Signal Spacing

A Technical Memorandum

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LIST OF EXHIBITS

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TRAFFIC SIGNAL SPACING

Traffic signal spacing needs to result in a system of intersections that can be signalized, now or in the future, while providing maximum flexibility for efficient traffic progression over a wide range of speeds and cycle lengths.

Development of a traffic signal system that can provide for the safe and efficient movement of traffic involves the following three issues:

1. Location – Planning for the location of intersections (including both public roadways and connections to major generators) that can be signalized. Such locations should enable Traffic Engineers to implement signal timing plans that will: (a) provide efficient traffic flow under a range of peak and off-peak conditions, and (b) respond to changing traffic patterns that occur over time as urbanized areas expand and lane traffic patterns change.

2. Installation – Installing the traffic signals, traffic detectors, controllers, and interconnect equipment at an individual intersection when one or more of the established warrants are met, and incorporating the timing of the intersection into a coordinated traffic control plan.

3. Operations – Timing the signal system to provide efficient traffic progression throughout each day in response to changing weekday and weekend traffic conditions.

This technical memorandum addresses the first of these three issues – rationale for spacing of intersections that are signalized and those that might be considered for signalization at some time in the future.

INTRODUCTION

Closely spaced or irregularly spaced traffic signals on suburban and urban arterials result in an excessive number of stops, unnecessary delay, increased fuel consumption, excessive vehicular emissions, and high crash rates. Conversely, long and uniform signal spacing permits timing plans that can efficiently accommodate varying traffic conditions during peak and off-peak periods, as well as implementation of signal timing plans as traffic changes occur over time. Therefore, selecting a long and uniform signalized intersection spacing is the first essential element in establishing access spacing standards.

Traffic signal systems need to provide efficient traffic flow as traffic conditions vary between peak and off-peak periods throughout the day and change over a long period of time.

Exhibit 1: Basic Conditions for Which a Traffic Signal System Needs to Respond
Peak Periods • High volume • Slower speeds, ≤30 mph (≤50 km/h) • Long cycles, 120 sec. Off-Peak Periods • Lower volumes • Higher speeds, 40-55 mph (65-85 km/h) • Shorter cycles, 60-80 sec.

Progression at reasonable speeds can be achieved at short signal spacings such as at ¼ mile only so long as the traffic volumes are very low so that short cycles (60 seconds or less) can be used. As arterial and cross-street street traffic volumes increase, longer cycle lengths must be used to increase capacity by minimizing lost time. As a result, cycle lengths of 90 to 120 seconds are commonly used on major urban arterials during peak periods in developed urban areas.

Experience has shown that high traffic volumes and capacity problems will result on major arterials when the area is fully urbanized. Therefore, the future cycle length must be considered in selecting a signalized intersection spacing pattern which will provide efficient progression at desired speeds and high traffic volumes. The cycle length at the most critical intersection will govern the cycle length for the entire system.

Major arterials in developed urban areas experience very high travel demand during the morning and after work peak periods. Hence, capacity in peak periods is always an issue once the property in the vicinity of the major street becomes fully urbanized. It has long been recognized that maximum flow rates are achieved when traffic is moving at a uniform speed of about 40 mph to 45 mph. It might also be noted that fuel consumption and emissions are also at a minimum under these conditions.

Short traffic signal spacings result in: 1) High accident rates; 2) limited flexibility for signal timing; 3) more speed changes; 4) reduced fuel economy; and 5) increased emissions.

Urban traffic signal systems must be able to respond to two general conditions: 1) off-peak periods when short cycle lengths are used to efficiently accommodate relatively low traffic volumes at relatively high speeds; and 2) peak periods when longer cycles are needed because of high volume but slower speeds. Additionally, a traffic signal system must be able to adjust to changing travel patterns that occur over a long period of time.

SAFETY AND OPERATIONAL EFFECTS

Inspection of Exhibit 2 indicates that the crash rate on 4-lane median divided roadways is essentially constant at densities of two signals or fewer per mile. The crash rate increases substantially when there are more than two signals per mile. Exhibit 3 shows that on 4-lane roadways with a continuous two-way left turn lane, the crash rate increases at all levels of increased traffic signal density.

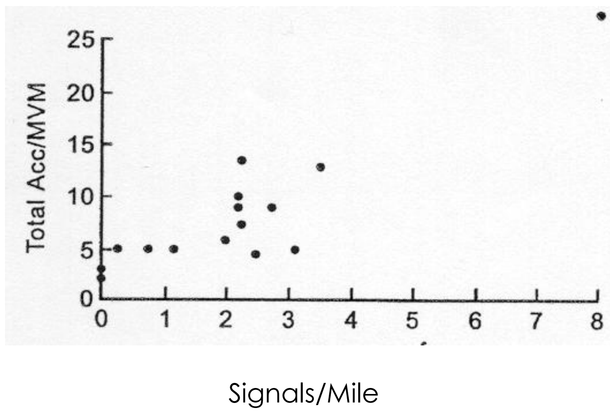

Exhibit 2: Effect of Signal Spacing on Four-Lane Roadways with a Raised Median

Source: Squire and Parsonson [1]

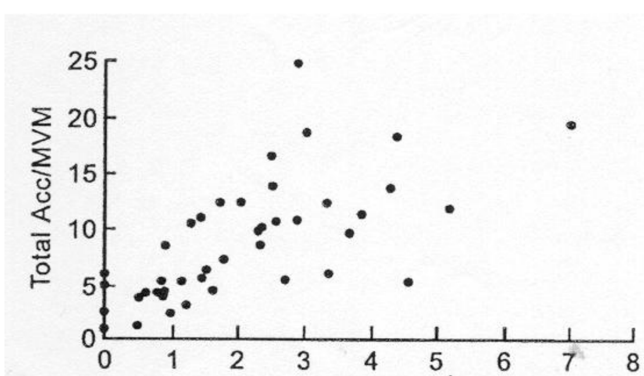

Exhibit 3: Effect of Signal Spacing on Four-Lane Roadways with a TWLTL

Hauer [3] used the following model to develop the curves for collisions at 4-way signalized intersections shown in Exhibit 1-4:

$$A = \alpha \; x \; q_{main\ \ road}^{\beta\, main\ \ road} \quad x \quad q_{minor\ \ road}^{\beta\, minor\ \ road}$$

Where: *A* = the number of collisions
∀ = a regression constant
q = the roadway ADT
∃ = regression coefficients that are exponents to q

∃ = 0.5 when both roadways have the same ADT. Values larger than 0.5 indicate that the minor road ADT is less than that on the main road. Exhibit 4 indicates that 2 signalized intersections per mile can be expected to result in 1.4 to 1.6 times the number of collisions as one intersection per mile. Four intersections per mile can be expected to increase the number of collisions by a factor of 2 (∃ = 0.5) to 3 (∃ - 0.7). This is a fairly dramatic decrease in safety.

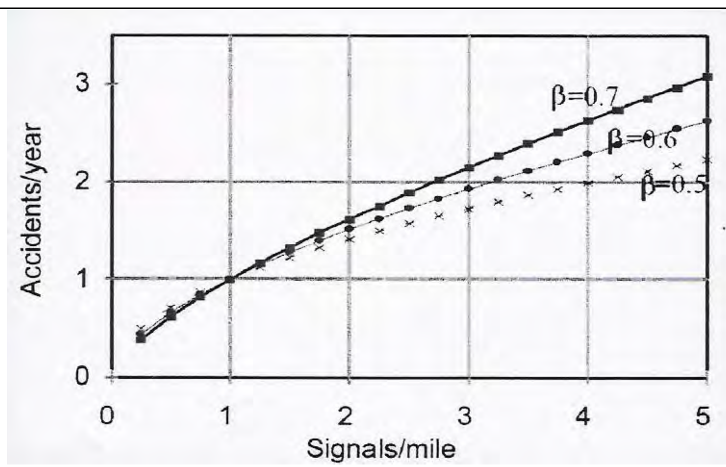

Exhibit 4: Effect of Traffic Signal Density on Traffic Accidents

Source: E. Hauer [3]

SIGNAL SPACING IS A VARIABLE WHEN PLANNING AN URBAN STREET SYSTEM

Traffic signal progression depends upon a fixed relationship between the following variables:

1) Signal spacing,
2) Speed of progression,
3) Cycle length, and
4) Efficiency of progression.

The Colorado Demonstration Project [9] concluded that increased signal spacing and fewer intersections can reduce vehicle-hours of travel by 40% and vehicle-hours of delay by nearly 60%. (See Exhibits 5 and 6.)

Exhibit 5: Estimated Savings in Travel Time and Delay for a Five-Mile Roadway Segment

	Total Travel (vehicle-hours per hour)	Total Delay (vehicle-hours per hour)
Access Control	542	275
Uncontrolled Access	942	675
Percent Change: Access Control vs. Uncontrolled	-42%	-59%

Source: Adapted from Colorado Access Control Demonstration Project [9]

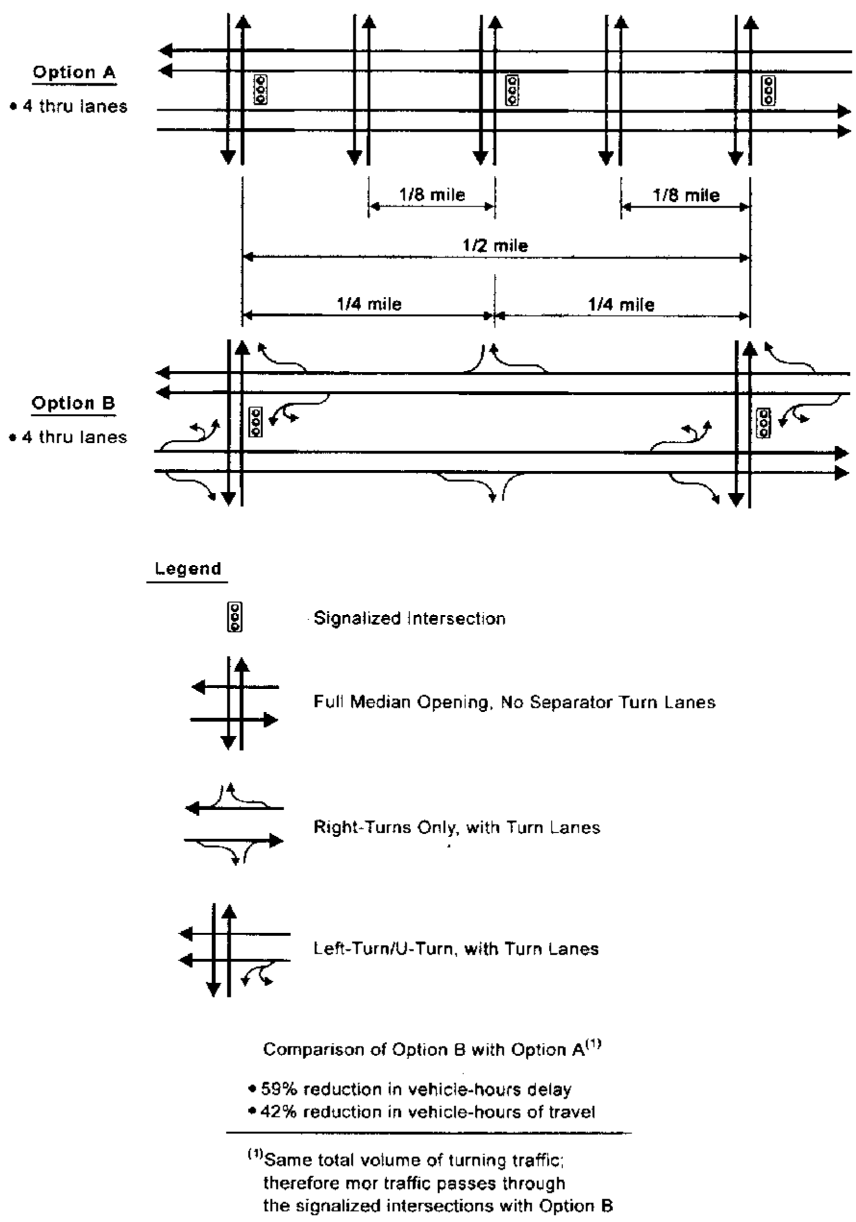

Exhibit 6: Schematic Illustration of Scenario Compared in the Colorado Access Demonstration Project

Source: Data from the Colorado Access Control Demonstration Project [9], Sketch from *Transportation and Land Development* [7].

Analysis for the Florida DOT analysis concluded that a 4-lane divided roadway with ½-mile signal spacing and limited median access can carry the same volume of traffic as a 6-lane divided roadway with ¼-mile signal spacings and poorly designed median openings.

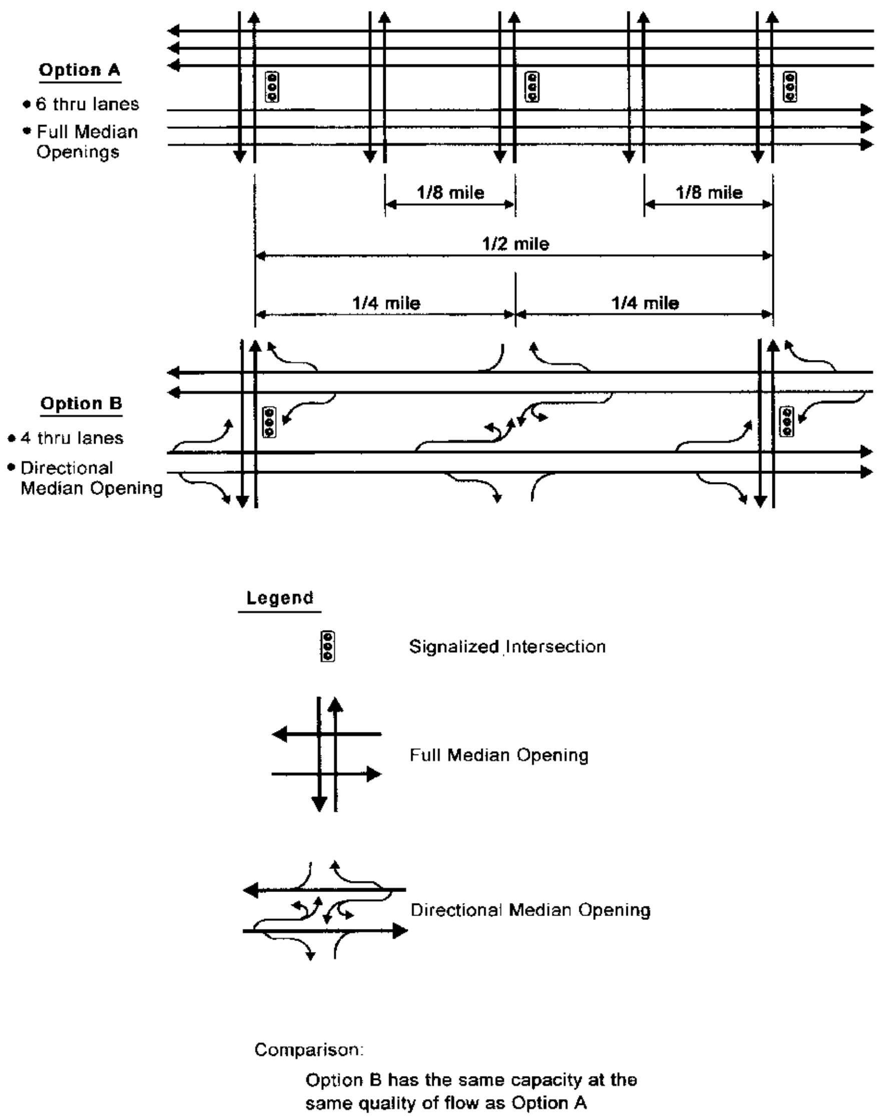

Exhibit 7: Schematic Illustration Comparing Equivalent 6-Lane and 4-Lane Divided Roadways

Source: *Transportation and Land Development* [7].

The common practice when reconstructing a roadway to increase capacity is to increase the number of traffic lanes. This often requires additional right-of-way (a solution that is costly and disruptive to existing developed sites). In many instances, it also results in excessively short driveway throat length (resulting in an overlap between conflicts at the roadway and driveway intersections with conflicts on site). Widening also often results in excessive driveway grades as well as excessive changes in grade between the roadway cross-slope and the driveway. Exhibit 7 suggests that increasing the signal spacing through effective access management may be a practical alternative to roadway widening (especially where right-of-way acquisition is involved).

Long and uniform spacing of major signalized intersections enables the Traffic Engineer to develop signal timing plans that can provide efficient traffic flow over a wide range of conditions.

Exhibit 8: Efficient Traffic Flow Speeds

Minimum Fuel Consumption:
- 25-60 mph

Minimum Emissions:
- Carbon Monoxide 30-55 mph
- Volatile Organic Compounds 35-60 mph

Nitrogen Oxides 20-45[(1)] mph

[(1)]Based on Mobile 5; Mobile 6 shows little increase until speed > 70 mph.

Source: Adapted from *Transportation Energy Data Book* [4]

Fuel consumption is minimized at speeds of 30-60 mph. Fuel efficiency drops substantially when speeds are below 25 mph. Furthermore, the traffic flow rate (vehicles passing a point) also drops rapidly at speed falls below 35 mph.

Emissions of carbon monoxide and volatile organic compounds are minimum at speeds between 35 and 55 mph. Emissions of Oxides of Nitrogen are minimum at speeds between 10 and 50 mph. (The emissions model MOBILE 6 recently released indicates that emissions do not increase substantially at speeds between 55 mph and 70 mph).

Therefore, progression speeds of 35 mph, or higher, is desirable. Furthermore, speeds less than 30 mph result in a rapid decrease in traffic flow rate (capacity) and fuel efficiency, as well as large increases in vehicular emissions.

Efficient traffic progression (progression band width divided by cycle length) is essential on major suburban/urban roadways in order to maximize safety and capacity. Moreover, at high efficiencies, fewer vehicles are required to come to a stop. Deceleration “noise” (successive deceleration followed by acceleration) is reduced; thus, vehicle emissions, fuel consumption and delay are minimized. Because capacity will always be an issue on a major urban arterials after urban development has occurred, the signal spacings must be such that very high progression efficiencies can be obtained over a wide range of through and turn volumes that change over time and which differ by time of day. The New Jersey DOT, for example, specifies a minimum acceptable through band width of 50% on those facilities functionally classified as principal arterials [5].

Exhibit 9 gives cycle length, progression speed and signal spacings that provide maximum progression efficiency. Exhibit 10 gives the progression speed for combinations of cycle length and signal spacing. It should be noted that cycle lengths less than 95 seconds result in excessively high progression speeds. Cycle lengths longer than 95 seconds produce progression speeds that might be appropriate on rural highways and low volume suburban roadways. Intersections in rural areas are rarely signalized; therefore, progression speed and platooning are not issues of concern. However, any location that might be considered for signalization if urban development should occur at some distant point in time should be at a long, uniform interval (i.e., 1-mile or multiples of one mile).

Exhibit 9: Optimum Signalized Intersection Spacing in Feet Needed to Achieve Efficient Traffic Progression at Various Speeds and Cycle Lengths										
Cycle Length (sec)	Speed (mph)									
	25	30	35	40	45	50	55	60	65	70
60	1,100	1,320	1,540	1,760	1,980	2,200	2,420	2,640	2,860	3,080
65	1,190	1,430	1,670	1,905	2,145	2,385	2,620	2,860	3,100	3,320
70	1,280	1,540	1,800	2,050	2,310	2,570	2,820	3,080	3,337	3,595
75	1,375	1,650	1,925	2,200	2,475	2,750	3,025	3,300	3,575	3,850
80	1,470	1,760	2,050	2,350	2,640	2,930	3,220	3,320	3,813	4,105
85	1,560	1,870	2,180	2,495	2,805	3,115	3,430	3,740	4,050	4,365
90	1,630	1,980	2,310	2,640	2,970	3,300	3,630	3,960	4,290	4,620
95	1,740	2,090	2,440	2,785	3,135	3,485	3,830	4,180	4,530	4,875
100	1,835	2,200	2,565	2,935	3,300	3,665	4,035	4,400	4,765	5,135
105	1,925	2,310	2,695	3,080	3,465	3,850	4,235	4,620	5,005	5,390
110	2,016	2,420	2,825	3,225	3,630	4,035	4,435	4,840	5,243	5,645
115	2,110	2,530	2,950	3,375	3,795	4,215	4,640	5,060	5,480	5,905
120	2,200	2,640	3,080	3,520	3,960	4,400	4,840	5,280	5,720	6,160

$$\text{Spacing in feet} = \frac{\textit{(Velocity in mph)(Cycle Length in Seconds)}}{\textit{1.3636 (a constant)}} = \frac{VC}{1.3636}$$

Exhibit 10: Progression Speed in mph as a Function of Signal Spacing and Cycle Length						
Cycle Length (sec.)	Spacing in Miles (feet)					
	1/8-mile (660 ft.)	1/4-mile (1,320 ft.)	1/3-mile (1,760 ft.)	1/2-mile (2,640 ft.)	3/4-mile (3,960 ft.)	1-mile (5,280 ft.)
60	15	30	40	60	90	120
65	14	28	37	55	83	110
70	13	26	34	51	77	103
75	12	24	32	48	72	96
80	11	22	30	45	67	90
85	10.5	21	28	42	64	85
90	10	20	27	40	60	80
95	9.5	19	25	38	57	76
100	9	18	24	36	54	72
105	8.5	17	23	34	51	69
110	8	16	22	33	49	65
115	7.8	15.7	21	31	47	63
120	7.5	15	20	30	45	60

$$V = \text{Velocity in mph} = \frac{1.3636 \text{ (a constant) x Spacing (in ft.)}}{\text{Signal Cycle Length (in sec.)}} = \frac{1.3636S}{C}$$

LONG SIGNAL SPACINGS PROVIDE THE FLEXIBILITY TO OPERATE WITH A RANGE OF PROGRESSION SPEEDS AND CYCLE LENGTHS

Experience has shown that high volumes and capacity problems will result on major arterials when the area is fully urbanized. Therefore, the future cycle length must be considered in selecting a signalized intersection spacing pattern that will provide efficient progression at desired speeds and maximize flow rates in the future as well as at the present time.

The longer the distance between access connections, the higher the volume at those connections that are permitted. Hence, assuming the same density of development -- with one signalized connection per mile, each intersecting cross-road can be expected to have twice the volume of cross-road approaches as a one-half mile interval. Experience has shown that an intersection of a 6-lane divided roadway and a 4-lane divided roadway (with dual left-turn lanes and right-turn lanes on all four approaches) is the maximum configuration for a signalized intersection and still achieve high utilization of the traffic lanes. An intersection of two 6-lane divided roadways cannot accommodate the turning volumes and will need to be replaced by an interchange in order to achieve efficient utility of the 6 lanes on both roadways. However, the one-mile interval will permit the replacement of at-grade intersections with grade separated interchanges.

It is desirable to have a coherent platoon of traffic, with a length measured in seconds not to exceed the green progression band width. It is also desirable to achieve the repeated arrival of these platoons on green, not red, at each successive signal.

Platoons tend to disperse with increased distance, and hence travel time. This dispersion is the result of different drivers traveling at different speeds. Faster drivers tend to pull away while slower drivers lag behind. Platoon dispersion results from drivers adjusting the relative distance between their vehicle and the leading and following vehicles. The rate of dispersion is a function of a) the length of the original platoon, and b) the travel time in seconds. Travel time at a selected progression speed is directly related to distance. Hence, platoon dispersion increases as the distance between signals in a coordinated traffic signal system increases. Dispersion models are incorporated in PASSER II and TRANSYT-7F.

Progression at reasonable speeds can be achieved in short signal spacings such as ¼-mile (1320 ft.) only so long as the traffic volumes are very low and short cycles (60 seconds or less) can be used. A 60-second cycle will result in a progression speed of about 30 mph.

As arterial and cross-street traffic volumes increase, longer cycle lengths must be used in order to increase capacity by minimizing lost time. As a result, cycle lengths of 90 to 120 seconds are commonly used on major urban arterials during peak periods in developed urban areas. With a 90-second cycle and a ¼-mile spacing the progression speed is only 20 mph, with a 120-second cycle it drops to less than 15 mph.

With a ½-mile signal spacing, right-in/right-out only might be considered at the intermediate ¼-mile point. This will facilitate development of a circulation system and development pattern. U-turns might be accommodated at unsignalized median openings or at the signalized intersections. Drivers utilizing the u-turn will leave “gaps” in the left-turn traffic stream.

Maximum traffic flow through a coordinated traffic signal system occurs at speeds of slightly over 40 mph to about 45 mph. Additionally, high fuel efficiency and relatively low vehicular emissions occur at speeds between 30 and 55 mph [4].

The flexibility to select from a range of cycle lengths that will provide a range of speeds and efficient traffic progression (progression band width divided by cycle length) increases as traffic signal spacing increases. For this reason, a number of agencies (Colorado, Florida, Minnesota for example) have selected one-half mile as the standard interval for allowing full median openings and other locations that might be considered for signalization. (The Minnesota and the Arizona DOT’s have a one-mile signal spacing on some roadways that have been assigned to a very high access management category – those just below the freeway category – where development is sparse. They will permit the addition of signalized intersections at the ½-mile points if and when development should occur.)

Exhibit 11 shows that for a ¼-mile spacing and cycle lengths between 60 seconds and 120 seconds, the range of two-way traffic progression is between 15 and 30 mph. These speeds are below the speed that will provide high throughput (capacity) and good fuel efficiency (see Exhibit 8).

Exhibit 12 shows that with a ½-mile signal spacing, cycle lengths between 60 and 120 seconds provide a much larger range of progression speeds (30 to 60 mph). Moreover, this range in progression speed also provides for high throughput, efficient fuel consumption, and relatively low vehicular emissions. Off-peak cycle lengths of 65 to 80 seconds will provide progression appropriate for major suburban arterial roadways. These same cycle lengths (65 to 80 seconds) will not provide for efficient progression with a ¼-mile spacing.

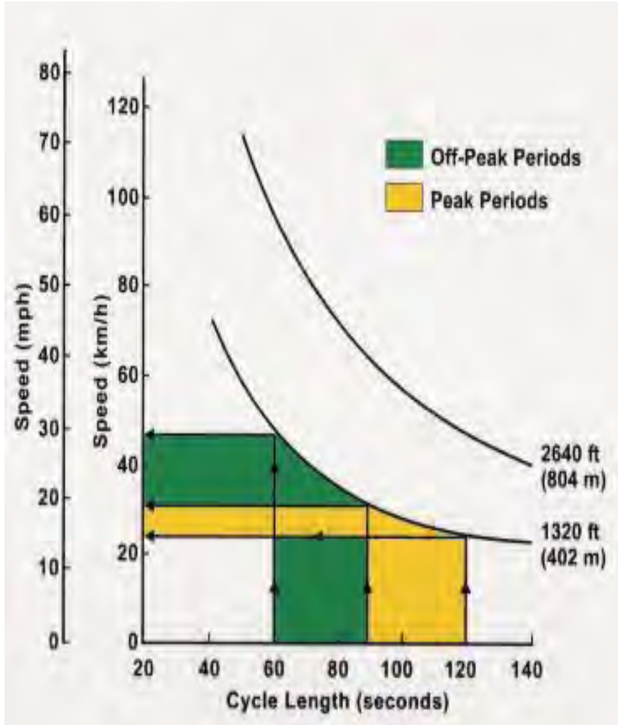

Exhibit 11: Range of Speeds and Cycle Lengths with a 1320 ft. Signal Spacing

Source: *Transportation and Land Development* [6]

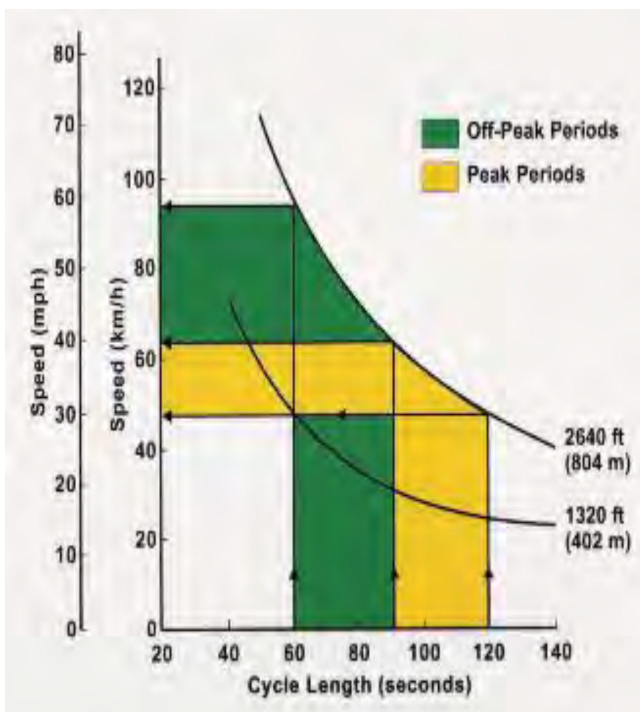

Exhibit 12: Range of Speeds and Cycle Lengths With a 2640 ft. Signal Spacing

Source: *Transportation and Land Development* [6]

WHEN A SIGNAL LOCATION DOES NOT CONFORM TO THE UNIFORM INTERVAL

Uniform, or near uniform spacing of arterial-arterial intersections is essential if efficient traffic progression is to be achieved. When signal spacing deviates from a uniform spacing, the green time for the major arterial must be increased to maintain progression efficiency. Studies show that for short cycles (i.e., 60 seconds) a one percent deviation from optimum spacing will reduce the progression band by one percent. For longer cycle lengths (i.e., 120 seconds) a one percent deviation will reduce the through band by 2%. Main street green must be increased, and cross-street green reduced in order to compensate.

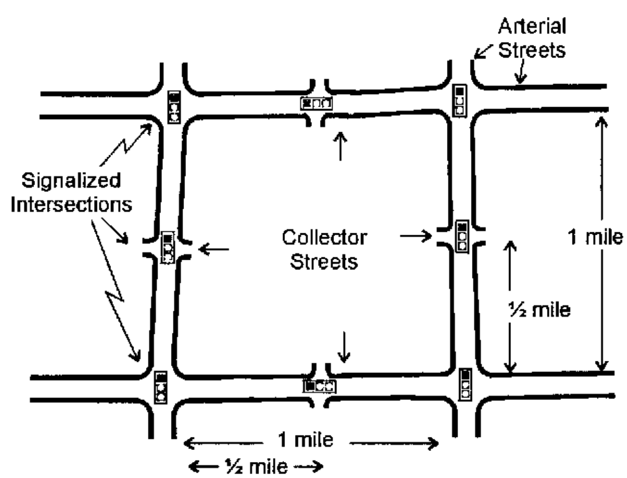

Exhibit 13: Desirable Signalized Intersection and Arterial Roadway Spacing

Source: *Transportation and Land Development* [6]

Capacity at the intersection of two major urban arterials will ultimately become a problem. Therefore, major arterials need to be located at multiples of the selected uniform signal spacing interval in order to provide traffic progression during both peak and off-peak periods. For example, with a ½- mile signal spacing interval, major urban arterials should be spaced 1 mile apart. This will allow for a collector street to be located between the arterials. Alignment of the collector streets is dependent upon the subdivision layout. (Ideally, the pattern of collector streets within residential areas should discourage through traffic from using the collectors as an alternative to the arterial streets.)

Because of the lower volume on the collector, or other minor access connection, its location can commonly deviate from the adopted uniform interval. Where necessary an approach can be widened to increase the number of lanes at the intersection – thus reducing the green time needed to accommodate the traffic volume. In some cases it may be appropriate to increase the number of left-turn lanes on the major road approach to a minor connection from a single lane to a dual left-turn lane.

In any case, criteria for the minimum progression band (such as Exhibit 15) should be adopted by regulation.

Exhibit 14: Suggested Minimum Progression Band Widths[(1)]

		Peak Periods		Off-Peak Periods	
Functional Design Type	Level of Access	Speed (mph)	Min. Band Widths (%)	Speed (mph)	Min. Band Widths (%)
Freeway	1	NA	NA	NA	NA
Major Arterial	2	≥ 30	50	≥ 45	≥ 45
	3	≥ 30	50	≥ 45	≥ 45
Minor Arterial	4	≥ 30	40	≥ 35	≥ 40
	5	≥ 20	35	35	30
Major Collector	6	NA	NA	≥ 30	≥ 40%
Minor Collector or Local Street	7	NA	NA	NA	NA

[(1)]Band width as a percent of cycle length = [(green and yellow) ÷ cycle length] 100

Where a deviation from the adopted uniform signal spacing interval for a state highway access management category is requested, the applicant should be required to present justification as to why the signal is necessary at the requested location to provide safe and efficient traffic flow on the public roadway system. Additionally, a traffic study, acceptable to the Department should be required to demonstrate that the specified minimum band width can be achieved.

It is suggested that regulations contain requirements be adopted: a) progression efficiency (progression band width divided by cycle length) for each roadway category such as illustrated in Exhibit 14; and, b) other conditions to be used in the analysis will be stipulated by the Department. These other conditions are:

1. The segment length
2. The location of existing and possible future signals
3. The combinations of progression speed and cycle length to be used in the analysis. These combinations shall include a) a.m. peak period, b) mid-day, c) p.m. peak period, d) evening, and e) any

other weekday or weekend periods of interest or concern to the Department
4. The analysis model/procedure to be used
5. Any conditions such as traffic volumes as may be identified by the Department.

The regulations should also require that the analysis be performed by, or under the direct supervision of, a qualified Professional Engineer licensed in the State.

In addition to the above requirements, the regulations should state that an authorized signal shall meet one or more of the warrants specified in the Manual on Uniform Traffic Control Devices at the time of installation.

Exhibit 15: Suggested Requirements for Analysis of Signal Locations
• Roadway Segment • Signal Location (existing and future) • Combinations of - Cycle length - Speed - Efficiency • Model to be used • Traffic volumes • Other considerations • Analysis by a qualified P.E.

Efficient traffic progression is essential in major arterials. On lower functional class roadways, progression speed and efficiency are less important.

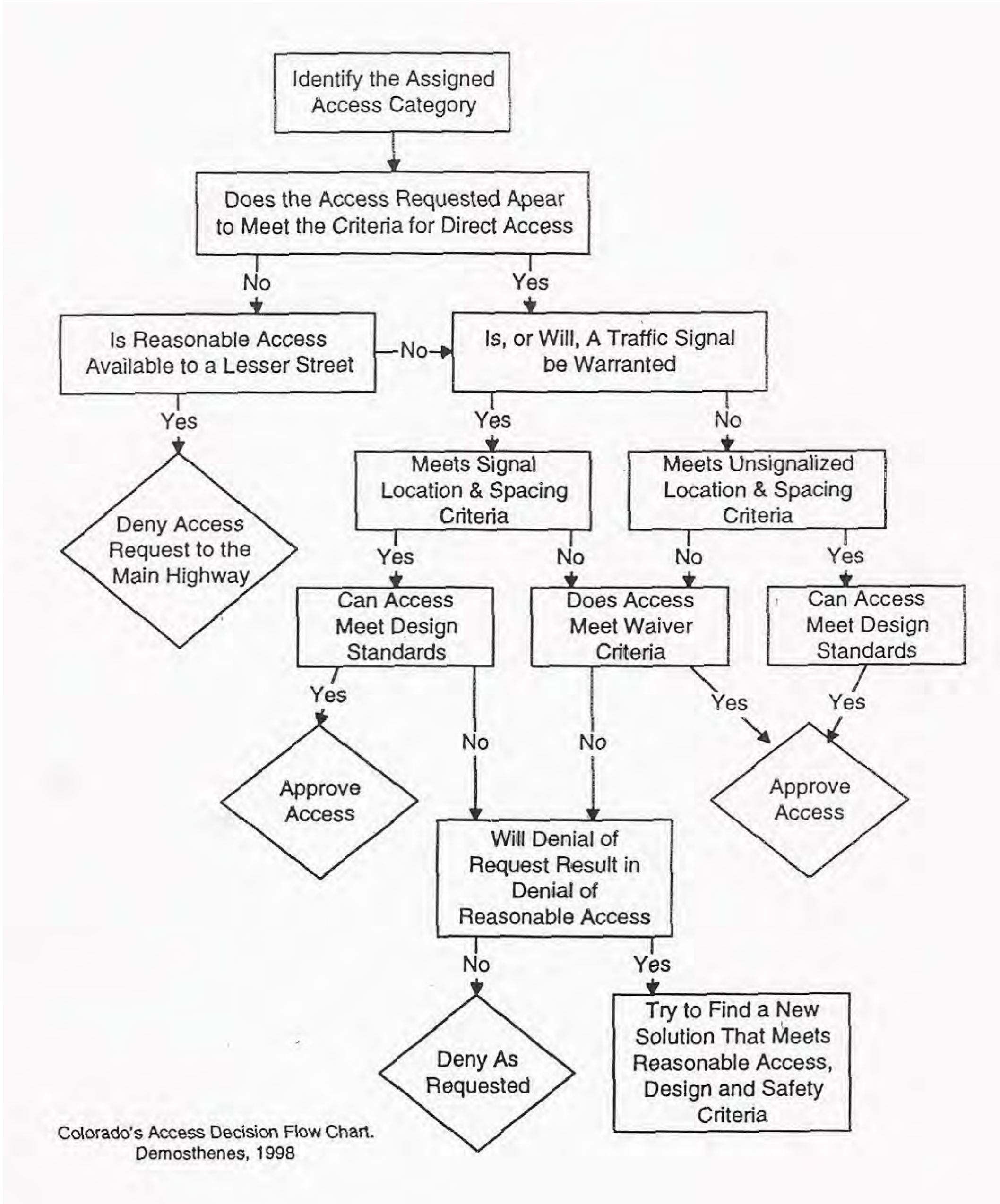

Exhibit 16: Recommended Procedure for Review of Full Median Openings and Proposed Signal Locations

Source: Colorado DOT, also see TRB Access Management Manual page 232

REFERENCES

1. C. A. Squire and P. S. Parsonson, "Accident Comparisons of Raised Medians and Two-Way Left-Turn Lanes," TRB Record 1239, Transportation Search Board, National Research Council, 1989.

2. J. Gluck, H. S. Levinson and V. G. Stover, "Impacts of Access Management Techniques," NCHRP Report 420, National Cooperative Highway Research Program, Transportation Research Board, National Research Council, 1999.

3. E. Hauer, "Access and Safety", Unpublished paper, April 15, 2001.

4. Stacy C. Davis, "Transportation Energy Data Book", Center for Energy Analysis, Oak Ridge Laboratory July 31, 2008.

5. State Highway Access Management Code, Department of Transportation, State of New Jersey.

6. V. G. Stover and F. J. Koepke, Transportation and Land Development, Institute of Transportation Engineers, 2002.

7. V. G. Stover, P. B. Demosthenes, and E. M. Weesner, "Signalized Intersection Spacing: An Element of Access Management," Compendium of Papers, 61st Annual Meetings, Institute of Transportation Engineers, September 1991.

8. NHI Course 133078, "Access Management Location and Design," National Highway Institute, Federal Highway Administration, 2000.

9. Final Report of the Colorado Access Control Demonstration Project, Colorado Department of Highways, June 1985.

10. Access Management Manual, Transportation Research Board, 2003.

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Attachment A

Draft Prototype Regulations

The policy in this attachment is based on posted speeds. Such a procedure might be applied in absence of adoption of Access Management Categories; or until such a system of categorization of roadways for access management has been implemented.

1. PURPOSE: This directive sets forth the policy of the Department of Transportation and Development for planning the location of signalized intersections, and the installation of new traffic signals.

2. SCOPE: This policy applies to all state highways.

3. DEFINITIONS:

   A. Cycle Length: The time interval in seconds from the beginning of a traffic signal phase to the beginning of the same following phase (e.g., from the beginning of a GREEN phase to the beginning of the following GREEN)

   B. Progression Speed: The uniform/constant speed in miles per hour at which a vehicle can travel through several traffic signals without stopping.

   C. Progression Band Width/Band Width: The time interval in seconds between when the first and last vehicles can proceed at a constant speed through a series of traffic signals without stopping at a traffic signal.

   D. Percent Band Width: The band width in seconds (BW) divided by the cycle length (C) in seconds times 100;

      % Band width = (BW/C)(100)

4. POLICY:

   A. All new traffic signal locations:
      1. Shall conform to a uniform interval of 2640 feet where the posted speed is 30 mph or higher unless the Chief Engineer approves a deviation as provided for in Section C.

2. Where the posted speed is less than 30 mph, the Chief Engineer may approve a signal if the location will not result in a progression speed nor a progression band width that is less than that currently achievable.

3. A traffic signal shall not be installed until it meets Warrant 1a (100%) or Warrant 7 in the MUTCD.

B. All new traffic signal locations shall have a left-turn deceleration/storage lane and a right-turn deceleration/storage lane of a design approved by the DOTD. Where the projected volume is expected to exceed 200 vph in any 60-minute period, a dual left-turn lane may be required. The cost of providing the left-turn and right-turn lanes shall be the responsibility of the party/agency requesting the traffic signal.

C. Deviations

1. A deviation from the 2640 foot uniform spacing interval may be approved by the Chief Engineer provided that a traffic study performed by, or under the direct supervision of a Professional Engineer registered in the State using the information listed in Table A demonstrates that the resulting progression bandwidth will not be less than 40% in any 60-minute peak period nor less than 45% in any 60-minute non-peak period. The conditions in Table A will be provided by the DOTD or shall have written approval of the DOTD prior to the start of the traffic study.

2. Upon receipt of the signed and sealed study report, the Chief Engineer shall have 21 working days to:

   a. approve the requested deviation,
   b. disapprove the requested deviation, or
   c. request additional evaluation from the applicant. When additional evaluation is requested, the applicant shall have 30 working days to submit the additional information. If the additional study/information is not received by the DOTD within 30 days, the deviation shall be denied.

[Note: Appropriate values for the percentages and number of days need to be selected]

Table A: Conditions to be Provided by, or Approved by, the DOTD When a Deviation from the Uniform 2640 foot Signal Spacing Interval
1. The specific roadway segment to be used 2. The location of existing and proposed or planned future traffic signals 3. Combinations of cycle length and progression speed for the weekdays, Saturday and Sunday, AM Peak, mid-Day, PM Peak, and evening hours, will represent present conditions and those that may be expected in the future. Combinations of cycle length and speed shall also be presented. 4. The model (analysis procedure) to be used 5. Traffic volumes. The volumes used in the analysis shall include the following: (a) the project 20-year volumes on the state highway, and (b) the project average and projected 85th percentile traffic volumes, at full build-out, (entering and exiting) the access connection proposed for signalization. 6. Any other conditions considered relevant or appropriate by the DOTD

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Attachment B

Draft Prototype policy based upon a hypothetical hierarchy of roadway categories.

A policy such as that herein would replace Section 4; Policy in Attachment A when and if a hierarchical system of roadway access management categories is implemented. Other sections in Attachment A would be unchanged. The access management categories and standards are for illustrative purposes to demonstrate the nature of regulations based on a hierarchical system of access management categories.

POLICY

All new traffic signal locations shall conform to the uniform interval given in Table A:

Table A: Uniform Traffic Signal Interval

Access Management Category	Uniform Spacing Interval (feet)
1	2640
2	2640
3	2640, speed > 35 mph 1320, speed # 35 mph
4	1320

Adopted access management categories might be based on a) roadway level-of-importance and urban/suburban/rural; or roadway level-of-importance and speed.

Table B: Minimum Progression Band Width		
Access Management Category	**Minimum Band Width**	
	Peak Periods	**Off-Peak Periods**
1	50%	45%
2	50%	40%
3 speed > 35 mph speed < 35 mph	45% 40%	40% 35%
4	40%	30%
5	Not applicable	30%