APPENDIX A

BACKGROUND FOR ACCESS SPACING STANDARDS

I. Access Management Classification System

The access management classification system specifies five access management categories based on level of importance for state highways.

1. Freeways
2. Limited access (NHS) highways
3. Statewide (NHS) highways
4. Regional highways
5. District highways

The classification is also stratified by rural and urban, and whether on an expressway or "other" facilities, or in a UBA or STA.

Definitions:

- Commercial Center – Is an area adjacent to a highway segment with approximately 400,000 ft^2 or more of gross leasable area or public space. The primary objective of the highway at this location is to maintain the movement function. (1999 Oregon Highway Plan, pg. 45).

- STA – A Special Transportation Area is to have highway facilities that emphasize access to community activities, businesses and residences and accommodate pedestrians along and across the highway in a downtown, business district and/or community center, including those in unincorporated communities as defined in OAR 660-22. (1999 Oregon Highway Plan, pg. 45).

- UBA – The Urban Business Area recognizes existing and future areas of commercial activity with highway facilities that emphasize maintaining existing speeds and through movement of traffic while balancing the needs for access to abutting properties. (1999 Oregon Highway Plan, pg. 45).

II. Possible Access Spacing Criteria

A. Factors that influence spacing and access standards

1. Driver characteristics

a) Perception – Reaction Time

The time required to see, understand, decide and react varies

with:

- Complexity of the condition
- Driver familiarity
- Driver expectations
- Driver work load

b) Deceleration/Braking

The braking required to slow or stop to avoid a situation must be:

- Comfortable to drivers
- Possible on a poor quality wet pavement

2. Traffic Operating Conditions and Complexity

a) Weaving operations among traffic movements create conflicts

b) Various vehicle types have different operating characteristics and sizes creating conflicts and complexity

c) Large, long haul trucks impact local facilities more than delivery vehicles

d) Long distance and through trips tend to drive faster, due to desired time-distance economy

e) Higher volumes increase the level of conflicts

f) Higher speeds give less time to react and requires longer braking distance

3. Land Use Influences

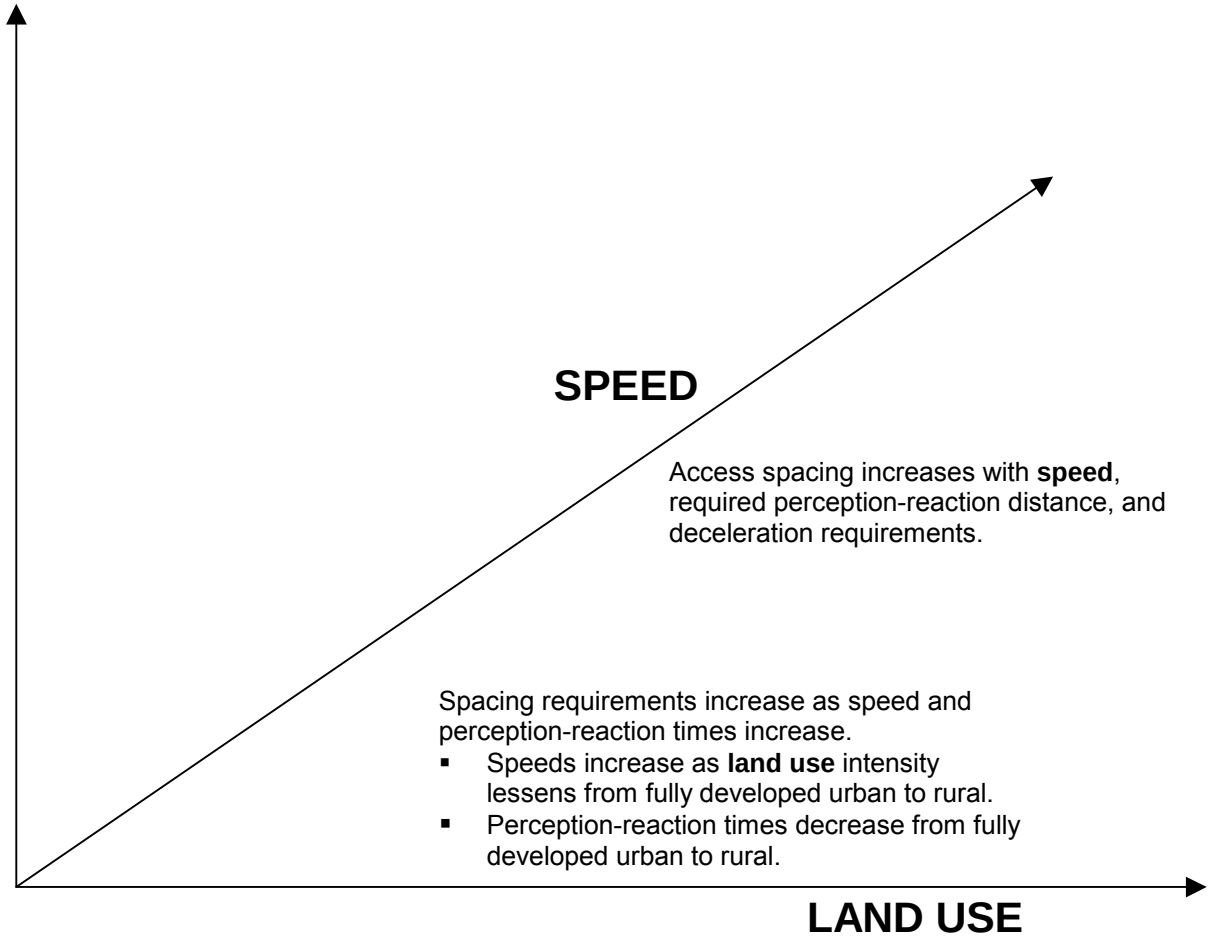
a) Access to local land use creates slowing and turning movements

b) Conflicts increase and become more severe as land use intensifies

c) Increased intensity of adjacent activities including pedestrians, bicyclists, increased signage, and visual overload creates more complexity, conflicts and confusion, requiring longer perception reaction times

4. Logic Diagram

The logic employed to determine the necessary access spacing or location is given on the accompanying diagram.



	Fully Developed Urban	**Urban**	**Rural**
Complexity; i.e., roadside activities, traffic controls, signs, information load	High complexity	Moderate complexity	Simple conditions
Conflicts; i.e., pedestrians, driveways, parking	Numerous	Moderate	Few
Traffic volumes; i.e., more interactions, more decisions, less flexibility	High	Moderate	Low
Driver expectations/understanding	Potential major confusion	Some confusion	Little confusion
Driver alertness	Very alert	Alert	Less alert

B. Access Spacing Criteria

The decisions on spacing and location of approaches can be based on a number of variables, including:

1. Stopping Sight Distance

a. AASHTO Stopping Sight Distance

This is the distance required from a 3.5 ft (1070mm) eye height for a driver to see one clearly discernible object, of 0.5 ft (150 mm) or more in height in the roadway with enough distance to perceive, react and brake to stop on a poor wet pavement.

b. Comfortable Stopping Sight Distance

This distance includes the 2.5 second perception reaction distance plus a more comfortable deceleration rate of 6 ft/sec^2, which matches more closely what drivers prefer.

c. Alerted Sopping Sight Distance

A perception reaction time of 1 second may be used with braking on a poor wet pavement with coefficient of friction about equal to 0.32. This provides adequate stopping distance for an emergency stop, and is not recommended for setting spacing standards and approach locations.

2. Decision Sight Distance

When conditions become more complex, volumes are high, driver familiarity is lacking, and driver expectations don't match conditions, decision sight distance is a good measure to determine spacing criteria. The driver perception reaction times are about 6-10.5 sec and maneuvering times are about 4 to 5 seconds allowing more time to comprehend and deal with the complexity and expectations of drivers. Urban areas require more perception-reaction time than rural due to the higher complexity of the conditions and increased driver work load.

a. Decision Sight Distance to a Stop

When the operating conditions may end with the driver having to stop, this criteria gives additional time to deal with the added complexity plus the distance required to stop.

b. Decision Sight Distance for a Speed, Path, or Direction Change

When the operating conditions require a lane change or major change in path or speed, this criteria can be used. This would often be used on multi-laned facilities.

3. Intersection Sight Distance

All approach road connection sites are intersections. Consequently, intersection sight distance could be a logical criteria. This is the required sight distance to an approaching vehicle of 4.25 ft height from a vehicle set 10 ft (3 m) back from the edge of the roadway, with the driver's eye located 15 ft (4.5 m) back from the roadway edge and at a height of 3.5 ft (1070 m).

a. AASHTO Intersection Sight Distance

- Crossing from Stop Control

  This yields a limiting safety condition for vehicles crossing the roadway.

- Left turns from Stop Control

  This yields a comfortable condition where vehicles on the major facility only have to slow approximately 10 mph (15km/h).

- Right turns form Stop Control

  This is same as left turns.

b. ODOT Adopted Policy for Approach Sight Distance

A driver must be able to see a 4.25 ft (1300 mm) vehicle with 7 seconds travel time from a 3.5 ft (1070 mm) driver's eye set 15 ft (4.5 m) back from the edge of the roadway.

4. At–Grade intersection Spacing-

The at-grade intersection spacing may be fixed by two conditions:

- The minimum distance between on-ramp and off-ramp terminals to allow for weaving.

- The desirable spacing between signalized intersections to promote signal coordination.

a. At-grade intersection spacing-

This applies on expressways where the distance between on-ramps and off ramps for interchanges that may be constructed now or in the future must be preserved, as part of an upgrade to a freeway.

b. Signalized intersection-

This applies on signalized arterials or collectors where the objective is to provide coordination of flow, usually ½ mi. (880 m).

5. Functional Intersection Area

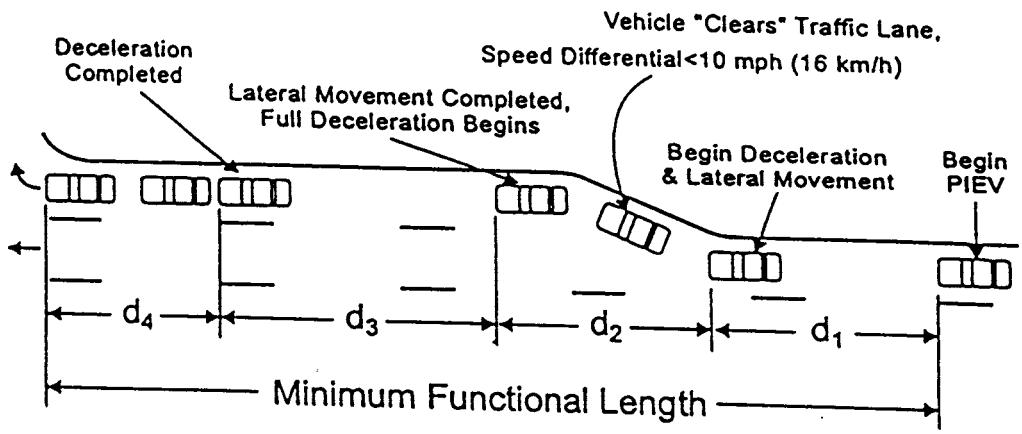
The functional intersection area is the distance required to perceive and react, decelerate to a stop and queue at an intersection. Desirably, in this distance no intersecting approaches for crossing maneuvers would be permitted. Two functional intersection area criteria are specified:

- Limiting functional intersection area-

  based on 9ft/sec^2 (2.75m/sec^2) deceleration rate

- Desirable functional intersection area-

  based on 6ft/sec^2 (1.83m/sec^2) deceleration rate



6. Typical block

This is the typical minimum block length found in urban areas

III. ODOT Access Spacing Standards

The access spacing standards are specified based on:

- Level of importance:

  Freeway, statewide, regional and district

- Land use:

  Rural, urban, UBA and STA

- Posted speed:

  ≤25, 30 & 35, 40 & 45, 50 and ≥55mph

A. Standards

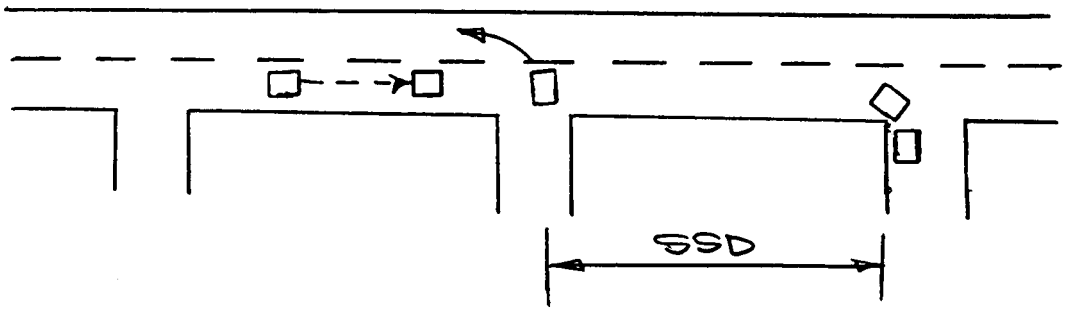
The standards are set to provide a comfortable condition with adequate perception-reaction to deal with the complexity of conditions

B. Minor Deviations Limits

These limits are set to give an acceptable condition, but not less than stopping sight distance

C. Stopping Sight Distance as a Minimum Spacing Criteria

Research done on the ODOT-OSU Access Management research project showed that stopping sight distance should be the minimum spacing between approach roads where left-turns in and out are permitted. Under these conditions, the left-turning vehicle creates a visual block to downstream operations, not allowing a driver to see vehicles, pedestrians or bicyclists at the downstream approach with enough distance to stop.



Where left turns in and out are prohibited, as with a median, the spacing may be half of SSD. (See Background Paper 5-C).

Summary of Spacing Criteria

	Desirable Functional Intersection Area (6 ft/sec^2)	Limiting Functional Intersection Area (9 ft/sec^2)	Decision Sight Distance				Stopping Sight Distance		
			Speed, Path & Direction Change		To Stop				
			Urban	Rural	Urban	Rural	Comfortable	AASHTO w/ 3^s Piev	AASHTO
≥55	875	565	1125	875	1140	590	750	580	550
50	750	480	1025	760	975	500	640	500	475
45	630	405	925	675	850	415	435	415	400
40	525	335	825	600	725	345	435	345	325
35	425	270	725	525	610	275	350	275	250
30	325	215	450	450	500	220	275	220	200
≤25	225	170	525	375	400	165	205	165	150