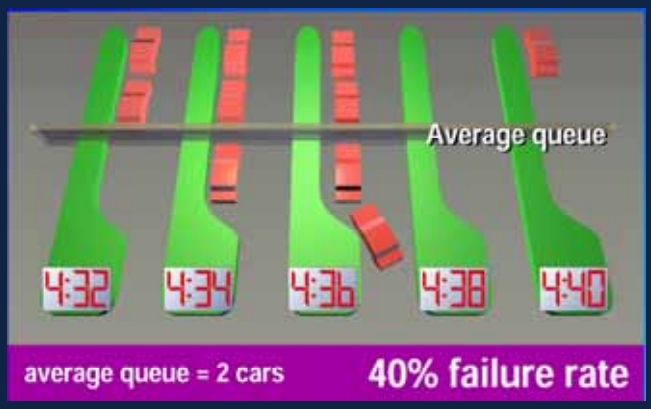


Driveways impact flow and conflict

No Right Turn lane reduces signal capacity, increases delay

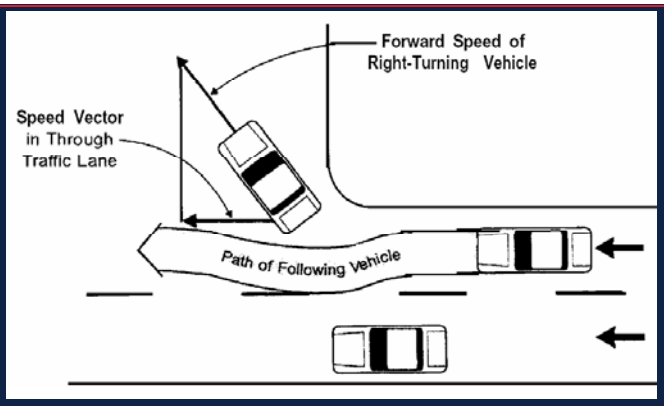
When turn lanes are too short, they impact flow and safety

Why Designing for Average Queue will cause some failures



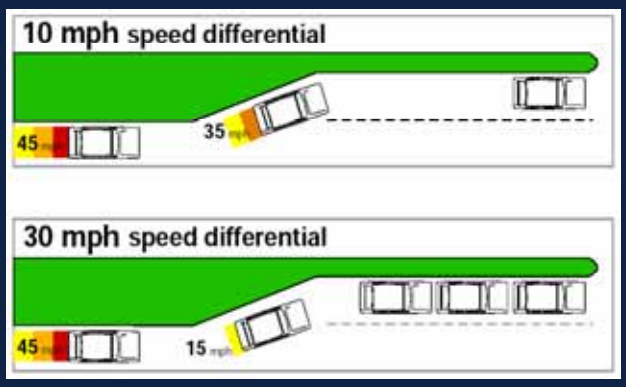
Source: Florida DOT

Speed differential is a conflict

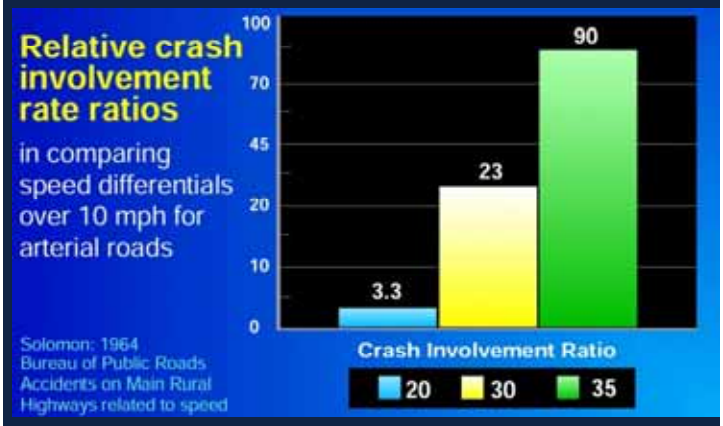


- Speed differential = speed of through traffic minus the speed vector of the right turning vehicle. (not its 'speed')

Combining Storage and Decel defeats speed differential mitigation



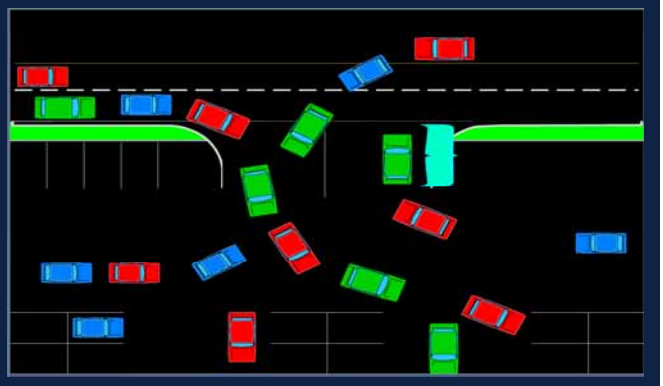
Source: Florida DOT



New Boise subdivision without right-turn lane

Goal – Good Turn Lanes

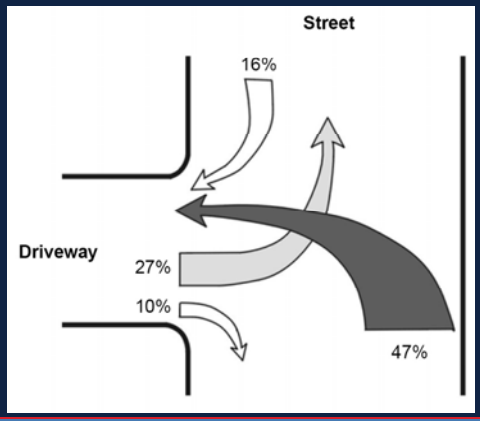
Lack of driveway throat



Source: Florida DOT

Using Medians to Improve Operation and Safety

Left Turns Dominate Crash History



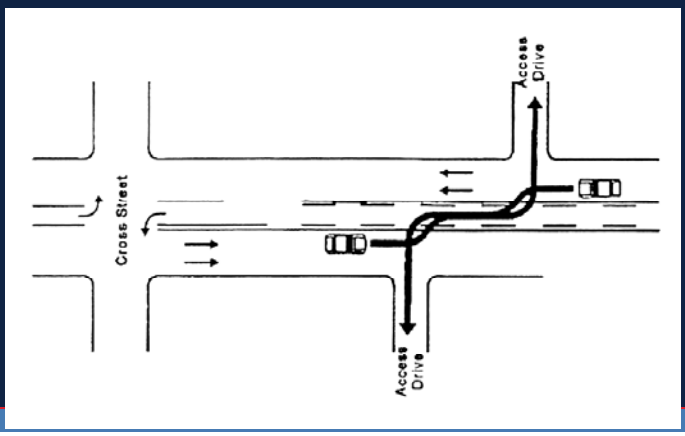
Raised or Painted Median?

- Generally, >25,000 daily means higher collision rate
- Painted medians are cheaper
- Paint does not control left turns
- Painted medians do not allow signs
- Raised medians have lower crash rates

Median Types

- Painted medians often need 'short' medians (for left turn bays)

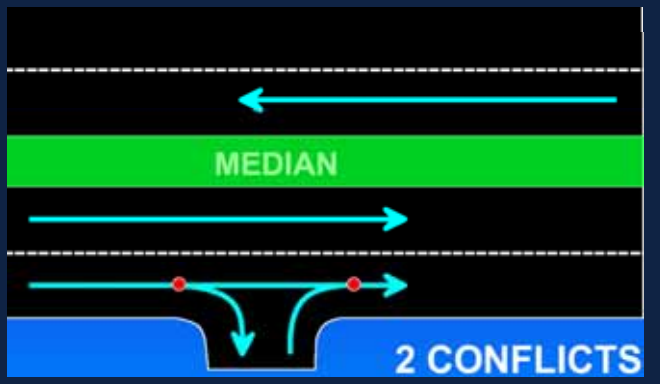
Overlapping Left-Turn Movements on TWLTL



TWLTL has limits

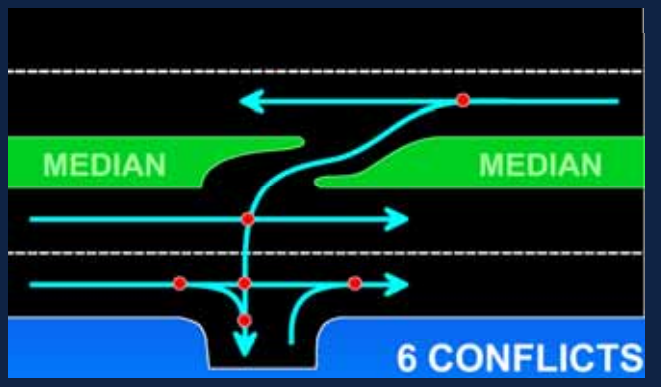
Mixed Median use in Phoenix

Median eliminates all left turns and the related problems



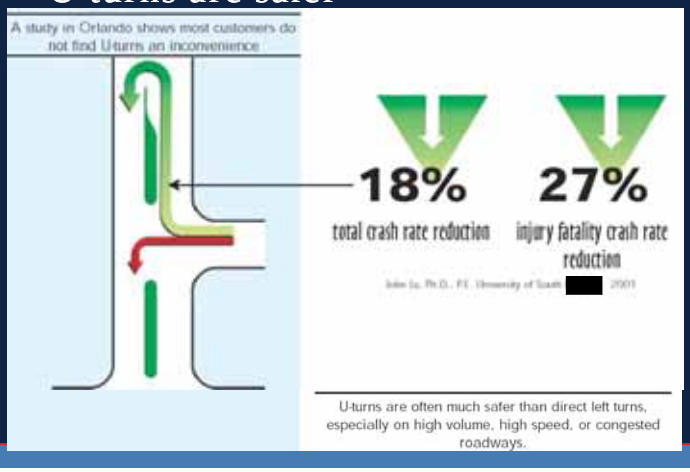
Source: Florida DOT

3/4 th opening / no left out



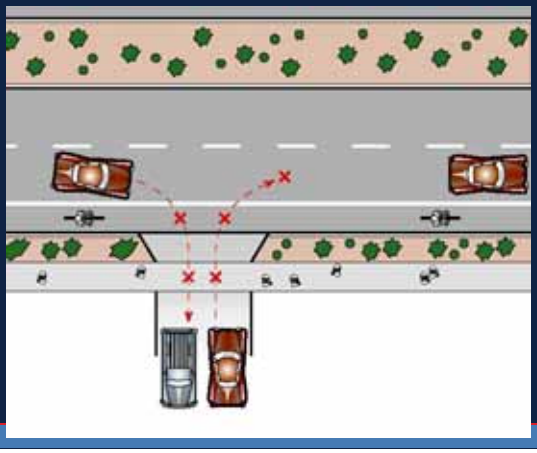
Source: Florida DOT

U-turns are safer



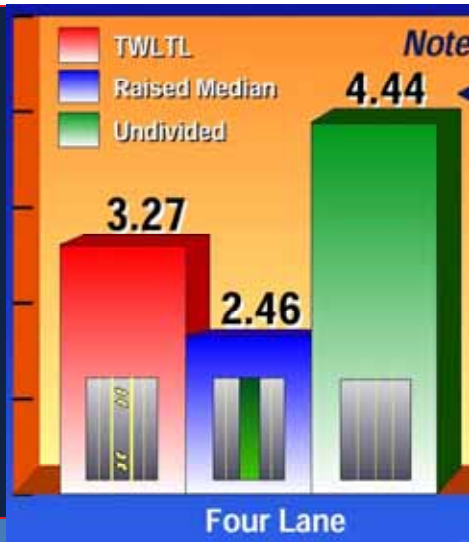
Full movement driveways increase bike and ped hazards

Medians reduce bike and ped conflicts



Decreasing crash rates by adding medians

Florida DOT



Source: Florida DOT

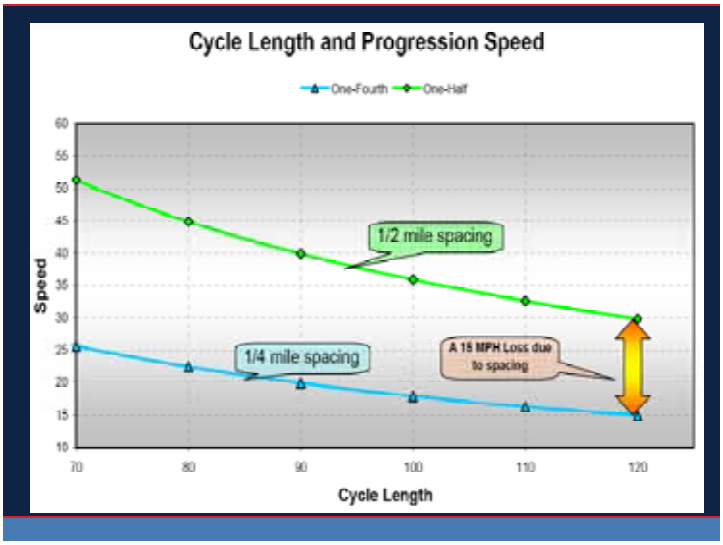
Memorial Drive, Atlanta; 35-55K ADT

Post Project – Memorial Drive

- **37 % drop in Total Accident Rate**
- 48 % drop in Injury Rate
- 59 % drop in Mid-block Injury Rate
- 40 % drop in Intersection Injury Rate
- Project has saved at least 15 lives and has prevented thousands of accidents since completion.

Traffic Signals and Spacing

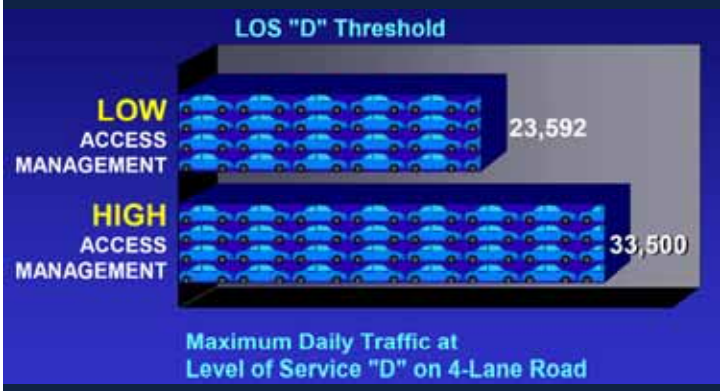
Traffic signals produce and greatest amount of Conflict and Workload



Similar Capacity

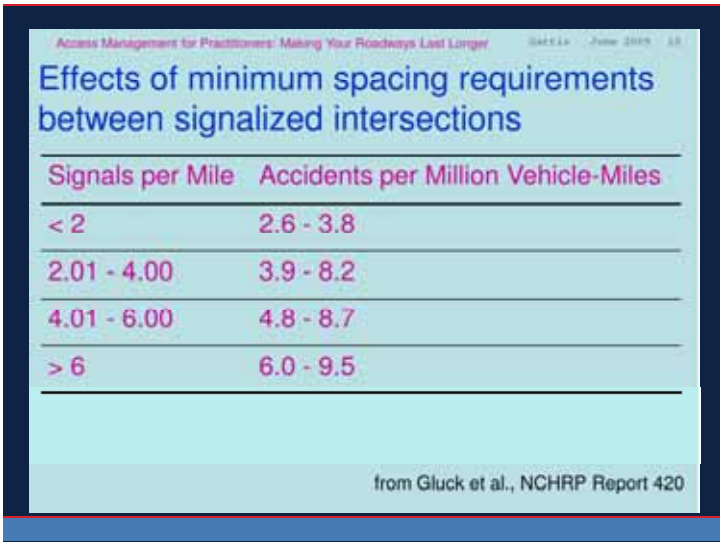
- 4 lane divided roadway with 1/2 mile signal spacing
- 6 lane divided roadway with 1/4 mile signal spacing

Capacity Benefits



Source: Florida DOT

Signals create rear-end conflicts



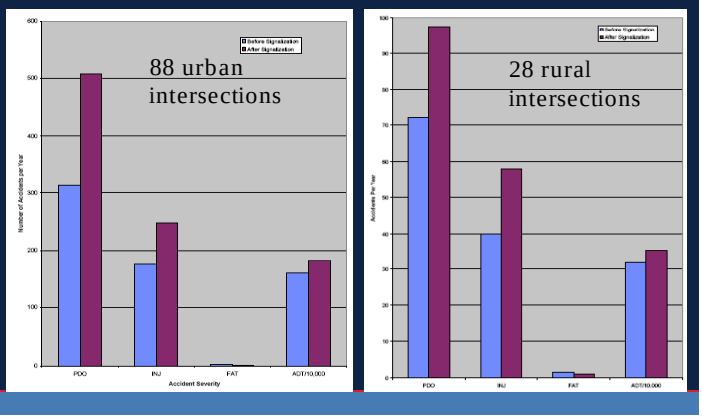
Without Exception, Traffic Signals are hazardous

- They may be less hazardous than the current situation
- They are not a safety enhancement.
- They allow safer left turns

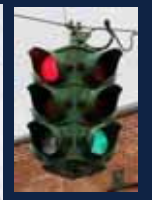
Relative crash frequency

- RURAL intersections
  - 0.7 per year unsignalized
  - 4.8 per year if signalized
- URBAN intersections
  - 1.4 per year unsignalized
  - 6.2 per year if signalized

Signals Increase Accidents



Are Traffic Signals Obsolete?



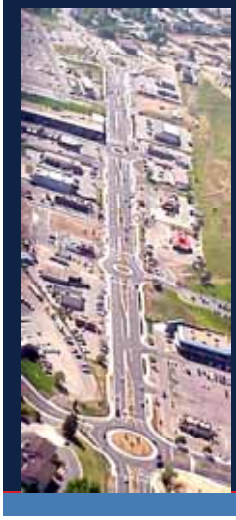
Why Roundabouts

Why are they replacing traffic signals

The Modern Roundabout As A Signal Alternative

Roundabouts replaces traffic signals in Golden and Avon CO

Avon, Colorado

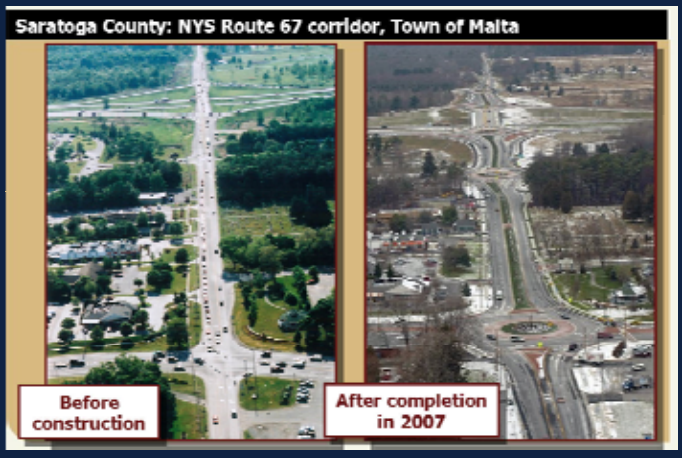


Crash reductions - Golden CO (3 years before & after)

- Commercial strip, 4 + TWLTL
- 60% drop in Crashes (mvm)
- 94% drop in injuries
  - Only 1 vehicular injury crash in 3 years (previous 3 years were 31)
- No Pedestrian crashes

La Jolla before

Context Sensitive – Rebuilt 1940s arterial using 5 Roundabouts (21k adt)



Source: NY DOT

Travel time statistics for the Route 67 corridor following opening of the 5th roundabout

Note: All measurements taken in the eastbound direction at approximately 5:00 PM

NYS Route 67 Corridor, Town of Malta
Travel Time Statistics - Before and After Roundabout Construction

		Before June 7, 2005	After Oct. 5, 2006	After June 19, 2007
Begin	State Farm Rd	0	0	0
Arrive	I-87 Southbound Ramps	0:40	0:27	0:29
Leave	I-87 Southbound Ramps	2:22	0:30	0:31
Arrive	I-87 Northbound Ramps	2:40	0:52	0:48
Leave	I-87 Northbound Ramps	2:40	0:55	0:50
Arrive	Malta Commons	2:56	1:14	1:07
Leave	Malta Commons	3:08	1:16	1:09
Arrive	US 9 Intersection	3:58	1:49	1:44
Leave	US 9 Intersection	6:23	1:57	2:00
Total Time Through Corridor		6:23	1:57	2:00
70% Reduction in Travel Time thru Corridor after Roundabouts				

Signal corridor speed <10 mph

Roundabout corridor speed >30 mph

34

Source: NY DOT

- Bend Oregon, pop 65,000 has 23 single lane roundabouts
- Carmel Indiana, Pop 70,000, has over 50 roundabouts
- Colorado Spgs CO pop 450k has 44+ roundabouts
- Over 220 in Colorado

NEW YORK STATE
Department Of Transportation

- NYSDOT- "Signal Policy"
- "When the analysis shows that a roundabout is feasible, it should be considered the Department's preferred alternative due to the proven substantial safety benefits and other operational benefits."

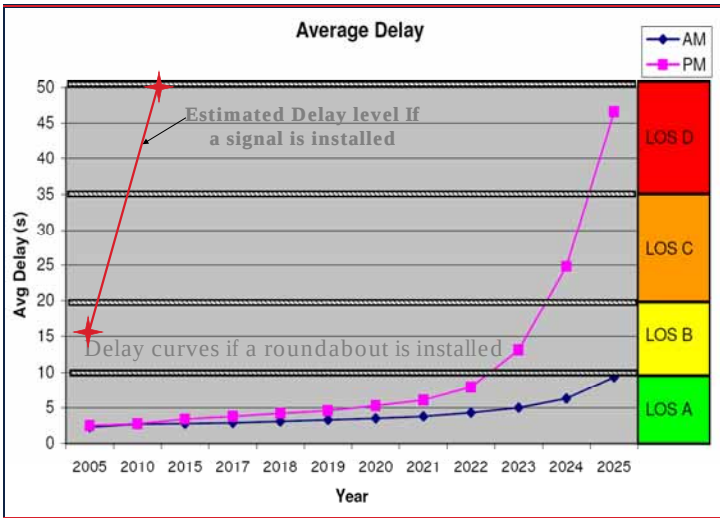
Commercial Area

Dual RBT in Commercial Area

Many states are replacing isolated rural signals with roundabouts

Increased Traffic Capacity

- Will typically outperform a traffic signal in terms of delays and queues



Average Delay for Roundabout

Provides new alternatives (Kansas)

Hi-speed rural in Lafayette, Louisiana

Ten more urban ones in design

Completed RBT

(Mark Johnson MTJ Engineering)

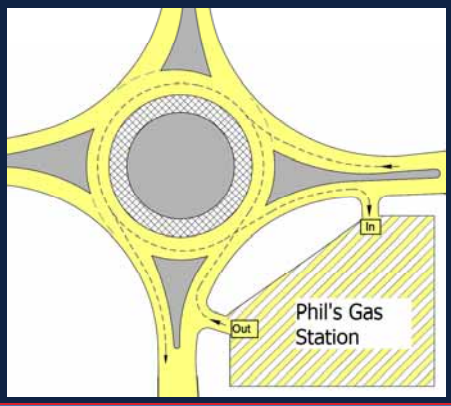
Photo from Michigan DOT

Access Control and Roundabouts

- Are traffic signals obsolete?
- Roundabouts achieve 70 to 90% injury crash reduction compared to signal.
- Roundabouts with non-traversable medians between – the best AM solution.

Arizona DOT

While it should not be encouraged for new development, it helps in retrofit situations



TRB National Roundabout Conference

Next: May 2011, Carmel Indiana

For Previous conference materials go to www.teachamerica.com/roundabouts/ra_conference.htm

Access Management Planning

- A plan for a specific segment
- Joint effort to set function and purpose
- Determine performance measures
  - Safety, capacity, efficiency
- Level of allowable private access
- Locations of public intersections
- Final joint agreement for all access permitting.

US 20/26 Preservation Study

US 20/26 from I-84 to Eagle Road (15 mi)

- Crash History (January 1999 - July 2005)
  - Total Crashes: 500
  - Fatal Crashes: 8
  - Injury Crashes: 230
  - Access Related Crashes: 338 (67%)
  - 73% of Injury Crashes were Access Related
  - 62% of Fatal Crashes were Access Related

Traffic Growth Estimates

U.S. 20/26 Traffic Volumes

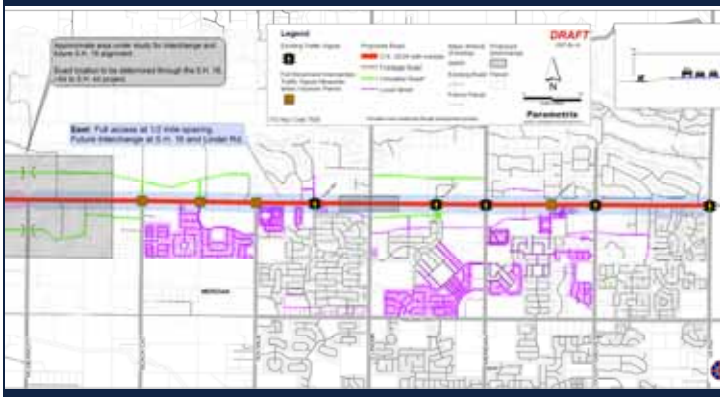
Eagle Road to I-84 (Caldwell)

Road Segment	2005	2030*
Eagle to Black Cat	14,000 – 21,400	38,000 – 52,000
Black Cat to Midland	12,000 – 15,000	24,000 – 32,000
Midland to I-84	10,000 – 12,000	19,000 – 23,000

*Based on Community Planning Association of Southwest Idaho demographics

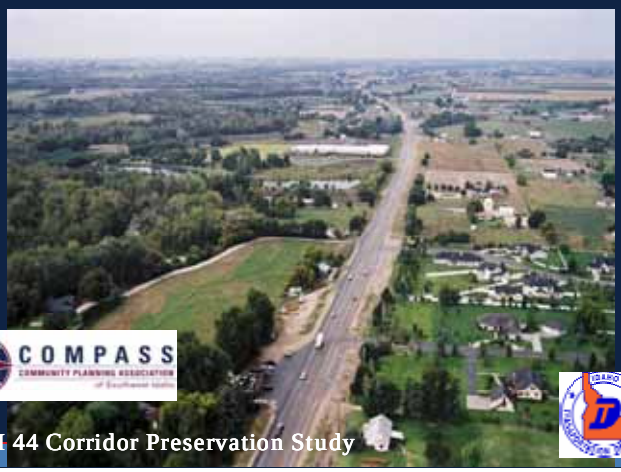
From RBCI

- We thought we would suggest ½ mile
- Resounding public wanted 1 mile
- Strong interests in maintaining travel time.
- No other nearby route available.



Parametrix

What will SH 44 look like after 20 years of growth?



COMPASS

SH 44 Corridor Preservation Study

Lengthy queues and delay

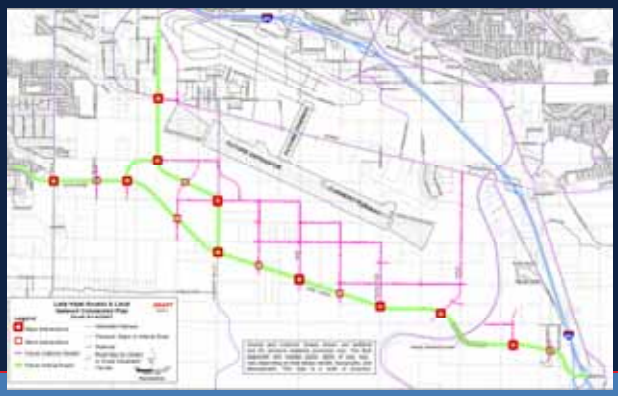
- RBTs are safer
- Medians and RBTS are safest
- Circulation parallel.
- How can we integrate RBTs and medians into our “old” thinking?
- Can we just flip a switch? Yesterday signals and today RBTs? Why not?

Access Control and Roundabouts

- Are traffic signals obsolete?
- Roundabouts achieve 70 to 90% injury crash reduction compared to signal.
- Roundabouts with non-traversable medians between – the best AM solution.

Source: Parametrix

Draft network to support employment, residential, and airport growth



Fairview, W of Orchard, widening, more capacity and managed access.

Fairview

Source: Parametrix

Draft Concept for a Portion of Fairview

Source: Parametrix

Interchange Access Planning

No Plan, No Vision, No Controls

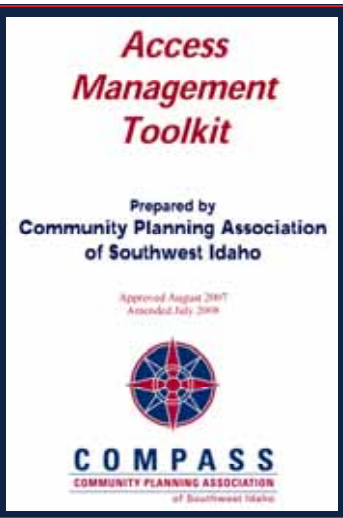
How Can Local Governments Institute Access Management Strategies

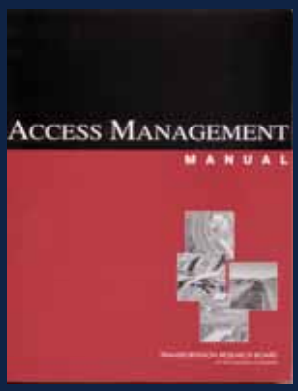
- Local Comprehensive Plan
- Land development and subdivision regulations
- Roadway & access design standards
- Site plan review criteria
- Corridor management plans

Federal Highway Administration
Office of Operations Washington, DC
www.ops.fhwa.dot.gov/access_management

CD with report and movie is available:
Neil Spiller at FHWA
Neil.Spiller@dot.gov

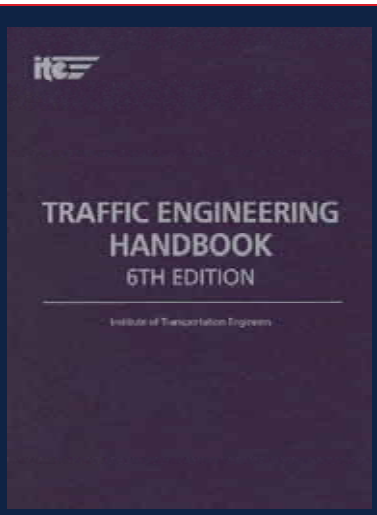
COMPASS is the MPO for the Boise/Nampa urbanized area – Idaho
(2008)

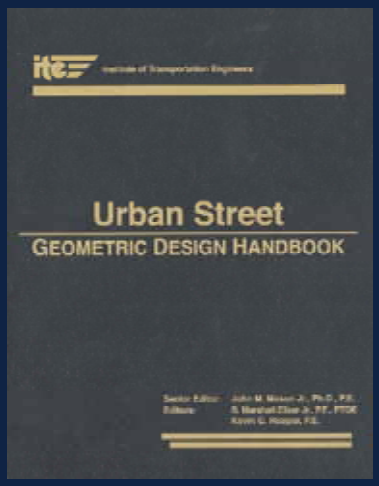


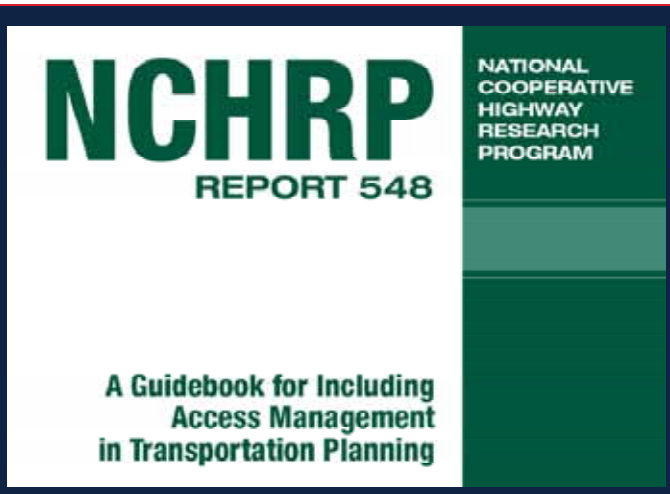


Access Management Manual.
Transportation Research Board of the National Academies
Washington, D.C., 2003.

Stover, V.G. and Koepke, F. J., ***Transportation and Land Development*****, 2nd Edition, Institute of Transportation Engineers, Washington, DC, U.S.A., 2002**



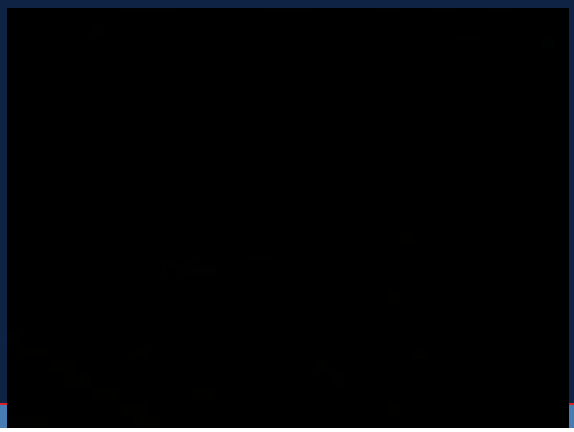




Key Resources

- *Access Management Manual*, TRB 2003.
- Large collection of reports, presentations, references and conference proceeding, http://www.accessmanagement.info
- The biennial TRB National Conference on Access Management. Next conference, Natchez, Mississippi, Oct 13-16, 2010.
- *NCHRP Report 548: A Guidebook for Including Access Management in Transportation Planning*, TRB, 2005.
- Fitzpatrick, K. and M. D. Wooldridge, *NCHRP Synthesis 299: Recent Geometric Design Research for Improved Safety and Operations*, TRB 2001.
- *Intersection Safety Issues Brief #8: Toolbox of Countermeasures and Their Potential Effectiveness to Make Intersections Safer*, FHWA, ITE 2004.
- *Transportation and Land Development*, 2nd edition, ITE, 2002.
- *The Access Management Guidebook: Reducing Traffic Congestion and Improving Traffic Safety in Michigan Communities*, Planning and Zoning Center, Inc., for the Michigan DOT, 2001.

Movie from the Insurance Institute for Highway Safety



Site Design and Access Control

Florida DOT

Back access and internal circulation

Courtesy of Parametrix

Questions

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Hierarchy

- Local Speeds 12 to 30
- Collector Speeds 25 to 35
- At grade Arterial Speeds 35 to 65
- Freeway Speeds 55 to 75

Why there is a hierarchy

- No one wants driveways on a freeway
- No one wants freeway traffic on a residential street.
- Freeway shouldn't be narrow and residential streets shouldn't be wide
- Separating the driving purposes
- Separating the capacity demands
- Separating the speed demands
- #1 allows the design to fit the purpose

Guidebook for communities, by Michigan DOT
(2001)