

3.0 Design Criteria

3.1 GEOMETRIC DESIGN

The design criteria for the Gaetz Avenue Roadways are summarized in Table 3.1. The design criteria are based on City of Red Deer 2004 Design Guidelines and the TAC standards. Elements of functionality and safety were used to incorporate the design standards into the functional plan. The main component of the design is a widening of Gaetz Avenue to 6 lanes in conjunction with improvements to major intersections on Gaetz Avenue at locations such as Highway 11A, 32 Street and 19 Street. Service road reconfiguration is also associated with the widening of Gaetz Avenue.

Design speeds for arterial roadways within the City of Red Deer are typically 70 km/hr and are posted at 60 km/hr. The TAC guidelines state that for a 70 km/hr roadway design speed with greater than 6,000 vehicles per day, the clear zone will range from 6.0 meters where the boulevard is flat, to 8.5 meters where the boulevard has a 4:1 slope. The clear zone for the service roads would be 2 meters. Light standards may be located within the clear zone as these offer a safety benefit to the roadway and are significantly spaced to reduce the potential of a vehicle impact. The TAC guideline for light standard offsets for a roadway design speed of 70 km per hour is 4.1 meters. Figure U.C14 in the Urban TAC guidelines illustrates the recommended light standard offsets. The City of Red Deer Design Guidelines for a six lane divided arterial roadway positions non-frangible light poles at a distance of 4.4 meters from the curb line.

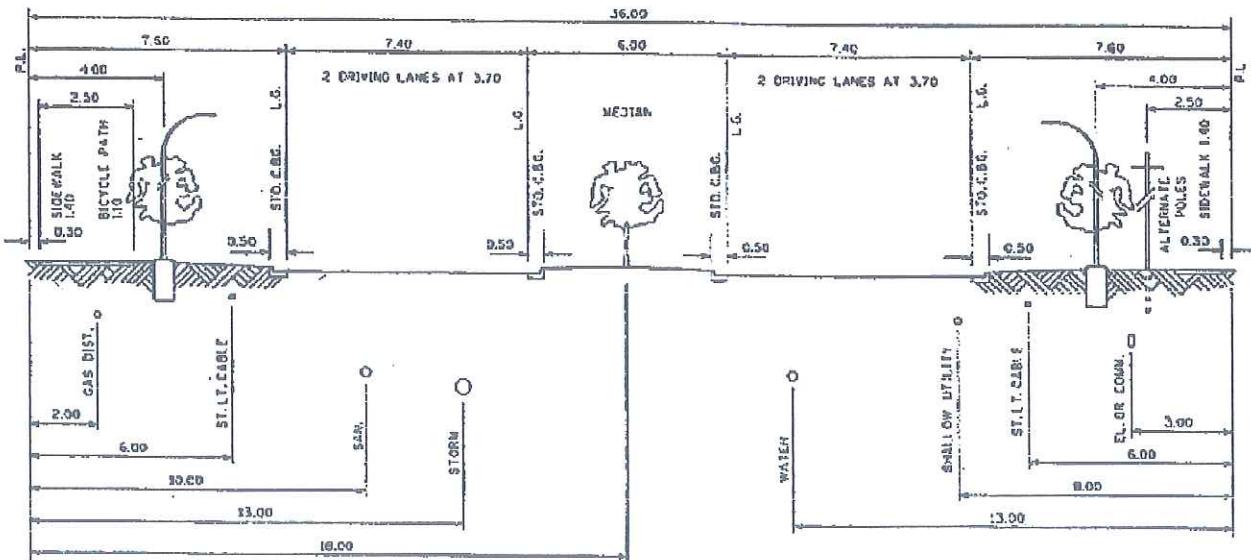
Mature trees with a trunk diameter of over 150 mm would need to be set back a minimum distance of 6.0 meters to comply with the TAC guidelines. Although 6.0 meters is desirable under the TAC guidelines, in the interest of providing the desired landscaping scheme, the setback distance for trees along the corridor would be at a minimum distance of 4.0 meters. The Calgary cross section standard for a divided arterial, shown in Figure 3.1 has been provided as evidence that another municipality has accepted a less than 6.0 meter offset for boulevard trees in support of a landscaping concept.

After the final widening of the corridor to 6 lanes, the resultant width of the boulevard where the service roads remain in place will vary between 5 and 10 meters depending on existing conditions. The boulevard width will be approximately 8.4 meters where the service roads are removed. The standard width for the center median will be 6.0 meters from lip of gutter to the lip of gutter.

The design speed for the corridor defines the intersection spacing and the sight triangle. Sight triangles are areas defined by the edge of the road and the line of sight that provide an opportunity for a motorist to judge traffic conditions. Considering the design speed on Gaetz Avenue, the influence of the horizontal and vertical alignment on the intersection spacing is not an issue.

Table 3.1 Proposed Design Criteria

	Gaetz Ave.	Service Road
Road Classification	Urban Arterial	Local road
Design Speed (Min.) (km/h)	70	50
Posted Speed (km/h)	60	50
Lane Widths (m)	3.7	3.7
Outside Shoulder Widths (Min.) (m)	0	0
Inside Shoulder Widths (Min.) (m)	0	0
Median Width (m)	6.0	0
Median Type	raised	N/A
Grade (Max.) (%)	4.0	4.0
Crest Vertical Curves (Min.) (K)	23	13
Sag Vertical Curves (Min.) (K)	12	9
Super Elevation (Max.) (Percent)	4	4
Radius (Min.) (m)	150	100
minimum SSD (m)	crest - 85 sag -85 comf.	crest - 63 sag -63 comf.
minimum DSD (m)	205	160
Clearance Box Struc. To Rail(m)	-	-
Clear zone(m)	6.0-8.5	2
Design Vehicle	Road way - WB15 Right in Right out Access - SU9	Road way - WB15 Bulb -WB15 Cul du Sac - SU9



NOTES:

- HYDRANTS ON 450 LINE.
- HYDRANT VALVES ON 1.00 LINE FROM WATER MAIN.
- SERVICE VALVES ON 450 LINE.
- TREES ON 4.00 LINE IN BOULEVARD AND 1.00 LINE IN MEDIAN.
- TREES SHALL BE OF A SPECIES AS APPROVED BY PARKS & RECREATION.
- ALL TREES TO BE SHALLOW ROOT SPACERS.
- POWER POLES, STREET LIGHT POLES, TRANSFORMER BOXES AND ALL OTHER SURFACE STRUCTURES SHALL MAINTAIN A MIN. OF 3.00m CLEARANCE FROM HYDRANT.
- GAS FEEDER MAINS IN CARRIAGE WAY DISTRIBUTION LINE IN BOULEVARD, OPPOSITE SIDE FROM OVERHEAD.
- WATER MAIN WILL BE INSTALLED ON THE OPPOSITE SIDE OF THE ROAD FROM STORM & SAN LINES.
- PRE-INSTALLED SERVICE CONNECTIONS TO BE INSTALLED 3.50m INSIDE P.L. OR 5.00m INSIDE P.L. WHEN CROSSING GAS AND ONE OTHER SHALLOW UTILITY.
- THIS STANDARD IS INTENDED AS A GUIDELINE FOR NEW DEVELOPMENT. WHERE NOT APPLICABLE MAKE ADJUSTMENTS AS REQUIRED.

		Drawn R.B.T.	Date JULY '94	THE CITY OF CALGARY		Metric
		Scale:	NTS	Divided Major		Sheet
No.	Date	App'd	Approved by City Engineer	36.00m R/W. 2x7.40m ROAD	File Number	14
3 : 00-71	ADDED SIDEWALK/BICYCLE PATH DIMENSION			36.00m R/W. 2x7.40m ROAD		454.1008.026
2 : 00-04	REVISED UTILITY COMPANY NAMES					
1 : 98-1C	REVISE SHALLOW UTILITY DVS					



3.2 ROADWAY CLASSIFICATION

Gaetz Avenue is classified as an urban arterial roadway. Typical cross sections for an urban arterial roadway in the City of Red Deer are illustrated in Figure 3.2. These particular cross sections were used as the basis for the development of a cross section that is specific to the redevelopment of Gaetz Avenue.

3.3 TURNING MOVEMENTS

Where City-owned service roads remain in place, the objective is to provide turning access for a WB-15 truck. WB-15 turning movements for a typical cross street intersection with full service roads were analyzed for wheel path conflicts. All the possible movements were considered and numbered to simplify the analysis. The WB-20 turning movements on the 12-metre radius bulb design are illustrated in Figure 3.3. A 12 meter diameter bulb will accommodate the travel of a WB-15 truck within standard lane widths.

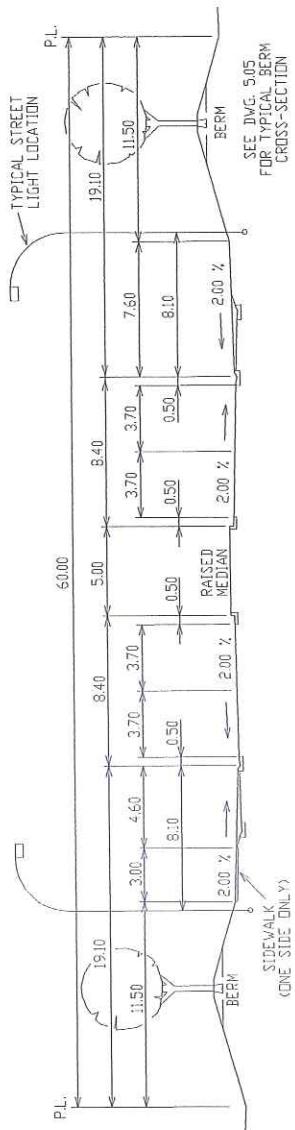
The WB-15 movements can be accommodated with minimal crossing of the centerline of the cross street or the service roads. The WB-19 movements on the other hand have numerous locations where the design vehicle wheel path crosses the centerline of both the cross street and the service roads. Where a special requirement for a larger vehicle to access properties is necessary, large bulbed roads are recommended.

The cul-de-sac design typically used on service roads in the City of Red Deer is as shown on Figure 3.4. The design utilizes a 12.5 meter radius and is intended for passenger car and medium single unit truck (MSU) only. This particular design is utilized to minimize the impact on the adjacent property. If larger vehicle (HSU), access is required, then the radius of the cul-de-sac should be increased to 15.25 meters.

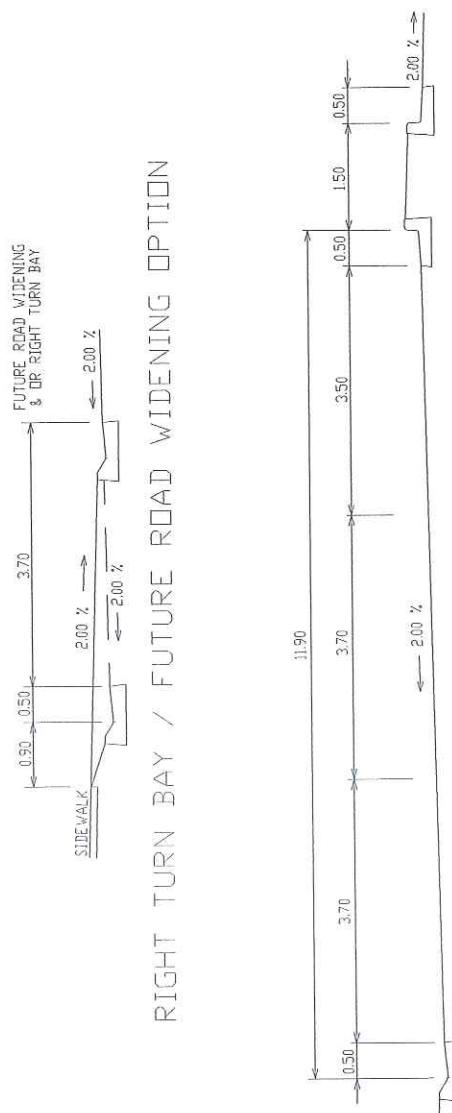
One of the objectives in the redevelopment of the service roads is to produce "T" intersections with the cross streets by eliminating one of the opposing service roads. In doing so the number of potential vehicle crossing conflicts are reduced from 32 to 16, improving safety and capacity at the intersection. An illustration from TAC showing vehicle crossing conflicts is shown in Figure 3.5.

3.4 BULBING AND CUL-DE-SACS

The offset of the bulbing of service roads from Gaetz Avenue has a significant impact on the operation of the cross street and service road intersections. In terms of TAC guidelines, the size of bulbing is related to the traffic volumes on cross streets, signalization, and mid-block median accesses. The lowest form of bulbing design is illustrated in Figure 3.6A where the crossroad volumes are less than 2,000 vehicles per day, the main intersection is not signalized, and the bulb size is a 12 meter radius. When the main intersection is signalized and cross street volumes exceed 2,000 vehicles per day it is suggested that a median be installed on the cross road as shown on Figure 3.6B. Considering these volumes, the queue lengths on the cross roads are such that the service road intersection becomes blocked. A median on the



BRIGHT TURN BAY / FUTURE ROAD WIDENING OPTION



LEFT TURN BAY OPTION

		THE CITY OF RED DEER ENGINEERING DEPARTMENT		
		DRAWN BY: D.W.K.	DESIGN GUIDELINE DRAWINGS Roadway Design	APPROVED BY:
		DATE: OCT 10, 2000	DIVIDED ARTERIAL ROADWAY	STREETS-UTILITIES ENGINEER
		SCALE: N.T.S.		DRAWING NO. 5.03
NO.	DATE	REVISION		

May 2005
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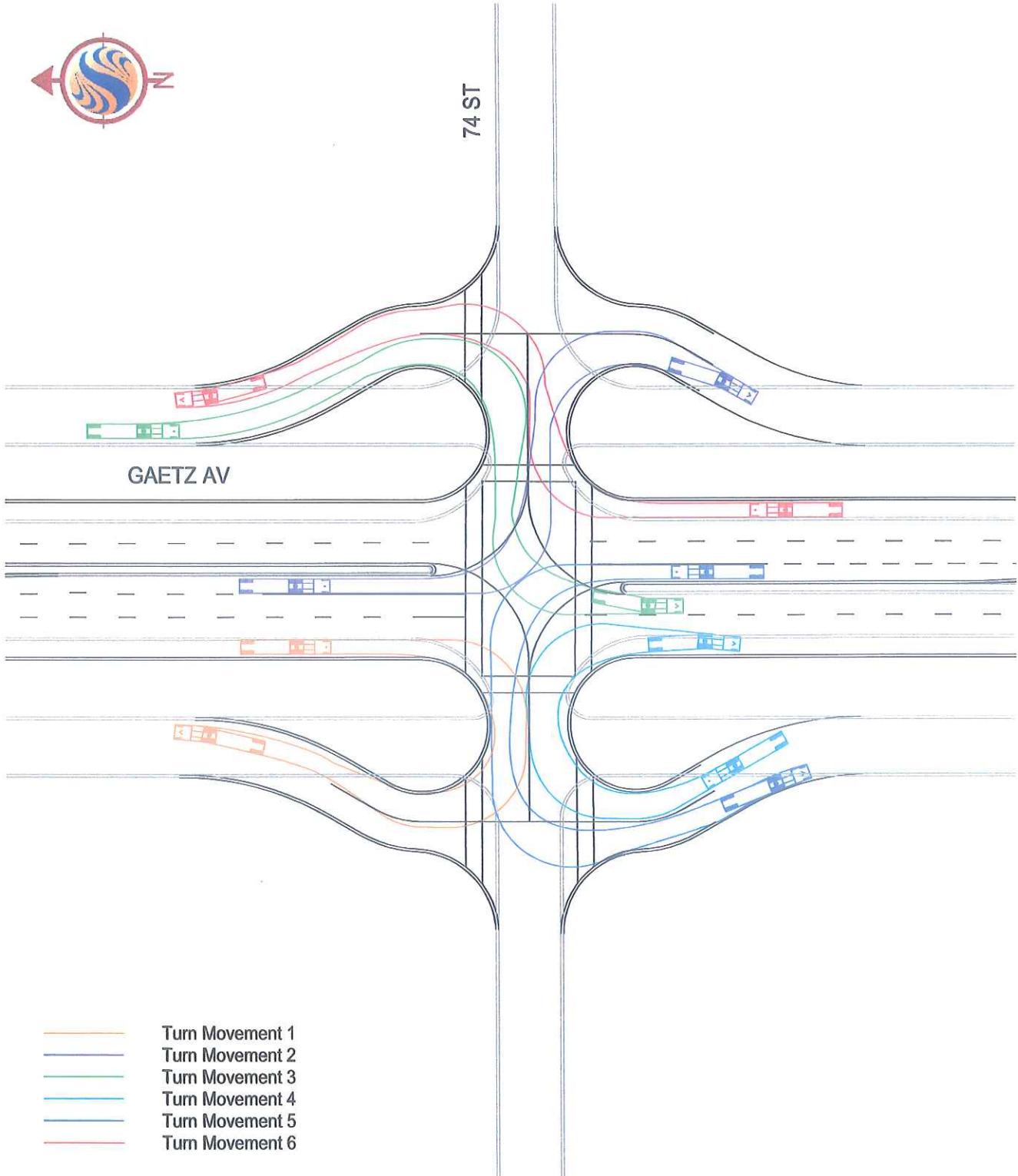
Client/Project

THE CITY OF RED DEER
GAETZ AVENUE REDEVELOPMENT
STUDY



Figure

Current Standard Divided Arterial Roadway



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Scale: NTS

Client/Project

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GAETZ AVENUE REDEVELOPMENT
STUDY

Figure No.

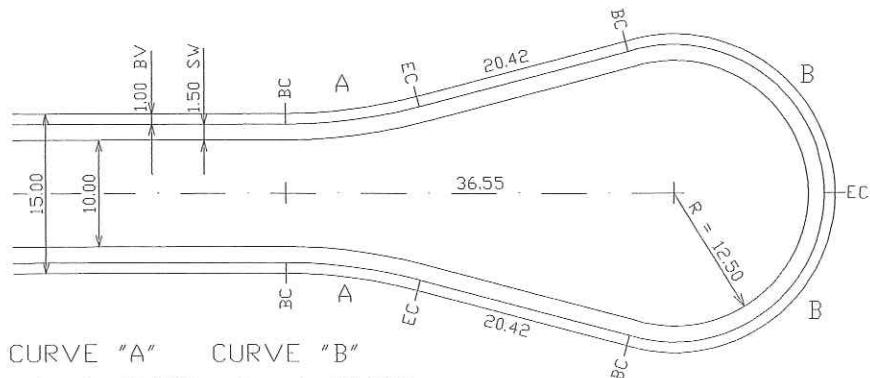
3.3

Title

Turning Movements
Gaetz Avenue & 74 Street
WB-15 Vehicle Body Envelope

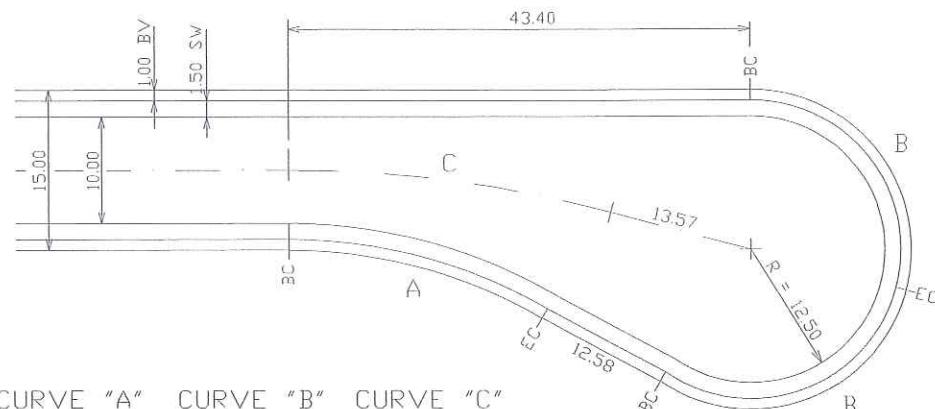


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CURVE "A" CURVE "B"

$\Delta = 15^{\circ} 0'0''$ $\Delta = 105^{\circ} 0'0''$
 R = 50.00 R = 15.00
 ARC = 13.09 ARC = 27.49
 TAN = 6.58 TAN = 19.55
 (at property line) (at property line)



CURVE "A" CURVE "B" CURVE "C"

$\Delta = 30^{\circ} 0'0''$ $\Delta = 105^{\circ} 0'0''$ $\Delta = 15^{\circ} 0'0''$
 R = 50.00 R = 15.00 R = 117.03
 ARC = 26.18 ARC = 27.49 ARC = 30.64
 TAN = 13.40 TAN = 19.55 TAN = 15.41
 (at property line) (at property line)

		THE CITY OF RED DEER ENGINEERING DEPARTMENT		
		DRAWN BY: D.W.K.	DESIGN GUIDELINE DRAWINGS Roadway Design	
		DATE: JAN 11, 2001	15/10 LOCAL RESIDENTIAL CUL - DE - SAC	
		SCALE: N.T.S.		
NO.	DATE	REVISION	APPROVED BY: STREETS-UTILITIES ENGINEER DRAWING NO. 5.27	May 2005 112870826

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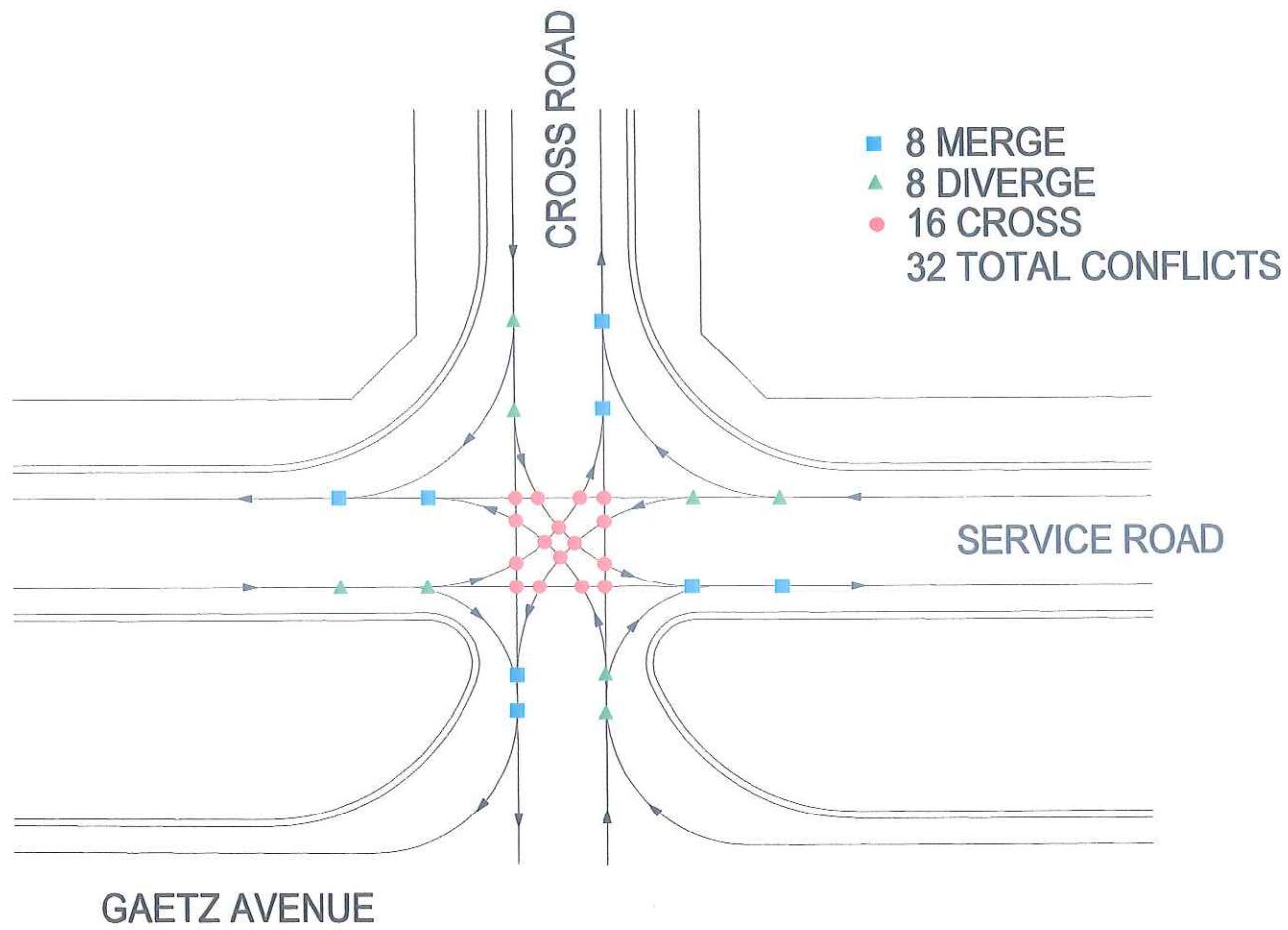
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Figure No.

3.4

Title
22 / 12.5 Local Industrial
Cul-De-Sac



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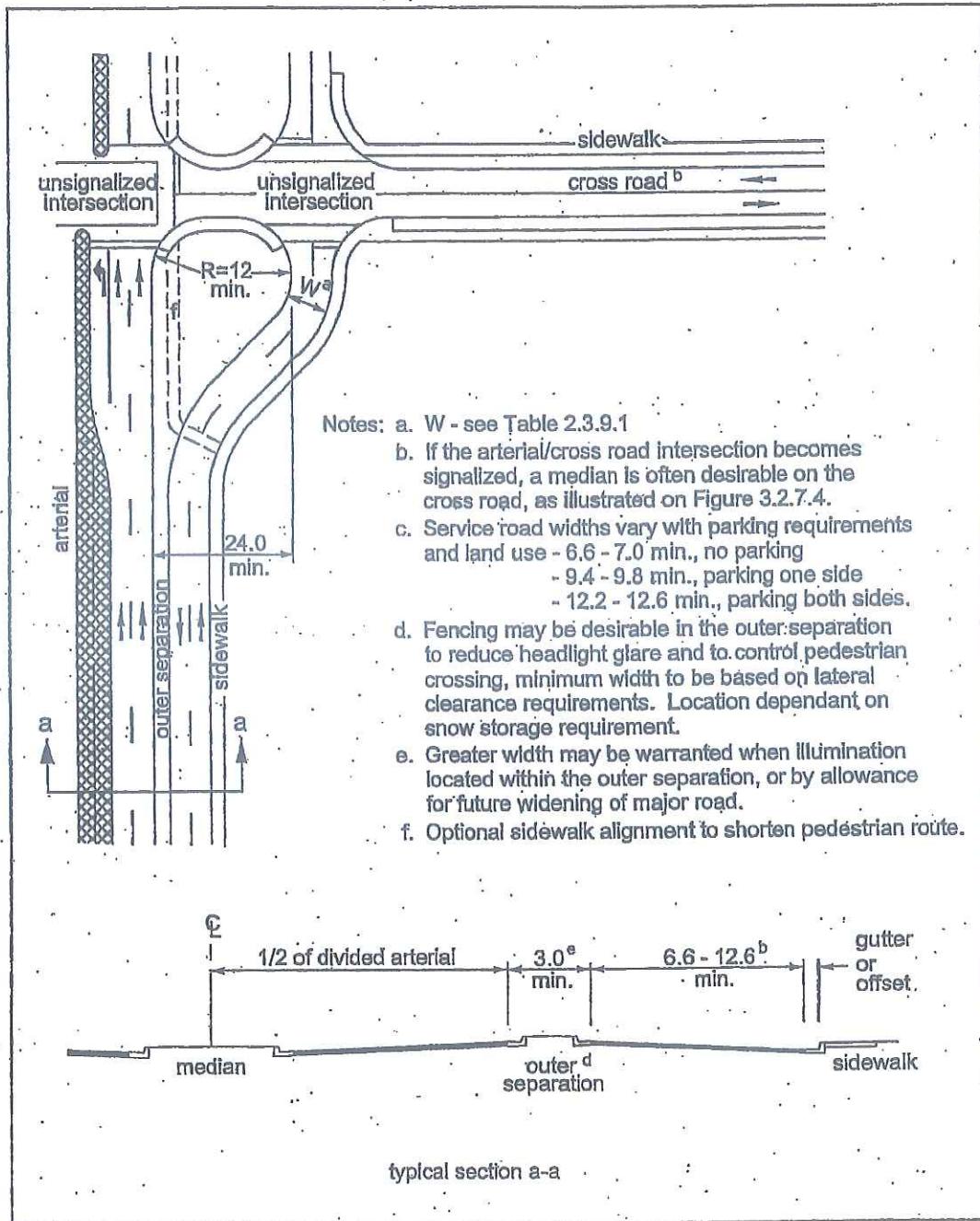
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GAETZ AVENUE REDEVELOPMENT
STUDY

Figure No.
3.5
Title
Intersection
Conflict Points



Figure 3.2.7.3 Two-Way Service Road / Cross Road Intersection Treatment, Cross Road Volumes ≤ 2000 veh/d, Unsignalized Intersection



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Figure No.

3.6a

Title

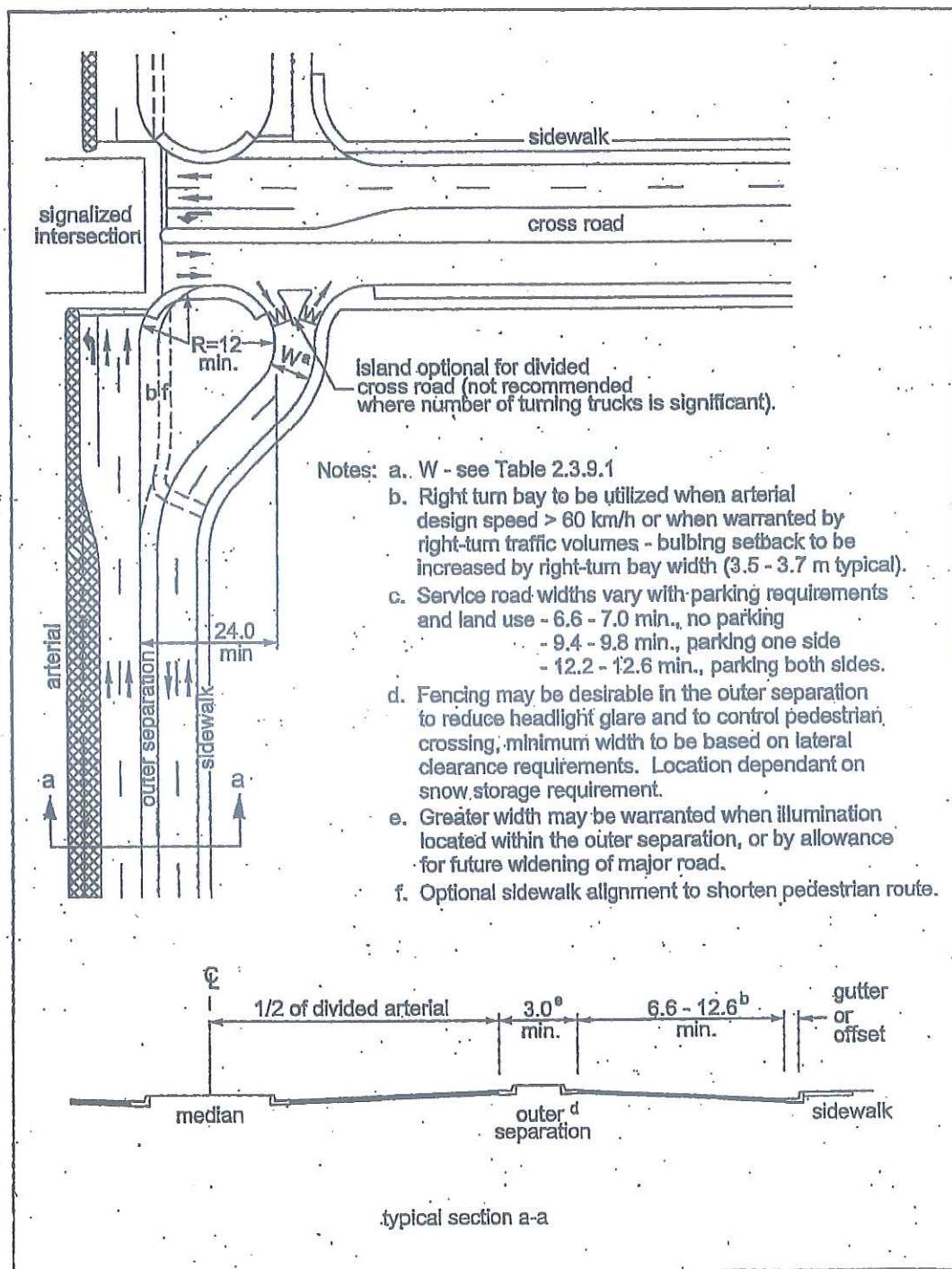
Service Road 24m Bulb
 < 2000 Vpd



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Figure 3.2.7.4 Two-Way Service Road / Cross Road Intersection Treatment, Cross Road Volumes > 2000 veh/d, Signalized Intersection



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Figure No.

3.6b

Title

Service Road 24m Bulb
> 2000 Vpd



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crossroad prevents left hand turns from the service road onto the crossroad. If the main intersection is signalized and there is no median installed on the cross road, the alternative is to use a bulb design with a 45 meter offset separating the service road from the main intersection. This increased distance provides for a larger queue length on the crossroad. The larger bulb design is illustrated in Figure 3.6C. Where the cross service road approaches 5,000 vpd, a typical service road offset of 45 meters is required to provide adequate channelization and queuing storage-length to allow the intersection to operate efficiently.

In a few cases it is difficult to accommodate the TAC design standard due to conflicts with existing development and buildings. In these instances a reduced level of service has been accepted which provides a lesser amount of queuing storage, but meets the requirements for major turning movements. The lesser TAC guideline is applied with the understanding that the level of service will be reduced. In these instances the preference for a large bulb is still shown in the design in the event that the effected property is redeveloped some time in the future.

Mid block service road bulbs that have been provided in conjunction with right-in/right-out accesses are required to be 24 meter diameter in order to accommodate the turning radius of the WB-15 truck. In some instances an 18 meter diameter bulb may be applied at mid block service road accesses in order to lessen the impact on the property. An 18 meter bulb will accommodate the turning radius of an SU-9 vehicle. The implementation of the appropriate bulb size is solely dependent on the access needs of the properties within the block.

Figure 3.4 represents the design guidelines and appropriate size for cul-de-sacs, which will accommodate an SU9 Vehicle. In some locations, where property parking lot configurations are accommodating, the service road ends at a property line rather than implementing a cul-de-sac.

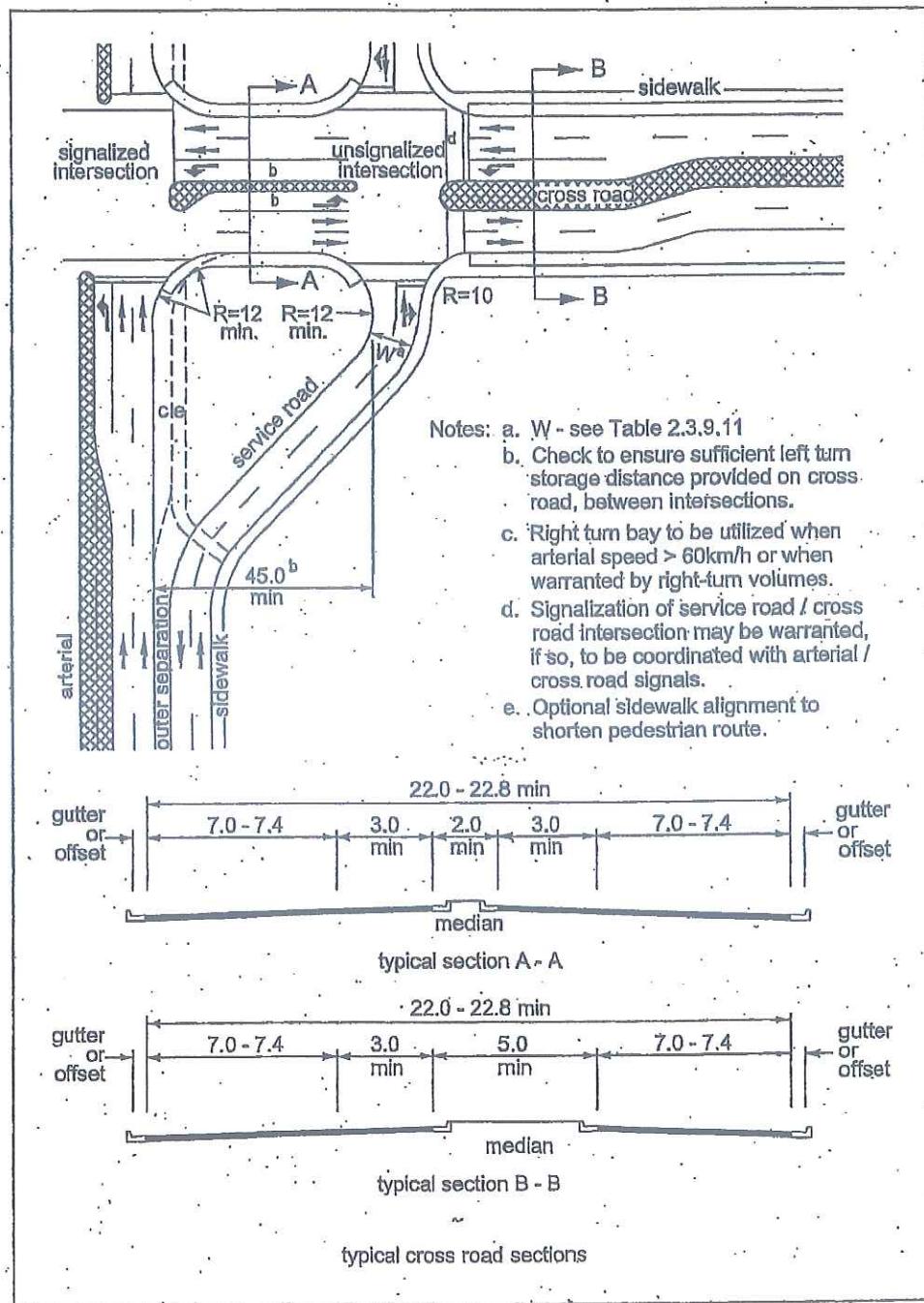
Table 3.2 lists the cross street traffic volumes for the existing and 115,000 population at significant cross street intersections in the study area. The table also identifies the desirable bulb offset requirements based on the T.A.C. guidelines for cross street volumes. These guidelines were utilized in the consideration of the configuration of the service road intersections in Section 5.0.

3.5 RIGHT-IN/RIGHT-OUT ACCESS

Right-in/right-out accesses are provided within the block, in instances where service roads are removed. The one-way lane widths are a minimum of 6.0 meter wide with a "pork chop" island that provides lane definition at the entry. The corner radii are 12 meters. This configuration will provide for access by SU9 size vehicles without cross over to opposing lanes at the entry.

At some business locations the service road provides access for WB15 vehicles at the front of the property. In instances where the service road is removed and right-in/right-out access is provided, the size of the access may need to accommodate WB15 trucks if rear access or access to the cross street is not available. The right-in/right-out access in these few instances will have larger dimensions to accommodate the turning movement.

Figure 3.2.7.5 Two-Way Service Road / Cross Road Intersection Treatment, Cross Road Volumes > 5000 veh/d, Signalized Intersection



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STUDY

Figure No.

3.6c

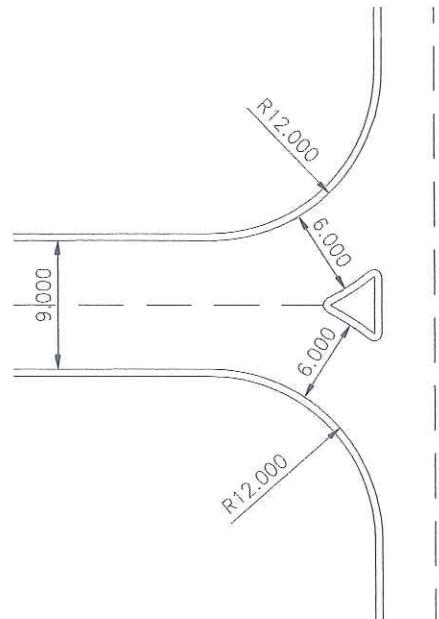
Title

Service Road 45m Bulb
> 5000 Vpd

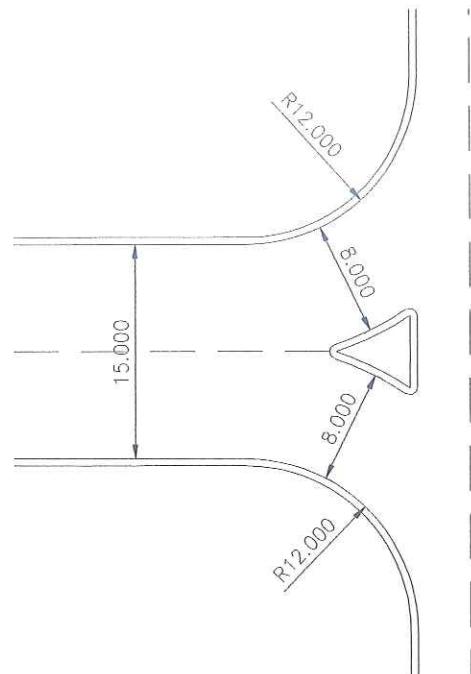


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RIGHT IN / RIGHT OUT ACCESS FOR SU9



RIGHT IN / RIGHT OUT ACCESS FOR WB-15

Table 3.2
Gaetz Avenue Corridor
24 Hour Traffic Volumes

Intersection	Existing Population	*115,000 Population	T.A.C. Bulb Requirements
80 Street East of Gaetz Avenue	2595	2270	24m
80 Street West of Gaetz Avenue	0	2070	24m
78A Street East of Gaetz Avenue	655	4525	45m
78A Street West of Gaetz Avenue	0	715	24m
78 Street East of Gaetz Avenue	7245	3270	24m
78 Street West of Gaetz Avenue	1195	1030	24m
76 Street East of Gaetz Avenue	4450	6010	45m
76 Street West of Gaetz Avenue	2705	2450	24m
74 Street East of Gaetz Avenue	5160	5390	45m
74 Street West of Gaetz Avenue	5280	6380	45m
71 Street East of Gaetz Avenue	2260	3810	45m
71 Street West of Gaetz Avenue	3370	4360	45m
68 Street East of Gaetz Avenue	4000	4300	45m
68 Street West of Gaetz Avenue	6000	6250	45m
Boyce Street East of Gaetz Avenue	4880	5800	45m
Boyce Street West of Gaetz Avenue	6730	8040	45m

*ESTIMATED VOLUMES

Figure 3.7 illustrates the dimensional criteria for right-in/right-out accesses.

After the widening of Gaetz Avenue to 6 lanes, the third travel lane in one direction will act as an auxiliary lane for vehicles to decelerate in use of the right-in/right-out out access points. The right-in/right-out accesses will be a significant advantage to businesses providing more direct access at a mid-block location than provided by service roads. The right-in/right-out accesses are expected to reduce traffic congestion at the cross streets intersections with Gaetz Avenue improving traffic flow at these locations.

3.6 SLOTTED LEFT TURN ACCESSES

Where business access is significantly affected by the loss of all turns intersection and roadway geometrics permit a provision for a slotted left turn may be considered. In each instance the level of safety and compromise of geometric standards must be found to be acceptable. In some locations consideration may be given for a signalized stop condition of the through traffic on Gaetz assisting vehicles turning left.

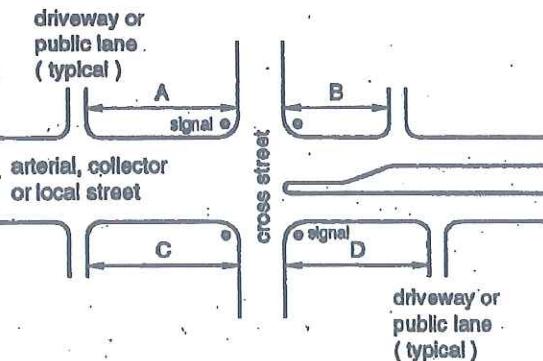
A few locations considered in the Gaetz Redevelopment Plan included the following.

- Intersection of 78 Street and Gaetz Avenue.
- 79 Street and Gaetz Avenue.
- Centre 76 Street access.
- 49 Avenue into the Capri Hotel and 51 Avenue to Southland Village.
- 37 Street
- 51 Avenue to service road near Pike Wheaton.

A detailed description of these locations are provided for in the Plan Description section 5.8.

In many cases there is not enough separation between opposite left turning bays to accommodate standard TAC transition tapers for deceleration. Left turn installations such as these should be considered on an individual basis with considerable discussion as they represent a compromise to the accepted standards and have the potential of setting precedence at other locations throughout the city. The compromised turn bay taper may cause some vehicle deceleration to occur in the through lanes on Gaetz Avenue reducing capacity and moderately increasing accident risk. Deceleration on the through lanes of Gaetz Avenue will be most prominent when the left turn bays are nearly full of vehicles. As traffic increases along Gaetz Avenue it may be necessary in some situations to consider closure of the slotted left turn lanes.

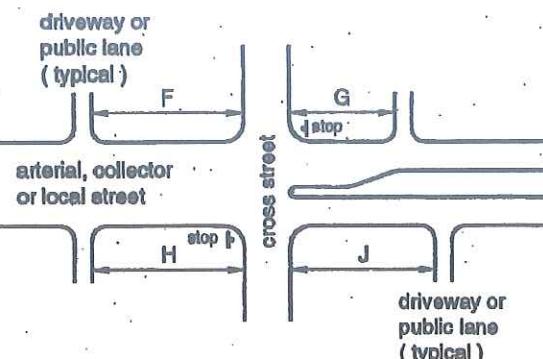
Figure U.K.5
Suggested minimum corner clearances to driveways or public lanes at major intersections



item	min. clearance, m		
	arterial	collector ²	local ²
A	70 ³	55	15
B	# ¹	25	15
C	70 ³	55	15
D	70 ³	55	15

Notes : 1. Distance (#) positions driveway or public lane in advance of the left turn storage length (min.) plus bay taper (des.).
 2. Lesser values reflect lower volumes and reduced level of service on collectors and locals.
 3. Reduced distances feasible if auxiliary lane implemented, see Section U.K.2.
 Values based on operating speed of 50 km/h, higher values desirable for higher speeds or may be warranted by traffic conditions.

a. signals at the cross street



item	min. clearance, m		
	arterial	collector ²	local ²
F	35	20	15
G	# ¹	25	15
H	25	25	15
J	35	20	15

Notes : 1. Distance (#) positions driveway or public lane in advance of the left turn storage length (min.) plus bay taper (des.).
 2. Lesser values reflect lower volumes and reduced level of service on collectors and locals.

b. stop control at the cross street



3.7 PRIVATE ACCESSES

Private property access would be provided by a 9.0 meter curb drop. At cross street intersections private accesses should be located at minimum of 24 meter offset from Gaetz Avenue and in instances where traffic volumes on the cross street exceed 2,000 VPD the desirable offset is 45 meters .

3.8 ACCESS SEPARATION

The guidelines for access separations identified in TAC Urban Supplement are provided in Figure 3.8. This set of criteria has been used to determine where right-in/right-out accesses are permitted to businesses and to mid-block service roads. Locating accesses across from left turn bays should also be avoided to prevent vehicles exiting the access and crossing three lanes join a left turn bay at an angle.

3.9 ACCESS MANAGEMENT TOOLS

Based on the design criteria outlined in this section, we have summarized the following access management tools that will be considered throughout the corridor. Combinations of these tools were used in the various applications to develop the access management plan.

Where service roads remain at cross street intersections they were reconfigured in the following manner.

- Installation of a 24 meters offset bulb on service roads with less than 2,000 VPD on the cross street.
- Where cross street traffic volumes are greater than 2,000 VPD, install a 24 meter offset bulb with a median on the cross street
- or
- Install a large 45 meter offset bulb on the service road.

Where service road connections to cross street intersections were closed at one end, install at mid block, a right-in/right-out access with a 24 meter offset bulb and;

- Install a cul-de-sac at the closed end of the service road closing access to the cross street.
- or
- End the service road at a driveway access providing that a parking area or other site roadway can accommodate the service road traffic destined for the business location.
- Where service roads were removed the following tools were applied.

- Remove the service road and provide mid block right-in/right-out access to each of the properties within the block and driveway access to corner properties from the cross street. Driveway access at the cross streets should have a minimum setback distance of 24 meters from Gaetz Avenue.

or

- Remove the service road and provide mid block right-in/right out access at strategic points within the block and develop a shared access drive lane between properties with connecting driveway access to the cross street on the corner properties. This requires a joint access agreement to be in place.

Section 5.8 describes in detail the application of the access management criteria in specific block-by-block situations.

3.10 BICYCLE PATHS AND WALKWAYS

Bicycle paths have been addressed in accordance with the City Guidelines and recommendations presented in the 2000 Bicycle Master Plan. A continuous bicycle path is a requirement for the corridor with the provision for cross street linkages including those to the main trail system. As per the City of Red Deer Guidelines, the bicycle pathways are typically 3.0 meters wide.

The City of Red Deer 2004 Design Guidelines have been used in the development of a plan to accommodate pedestrian and cyclist movements. Walkway locations, widths and intersection treatments are defined in accordance with the City's Guidelines and input from the City's Trails and Master Plan Steering Committee. The specific locations of cross walks are strategically placed in locations of high visibility where motorists would expect pedestrians to cross. Crosswalks have been accommodated at major intersections and on frequently traveled routes. Walkways throughout the corridor will be 1.5 meters wide and located in conjunction with business frontages. Walkway connections are to include bus stop locations.