THOROUGHFARE DEVELOPMENT MANUAL

City of Killeen

November 1984

A RESOLUTION ACCEPTING AND ADOPTING THE MASTER THOROUGHFARE PLAN AND DEVELOPMENT MANUAL FOR THE CITY OF KILLEEN.

WHEREAS, the City Council of the City of Killeen commissioned Vergil G. Stover, P.E., College Station, Texas, to develop a thoroughfare plan for the City of Killeen; and

WHEREAS, such a plan has been completed and presented to the City Council of the City of Killeen; and

WHEREAS, the City Staff has reviewed the plan and the City Council has reviewed the submitted map and manual, discussed the plan in Council Workshop and invited public comment in a regular meeting of the City Council, December 11, 1984; and

WHEREAS, the City Council finds that the plan and manual are essential to guide future public and private development decisions; and

WHEREAS, through the plan and manual the City has the opportunity to implement street development standards in undeveloped areas and improve and upgrade thoroughfares in already developed areas over of a period of years; and

WHEREAS, the intent of the City Council is to adopt a planning tool to guide the future development of the City; NOW, THEREFORE,

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF KILLEEN:

That the City Council of the City of Killeen hereby accepts and adopts the "Master Thoroughfare Plan" and the "Thoroughfare Development Manual" for the City of Killeen as prepared by Vergil G. Stover, P.E., November, 1984. Further, the City Council of the City of Killeen hereby expresses its intent that the plan and manual be used to plan and guide future public and private development decisions.

The City Staff is instructed to give due consideration to the thoroughfare plan in its review of development decisions for the future growth of the City of Killeen.

Nothing in this Resolution shall be constructed to prevent the amendment of the plan or manual, for good cause shown, so long as any amendment or modification is consistent with and contributes to the orderly development of the City of Killeen.

PASSED AND APPROVED at a regular meeting of the City Council of the City of Killeen, Texas, held on the 27th day of December, 19 84, at which meeting a quorum was present, held in accordance with the provisions of Article 6252-17, V.A.T.S.

APPROVED

Allen C. Cloud

Allen C. Cloud, MAYOR

ATTEST:

Nancy L. Dibert

Nancy L. Dibert, CITY SECRETARY

RESOLUTION 87-119R

A RESOLUTION AMENDING THE MASTER THOROUGHFARE PLAN FOR THE CITY OF KILLEEN.

WHEREAS, the City Council of the City of Killeen adopted the Master Thoroughfare Plan (Plan) and Development Manual (Manual) for the city of Killeen by Resolution 84-87R on December 27, 1984; and

WHEREAS, use and further study of the plan have disclosed the need for its amendment; and

WHEREAS, the City Council desires to amend the plan to provide for a more up-to-date planning tool to guide the future development of the City; NOW, THEREFORE,

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF KILLEEN:

That the City Council of the City of Killeen hereby amends the "Master Thoroughfare Plan," said amendment to be known as the "1987 Revised Master Thoroughfare Plan," the original copy of which is to be kept in the official files of the Department of Engineering and Planning.

Be It Further Resolved that the City Council of the City of Killeen hereby expresses its intent that the plan

and manual be used to plan and guide future public and private development decisions.

The City staff is instructed to give due consideration to the "1987 Revised Master Thoroughfare Plan" in its review of development decisions for the future growth of the City of Killeen.

Nothing in this Resolution shall be construed to prevent the amendment ofthe plan or manual, for good cause shown, so long as any amendment or modification is consistent with and contributes to the orderly development of the City of Killeen.

PASSED AND APPROVED at a regular meeting of the City Council of the City of Killeen, Texas, this 8th day of September, 1987, at which meeting a quorum was present, held in accordance with the provisions of Article 6252-17, V.A.T.S.

APPROVED

Dr. Sidney E. Young, MAYOR

ATTEST:

Doris J. Johnson, CITY SECRETARY

THOROUGHFARE DEVELOPMENT MANUAL

City of Killeen

November 1984

Mayor

Allen C. Cloud

Mayor Pro-Tem

Bobby Hoover

City Council

Paul Goode	*Bill McKinney*
Rosa Hereford	*Daniel Manfull*
Kenny Jean	*Hiram Reynolds*

City Manager

Robert M. Hopkins

Assistant City Manager

Dion Miller

Prepared by Vergil G. Stover, P.E.

College Station, Texas

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INTRODUCTION AND PURPOSE

As an urban area increases in population and land area, the physical facilities and municipal services must be extended and expanded. The thoroughfare system is the most permanent element of the urban scene. Once the alignment and right-of-way of major transportation facilities have been established and the adjacent property developed, it is nearly impossible to make significant changes in the system. Therefore, it is essential that a municipality establish a thoroughfare plan to guide future public and private development decisions.

In the developing urban fringe and the undeveloped area beyond, the municipality has the opportunity to implement street development standards which will help ensure their long term utility.

Within the already developed urban area, improvements to major thoroughfares are commonly restricted by inadequate rights-of-way, shallow building setbacks, and narrow parcel frontages. Upgrading must be accomplished in stages over a period of years with the ultimate objective of coming as close as possible to the standards for new facilities--in short, to do the best one can.

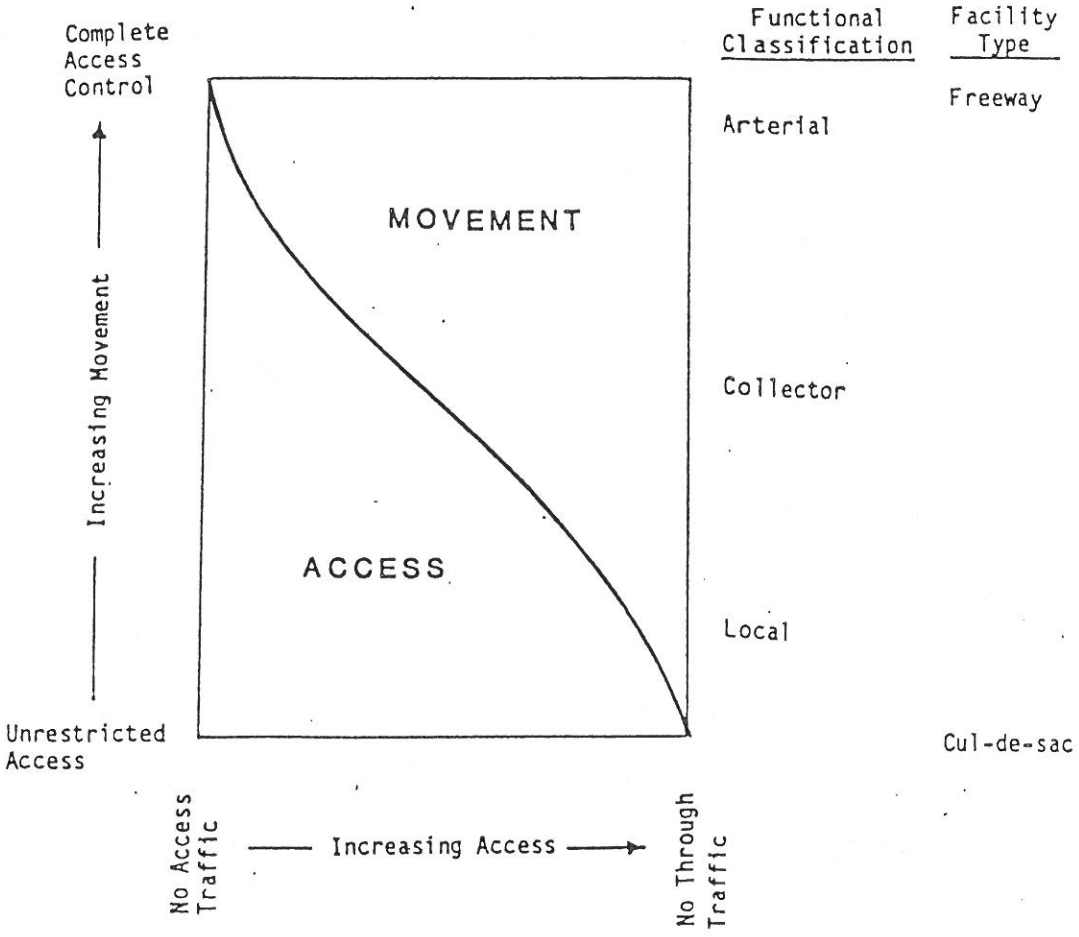
The purpose of this manual is to provide information necessary to the understanding and implementation of the Thoroughfare Plan. To this end, the manual includes background information on the functional design of major street systems and typical standards for different types.

THE CONCEPT OF FUNCTIONAL CLASSIFICATION

Functional Classification recognizes that individual roads and streets are part of a system serving trips having diverse origins and destinations. A typical trip involves the following stages: primary movement, transition, collection/distribution, access, and termination. The failure to recognize and accommodate each stage by appropriate design is a prominent cause of street and highway obsolescence. Conflicts, congestion, and accidents occur at interfaces where functional transitions are inadequate. In short, each element of a functional hierarchy serves as a collection/distribution facility for the next higher element. Functional street and highway classification thus groups facilities according to the character of service--movement or access--they are intended to provide.

As indicated in Figure 1, three general classifications (arterial, collector, and local) are commonly employed. Each in turn is subdivided into various typical cross sectional designs to meet the specific needs of the particular state or local jurisdiction. While the terms "major" and "minor" are used herein, "primary" and "secondary", respectively, are equivalent and are also frequently employed.

Major arterials serve (or should serve) the principal function of movement. Access should be permitted only to the extent that the movement function is not compromised. The freeway is the limiting facility design type of the major arterial classification. Access, public and private, to at-grade major arterials can be provided where appropriate spacing and design criteria are employed. Minor arterials provide less consideration to the movement function and therefore can accommodate more access. At the other end of the classification system, local streets provide the function



FUNCTIONAL CLASSIFICATION
FIGURE 1

of access. Movement is incidental to reaching a higher classification of street (e.g., a collector).

Collector streets accommodate the functions of movement and access equally. However, a variety of collector street cross sections may exist depending on the nature of the adjacent land use and expected traffic.

It is important to note that the classification according to movement and access is a continuum from unrestricted access (no through traffic) to complete access control (no local traffic). There are no specific boundaries separating the functional classes. While higher classes of streets, as a group, carry larger traffic volumes than lower classes, actual (counted) traffic volumes are not an element in functional classification. Once the existing and future street system has been properly classified, there should be no need or justification to change it unless there is a significant change in the urban comprehensive plan.

The relationship of the different classes of streets in a street system based on functional design criteria is shown in Figure 2. A major arterial has signalized intersections with another major arterial, secondary arterial, or major arterial and should be designed so that only selected movements can be made at unsignalized access points. That is, the medial and marginal access design should prevent full 3-way or 4-way midblock (unsignalized) access to the major arterial. At the other end of the classification spectrum, a local street intersects with a minor collector or a major collector only.

It is significant that the new edition of A Policy on Geometric Design of Highways and Streets (1984) adopted by the American Association of State Highway and Transportation Officials (AASHTO) sets forth function as the basis for design criteria. In the past, facilities having comparable

FUNCTIONAL STREET DESIGN

In a street system which has been developed based on functional criteria, about 75% of the vehicle-miles of travel will be carried on the arterial streets which typically will comprise about 10% of the street mileage in a street system design in accordance with functional criteria. While local streets should comprise about two-thirds of the total street mileage, they should carry less than 10% of the vehicle-miles of travel; a percentage higher than 10% would suggest a deficiency in the arterial street system (1). The development of a street system based on functional concepts has numerous benefits including:

1. The arterials can be designed to safely accommodate the high traffic volumes and high speeds.
2. Traffic control is simplified.
3. The pavement of designated streets can be designed to carry the high repetitions and high wheel loads. Other streets can be designed for a low number of repetitions and light wheel loads. Consequently, total maintenance costs are reduced.
4. Residential areas are not subject to through traffic which makes them more desirable and safer places to live. Land use patterns (including residential, commercial, industrial, and public uses) are more stable.

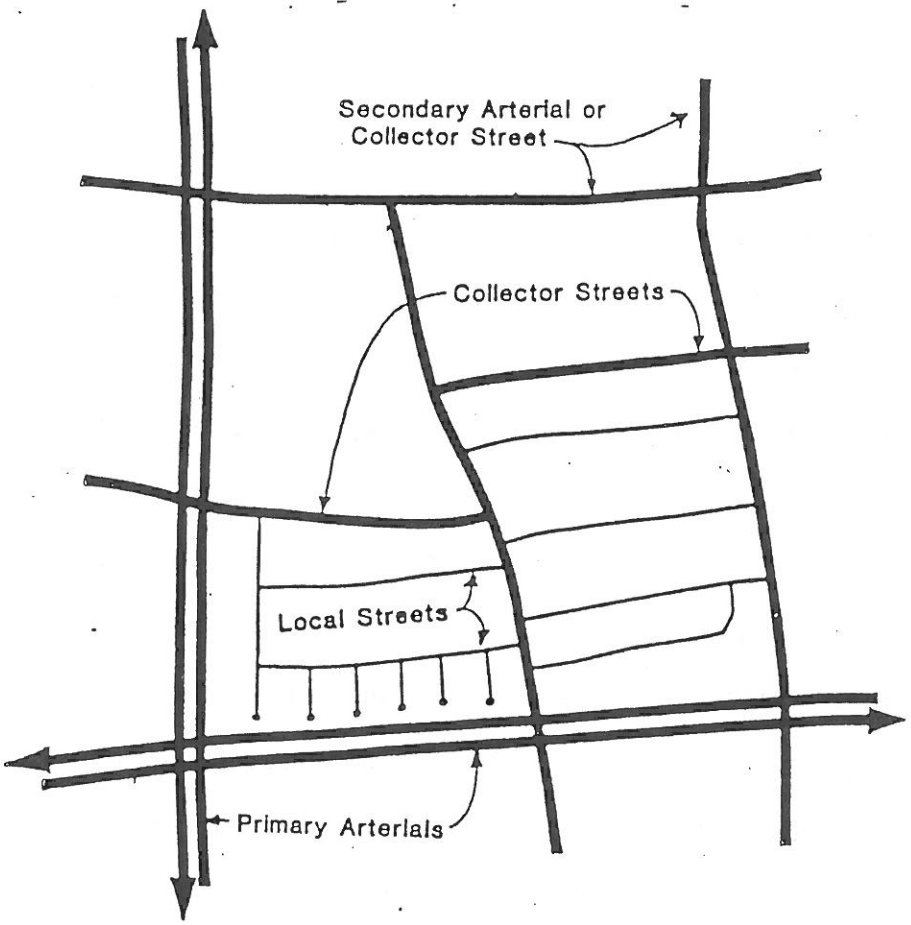
The principal features which are typical of each of the functional classes and cross section types are identified in the following text and figures. The principal design criteria are summarized in Table 1.

(1) System Considerations for Urban Arterial Streets, An ITE Instructional Report, Institute of Traffic Engineers, October 1969, page 14.

TABLE 1
SUMMARY OF MINIMUM STANDARDS FOR A STREET SYSTEM BASED ON FUNCTIONAL DESIGN CRITERIA

	Major Arterial (at-grade)		Minor Arterial		Major Collector		Streets in Residential Areas (2)			
	6-lane	4-lane	5-lane	4-lane	5-lane	4-lane	Major Collector	Minor Collector	Local Street Loop (3)	Local Street Cul-de-sac
Paved section, back-to-back of curb (ft.)	-	-	80	47-51	59	45	41	37	29	29
Number of lanes	6	4	5	4	4	4	2	2	n.a.	
Lane width (ft.)	11-12	11-12	11-12	11-12	10-11	11	12	10	n.a.	
Median width (ft.)	25-30	16	14	n.a.	12	not applicable				
Right turn lane	channelized or continuous		continuous	channelized or continuous	not applicable					
Left turn lane(s)	double at signals	single	continuous 2-way left	n.a.	continuous 2-way left	not applicable				
Right-of-way (feet): recommended	140	110	100	80	90	80	70	65	60	60
Right-of-way (feet): absolute	120	95	80	75	75	75	70	60	50	50
Operating speed (mph)	45	45	40	40	35-40	35-40	35	30	25	25
Minimum radius (ft.)	1200	1200	1000	1000	700	700	500	350	175	175
Signal Spacing (ft.)	1/4 mile		1/4 mile		not applicable					
Corner clearance: upstream approach (ft.)	450	450	400	350	200	200	150	most distant location (5)		
Corner clearance: downstream (ft.)	350	350	300	300	200	200	150	most distant location (5)		
Unsignalized access spacing (ft.)	350	350	300	300	200	200	150-200	lot frontage		
Parking	prohibited				prohibited		permitted			permitted
Sidewalk	separate ROW		both sides @ ROW		both sides				desirable, both sides	
Continuity	throughout urbanized area		3 miles		1.5 miles		1 mile	0.5 mile	1400 ft.	750 ft.
Max. dwellings served	not applicable						1000	400	50(6)	24(6)

(1) multi-residential, retail, office, industrial, institutional, and all uses other than single-family & duplex residential
(2) single-family or duplex residential
(3) two-ways out (e.g. other than cul-de-sac)
(4) dwellings shall not have direct access to a major collector except at intersection approaches
(5) access to corner lots shall be to the lesser street and located at the property line most distant from the intersection
(6) maximum number of dwellings is a more critical criteria than street length



SCHEMATIC STREET CONFIGURATION BASED ON FUNCTIONAL CLASSIFICATION
FIGURE 2

traffic volumes were designed to provide the same level-of-service. The new AASHTO manual reflects a major change in design policy.

Relationship to the Comprehensive Plan

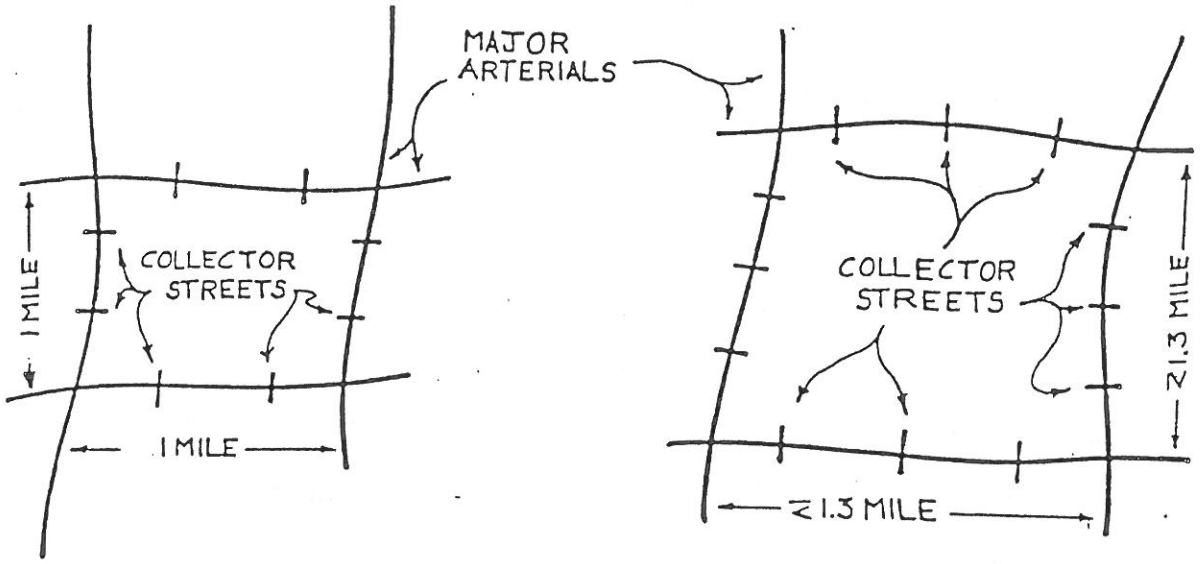
A direct relationship must exist between the thoroughfare plan and the land use plan. Their compatibility can be evaluated using the computer models utilized in urban transportation studies. Simplified and manual techniques also can be used to evaluate the compatibility of proposed land use and transportation plans.

Once a comprehensive plan has been properly developed, appropriate policies and programs must be consistently applied. Failure to do so will result in premature obsolescence of both public and private investment, traffic accidents, and unstable land use patterns. The essential elements of the arterial street system which must be clearly identified and implemented through the planning process are: (1) right-of-way width, (2) signalized intersection spacing, and (3) unsignalized access management.

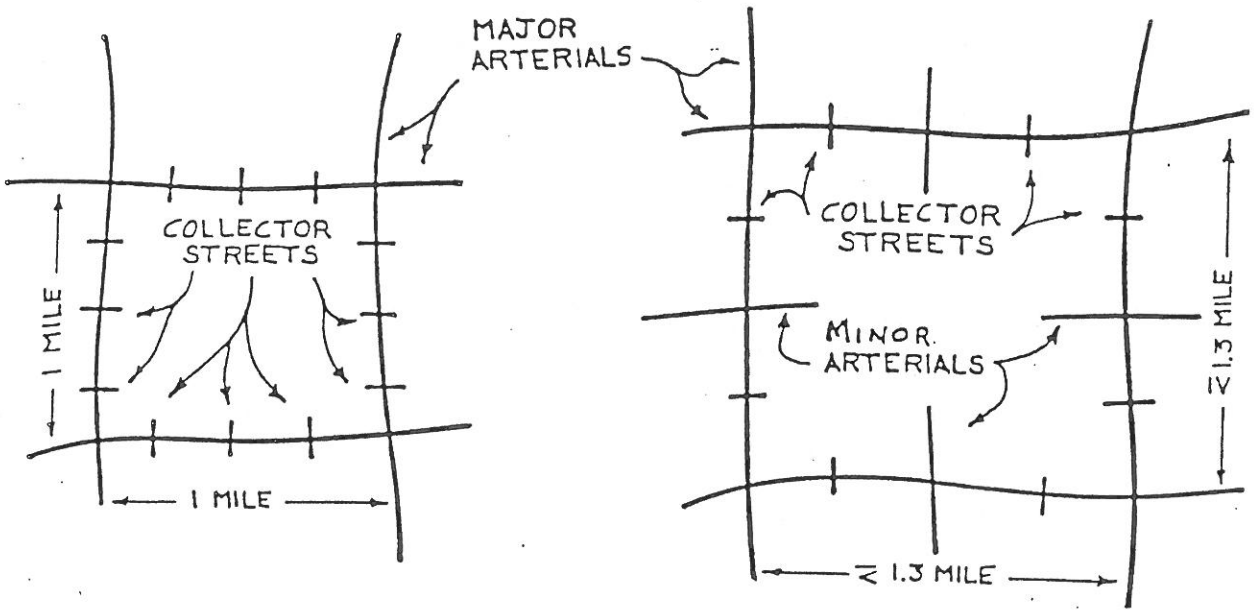
Arterial spacing and signalized access patterns which are typically desirable and appropriate at the gross population densities of southwestern cities are shown in Figure 3. Specific consideration for large traffic generators such as military bases and regional shopping centers will result in the need for an increased number of lanes or closer spacing of multi-lane facilities in the vicinity of such traffic generators.

Anticipating Traffic Needs

In a small village, the traffic demand is so small that problems do not develop. In a municipality of fewer than about 1,000 persons, the most



Gross Residential Densities Less Than 3000 persons/square mile



Gross Residential Densities Less Than 5000 persons/square mile

SCHEMATIC ARTERIAL SPACING AND
SIGNALIZED INTERSECTION PATTERNS
FIGURE 3

important streets are in the lower end of the collector category. In these situations, little attention needs to be given to the design of the street system since traffic volumes on all segments of the street system are very low and trip lengths are very short. Unless the community is impacted by tourists or other unusual traffic, capacity is not a problem at intersections and stop signs, and the right-of-way rule is adequate traffic control.

When the urban area population exceeds about 35,000, conditions such as narrow rights-of-way, inadequate spacing of major intersections, and unrestricted access begin to cause problems where none previously existed. The results are manifested in traffic congestion, accidents, through traffic in formerly quiet residential areas, and unstable land use patterns. Unless the street system was designed in anticipation of the future needs, the corrective actions will be expensive or impossible to make.

In order to provide flexibility in adjusting to changing conditions, the following priorities are recommended in the planning of arterial systems:

1. Obtain adequate right-of-way to accommodate separate through lanes, right-turn lanes; and,
2. Establish long and uniform signalized intersection spacing (not less than one-quarter mile).
3. Implement access management policies and design guidelines.

Major Arterials

The major arterials connect the major neighborhoods, large commercial and industrial areas, industrial parks and other major activity centers serving the entire urban area. They also provide connection with the major inter-city highways serving the urban area. Most, if not all, major arterials should be continuous throughout the developed urban area and developing fringe. Depending on the size of the urban area and layout of the arterial system, trips over 3-5 miles in length should occur on the major arterials. Level of-service speeds of 45 mph should be achieved on at-grade major arterials in off-peak periods with speeds of 30-35 mph during the a.m. and p.m. peak traffic periods.

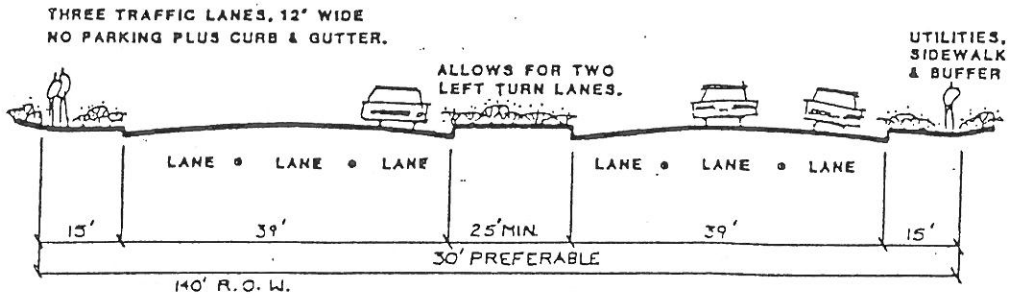
Access to a major arterial should be via public or private facilities which are of a collector or higher functional classification. Direct access to individual residences should be prohibited. Direct signalized access to commercial, industrial, multi-family, or other development may be provided so long as the access location conforms to the long, uniform signal spacing necessary to achieve progressive traffic flow. Unsignalized direct access to an arterial can be provided so long as the access does not interfere with the movement function. Therefore, careful attention must be given to corner clearance (distance from an adjacent signalized intersection), spacing between unsignalized access, and the horizontal and vertical design of the access.

Separate left and right turn lanes should be provided at all signalized access (public and private). Medial access at unsignalized intersections (public and private) should be designed so as to limit the movement to

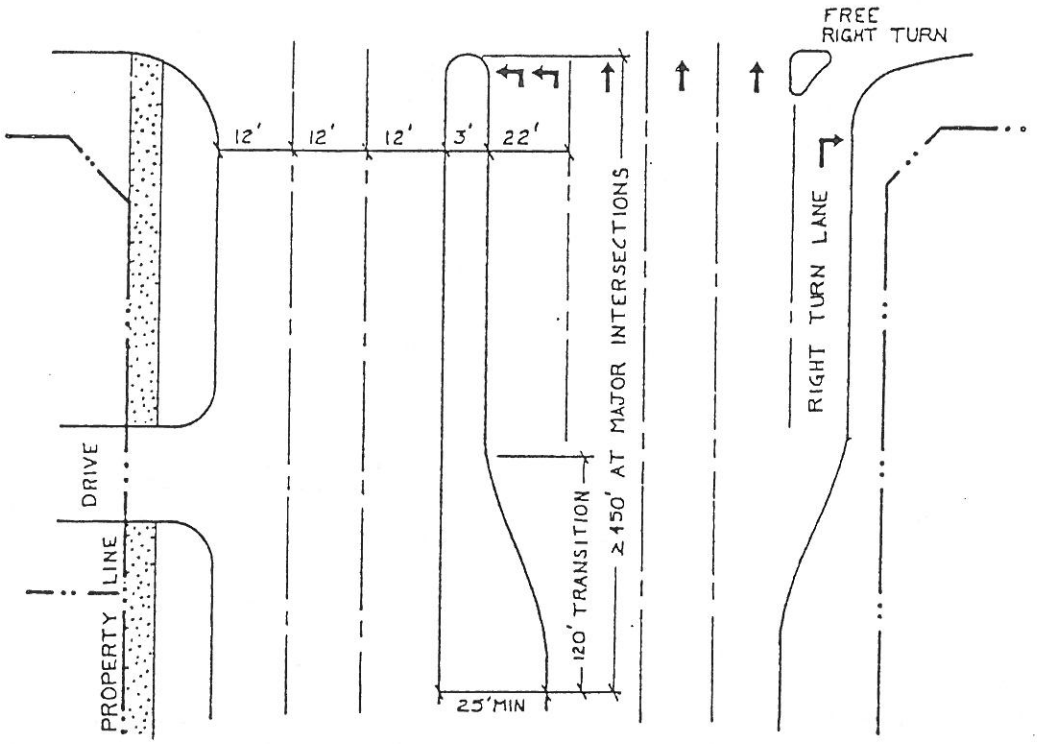
specific maneuvers. Medial and marginal access should be spaced and designed to limit the speed differential to 15 mph, preferably 10 mph, or less.

The right-of-way and median widths of major arterials should be adequate to allow for the provision of double left turns at all intersections with other major arterials.

Sketches showing the principal features of typical 6-lane and 4-lane major arterials are given in Figures 4A and 5A respectively. Design standards are given in Figures 4B and 5B.



Typical Cross Section



Lane widths indicated are exclusive of curb and gutter

Typical Plan View

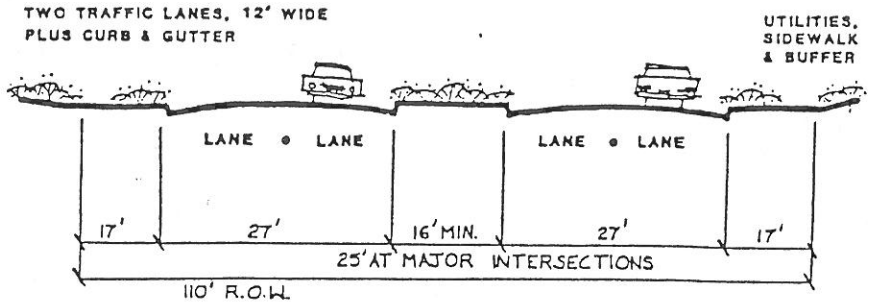
MAJOR ARTERIAL: SIX-LANE DIVIDED
FIGURE 4A

DESIGN ELEMENT		STANDARD		
		Minimum	Desirable	Recommended
NUMBER TRAFFIC LANES		6	6	6
LANE WIDTHS (feet)		11'	12'	12'
RIGHT-OF-WAY WIDTH (feet)		120'	150'	140'
SPACING		1 mile	1 mile	1 mile
LENGTH		Continuous		
DESIGN SPEED (m.p.h.)		40 m.p.h.	45 m.p.h.	45 m.p.h.
GRADE (percent)		.05%	0.5%-4%	0.5%-6%
STOPPING SIGHT DISTANCE		275'	500'	400'
HORIZONTAL CURVE, Radius		900'	1200'	1200'
VERTICAL CLEARANCE (feet)		15'	16.5'	16.5'
LATERAL CLEARANCE (feet)		2'	8'	6'
SIGNAL SPACING		1/4 mile	1/3 mile	1/4 mile
ACCESS SPACING UNSIGNALIZED		300'	500'	350'
PARKING		Prohibited		
CORNER CLEARANCE	Upstream	400'	500'+	450'
	Downsteam	300'	400'	350'
MEDIAN OPENING DISTANCE		450'	600'	600'
CURB RETURN (radius)		50'	100'	75'
*MINIMUM PARCEL SIZE AT CORNERS	Upstream	450'	600'	500'
	Downstream	350'	500'	400'

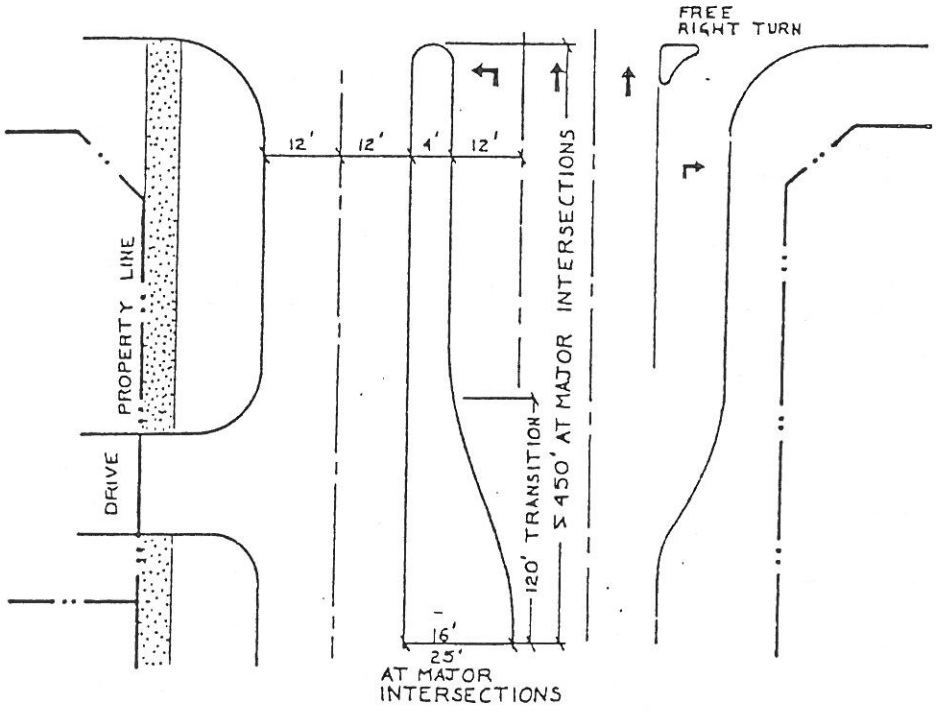
CAPACITY FOR SYSTEM PLANNING		
24 HOUR TRAFFIC VOLUMES	34,000 LOS D**	31,000 LOS C**
1 HOUR TRAFFIC VOLUMES	1,000 LOS D	1,600 LOS C

*When a corner lot has access to one street, the minimum parcel size does not apply to the frontage on which there is no access
**Level of Service

DESIGN STANDARDS FOR SIX-LANE DIVIDED ARTERIAL
FIGURE 4B



Typical Cross Section



Lane widths indicated are exclusive of curb and gutter

Typical Plan View

MAJOR ARTERIAL: FOUR-LANE DIVIDED
FIGURE 5A

DESIGN ELEMENT		STANDARD		
		Minimum	Desirable	Recommended
NUMBER TRAFFIC LANES		4	4	4
LANE WIDTHS (feet)		11'	12'	12'
RIGHT-OF-WAY WIDTH (feet)		95'	110'	110'
SPACING		1 mile	1 mile	1 mile
LENGTH		Continuous		
DESIGN SPEED (m.p.h.)		40 m.p.h.	45 m.p.h.	45 m.p.h.
GRADE (percent)		0.5%	0.5%-4%	0.5%-6%
STOPPING SIGHT DISTANCE		275'	500'	400'
HORIZONTAL CURVE, Radius		900'	1200'	1200'
VERTICAL CLEARANCE (feet)		15'	16.5'	16.5'
LATERAL CLEARANCE (feet)		2'	8'	6'
SIGNAL SPACING		1/4 mile	1/3 mile	1/4 mile
ACCESS SPACING UNSIGNALIZED		300'	500'	350'
PARKING		Prohibited		
CORNER CLEARANCE	Upstream	400'	500'+	450'
	Downsteam	300'	400'	350'
MEDIAN OPENING DISTANCE		450'	600'	600'
CURB RETURN (radius)		50'	100'	75'
*MINIMUM PARCEL SIZE AT CORNERS	Upstream	450'	600'	500'
	Downstream	350'	500'	400'

CAPACITY FOR SYSTEM PLANNING		
24 HOUR TRAFFIC VOLUMES	25,800 LOS D	23,000 LOS C
1 HOUR TRAFFIC VOLUMES	1,350 LOS D	1,200 LOS C

*Does not apply to the frontage on which there is no access when corner lot has access to only one street.

DESIGN STANDARDS FOR FOUR-LANE DIVIDED ARTERIAL
FIGURE 5B

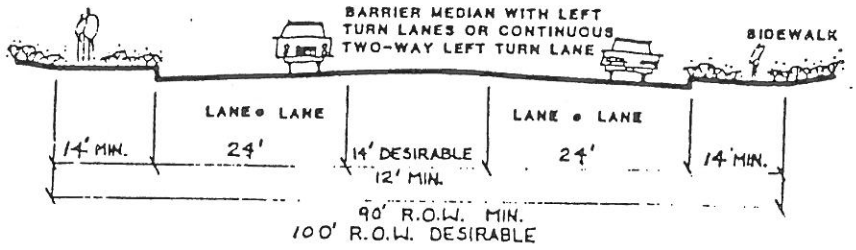
Minor Arterials

Depending upon a municipality's policies relative to the layout of the arterial system and land development patterns, minor arterials might be numerous or nearly absent from the arterial system. In those systems which have extensive minor arterial mileage, they are less continuous than the major arterials and serve trips of 2-3 miles in length. They will serve activity centers such as junior high schools (middle schools), large residential neighborhoods, commercial office and retail areas in the range of 50,000 to 200,000 square feet, and community parks.

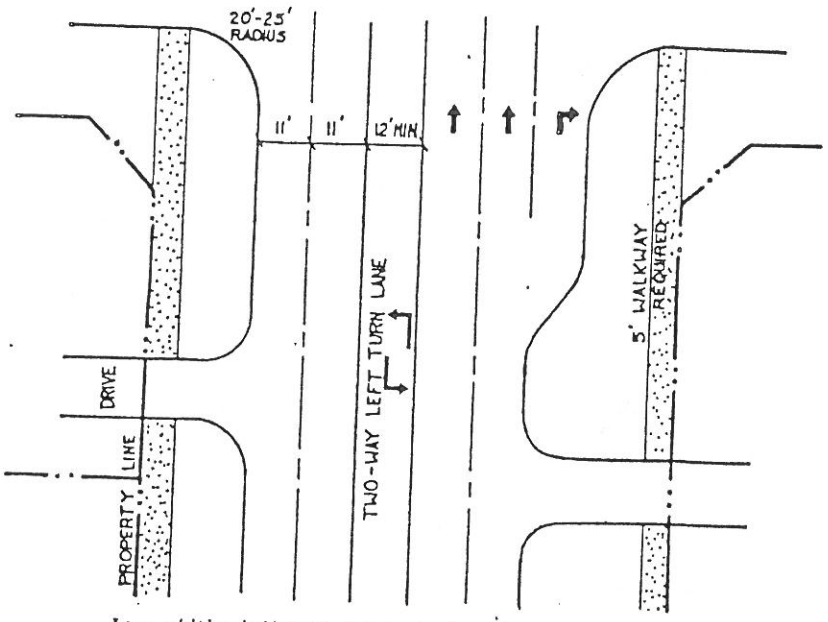
If an urban area chooses to develop without minor arterials as part of the arterial system, additional attention needs to be given to the capacity of major collector streets within multi-family residential areas and in proximity to commercial retail, office, and industrial area.

Construction of facilities with continuous two-way left turns (Figure 6) will encourage strip development. As traffic volumes in the through lanes increase, it will become increasingly difficult and dangerous to make left turns to or from the adjacent properties. This can be expected to lead to unstable land uses and decreased property values as better shopping opportunities are developed elsewhere. Use of this cross section should be restricted to those locations where closely spaced, low volume access points already exist. The 4-lane undivided cross section should be used only in areas where the adjacent development has large frontages with infrequent access--such as single family residential development. The width of the right-of-way and the paved section should be increased in order to provide left and right turn bays at all intersections. If the turn lanes are not

part of the original construction, sufficient right-of-way should be contained to add them when development occurs.



Typical Cross Section



Lane widths indicated are exclusive of curb and gutter

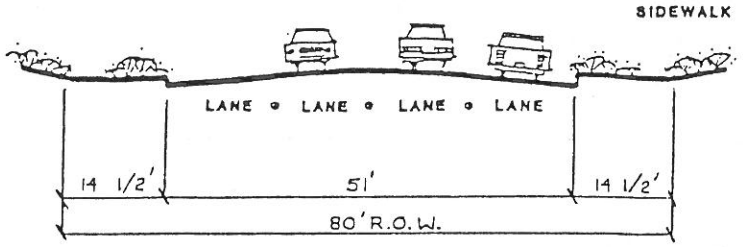
Typical Plan View

MINOR ARTERIAL WITH CONTINUOUS TWO-WAY LEFT TURN LANE
FIGURE 6A

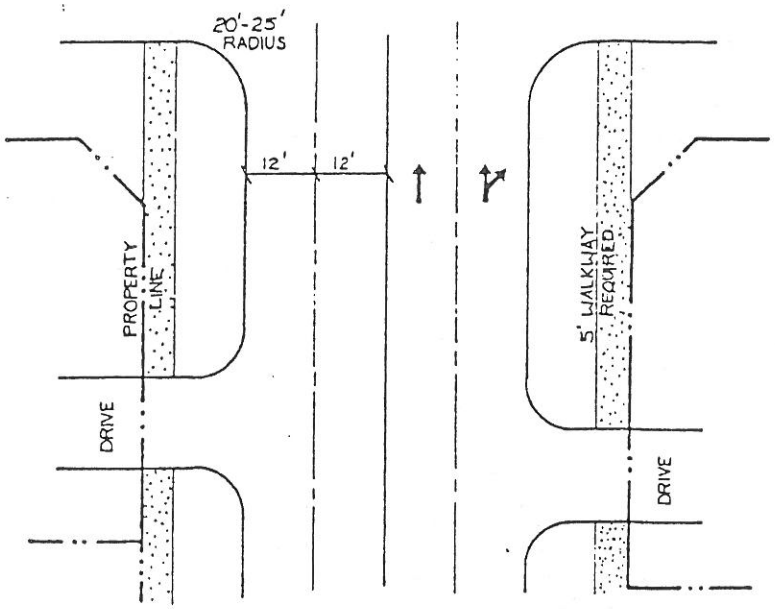
DESIGN ELEMENT		STANDARD		
		Minimum	Desirable	Recommended
NUMBER TRAFFIC LANES		4	4	4
LANE WIDTHS (feet)		11'	12'	12'
RIGHT-OF-WAY WIDTH (feet)		80'	110'	100'
SPACING		1/2 mile		
LENGTH		2 miles	4 miles	4 miles
DESIGN SPEED (m.p.h.)		35 m.p.h.	40 m.p.h.	40 m.p.h.
GRADE (percent)		0.5%	0.5%-5%	0.5%-7%
STOPPING SIGHT DISTANCE		250'	500'	400'
HORIZONTAL CURVE, Radius		700'	1000'	1000'
VERTICAL CLEARANCE (feet)		15'	16.5'	16.5'
LATERAL CLEARANCE (feet)		2'	6'	6'
SIGNAL SPACING		1,200'	1/4 mile	1/4 mile
ACCESS SPACING UNSIGNALIZED		200'	300'	300'
PARKING		Prohibited		
CORNER CLEARANCE	Upstream	300'	450'	300'
	Downsteam	200'	300'	250'
MEDIAN OPENING DISTANCE		Continuous two-way left turns		
CURB RETURN (radius)		20'	25'	25'
*MINIMUM PARCEL SIZE AT CORNERS	Upstream	350'	500'	350'
	Downstream	250'	350'	300'
CAPACITY FOR SYSTEM PLANNING				
24 HOUR TRAFFIC VOLUMES		21,100 LOS D	18,900 LOS C	
1 HOUR TRAFFIC VOLUMES		1,200 LOS D	1,075 LOS C	

*Does not apply to the frontage on which there is no access when corner lot has access to only one street.

DESIGN STANDARDS FOR MINOR ARTERIAL
WITH CONTINUOUS TWO-WAY LEFT TURN LANE
FIGURE 6B



Typical Cross Section



Lane widths indicated are exclusive of curb and gutter

Typical Plan View

FOUR-LANE UNDIVIDED MINOR ARTERIAL
FIGURE 7A

DESIGN ELEMENT		STANDARD		
		Minimum	Desirable	Recommended
NUMBER TRAFFIC LANES		4	4	4
LANE WIDTHS (feet)		11'	12'	11-12'
RIGHT-OF-WAY WIDTH (feet)		75'	85'	80'
SPACING		1/4 mile		
LENGTH		1/2 mile	1 mile	1/2 mile
DESIGN SPEED (m.p.h.)		35 m.p.h.	40 m.p.h.	40 m.p.h.
GRADE (percent)		0.5%	0.5%-7%	0.5%-10%
STOPPING SIGHT DISTANCE		250'	500'	400'
HORIZONTAL CURVE, Radius		700'	1000'	1000'
VERTICAL CLEARANCE (feet)		15'	16.5'	16.5'
LATERAL CLEARANCE (feet)		2'	6'	6'
SIGNAL SPACING		1,200'	1/4 mile	1/4 mile
ACCESS SPACING UNSIGNALIZED		300'	300'	300'
PARKING		Prohibited		
CORNER CLEARANCE	Upstream	300'	450'	300'
	Downsteam	200'	300'	250'
MEDIAN OPENING DISTANCE		Not Applicable		
CURB RETURN (radius)		20'	25'	25'
*MINIMUM PARCEL SIZE AT CORNERS	Upstream	350'	500'	350'
	Downstream	250'	350'	300'
CAPACITY FOR SYSTEM PLANNING				
24 HOUR TRAFFIC VOLUMES		11,700 LOS D	10,500 LOS C	
1 HOUR TRAFFIC VOLUMES		775 LOS D	700 LOS C	

*Does not apply to the frontage on which there is no access when corner lot has access to only one street.

DESIGN STANDARDS FOR FOUR-LANE UNDIVIDED MINOR ARTERIAL
FIGURE 7B

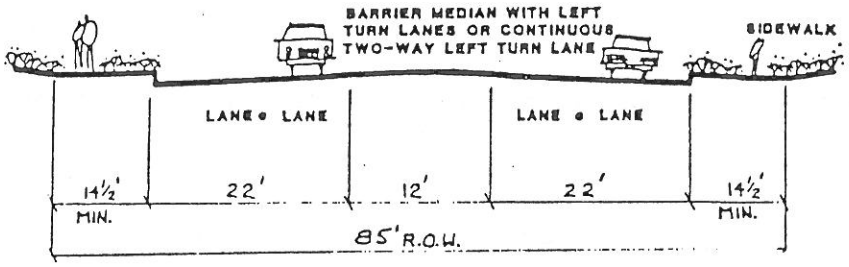
Major Collectors

Collector streets provide the function of collecting traffic from local and minor collector streets and conveying it to the arterial system, and the reverse function of distributing traffic from the arterials. They should provide connection between adjacent neighborhoods and serve to elementary schools, neighborhood parks, churches, and neighborhood commercial development. Continuity and trip length served will depend upon the extent of the minor arterials. When the arterial network includes a complete minor arterial component, continuity should be less than 1.5 miles. In absence of secondary arterials, continuity should be one to two miles. Average speeds should be about 35 mph.

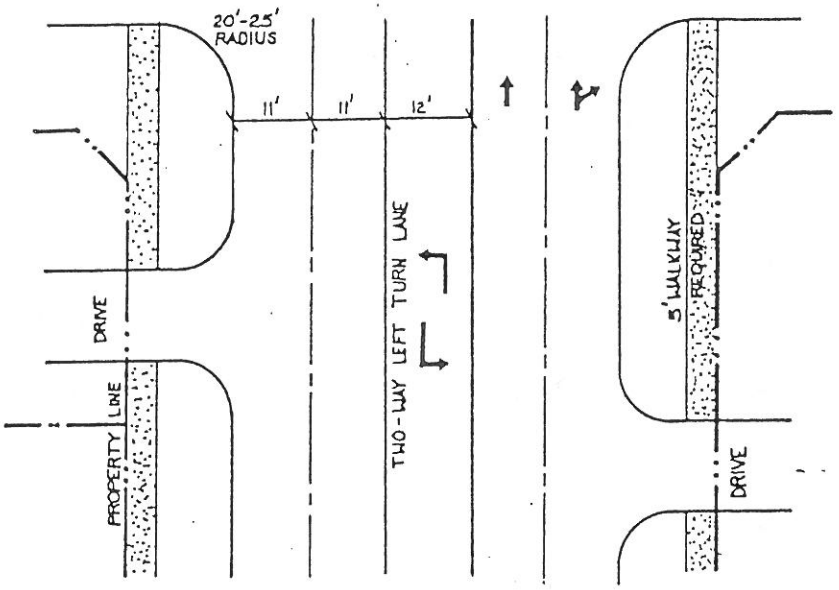
The division between major and minor collectors serving residential development should be the number of dwelling units served. However, a "rule-of-thumb" applicable to typical southwest suburban development is one-half mile. Major collectors are those which are continuous for one-half mile or more from the intersection with an arterial (major or minor).

No direct access to an individual residence should be provided from a major collector. In single-family detached and duplex residential subdivisions, such residences on corner lots should have access to a minor collector or local street.

As previously stated, the continuous two-way left turn encourages strip development. Furthermore, when right turns are made from the outside, traffic conflicts with high speed differentials will occur. Therefore, it is suggested that the 5-lane cross section with the continuous 2-way left turn lane be utilized where strip development already exists and for new development where the continuity is less than one mile.



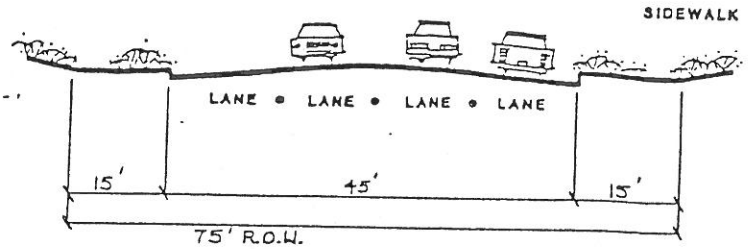
Typical Cross Section



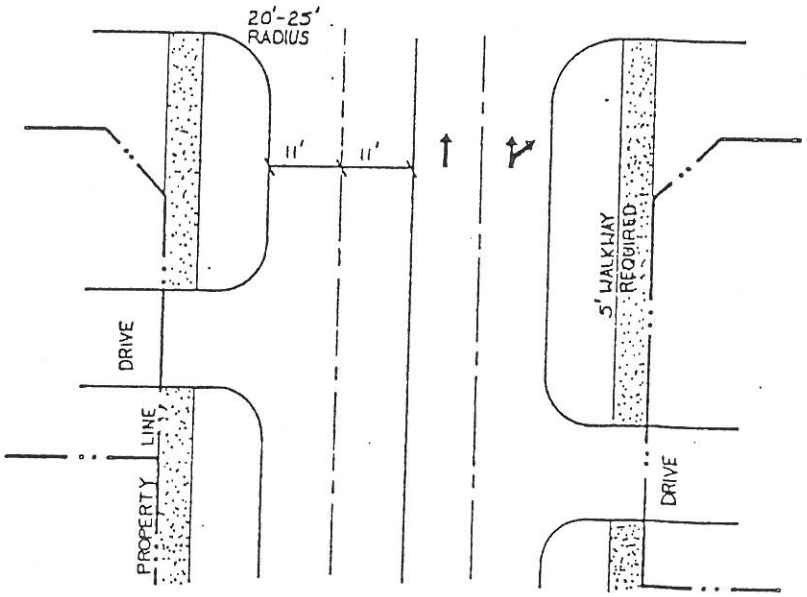
Lane widths indicated are exclusive of curb and gutter

Typical Plan View

MAJOR COLLECTOR WITH CONTINUOUS LEFT TURN LANE
FIGURE 8A



Typical Cross Section



Lane widths indicated are exclusive of curb and gutter

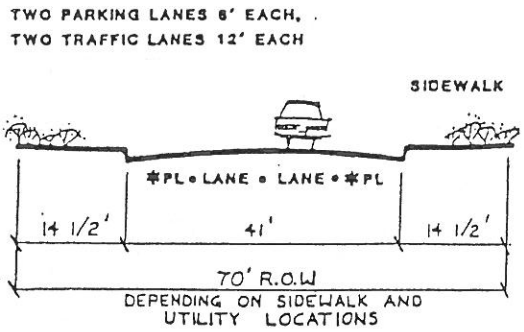
Typical Plan View

MAJOR COLLECTORS WITH FOUR LANES
FIGURE 8B

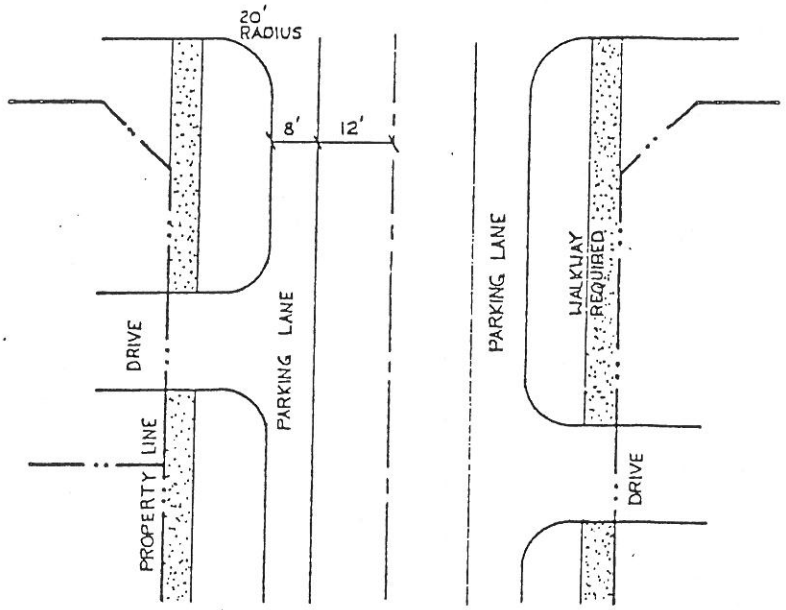
DESIGN ELEMENT		STANDARD		
		Minimum	Desirable	Recommended
NUMBER TRAFFIC LANES		4	4	4
LANE WIDTHS (feet)		10'	12'	11'
RIGHT-OF-WAY WIDTH (feet)		75'	90' w/5 lane 80' w/4 lane	90' w/5 lane 75' w/4 lane
SPACING		1/4 mile		
LENGTH		1/2 mile	1 mile	
DESIGN SPEED (m.p.h.)		35 m.p.h.	40 m.p.h.	40 m.p.h.
GRADE (percent)		0.5%	0.5%-7%	0.5%-10%
STOPPING SIGHT DISTANCE		250'	500'	400'
HORIZONTAL CURVE, Radius		500'	700'	600'
VERTICAL CLEARANCE (feet)		15'	16.5'	16.5'
LATERAL CLEARANCE (feet)		2'	6'	6'
SIGNAL SPACING		Not Applicable		
ACCESS SPACING UNSIGNALIZED		150'	200'	200'
PARKING		Prohibited		
CORNER CLEARANCE	Upstream	100'	300'	200'
	Downsteam	100'	300'	200'
MEDIAN OPENING DISTANCE		Continuous 2-way left turn w/5 lane Not Applicable w/4 lane		
CURB RETURN (radius)		20'	25'	25'
*MINIMUM PARCEL SIZE AT CORNERS	Upstream	150'	350'	250'
	Downstream	150'	350'	250'
CAPACITY FOR SYSTEM PLANNING				
24 HOUR TRAFFIC VOLUMES		11,700 LOS D	10,500 LOS C	
1 HOUR TRAFFIC VOLUMES		775 LOS D	700 LOS C	

*Does not apply to the frontage on which there is no access when corner lot has access to only one street.

DESIGN STANDARDS FOR MAJOR COLLECTOR
FIGURE 8C



Typical Cross Section



Typical Plan View

MAJOR COLLECTOR IN SINGLE FAMILY DETACHED RESIDENTIAL AREA
FIGURE 9A

DESIGN ELEMENT		STANDARD		
		Minimum	Desirable	Recommended
NUMBER TRAFFIC LANES		2	2	2
LANE WIDTHS (feet)		11'	12'	12'
RIGHT-OF-WAY WIDTH (feet)		60'	75'	75'
SPACING		1/4 mile		
LENGTH		n.a.	1/2 mile	1/4 mile
DESIGN SPEED (m.p.h.)		30	30-35	30-35
GRADE (percent)		0.5%	0.5%-7%	0.5%-10%
STOPPING SIGHT DISTANCE		250'	350'	300'
HORIZONTAL CURVE, Radius		400'	600'	500'
VERTICAL CLEARANCE (feet)		15'	16.5'	16.5'
LATERAL CLEARANCE (feet)		2'	6'	6'
SIGNAL SPACING		Not Applicable		
ACCESS SPACING UNSIGNALIZED		Not Applicable		
PARKING		Permitted		
CORNER CLEARANCE	Upstream	125'	200'	150'
	Downsteam	125'	200'	150'
MEDIAN OPENING DISTANCE		Not Applicable		
CURB RETURN (radius)		15'	20'	20'
*MINIMUM PARCEL SIZE AT CORNERS	Upstream	175'	250'	200'
	Downstream	175'	250'	200'

CAPACITY FOR SYSTEM PLANNING

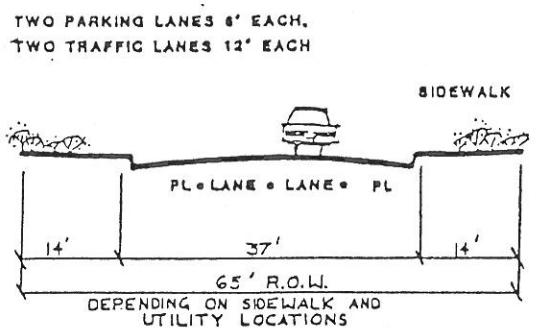
24 HOUR TRAFFIC VOLUMES		1 HOUR TRAFFIC VOLUMES	
5,000 w/o Houses Fronting	2,000 w/ Houses Fronting	500 w/o Houses Fronting	200 w/ Houses Fronting

DESIGN STANDARDS FOR MAJOR COLLECTOR
IN SINGLE FAMILY DETACHED RESIDENTIAL AREA
FIGURE 9B

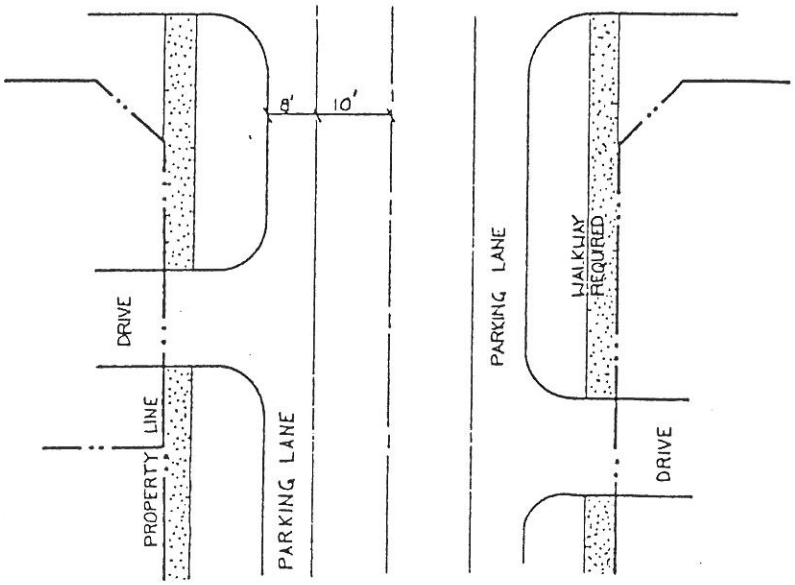
Minor Collectors

When traffic volumes are low and speeds are low, individual residences might have direct access to a collector street. A rule-of-thumb is if the continuity of the collector is less than one-half mile, direct access may be permitted. A more sophisticated (and difficult to administer) requirement is to set a limit on the number of dwelling units served.

For development other than single family detached and duplex residential, the on-site circulation should be designed to serve the local and minor collector functions.



Typical Cross Section



Typical Plan View

MINOR COLLECTOR IN SINGLE FAMILY DETACHED RESIDENTIAL AREA
FIGURE 10A

DESIGN ELEMENT	STANDARD		
	Minimum	Desirable	Recommended
NUMBER TRAFFIC LANES	2	2	2
LANE WIDTHS (feet)	10'	11'	10'
RIGHT-OF-WAY WIDTH (feet)	60'	65'	65'
SPACING	1/4 mile		
LENGTH	n.a.	1/4 mile	1/4 mile
DESIGN SPEED (m.p.h.)	30	30-35	30-35
GRADE (percent)	0.5%	0.5%-7%	0.5%-10%
STOPPING SIGHT DISTANCE	250'	350'	300'
HORIZONTAL CURVE, Radius	300'	600'	350'
VERTICAL CLEARANCE (feet)	15'	16.5'	16.5'
LATERAL CLEARANCE (feet)	2'	6'	6'
SIGNAL SPACING	Not Applicable		
ACCESS SPACING UNSIGNALIZED	150'-200'	150'-200'	150'-200'
PARKING	Permitted		
CORNER CLEARANCE — Upstream / Downsteam	Locate Driveway at Most Distant Property Line		
MEDIAN OPENING DISTANCE	Not Applicable		
CURB RETURN (radius)	20'	20'	20'
*MINIMUM PARCEL SIZE AT CORNERS — Upstream / Downstream	70'	70'	70'

CAPACITY FOR SYSTEM PLANNING	
24 HOUR TRAFFIC VOLUMES	2,000
1 HOUR TRAFFIC VOLUMES	200

DESIGN STANDARDS FOR MINOR COLLECTOR IN SINGLE FAMILY DETACHED RESIDENTIAL AREA
FIGURE 10B

Local Streets

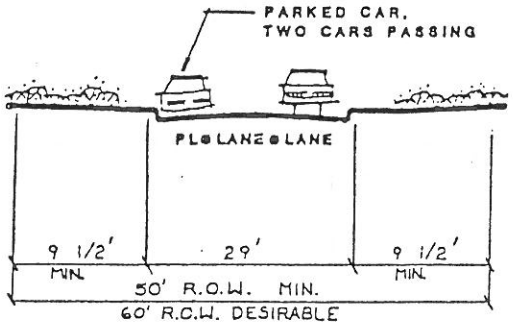
The function of local streets in a residential subdivision is to provide access to individual lots. The layout of the subdivision streets should ensure low traffic volumes and slow speeds (20-25 mph) on local residential streets. Consequently, local streets should be discontinuous, curvilinear, and connect to the collector street at 3-way intersections. Within the interior of a residential area, 4-way intersections should be avoided. When 4-way intersections cannot be avoided, one or both of the local streets should be a cul-de-sac. The maximum length for local streets should be specified in terms of both length in feet and in the maximum number of dwelling units. Suggested maximums are:

cul-de-sac: 24 dwelling units on 750 feet, whichever is less.

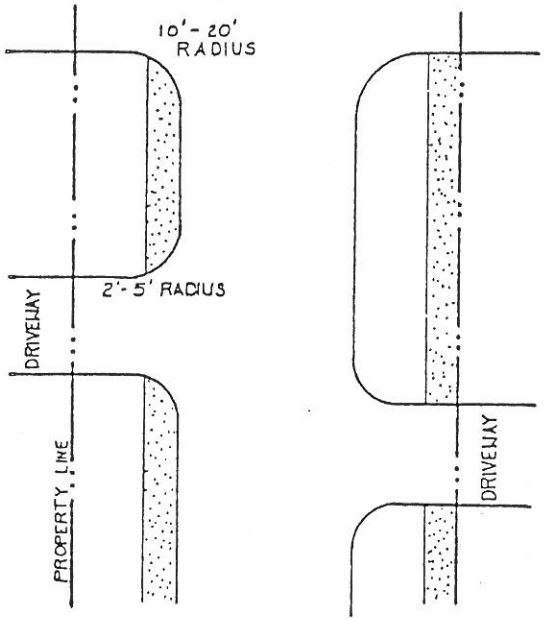
two ways out: 50 dwelling units or 1400 feet, whichever is less.

In all areas other than those developed as single family detached or duplex, the circulation isles within the parking areas are the equivalent of the local street. Therefore, in commercial retail, commercial office, industrial and multi-family residential areas, the lowest functional class of public street will be a minor collector.

Where lot sizes are very large (one acre or more), a "rural" type cross section might be permitted.



Typical Cross Section



Typical Plan View

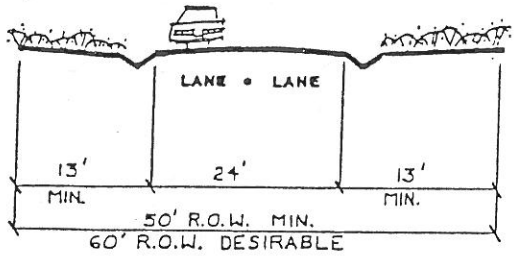
LOCAL RESIDENTIAL STREET
FIGURE 11A

DESIGN ELEMENT	STANDARD		
	Minimum	Desirable	Recommended
NUMBER TRAFFIC LANES LANE WIDTHS (feet)	Two vehicles can meet with parking one side; One Moving vehicle with parking on both sides.		
RIGHT-OF-WAY WIDTH (feet)	50'	60'	60'
SPACING	Twice Lot Depth		
LENGTH	n.a.	24 d.u. on Cul-de-sac 50 d.u. on Loop Street	
DESIGN SPEED (m.p.h.)	20	20-35	20-25
GRADE (percent)	0.5%	0.5%-7%	0.5%-10%
STOPPING SIGHT DISTANCE	200'	300'	250'
HORIZONTAL CURVE, Radius	150'	200'	175'
VERTICAL CLEARANCE (feet)	15'	16.5'	15'
LATERAL CLEARANCE (feet)	2'	6'	6'
SIGNAL SPACING	Not Applicable		
ACCESS SPACING UNSIGNALIZED	Not Applicable		
PARKING	Permitted		
CORNER CLEARANCE — Upstream Downsteam	Locate Driveway at Most Distant Property Line		
MEDIAN OPENING DISTANCE	Not Applicable		
CURB RETURN (radius)	10'	15'	15'
*MINIMUM PARCEL SIZE AT CORNERS — Upstream Downstream	50'	75'+	60'+

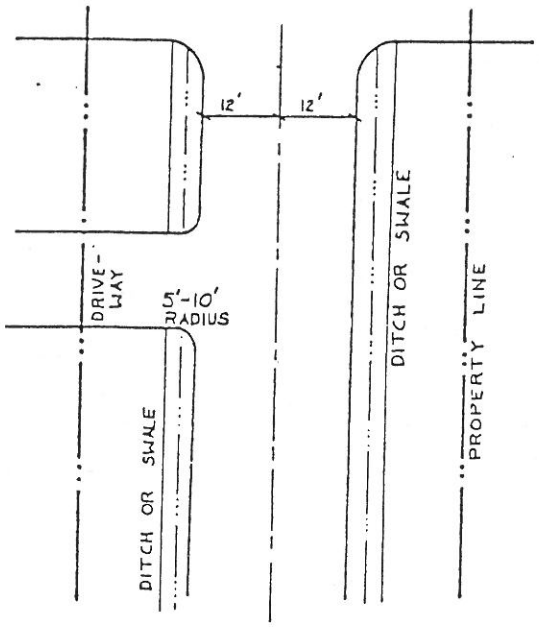
CAPACITY FOR SYSTEM PLANNING

24 HOUR TRAFFIC VOLUMES	500 on Loop Street 250 on Cul-de-Sac
1 HOUR TRAFFIC VOLUMES	50 on Loop Street 25 on Cul-de-Sac

DESIGN STANDARDS FOR LOCAL RESIDENTIAL STREET
FIGURE 11B



Typical Cross Section



Typical Plan View

SUBURBAN ESTATES LOCAL STREET
FIGURE 12A

DESIGN ELEMENT		STANDARD		
		Minimum	Desirable	Recommended
NUMBER TRAFFIC LANES		2	2	2
LANE WIDTHS (feet)		11'	12'	12'
RIGHT-OF-WAY WIDTH (feet)		50'	65'	60'
SPACING		Not Applicable		
LENGTH		n.a.	1/2 mile	1/2 mile
DESIGN SPEED (m.p.h.)		20 m.p.h.	35 m.p.h.	30 m.p.h.
GRADE (percent)		0.5%	0.5%-7%	0.5%-10%
STOPPING SIGHT DISTANCE		200'	350'	300'
HORIZONTAL CURVE, Radius		200'	500'	300'
VERTICAL CLEARANCE (feet)		15'	16.5'	15'
LATERAL CLEARANCE (feet)		2'	6'	6'
SIGNAL SPACING		Not Applicable		
ACCESS SPACING, UNSIGNALIZED		200'	200'	200'
PARKING		Prohibited or Discouraged		
CORNER CLEARANCE	Upstream	200'	200'	200'
	Downsteam	200'	200'	200'
MEDIAN OPENING DISTANCE		Not Applicable		
CURB RETURN (radius)		10'	15'	15'
*MINIMUM PARCEL SIZE AT CORNERS	Upstream	200'	250'	250'
	Downstream	250'	250'	250'

CAPACITY FOR SYSTEM PLANNING	
24 HOUR TRAFFIC VOLUMES	2,000
1 HOUR TRAFFIC VOLUMES	200

DESIGN STANDARDS FOR SUBURBAN ESTATES LOCAL STREET
FIGURE 12B

Corner Clearances

The distance needed for corner clearance upstream from an intersection depends upon the speed of traffic on the approach and the distance required for a passenger car to maneuver into a left- or right-turn bay and, queue storage during peak periods. The upstream corner clearances and median opening distances indicated are based upon maneuver distances at off-peak speeds. During peak periods, the queue lengths may require substantially longer lengths for turn bays in order to avoid queue build-up extending back into the through traffic lanes.

The downstream corner clearance is a function of the design of the intersection. Special care needs to be taken to ensure that the corner clearance is adequate where the access is downstream from a free-right turn having a long radius. It would be desirable to develop and adopt typical at-grade intersection designs for the several combinations of functional classes (i.e., major arterial-major arterial, major arterial-major collector, etc.) which shown all critical dimensions.

Capacities

The capacity of an arterial street is generally controlled by the capacity of the intersection with another arterial. The specific capacity is a function of several factors including: the left-turns, the right-turns, cycle length, signal phasing, intersection geometry, grades, trucks and buses, spacing of signalized intersections, and the operation of the signal system.

Collector street capacity may be limited by the intersection capacity of a stop-controlled or signal-controlled intersection. The capacities given on the following page assume signal control at an intersection. It is further assumed that the collector street intersects the arterial at a location which conforms to a long, uniform signal spacing on the arterial conducive to good traffic progression.

A variation of the Critical Movements Analysis, Transportation Research Board Circular 212, was used in assuming the standard conditions: 10% left-turns, 10% right-turns, 5% trucks, 50-50 cycle split typical signal phasing (4-phase at major intersections, and 2- or 3-phase at minor intersections, and a 90-second cycle.

Typical approach capacities for system planning purposes are given in Table 2.

Where direct access is provided to the main lanes of an arterial, the capacity of the access point must be specifically analyzed.

There is no procedure at present to generalize the impact of direct access on arterial street capacity (each situation must be considered as a specific case). However, Bochner ("Regulation of Driveway Access to Arterial Streets," Public Works, October 1978) has estimated that capacity is reduced 1% for each 2% turns.

TABLE 2
TYPICAL APPROACH CAPACITIES FOR SYSTEM PLANNING

Street Type		Peak Hour Character		Approach Capacity for Level of Service			
Functional Class	No. Lanes	% of Directional 24 hr.	Split	C Hourly	C 24-Hour	D Hourly	D 24-Hour
Major Arterial	6	9.5	55/45	1,600	31,000	1,800	34,500
Major Arterial	4	9.5	55/45	1,200	23,000	1,350	25,800
Minor Arterial	5	9.5	60/40	1,075	18,900	1,200	21,100
or Major Collector	4	9.5	70/30	700	10,500	775	11,700
Minor Collector	2	9.5	70/30	700	10,500	775	11,700

Notes: The continuous left-turn lane of the 5-lane street is assumed to serve as a left-turn bay at intersections. The capacities shown above for the collector streets are for multi-family apartments, commercial, or industrial development. Capacity is not an appropriate criteria where the adjacent land use is single family detached or duplex development; with these uses, it is suggested that city policy limit the volume to no more than 3,000 vehicles per day where houses front on and have direct access to the collector street and to no more than 5,000 where houses do not have direct access to the collector (i.e., houses on corner lots have access to the lesser street).

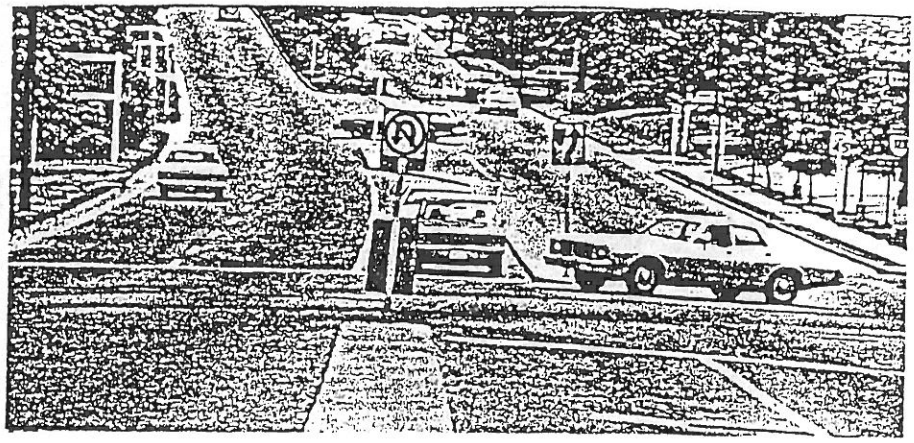
Level of Service

Levels-of-Service are illustrated in Figure 13 by the traffic on the right-hand side of the street (moving toward the camera). At Level-of-Service D, long lines of vehicles waiting at a signal are typical. A high percentage of the time (50% to 70% of the green phases) will be fully utilized by moving vehicles with motorists find driving stressful and traffic objectionable.

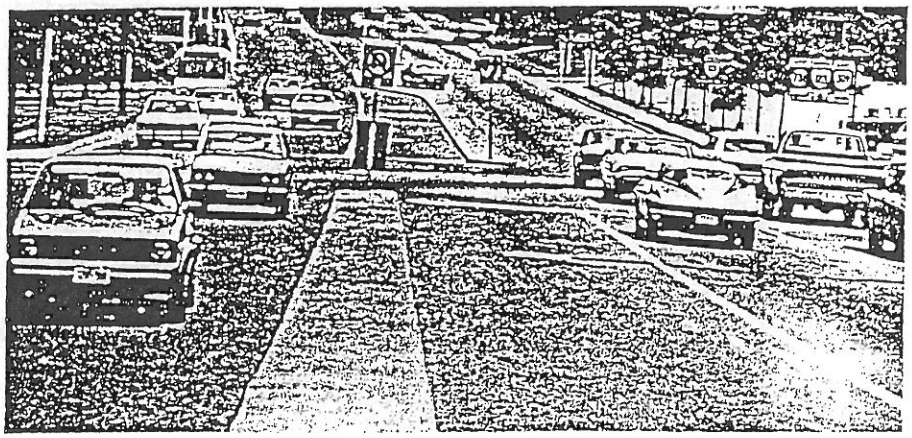
At Level-of-Service E, conditions are stop-and-go; all green phases are fully utilized by moving vehicles. Delays are long and many vehicles stopped at a signal will not clear the intersection until the second or third cycle; a few will be delayed longer.

Level-of-Service C is the range of stable traffic flow and commonly has been used for planning of street systems. Most vehicles approaching a signal on the green indicator will clear the intersection on that phase. Rancier in the mid-day is typical of Level-of-Service C.

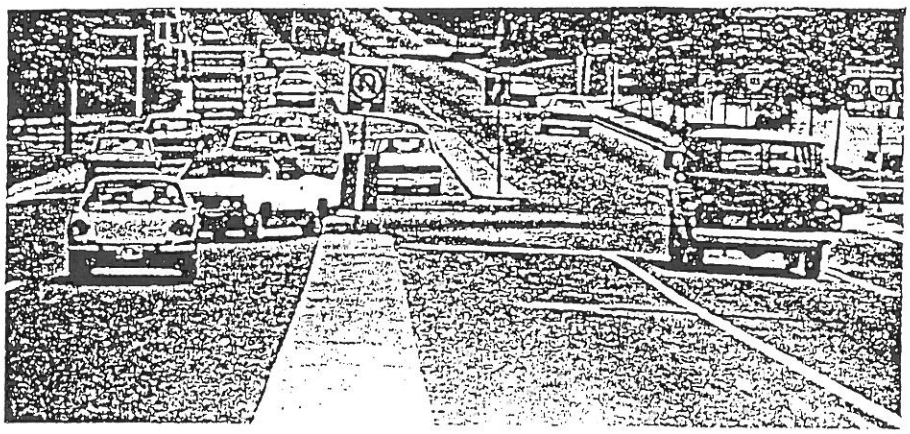
"A"



"B"

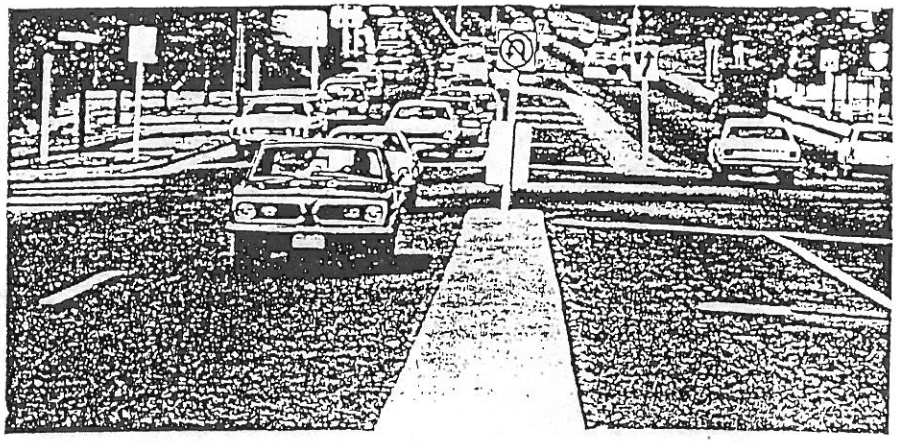


"C"



LEVEL-OF-SERVICE ILLUSTRATIONS
FIGURE 13

"D"



"E"

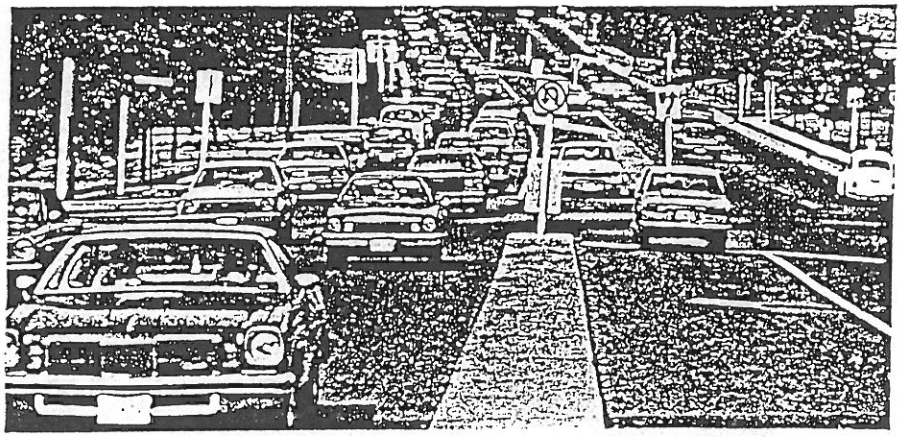


FIGURE 13 Continued

PROBLEM LOCATIONS

There are a number of situations where existing conditions create problems in the circulation system. Some of the more significant are described below. The locations are keyed to figures which show the street system in vicinity of the problem location.

Location A (See figure 14A)

The intersection of Willow Springs Road and Wales Drive is immediately adjacent to the intersection with the future major arterial extending to the west and the intersection with the east-bound frontage road. This creates a very large intersection area with an extremely complex pattern of conflicting traffic movements. Consequently, this intersection will have a low capacity and high accident potential. Further, as the area to the south and west develops, there will be considerable intrusion of non-local traffic through the existing residential area.

Eliminating the connection of Willow Springs Road with the proposed major arterial and eastbound frontage road would make a loop of Willowsprings Road and Wales. Royal Vista might be extended to intersect the major arterial and/or a new north-south collector might be constructed to the west of the existing city limits.

Locations B1 to B4

The street pattern south of US 190 and west of Old 440 is conducive to large volumes of non-local traffic travelling through an established residential area as the area to the west develops. This problem is most

severe along West Lane, Leader Drive, Farhills Drive, and Edgefield.

Farhills is probably the most likely (least undesirable) street to use for an east-west collector. The street system to the west of the existing developed area should be designed to minimize the traffic impact on the existing residential area as further development occurs.

If non-local traffic becomes a severe problem, consideration might be given to modifying the street pattern to discourage through movement. This will require overwhelming public support and very extensive planning. Careful design of the local and collector street system in the developing area will minimize the traffic impact in the existing development.

Location C

The Willow Springs-Bermuda alignment also has the potential for intrusion by non-local traffic. However, the street pattern/lot arrangement makes the problem with this location less serious than the previous ones (Location B1 to B4). Elimination of the direct connection with the major arterial and eastbound frontage road (Location A) should be effective in limiting traffic on Bermuda to that appropriate for a major residential collector.

Location D (Figure 14B)

The Jasper - Florence - east-bound frontage road creates a complex intersection. Second Street should serve as a collector serving the Central Business District. Jasper is needed as an east-west major collector.

It is recommended that a study be made of the problems and advantages that might be obtained by closing the section of the frontage road between Florence and DuBroc Drive.

Location E

Trimmier Road is essential as the principal connector between the Central Texas Expressway (US 190) and the Killeen Central Business District (CBD). The proximity of Trimmier-Grandon intersection with the interchange with US 190 will interfere with the operation of the interchange. The problem is compounded by traffic using Grandon to reach the Killeen Mall.

Location F (Figure 14C)

The intersection of Nolan Road and Elms Road is immediately adjacent to the Elms Road east-bound frontage road and results in a complex traffic conflict area which will have reduced capacity and high accident potential. Since grade-separations are both costly and few in number, achieving high capacity at these locations is essential. It is recommended that Nolan Road be realigned to intersect Elms Road at least 1000 feet from the east-bound frontage road.

The distance between the intersection of Dogwood with FM 2410 and its intersection with the west-bound frontage road is inadequate to avoid the operation at one intersection influencing that at the other under high volume conditions. The intersection of Dogwood and FM 2410 needs to be redesigned to obtain better alignment of the approaches on Dogwood, and, if possible, somewhat greater separation with the west-bound frontage road. The section of Dogwood north of the Central Texas Expressway should be redesigned to help compensate for the proximity of intersections.

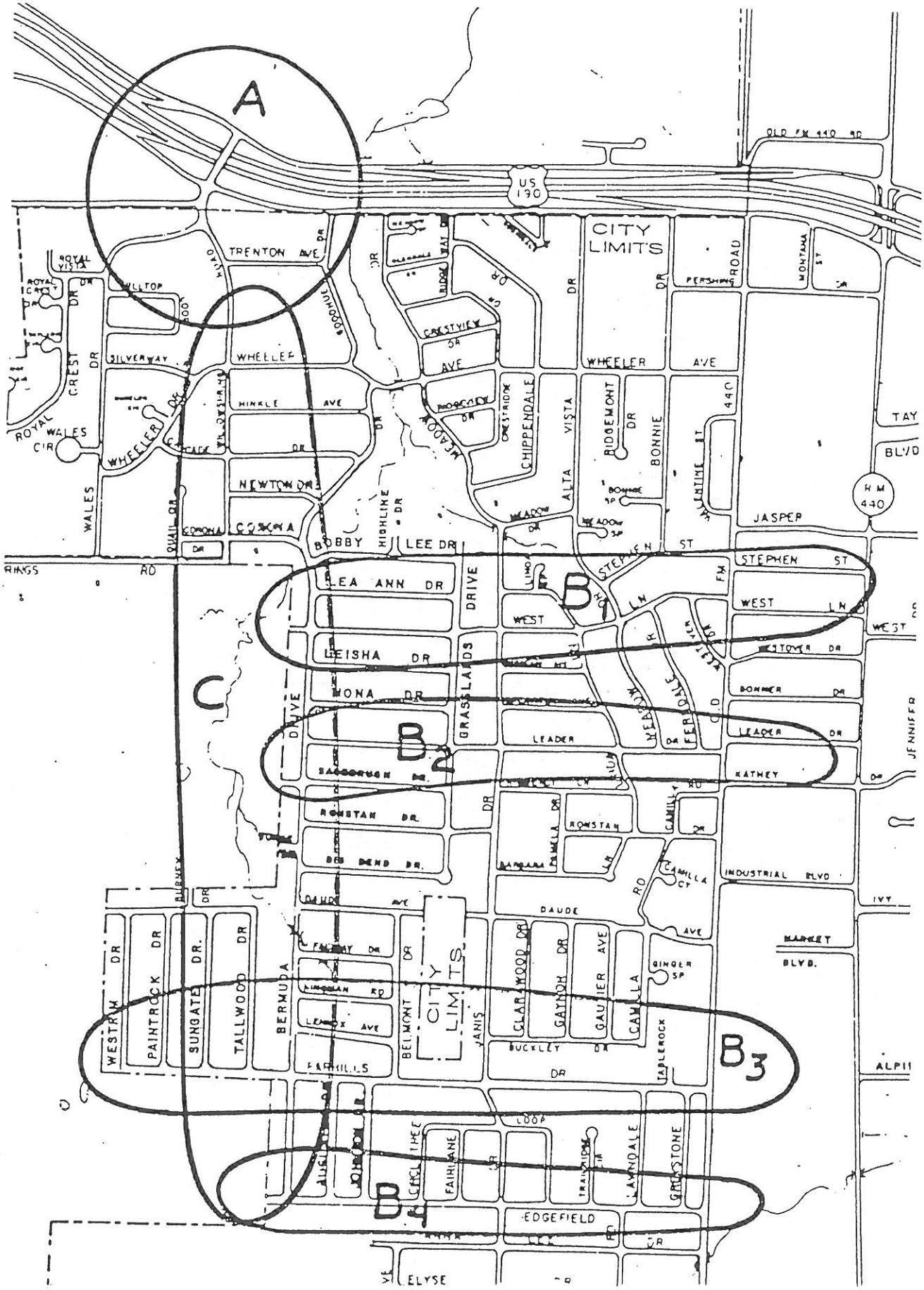
Trimmier Road

The only direct connections between the Central Texas Expressway (US 190) and the Killeen Central Business District (CBD) is via Trimmer Road - 10th Street. The paved cross section is grossly inadequate to provide a high level-of-service. Furthermore, the insufficient right-of-way and adjacent development will make improvement difficult and very expensive. Yet, if the CBD is to be enhanced, expensive and controversial improvements will be essential.

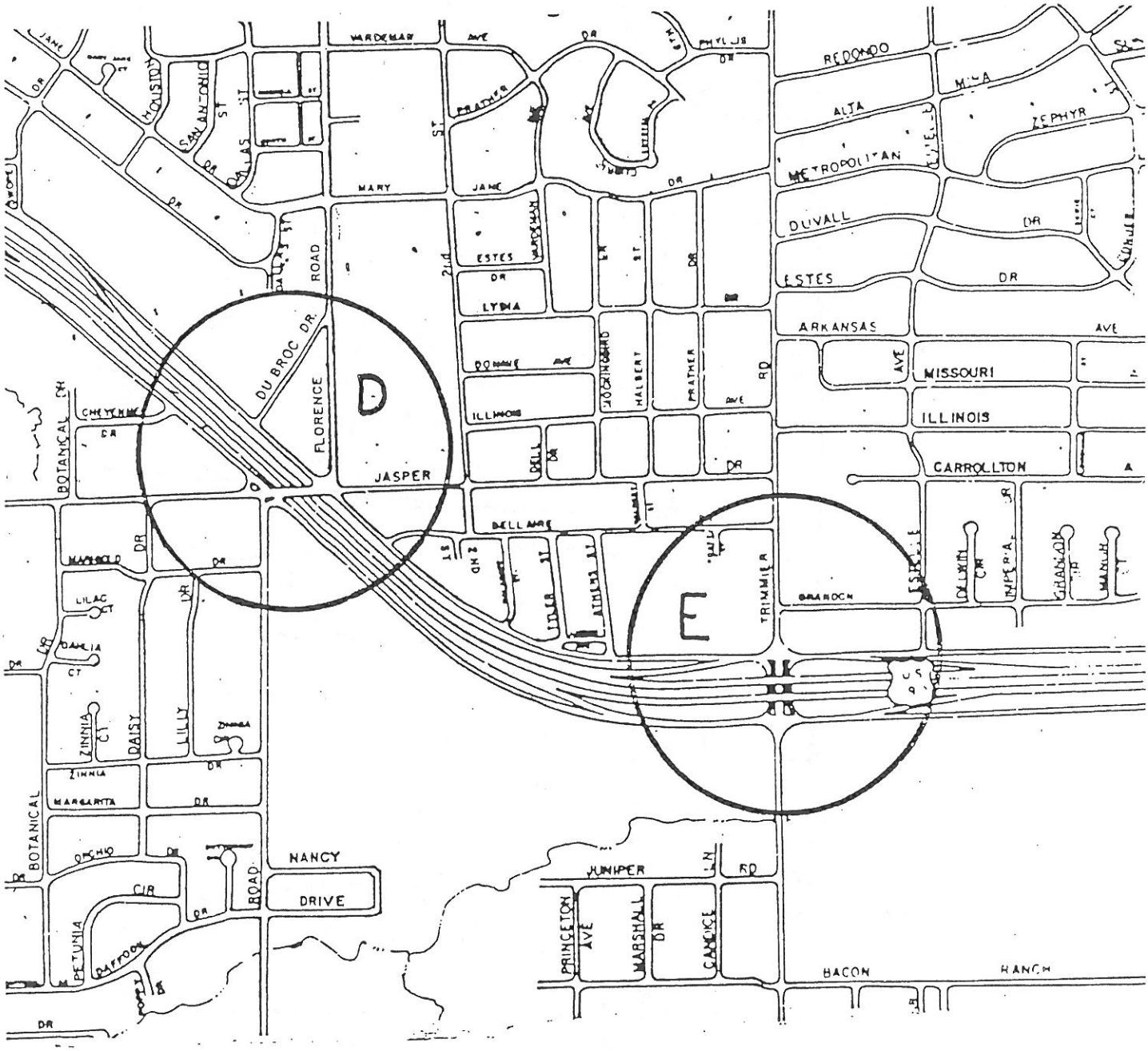
Lake Road

The proposed opening of a gate to Fort Hood off WS Young Drive in the vicinity of the Lake Street intersection will result in substantial through traffic on Lake Street. This traffic intrusion will have a negative impact on the existing residential area--especially those sections where residences front in and have direct access to Lake Street. The problem will be similar to that which occurred to Illinois Avenue with the opening of Killeen Mall.

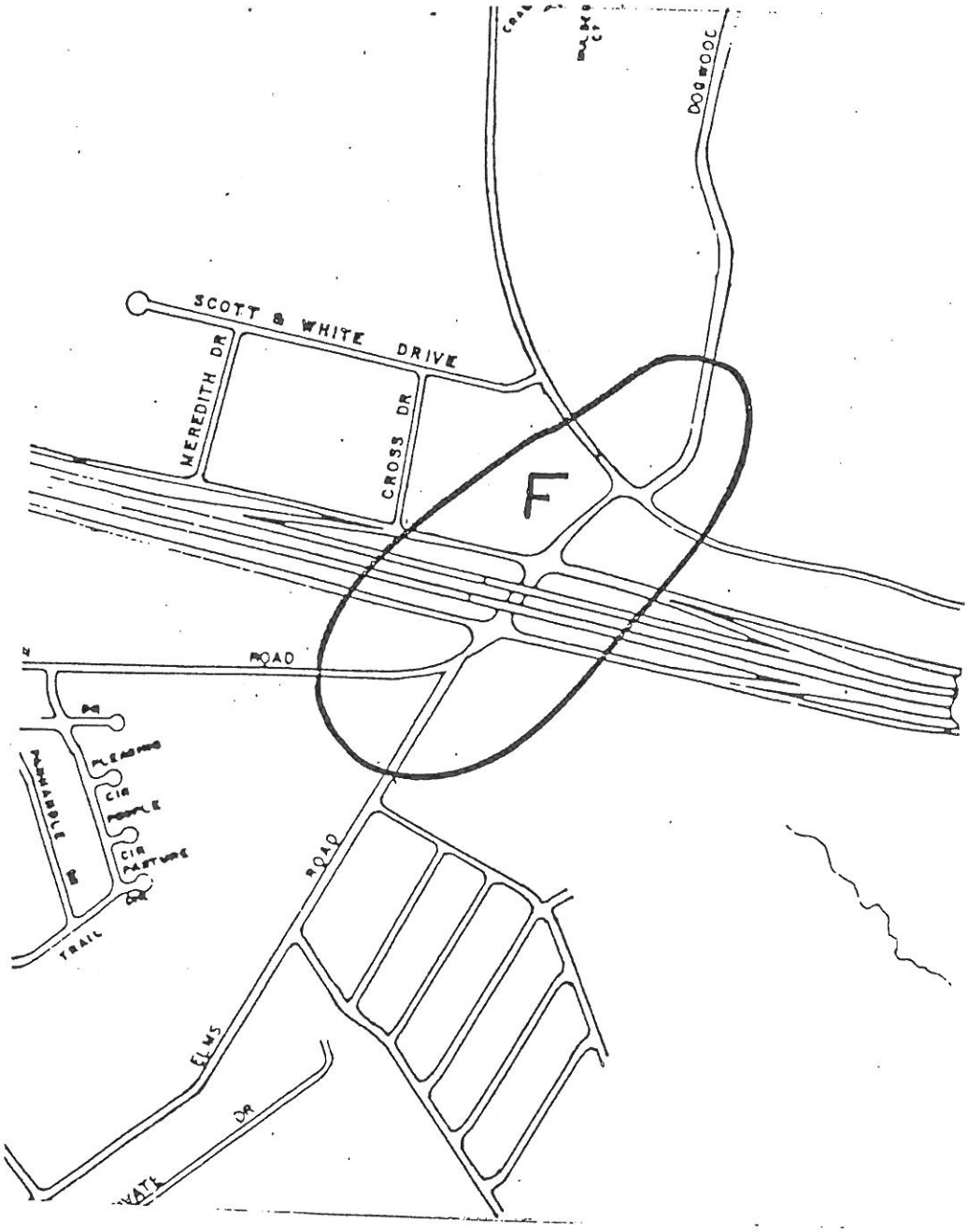
The impact of the new gate opening could be minimized by making Lake Road discontinuous. Careful study would need to be given to the problem in order to avoid simply shifting the problem to some other street(s). Experience elsewhere has demonstrated that (1) detailed study must be given to the problem and possible alternatives, (2) extensive citizen involvement is essential, and (3) there must be overwhelming public support for the street system modifications--especially on the part of the residents of the neighborhood involved.



PROBLEM LOCATIONS
FIGURE 14A



PROBLEM LOCATIONS
FIGURE 14B



PROBLEM LOCATIONS
FIGURE 14C