APPENDIX C-10 - MINIMUM ACCESS SPACING GUIDELINES

MINIMUM ACCESS SPACING GUIDELINES 2008

TYPE OF ACCESS BEING REQUESTED	TYPE OF COUNTY HIGHWAY FUNCTION AFFECTED BY ACCESS			
	PRINCIPAL ARTERIAL	**Minor Arterial A and B Minor**	**Collector**	**Local**
A. Private Residential (3 or less shared driveways)	Not Permitted	*Not Permitted in 2030 Urban Services Area & Urban reserve *1/4 mile in rural	1/8 Mile	Determination based on other criteria
B. Commercial Driveways, Or Private Streets	Not Permitted	Not Permitted	*Right In/Right out at 1/8 Mile *Full access at 1/4 Mile	Determination based on other criteria
C. Local Streets	Not Permitted	*Full access at 1/4 Mile *Right in/Right out at 1/8 Mile	1/8 Mile	1/8 Mile
D. Collector Streets	*1 Mile Full Access (rural) *3/4 or Right In/Right out at 1/2 Mile (urban)	*Full access at 1/4 Mile *Right in/Right out at 1/8 Mile	1/4 Mile	1/4 Mile
E. Minor Arterial	*1 Mile Full (rural) *1 Mile full Access (urban)	*1/2 to 1 Mile (urban) *1/2 Mile to 1 Mile (rural)	*1/4 to 1 Mile (urban) *1/2 to 1 Mile (rural)	*1/4 to 1 Mile (urban) *1/2 to 1 Mile (rural)

Notes:

1. The Functional Classification is based on the Future Functional Classification Map (Figure VI-17).
2. Fully developed urban area will require individual evaluation on a case by case basis.
3. When there is opportunity for private or public access on more than one public roadway, access shall be taken on lower functional roadway.
4. Turn lanes shall be required at all access locations except for private residential direct access in the rural area.
5. Intersection Control/Signals shall be installed only where warranted and justified, consistent with the MMUTCD. 1 mile signal spacing on Principals and 1/2 mile signal spacing will be preserved on other roadways.
6. Access spacing may be modified to be more or less restrictive per adopted County corridor study.
7. Private residential access in the rural area shall be located where there is the optimum distance or future shared access
8. Environmental constraints may be considered when determining access spacing locations.
9. Access spacing within Interchange influence areas shall meet all stopping and intersection site distance requirements on Principal Arterials.
10. Existing access on Principal Arterials outside the 2030 service area may be relocated provided sight distance is improved and opportunities for access consolidation do not exist. Future removal of the access must be planned for.

This technical appendix establishes guidance on intersection influence, or functional areas, signal spacing and the application of access management. This document, 11/18/2008, is an evolving technical document and is updated as technical information becomes available. Please contact Scott County Public Works for the most recent technical appendix. Figure 1 is the County's Minimum Access Spacing Guidelines.

Intersection Influence Areas

An intersection is defined by both its physical area and its influence area. The physical area, shown in Figure 2, is simply the area between all approaches. The influence area, sometimes called the functional area shown in Figure 2, is larger than the physical area and extends both upstream and downstream from the physical intersection area and includes any turn lanes, channelization and distance for drivers to make decisions.

The intersection influence area is actually the summation of separate areas – upstream influence area and downstream influence area, shown in Figure 3. The upstream influence area is located on the roadway lanes approaching an intersection, driveway or entrance and the downstream influence area is the roadway heading away from the intersection. The upstream influence area is usually longer then the downstream influence area because it includes the summation of the following factors, shown in Figure 4:

Perception-Reaction Distance - the ability of the driver to both perceive and react to a downstream event, such as upcoming traffic control or stopped vehicles in the roadway.

Maneuver Distance – distance required for drivers to make a maneuver, such as a lane change, and either decelerate or stop before the Queue-Storage Distance (discussed below).

Queue-Storage Distance – as vehicles wait for traffic control to change they may form queues in the upstream influence area.

Minor Road/Access Intersection Sight Distance – approximately 10 seconds for a vehicle on the minor roadway to see oncoming vehicles on the upstream approach and make decisions to make maneuvers onto the mainline (crossing the roadway, turning right or left onto the roadway or waiting for another gap before making maneuvers) at unsignalized intersections.

The downstream influence area is a function of drivers accelerating, making left and right turns, encountering left- and right-turning vehicles from the cross-street, and preparing for deceleration at locations that are farther downstream. The influence areas of the downstream activities are not as well-defined as the factors corresponding to the upstream activities. The following factors are considered applicable to Scott County's access needs:

- Accommodation of acceleration lane if present, and
- Enough curbline or delineation for drivers turning onto the roadway to have enough time to properly position in the traffic lane which they are entering.

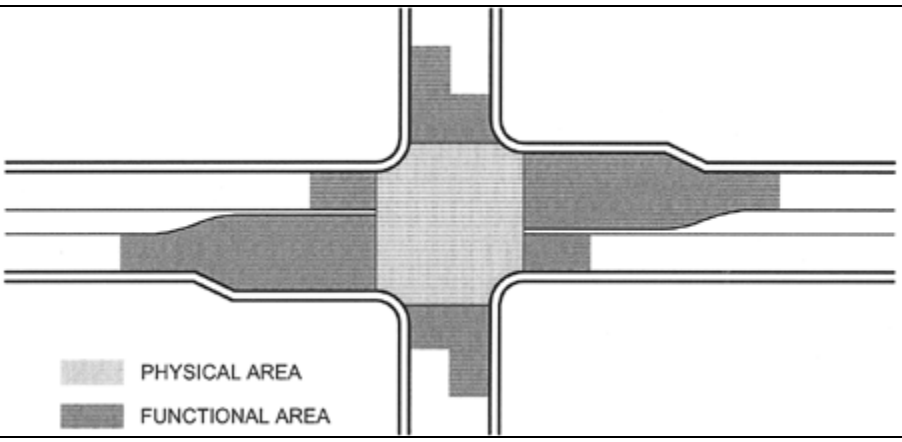


FIGURE 2 - COMPARISON OF PHYSICAL AND FUNCTIONAL AREAS OF AN INTERSECTION
Source: Signalized Intersections: Informational Guide, FHWA-HRT-04-091, August 2004

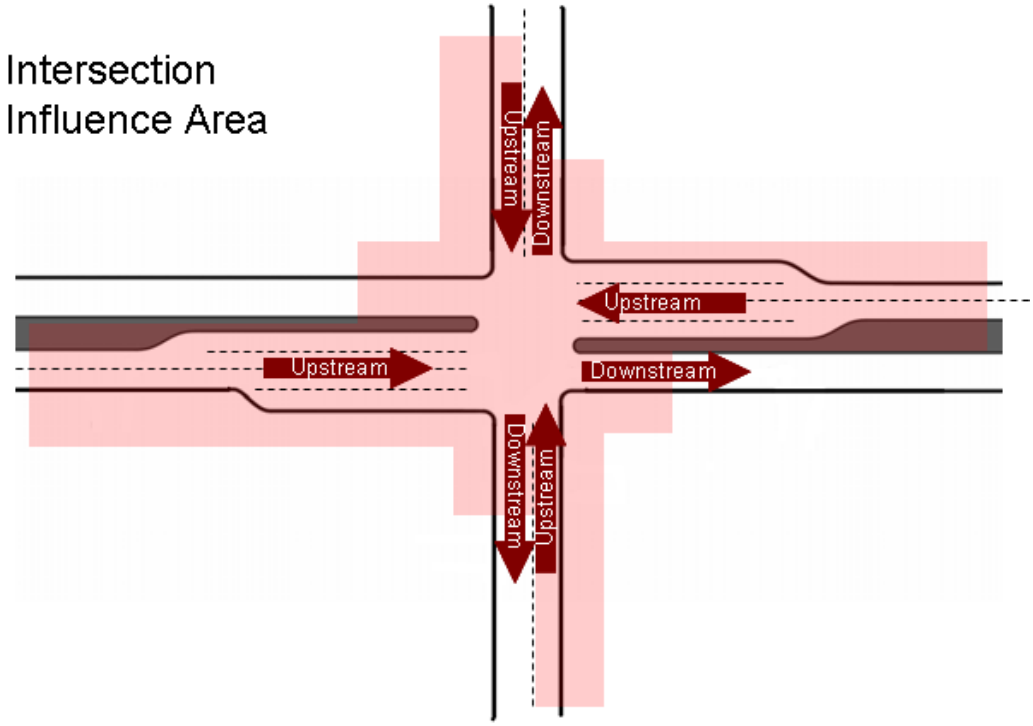


FIGURE 3 – UPSTREAM AND DOWNSTREAM INFLUENCE AREAS

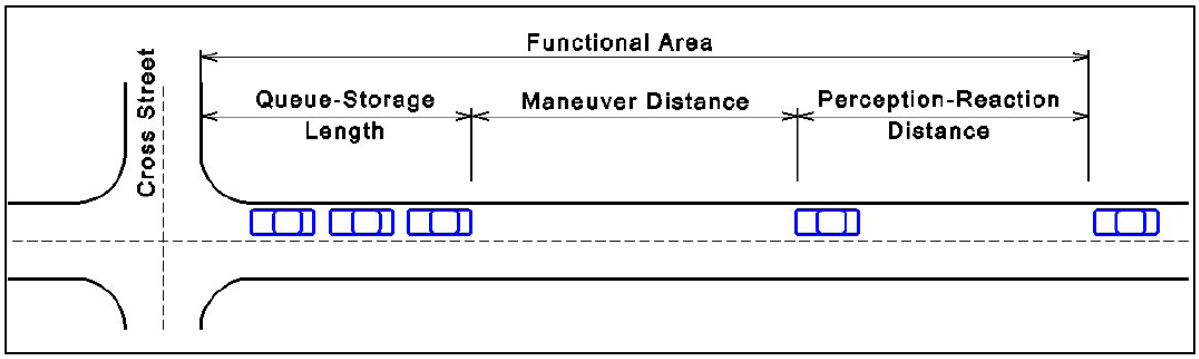


FIGURE 4 – UPSTREAM INFLUENCE (FUNCTIONAL) AREA FACTORS
Source: Mn/DOT Access Management Manual

On Principal arterial roadways public street accesses should not be located within the functional area of an intersection or in the influence area of an adjacent driveway or entrance. Also, the influence areas of two intersections should not overlap. An overlap in influence areas would create a situation where a driver would be required to perceive and react to multiple events and increase the chances of a conflict with another vehicle, or a crash. Figure 5 provides a graphical representation of the desire to not overlap influence areas. This functional area of an intersection should also be protected where ever possible on Minor Arterial roadways.

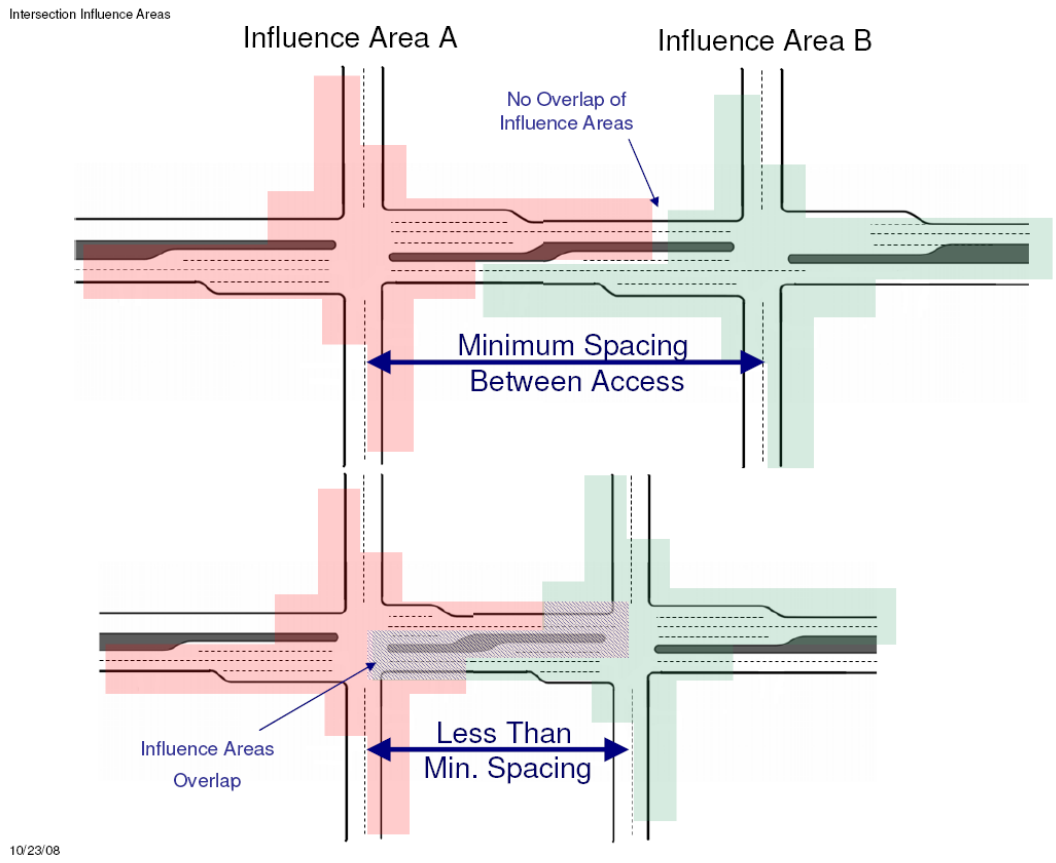


FIGURE 5 – INTERACTION OF INFLUENCE AREAS

Determining Intersection Influence Areas

The process for determining intersection influence areas are based on research and documentation in Mn/DOT's Access Management Manual and Discussion Paper No. 7 from the Transportation Research Institute[1].

Upstream Influence Area - the upstream influence area is a function of three factors: (1) perception-reaction distance, (2) maneuver distance, and (3) storage needs of the intersection. In addition to the three factors that affect the mainline roadway, the cross street intersection sight distance may also determine the necessary upstream influence area.

(1) Perception-reaction distance: distance traveled during the perception-reaction time. AASHTO Green Book[2] recommends a perception-reaction time of 2.5 seconds. The corresponding distance is a function of the design speed.

[1] Functional Intersection Area, Discussion Paper No. 7, Transportation Research Institute, Oregon State University, January 1996

[2] A Policy on Geometric Design of Highways and Streets, 2004, American Association of State Highway and Transportation Officials

(2) Maneuver Distance: the maneuver distance is the distance needed for deceleration and lane changing when a turn lane is present. In the absence of a turn lane, the maneuver distance is the deceleration distance required to make a comfortable stop.

(3) Queue-Storage Length: this is the distance required to accommodate the longest queue that is expected most of the time, either in the turn lane or at the stop bar.

While each of the three factors can be calculated, such a detailed approach would be appropriate for the examination of specific intersections. For a general countywide analysis, however, it is most convenient to use an average value that can reasonably be applied to all intersections. Based on Mn/DOT's Access Management Manual, for intersections that have turn lanes, the upstream influence area for roadways posted at 45 mph or greater is a distance of 650 feet. For roadways posted less than 45 mph, the upstream influence area is 435 feet. For roadways without turn lanes, the stopping sight distance (see Figure 6) is the appropriate upstream influence area. A summary of the upstream influence area distances is shown in Figure 5.

In addition to the upstream distances discussed, the intersection sight distance should be considered at unsignalized intersections to guarantee that there is no access located within the line of sight of the cross street vehicle (see Figure 7). While the upstream influence areas shown in Figure 5 should provide enough distance to allow adequate intersection sight distance, some cases may require a closer look at the two numbers.

Downstream Influence Area – the downstream influence area distance is either the length of an acceleration lane or, at a minimum, 90 feet [2]. The 90 feet is based on the amount of delineation or curbline required for drivers turning onto the roadway to properly position in the traffic lane which they are entering.

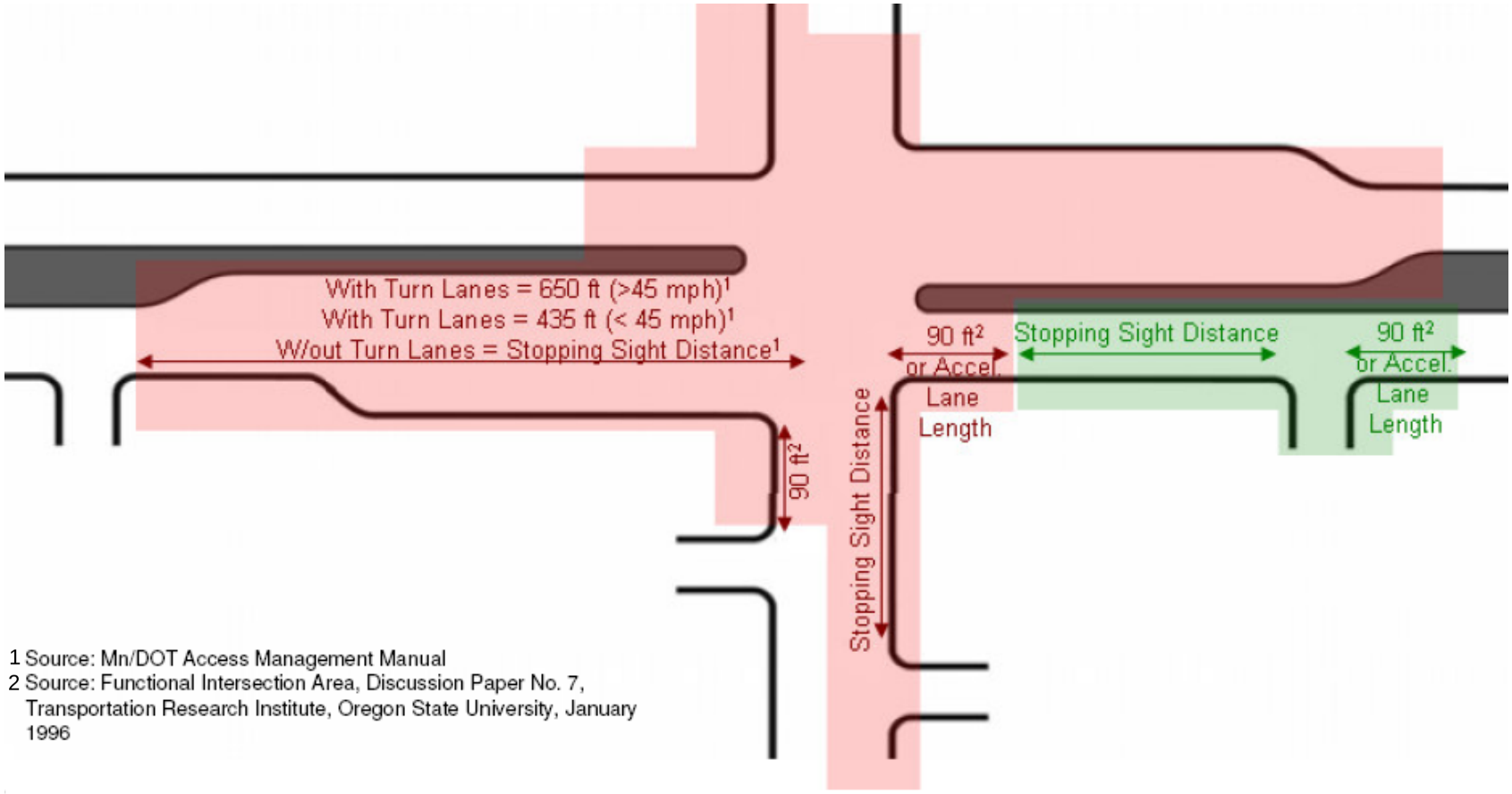


FIGURE 6 – INFLUENCE AREA DISTANCES

Table 2.5.09A
STOPPING SIGHT DISTANCES ON LEVEL TERRAIN

Metric					English				
Design speed (km/h)	Brake reaction distance (m)	Braking distance on level (m)	Stopping sight distance		Design speed (mph)	Brake reaction distance (ft)	Braking distance on level (ft)	Stopping sight distance	
			Calculated (m)	Design (m)				Calculated (ft)	Design (ft)
50	34.8	28.7	63.5	65	30	110.3	86.4	196.7	200
60	41.7	41.3	83.0	85	35	128.6	117.6	246.2	250
70	48.7	56.2	104.9	105	40	147.0	153.6	300.6	305
80	55.6	73.4	129.0	130	45	164.4	194.6	359.8	360
90	62.6	92.9	155.5	160	50	183.8	240.0	423.8	425
100	69.5	114.7	184.2	185	55	202.1	290.3	492.4	495
110	76.5	138.8	215.3	220	60	220.5	345.5	566.0	570
120	83.4	165.2	248.6	250	65	238.9	405.5	644.4	645
					70	257.3	470.3	727.6	730
					75	275.6	539.9	815.5	820

Note: Brake reaction distance predicated on a time of 2.5 s; deceleration rate of 3.4 m/s^2 (11.2 ft/s^2) used to determine calculated sight distance.

Increases or decreases in the level braking distances in Table 2-5.09A are warranted for grades of 3 percent or more. The braking distance formula should be modified as follows:

FIGURE 7 – MN/DOT ROAD DESIGN MANUAL STOPPING SIGHT DISTANCES

Definitions

Intersection Sight Distance (ISD), as illustrated in Figure 3.21, allows vehicles entering a highway to turn into the through-lane and get up to running speed without adversely slowing down through-traffic. The *Mn/DOT Road Design Manual*, Section 5-2.02, provides a detailed description of Intersection Sight Distance.

Figure 3.21: Intersection Sight Distance

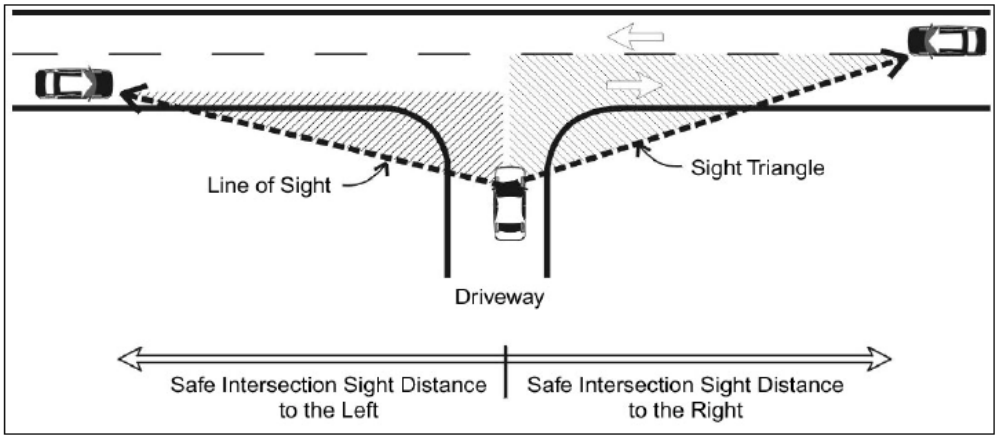


FIGURE 8 – MN/DOT ACCESS MANAGEMENT MANUAL – INTERSECTION SIGHT DISTANCE

Interchange Influence Areas

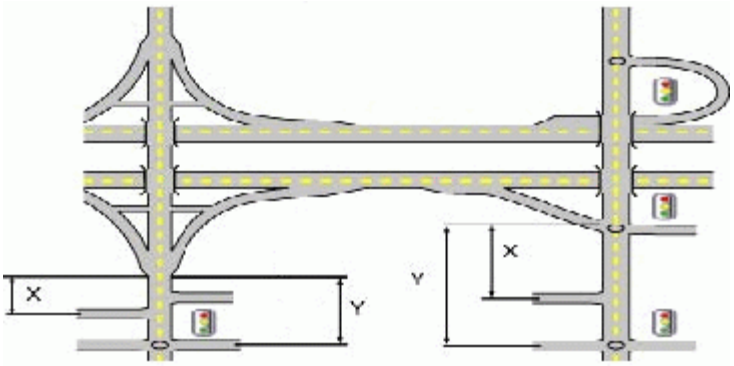
The following is guidance regarding the Functional Areas of Interchanges:

Adequate space is needed for traffic to make the transition from a road with interchanges to a road with at grade access points. The functional area of the interchange is where merging and diverging of traffic takes place. Drivers must travel along an exit ramp, find acceptable gaps, change lanes (weave) and merge within this distance.
A safe distance for this activity is to be provided from the end of the off ramp to the first driveway, median opening or intersection with a public road. This is measured from the point of intersection of the ramp baseline and roadway centerline. When only right turns into or out of a public roads are involved, a shorter clearance area may be used. On Principal or Future Principal Arterials These guidelines also apply to on-ramps and off ramps not associated with an interchange.

Interchange Clearance Situations

X = Distance from baseline off- ramp to first right-in, right-out public road intersection.

Y = Distance from baseline off-ramp to first major public road intersection, full median opening, or left-turn opportunity. Spacing greater than the distances shown is advantageous for safety and operations.



Minimum Guidelines for Interchange Area Clearance		
Type of Area	**Distance from Ramp to Right-In, Right-Out Street (X), ft. (1)**	**Distance to First Major Public Road Intersection, Full Median Opening, Or Left-Turn Opportunity (Y), ft. (2)**
Principal Or Future Principal	Generally not permitted	1,320 – 2,640
Minor	750 – 1,320	1,320 – 2,640
(1) right in, right out allow only if intersection influence area for next intersection is adequate. (2) Left turns are not to be allowed in this section of roadway. The public road intersection is likely to become a signalized intersection as the interchange area develops. Right –in, right –out driveway configuration is to include a non-traversable median.		

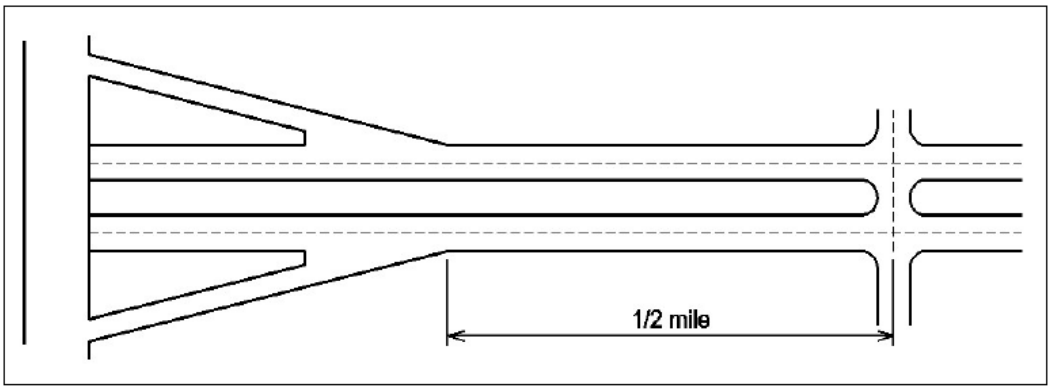
Note: All ramp measurements are taken to or from baseline ramp.

Clearance less than the range in the above table is to be supported by a study of alternatives to ensure safety and traffic flow. Other alternatives to be examined may include installation of raised medians, construction of a single point urban interchange, the use of roundabouts at the ramp and or outer road intersections or alternative access ways such as frontage and backage roads.

Figure 3.35 of Mn/DOT's Access Management Manual provides guidance for a ½ mile of spacing before a turn lane for a decision point (see excerpt below) on roadways transitioning from freeway to arterial geometrics.

- The median opening is located less than one-half mile from the merge point of an interchange ramp (as shown in Figure 3.35).

Figure 3.35: Spacing from Interchange Merge Point



Access Spacing Near Full Access At-Grade Intersections Based on Influence Areas

The influence area distances provided in Figure 5, along with the goal of not overlapping influence areas can be applied to determine appropriate distances between accesses. An example is shown below for spacing of a right-in/right-out access:

> Right-in/Right-out – the distance upstream of a full access location would range from 360 feet (if there are no turn lanes on a 45 mph roadway based on Stopping Sight Distance, Figure 6) to 650 feet. The distance a right-in/right-out could be located downstream of the full access would be 450 feet for a 45 mph roadway (90 feet for downstream influence area of the full access location plus 360 feet of stopping sight distance for the upstream influence area of the right-in/right-out). To be conservative, an estimate of 1/8 mile spacing for right-in/right-outs (close to the 650 feet required for the largest distance upstream of a full access) would be appropriate.

The distance of 1/8 mile is a common practice for state and county's when developing their access spacing guidelines. Some variations may apply when dealing with principal arterials where greater spacing of access is desired. As such, it is important to apply sound engineering judgment to determine where and if access should be allowed. Some important considerations in the evaluation would include the volume of traffic using the roadways, the type of turning maneuvers that will be most prominent, the type of median present, potential conflicts with and proximity to other access (influence areas), and the volume of traffic on the major street.

Signal Spacing Guidelines

The Transportation Research Board Access Management Manual (2003), contains valuable documentation of signal spacing research. The following are some key results:

- "Decreasing signal spacing from four to two per mile decreases total delay be nearly 60% and vehicle hours of travel by nearly 50%." (*Final Report of the Colorado Access Control Demonstration Project*. Colorado Department of Transportation, Denver, June 1985.)
- "Each traffic signal per mile added to a roadway reduces speed 2 to 3 mph." (*NCHRP Report 420: Impacts of Access Management Techniques*, TRB, National Research Council, Washington, D.C., 1999)
- "A four-lane divided arterial having signals at uniform ½ mile signal spacing could carry the same volume of traffic as a six-lane divided roadway with a ¼ mile signal spacing." (*Access Management Study for Wisconsin State Trunk Highway 50, Suburban Kenosha, Wisconsin*. CH2M HILL and S/K Transportation Consultants, Aug. 1998)
- "Several studies have found that the number of crashes and crash rates increases as the frequency of traffic signals increases. . . . an increase in signal density from 2 or less to 2 to 4 signals per mile can result in a 70% increase in the average crash rate . . . "(*NCHRP Report 420: Impacts of Access Management Techniques*, TRB, National Research Council, Washington, D.C., 1999)

In summary, ½ mile spacing or the equivalent of 2 signals per mile on a minor arterial and 1 mile on a principal arterial would provide benefits in operations and safety of a signalized corridor.