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16. Abstract

This report examines the physical and economical feasibility of converting rural frontage roads to an exclusive truck facility. The I-10 freeway corridor from Houston to Beaumont is selected for this evaluation. Three basic options are incorporated in the analysis. These are: 1) assign truck traffic to existing frontage roads; 2) construct exclusive facility on one side of freeway, and; 3) construct exclusive facility on both sides of freeway.

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PRELIMINARY ASSESSMENT OF THE FEASIBILITY OF CONVERTING THE I-10 FREEWAY FRONTAGE ROADS TO AN EXCLUSIVE TRUCK FACILITY

Stephen Albert

TTI Research Report 393-1
TTI Study 2-10-85-393

Conducted for

Texas State Department of Highways
and Public Transportation

in cooperation with

Federal Highway Administration

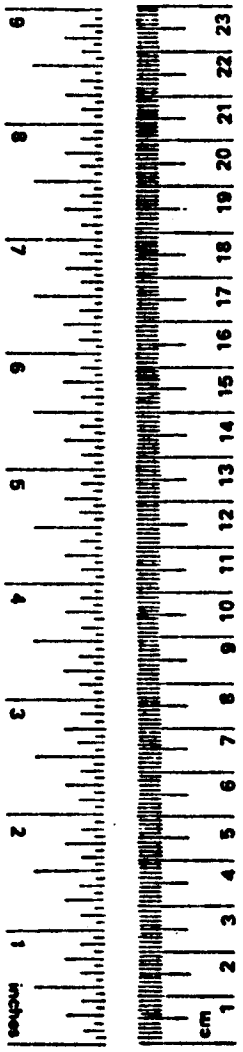
Texas Transportation Institute
The Texas A&M University System
College Station, Texas 77843

September 1986

METRIC CONVERSION FACTORS

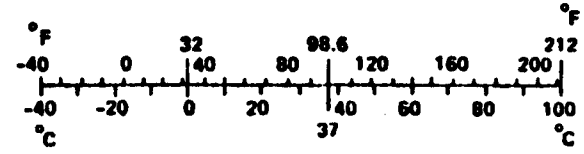
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

ABSTRACT

This report examines the physical and economical feasibility of converting rural frontage roads to an exclusive truck facility. The I-10 freeway corridor from Houston to Beaumont is selected for this evaluation. Three basic options are incorporated in the analysis. These are: 1) assign truck traffic to existing frontage roads; 2) construct exclusive facility on one side of freeway, and; 3) construct exclusive facility on both sides of freeway.

IMPLEMENTATION STATEMENT

The procedure report here are to be used with other information and procedures to *evaluate the possibility for exclusive truck facilities on or adjacent to existing interstate highways.

DISCLAIMER

The contents of this report reflect the views of the author who is responsible for the accuracy of the data and facts presented herein. The contents do not necessarily reflect the official view or policies of the Federal Highway Administration or the Texas State Department of Highways and Public Transportation.

This report does not constitute a standard, specification, or regulation.

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1. INTRODUCTION

1.1 Background

Increased concern in dealing with intercity truck traffic has brought about the consideration of segregating trucks from other vehicular traffic, either by assigning exclusive lanes on existing roadways, or by constructing new facilities for the exclusive use by trucks. Separating trucks from passenger vehicles should improve traffic safety and reduce conflicts for all vehicles, provide an opportunity to design and construct adequate pavement and bridge structures that will accommodate a concentration of heavy vehicles, and reduce overall maintenance costs on the truck facility and the facility from which trucks would be excluded. Furthermore, for the many heavily travelled highways that are due for extensive rehabilitation, the reconstruction costs could be scaled down if trucks could be excluded from these facilities and the subsequent savings could be directed towards the construction of exclusive truck facilities.

There are several alternative designs for using the existing right-of-way for an exclusive truck facility. This technical memorandum examines the physical and economical feasibility of converting the frontage road to an exclusive truck facility. The I-10 freeway corridor from Houston to Beaumont is used as a specific example in the evaluation.

1.2 Objectives

The objective of this technical memorandum is to examine the feasibility of using the section of right-of-way normally assigned to frontage roads for exclusive truck facilities.

1.2.1 Optional Designs for Using Freeway Frontage Roads as a Truck Facility

Option No. 1 - Assign Truck Traffic to Existing Frontage Roads

This option is unacceptable for several reasons. The existing design is inadequate for heavy truck traffic. The lane widths, pavement, structure and

alignment would have to be upgraded. The facility would have to be shared with non-truck traffic accessing the freeway, the cross streets and the abutting traffic. Traffic operations would be at lower levels of service than the mainlanes, and the number of conflicts for truck traffic would be high.

Option No. 2 - Construct an Exclusive Truck Facility on Only One Side of the Freeway. (One-way or Two-way)

This option requires the replacement of the existing frontage road with a high type design that provides the following features:

1. Complete control of access for the truck facility.

2. Access to and from the freeway mainlanes to the cross street.

3. Access for trucks to and from the freeway mainlanes.

4. Facilities for local circulation where access to adjacent property is changed.

Option No. 3 - Construct an Exclusive Truck Facility on Both Sides of the Freeway. (One-way)

This option would have the same general requirements as Option No. 2.

Discussion:

The questions that are posed by the design of a truck facility in the outer separation of the freeway are:

1. If there is an existing frontage road, how is the local circulation (traffic) to be accommodated.

    a) Share truck facility - Not acceptable
    b) Eliminate some movements - May be possible
    c) Provide new facility to replace old frontage road - Possible

d) Provide access to other existing roadways - Possible
e) Do not eliminate existing facility - Possible

2. Where there is access to cross streets to and from the freeway: (ramps)

a) Provide grade separation of truck facility - Possible
b) Eliminate access points - Possible but with difficulty
c) Eliminate truck facility in these areas - Possible

3. Where there are conflicts with cross streets, railroads, rivers, etc.

a) Provide grade separations for the truck facility - Possible
b) Eliminate conflicts - Possible but not probable
c) Eliminate truck facility in these areas - Probable

1.2.2 Discussion - One Side Versus Two Sides

One Side - One Way Operation

A truck facility on one side of the freeway would have to have a minimum of 30 feet. The cross section would have:

1 - travel lane	12 feet
1 - emergency passing lane	12 feet
2 - (3 ft.) lateral clearances	6 feet
	30 feet

The cross section would be striped to provide for passing zones of 2000 feet every 2 miles.

Grade separations for ramps, cross streets and natural barriers could be reduced in width to 20 feet.

One Side - Two Way Operation

A truck facility with two way traffic would have a minimum of 62 feet. The cross section would have:

2 - travel lanes	24 feet
1 - passing lane	14 feet
2 - (12 ft.) shoulders	24 feet
	62 feet

In restricted areas, the cross section would not permit passing and would eliminate shoulders. The cross section would have:

2 - travel lanes	24 feet
1 - median separation	4 feet
2 - lateral clearances	6 feet
	34 feet

Special provisions would be required at interchanges of the truck facility with the freeway or cross streets to carry the off peak direction traffic over the freeway mainlanes.

Two Side - One Way Operation

To provide exclusive one way facility in both directions, 2-30 feet roadways would be required. In restricted areas, 2-20 foot roadways would be required. It would appear that the costs of construction for the one way on two sides versus the two way on one side would be nearly the same; except for the amount of structures that would be required for the access ramps for the two way structure.

Advantages - Disadvantages of One Way Versus Two Way Truck Facility

One Way

The one way facility has the following advantages:

1. The smaller width requirement can be more easily accommodated on existing freeways.

2. The interchanges are less complicated and are less costly.

3. One option for providing grade separation at cross streets would be to combine the truck facility with the normal freeway lanes. The total width of structure could be reduced.

4. The smaller width requirement can provide more options for accommodating local traffic.

5. Only one direction of flow needs to be implemented at one time.

6. The facility can be used by mixed flow in the event of an emergency or under special traffic control plans for construction and maintenance.

The disadvantages of the proposed design are:

1. The passing opportunities may be limited because of the number of narrow structures and the emergency parking areas.

2. The costs to provide the two - one way roadways may be higher than the one - two way roadway.

Two Way

The two way facility has the following advantages:

1. The opposite side of the freeway can be used for local circulation.

The disadvantages are:

1. The interchanges are more complex.

2. There are more conflicts with two way operation

3. The facility would not be used by mixed flow in the two direction mode except in cases of emergencies.

To convert the frontage road to the exclusive use by trucks, the following must be done:

1. The existing roadway structure would be totally replaced by a heavy duty pavement.

2. The traffic using the existing frontage road would be provided with facilities that would approximate their existing access to the freeway and cross streets.

3. Businesses that would be adversely impacted by the change in traffic access would have to be compensated.

4. Grade separations would be constructed to eliminate conflicts with freeway mainlane ramps, cross streets and other natural or man made barriers.

5. Where sufficient space is not available to accomplish all of the above, extra right of way must be obtained by purchase or by shifting the freeway mainlanes.

This section has raised some interesting operational problems in constructing an exclusive truck facility within the existing freeway right-of-way. It has also shown the advantages and disadvantages of one-way versus two-way exclusive truck facilities on one or both sides, being constructed within the existing right-of-way. As a result of these discussions, the one way, two lane exclusive truck facility on either side of the freeway has more advantages and less disadvantages than other potential design options.

1.3 Related Research

Attempts to locate related exclusive truck facility research using the Transportation Research Information Service (TRIS) and National Transportation Information Service (NTIS) have resulted in little or no information. Terms used in the literature review were exclusive truck facilities, frontage or service roads, traffic operations and safety.

2. STUDY CORRIDOR

2.1 General

The 75 mile study corridor limits are the I-610 (East Loop) in Houston, and US 90 in Beaumont. Cities in the corridor are; Baytown, Mount Belvieu, Hankamer, Winnie, and Hampshire. Counties involved with the I-10 frontage road study are Harris, Chamber, and Jefferson, as shown in Figure 1. The I-10 frontage roads are not continuous uninterrupted facilities. The frontage roads intersect man-made and natural barriers, such as highways, farm-to-market roads, railroad crossings, coastal independent water authority canals and rivers. Some frontage road sections operate one way, some operate two way and in some segments there are no frontage roads on one or both sides of the freeway.

This section of the report presents a general overview of the traffic and safety conditions along the I-10 frontage road corridor.

2.2 Traffic Volumes

Average daily traffic (ADT) frontage road volumes were obtained from the State Department of Highways and Public Transportation (SDHPT) districts in the Houston-Beaumont corridor. As shown in Figure 2 traffic volumes on I-10 frontage roads range between 22,000 and 100 vehicles per day (vpd). Average daily traffic (ADT) volumes on the I-10 frontage roads range from 700 to 100 vpd in rural segments to a high of 22,000 to 10,000 vpd on those urban segments near Houston and Beaumont.

Preliminary surveys by the Texas Transportation Institute (TTI) indicate that trucks account for roughly one-third of total daily traffic on the I-10 mainlanes (Table 1). In terms of directional and hourly characteristics, eastbound truck traffic on I-10 tends to peak in the mid-to-late afternoon hours (Figure 3). Westbound truck traffic on I-10 tends to peak in the early morning and late night hours. Hourly frontage road characteristics were unavailable from SDHPT.

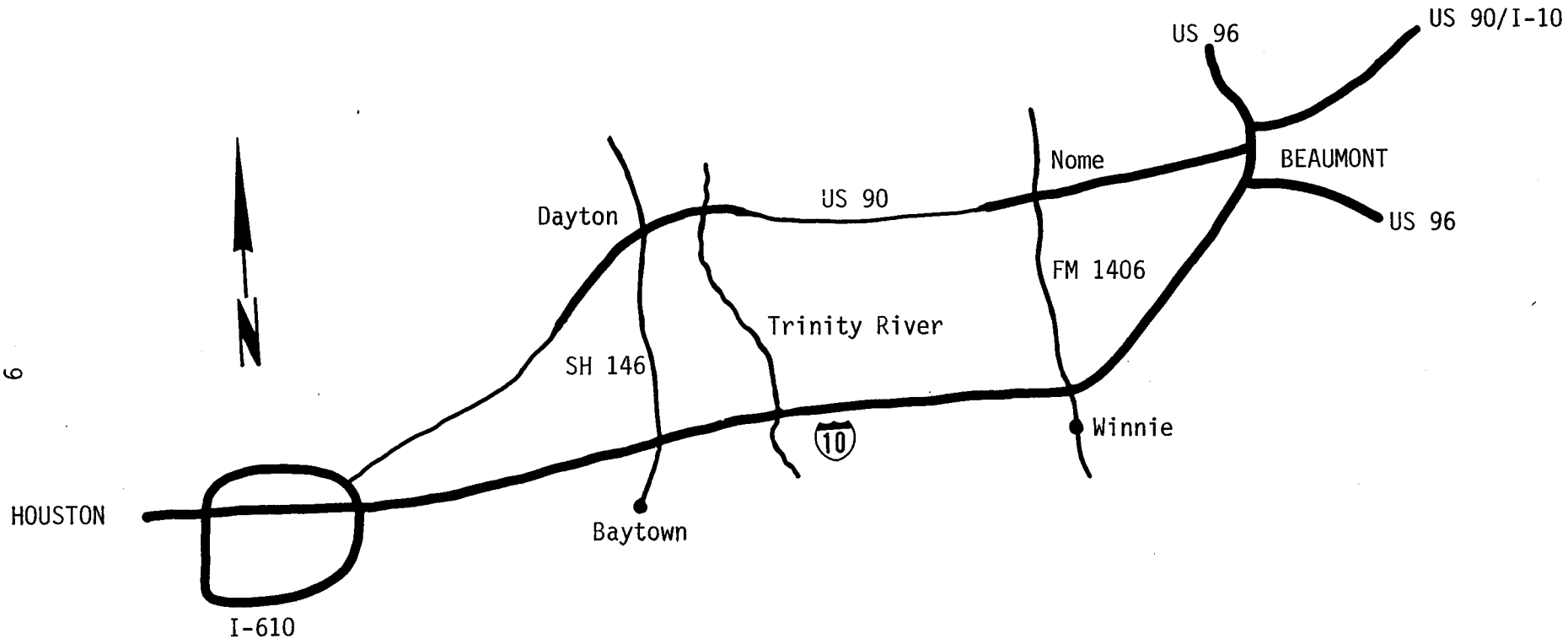
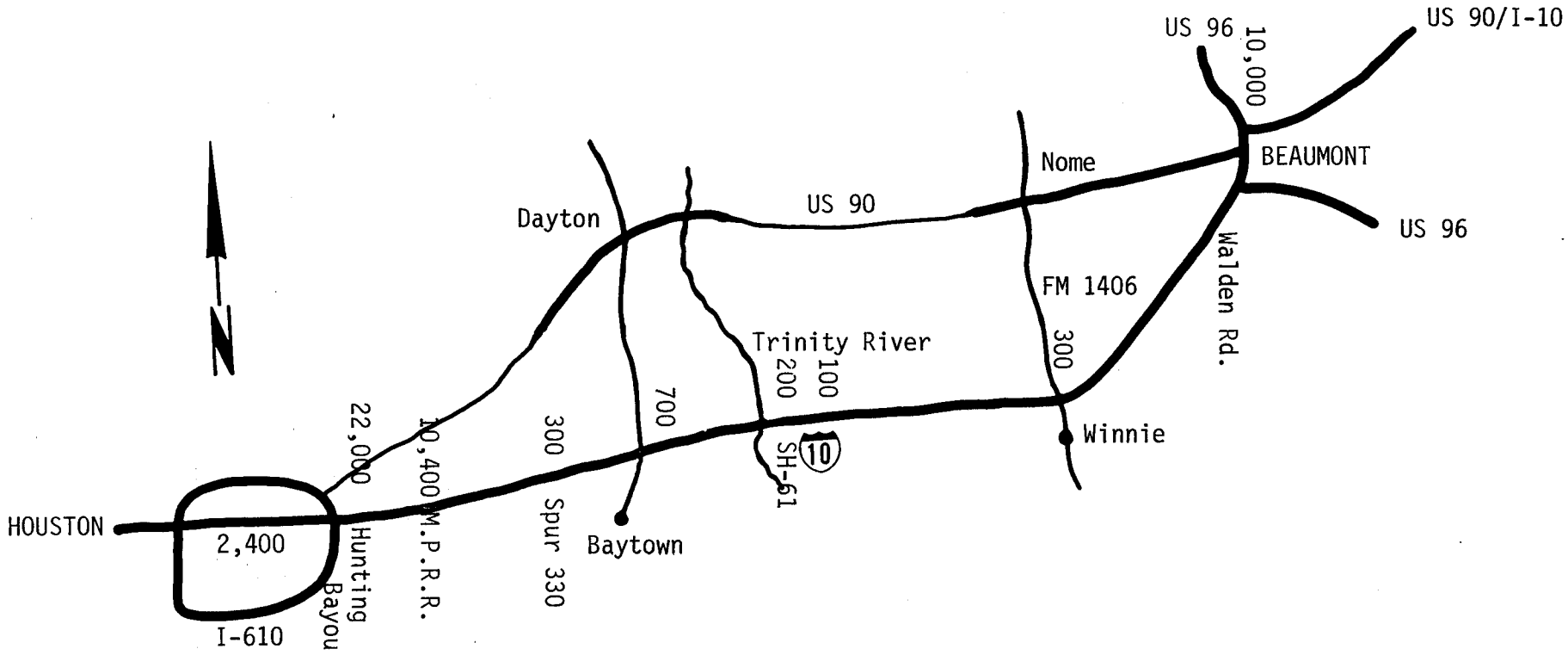
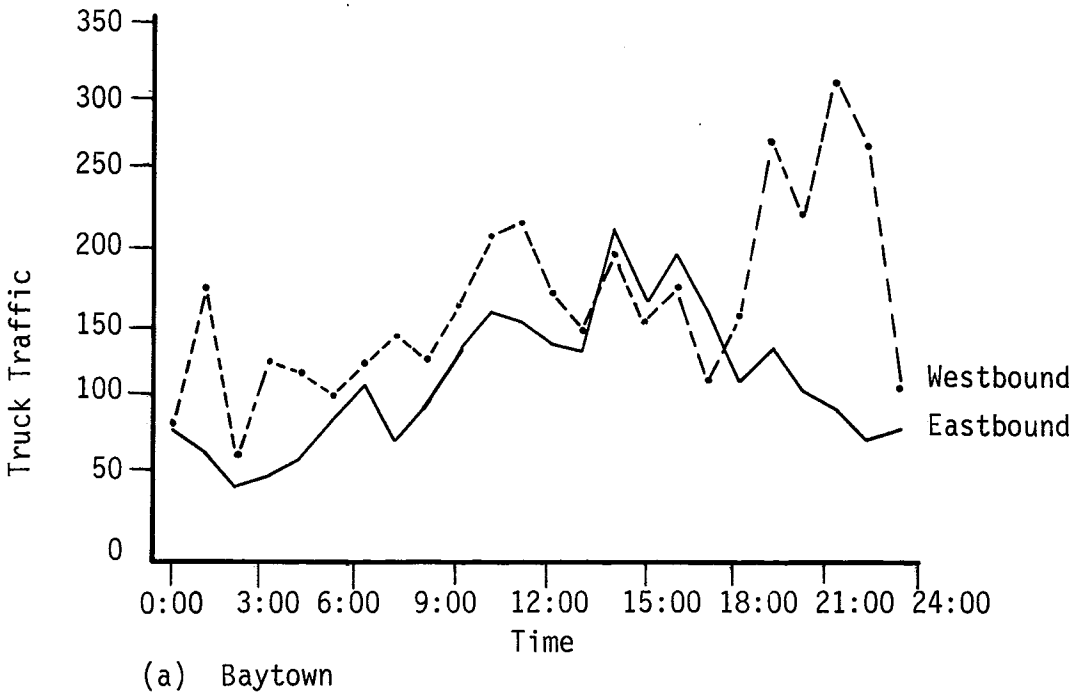


Figure 1. Beaumont-Houston Study Corridor

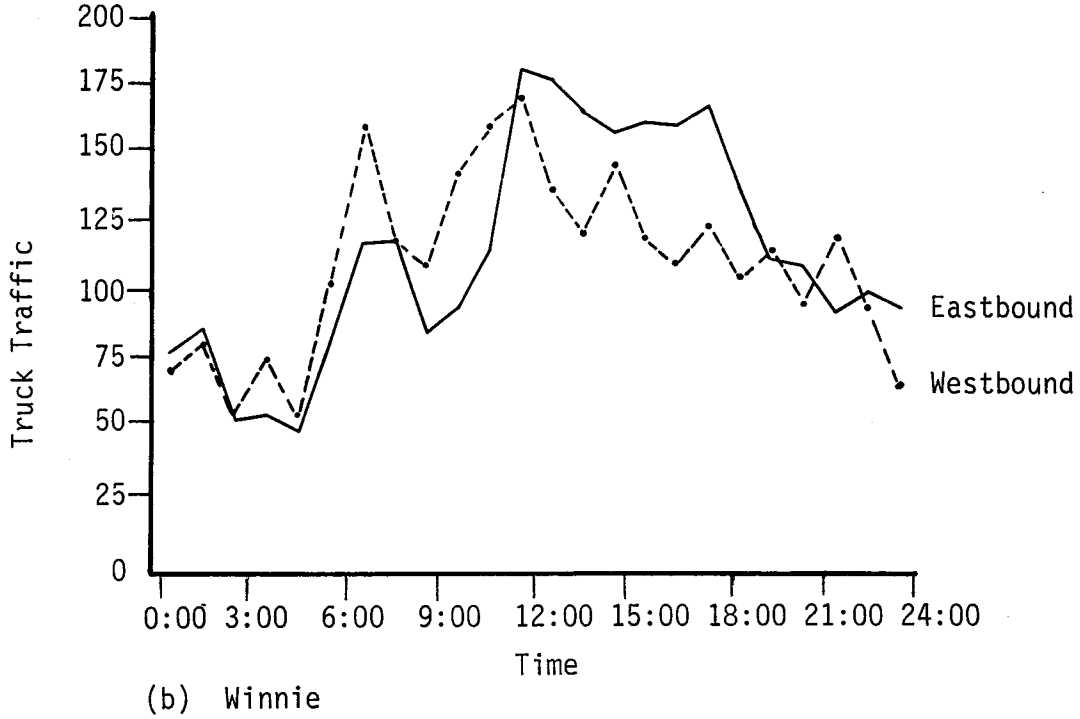


Source: State Department of Highways and Public Transportation (SDHPT)

Figure 2. Average Daily Traffic Volumes (1984) on Frontage Roads on I-10 Freeway



(a) Baytown



(b) Winnie

Figure 3. Hourly Truck Traffic Volumes I-10 (1985)

Table 1. 24-Hour Traffic Volumes I-10 (1985)

Location and Direction	Total Traffic	Truck[a] Traffic	
		Number	% Total
SH-146 - Baytown (WB)	11,164	3953	35%
SH-146 - Baytown (EB)	10,698	2724	26%
FM 1406 - Winnie (WB)	8,362	2686	32%
FM 1406 - Winnie (EB)	8,494	2749	32%

[a] Truck defined as vehicle with 3 or more axles.

Source: TTI Survey (2/86).

2.3 Frontage Road Intersection Traffic Control Devices

Table 2 shows the traffic control devices used at frontage road intersections in the study corridor. All frontage road intersections were at grade. The yield signs were used at the merge areas of the freeway exit ramps.

Table 2. I-10 Frontage Road Intersection Traffic Control Devices

Traffic Control Device	Number	% Total
Signal	26	42%
Stop Sign	28	45%
Yield Sign	8	13%
Total	62	100%

Source: TTI Survey (7/86).

Due to the scale of Figure 4 all frontage road discontinuities or breaks are not clearly shown. These breaks in the frontage road are due to natural barriers, railroad lines, interchanges and areas of no demand for such a facility. These breaks are summarized in Table 3.

Table 3. Discontinuous Frontage Road Locations (both directions)

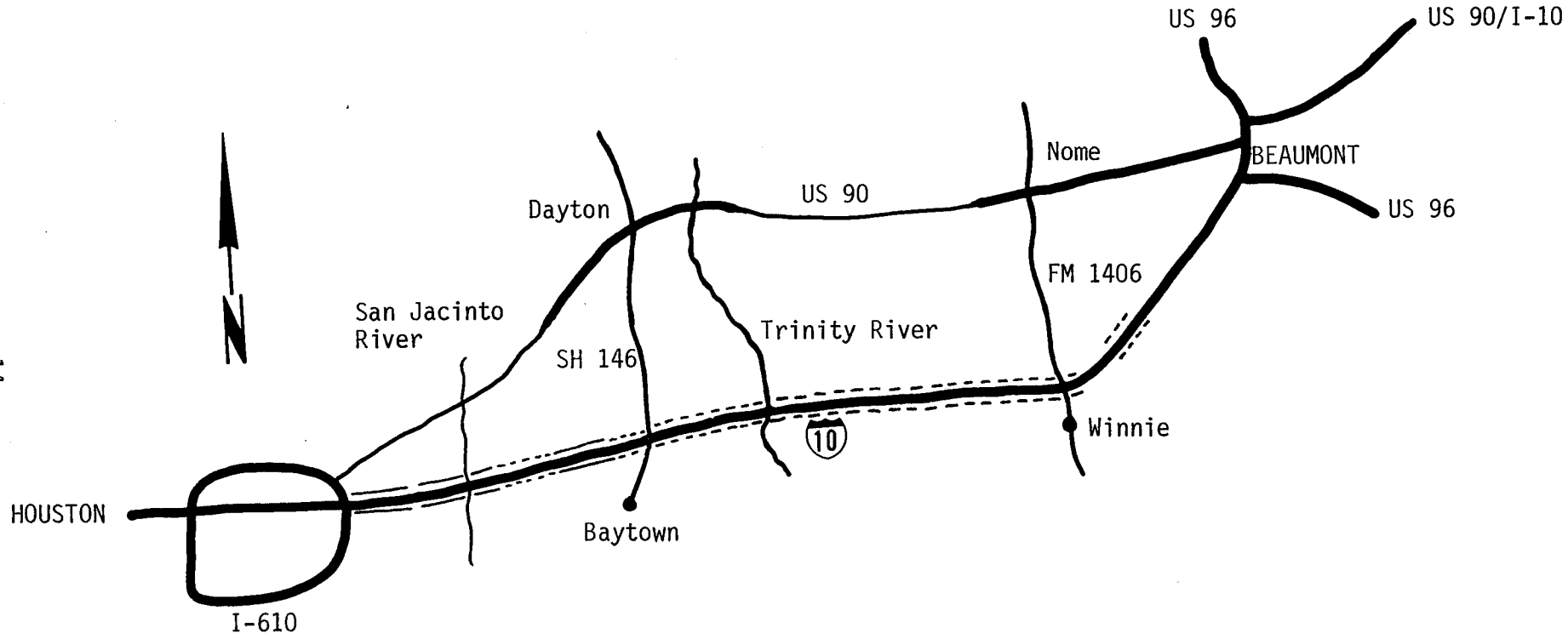
Location	Miles	Reason
Normandy to Uvalde	0.2	Greens Bayou
Monmouth to Spur 330	1.6	San Jacinto River
Wade Road	0.2	Mo. Pac. Railroad
SH-146	0.2	T.&N.O. Railroad/Cedar Bayou
Trinity River	2.5	Trinity River
Hamshire Road	0.3	Interchange
FM-365 to Walden Road	12.0	Demand

2.4 Frontage Road Operations

Figure 4 shows the I-10 frontage road operations between I-610 (East Loop) in Houston and US-90 in Beaumont. The 75 mile study corridor includes 23 miles of one-way, two-lane frontage roads, 35 miles of two-way, two-lane and 17 miles of no frontage roads. Lane widths for one-way and two-way frontage operation were 11 or 12 feet and 10 feet respectively. Some rural segments of the study corridor did have roads paralleling the I-10 freeway mainlane that are not classified as frontage roads because freeway access is not provided.

2.5 Ramp Types

There are three ramp types in the study corridor; buttonhook, braided and slip. (Figure 5) The predominate ramp type is the slip ramp. (Table 4)



——One-way two-lane frontage road
----Two-way one-lane frontage road

*Only major frontage road discontinuities shown.

Figure 4. I-10 Frontage Road Operations

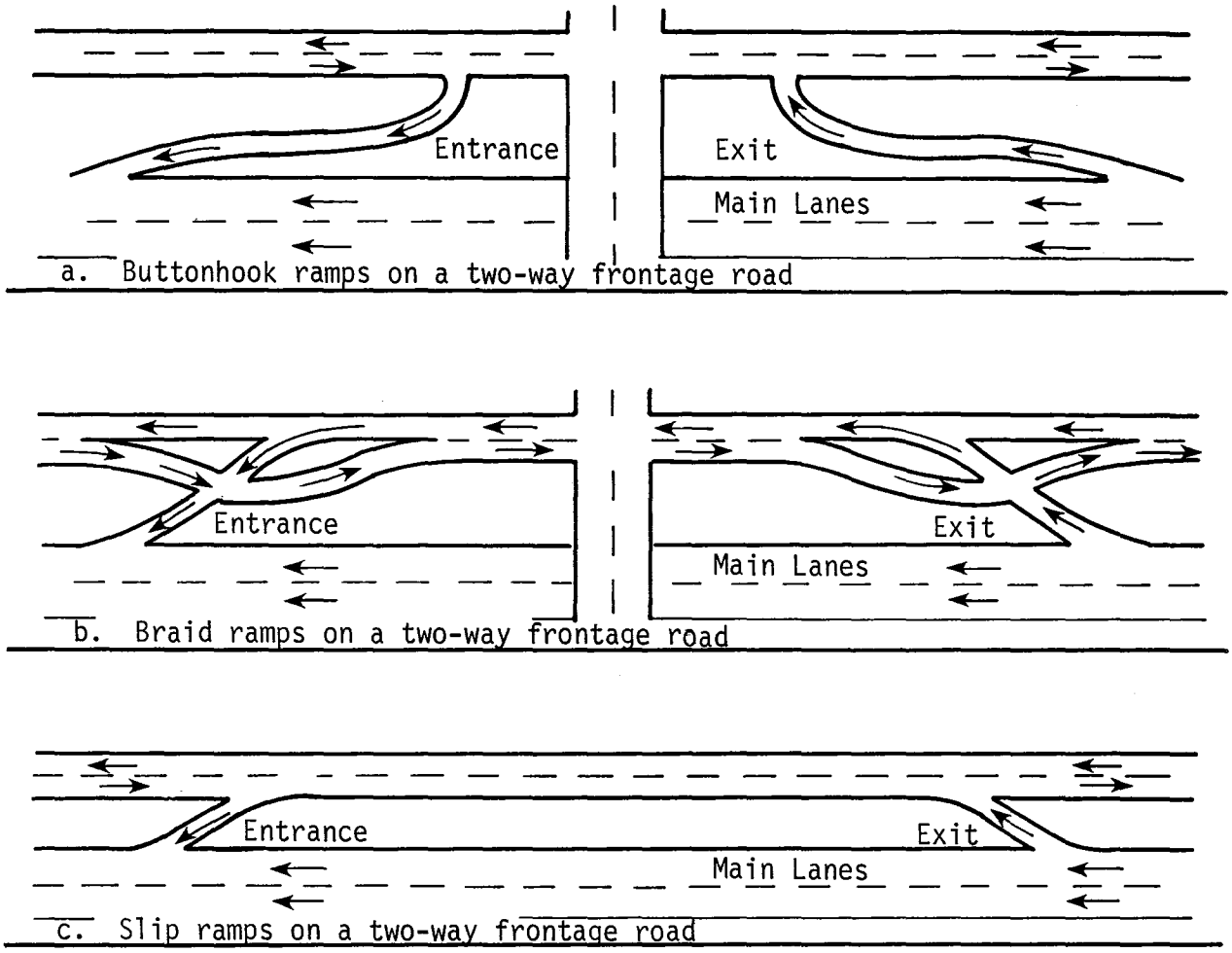


Figure 5. I-10 Types of Ramp Design

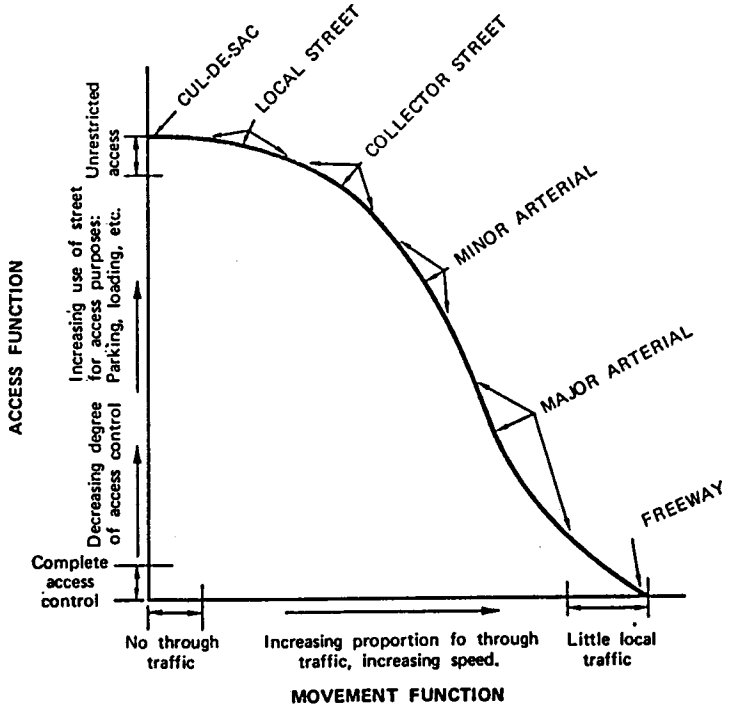
Table 4. I-10 Types of Ramp Design

Type	Number	% Total
Buttonhook	18	12%
Braided	2	1%
Slip	132	87%
Total	152	100%

Source: TTI Survey (1986).

2.6 Frontage Road Access

A dilemma facing the utilization of the I-10 frontage road as an exclusive truck facility is access control. Control of access is the condition where the right of owners or occupants of abutting land or other persons to access light, air or view in connection with a highway is fully or partially controlled by public authority (1). A conflict exists between effectively serving the through movement or providing access to local residents and abutting property business. The movement-access function and the roles of the various roadway types is illustrated below in Figure 6.



Control of driveways and roadside developments is an integral part of access control. When entrances are adequately spaced and traffic volumes using them are light, the highway will function efficiently. However, where the entrances are numerous and have heavy traffic volumes, particularly those serving industrial and commercial establishments, the capacity and safety of the highway are adversely affected (2).

The number of access points on the I-10 frontage road are numberous near Beaumont and Houston and few in the rural areas as shown in Table 5. If an exclusive truck facility was constructed the degree of access to the facility by pedestrians, private driveways, industrial and commercial establishments, as well as crossroad intersections will have to be addressed.

2.7 Accidents

Truck accident data for the Houston-Beaumont study corridor on the I-10 frontage roads is summarized in Table 6. The summary indicates a high number and percentage of truck accidents occur near the Houston urban area. Although removing trucks from mixed flow traffic may reduce the truck accident frequency, right-of-way constraints in the urban area would make construction costs very high.

2.8 Existing Frontage Road Widths

The opportunities and constraints offered by the existing cross section are key considerations in assessing the feasibility of an exclusive truck facility within the existing right-of-way. As shown in Figure 7, the cross section of an existing typical section in the I-10 frontage road study corridor appears to have available right-of-way in the outer seperation of roadway to retrofit a parallel exclusive truck facility. This subject is examined further in subsequent sections.

Table 5. I-10 Frontage Road Access Points by Segment and Economic Activity

	Segment	Industrial/ Manufacturing	Commercial			Driveways			
			Strip	Mall	Warehouse	Business	Private	Street	Office
EASTBOUND	I-610 to Thompson	4	5	6	4	51	15	40	8
	Wade to SH-146	4	1	4	0	8	12	6	2
	SH-146 to SH-124	0	0	0	0	18	9	14	0
	Brushkland to US-90	1	1	0	0	20	0	9	0
WESTBOUND	US-90 to Brushkland	0	0	0	0	22	7	19	0
	SH-124 to SH-146	0	0	0	0	4	12	11	0
	SH-146 to Wade	2	0	0	0	18	11	8	0
	Thompson to I-610	0	19	4	0	90	13	30	14

Table 6. Truck Accidents on I-10 Frontage Roads - I-610 to US 90

Section	1983 Total	1983 Truck[a]	1983 % Total	1984 Total	1984 Truck[a]	1984 % Total	1985 Total	1985 Truck[a]	1985 % Total
I-610 to Thompson									
Eastbound	164	32	20%	167	42	25%	138	25	18%
Westbound	173	34	20%	181	45	25%	192	36	19%
Wade to FM 565									
Eastbound	21	2	10%	24	5	21%	18	2	11%
Westbound	20	7	4%	24	6	25%	22	4	18%
FM 565 to SH 124									
Eastbound	15	2	13%	11	3	33%	15	3	20%
Westbound	15	6	40%	9	4	44%	5	3	60%
Brushkland to US 90									
Eastbound	49	8	16%	24	3	13%	23	4	17%
Westbound	70	13	19%	31	7	23%	27	3	11%

[a] Large trucks (over 10,000 pounds)

Source: Texas Department of Public Safety Accident Files (1983, 1984, 1985)

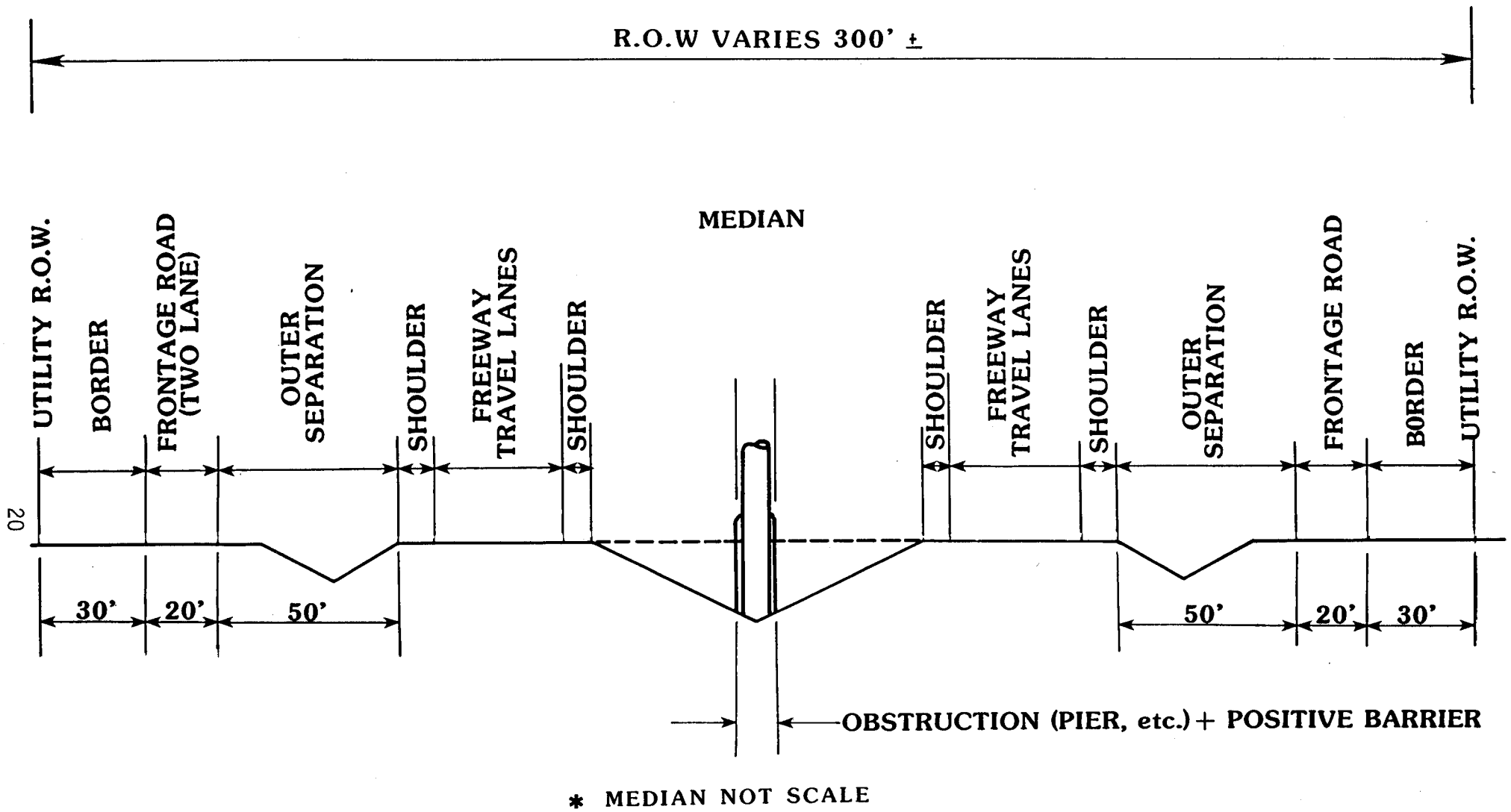


Figure 7. I-10 Existing Typical Cross Section

2.9 Proposed Improvements

The 75 mile study corridor overlaps two State Department of Highways and Public Transportation jurisdictional districts. These two districts, District 12 and District 20, coordinate all construction activities within the I-10 study corridor right-of-way.

Numerous construction activities are planned in District 12 area which extends to the Harris-Chambers County line. Major construction activities for the District 12 area for the next 10 to 20 years include full directional interchange at Beltway 8, Beltway 8 to SPUR 330 widen the mainlanes from six to eight with ten across the San Jacinto River and SPUR 330 to Chambers County line widen from four to six lanes, as shown by Figure 8.

In the District 20 jurisdictional area for the I-10 study corridor is from Chambers County line to US 90. Major construction in this section for the next 10 to 20 years includes SH 146 interchange reconstruction, from Chambers County line to SH 146 widen mainlanes from four to six lanes and bridge widening.

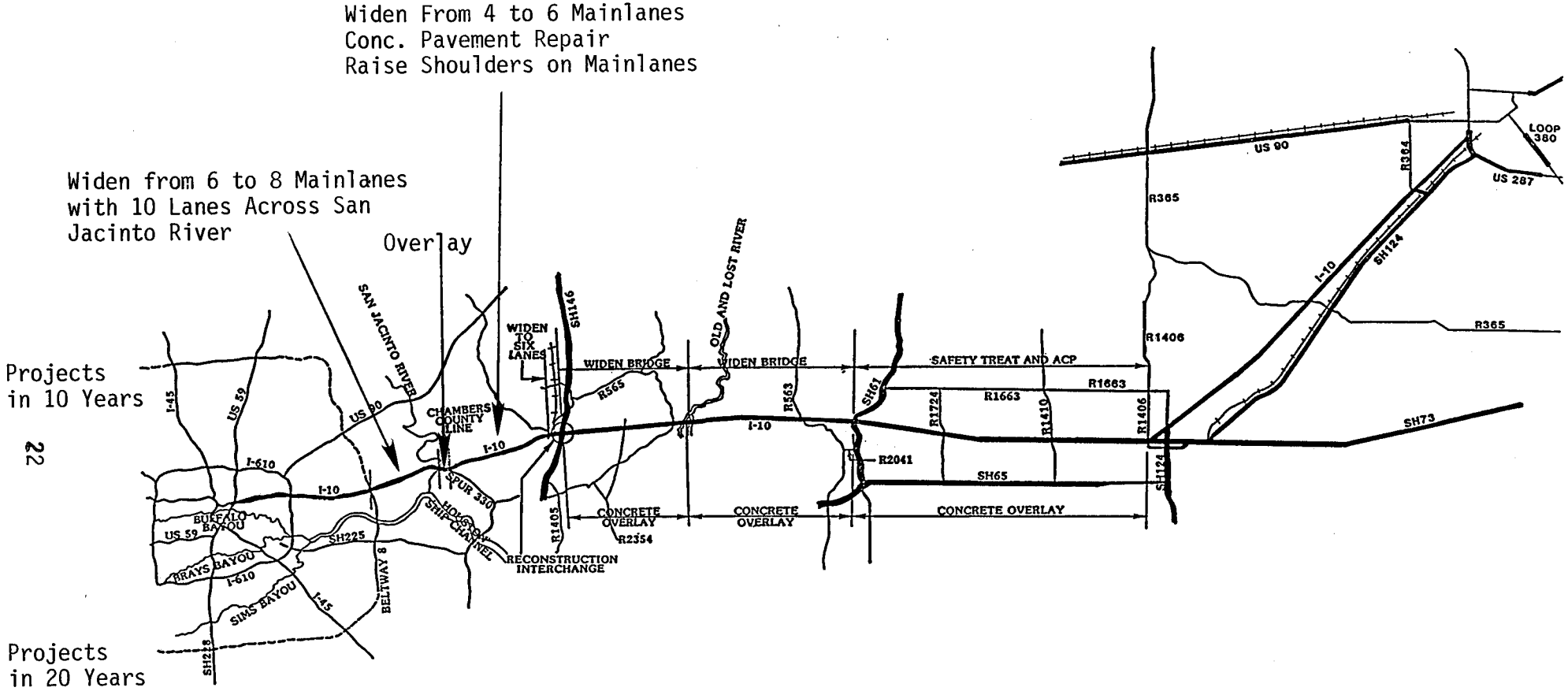


Figure 8. I-10 Proposed Improvements

3. POTENTIAL EXCLUSIVE TRUCK FACILITY SECTIONS

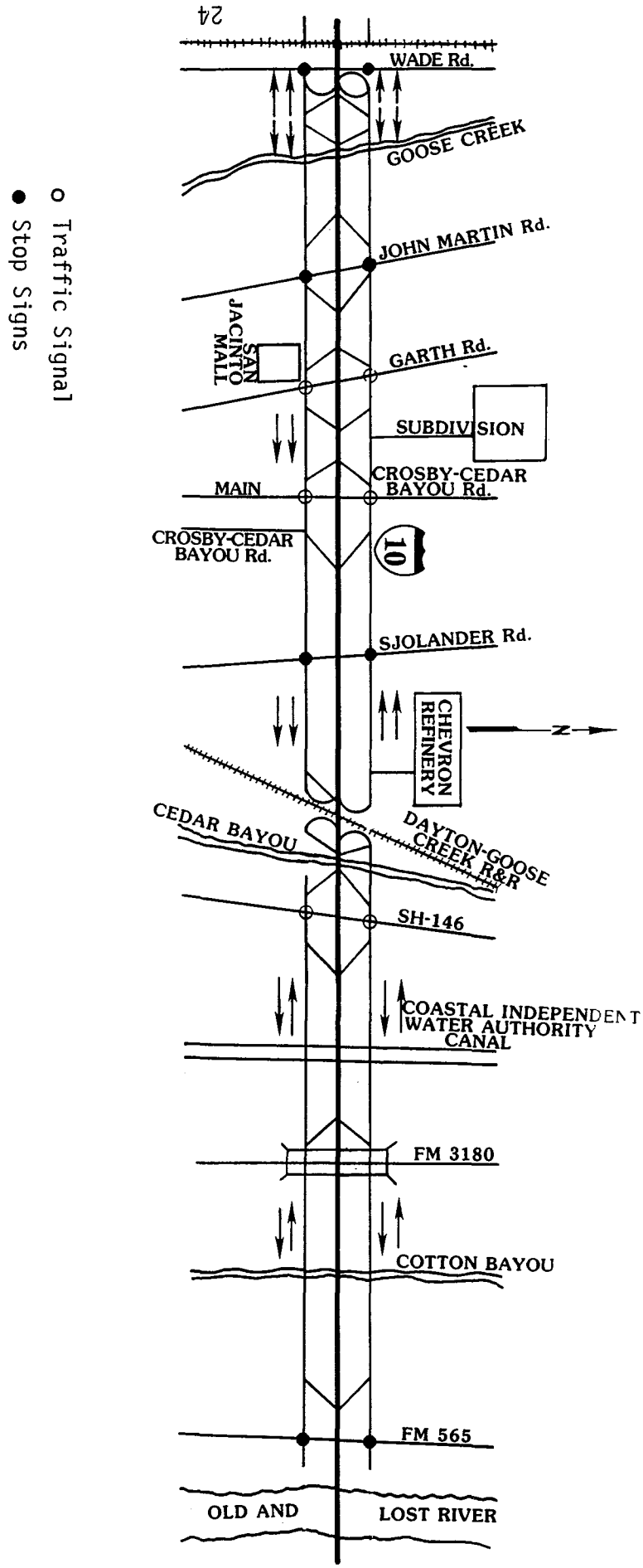
In order to examine the physical and economic feasibility of utilizing the existing I-10 freeway right-of-way to construct an exclusive truck facility, two candidate sections have been selected for analysis. These candidate sections were selected on the basis of their rural or urban location, frontage road operations and continuity, and representative typical design problems associated with constructing an exclusive truck facility within existing freeway right-of-way.

3.1 Description

The first potential exclusive truck facility section is located on the I-10 frontage road between Wade Road and FM 565, west of the Old and Lost River, as shown in Figure 9. The thirteen mile section is evenly divided between two lane, one way operation and two lane, two way operation. Discontinuous frontage road sections are due to railroad lines and bayous. The candidate section handles 300 to 700 vpd and is located in a predominately rural area, except a one mile segment near the San Jacinto Mall at Garth Road.

As shown previously in Table 5 the number of access points along this frontage road section is below the average for the study corridor. The majority of the access points are businesses, private driveways or access to the San Jacinto Mall. The frontage road travels through five intersections, three are signalized and two have stop signs as traffic control devices.

The second potential exclusive truck facility section is located on the I-10 frontage road from SH 61 to Devillier Road, just west of SH 124. The rural 13 mile candidate section carries 100 to 300 vpd and has a two lane, two way operation with each lane 10 feet wide. No discontinuous frontage road areas exist in this candidate section. Access points along this section are few. Although this candidate section does not have cross street intersections, it passes under four overpasses, over a bayou, a canal and two ditches, as shown in Figure 10.



o Traffic Signal

● Stop Signs

Figure 9. Candidate Section One

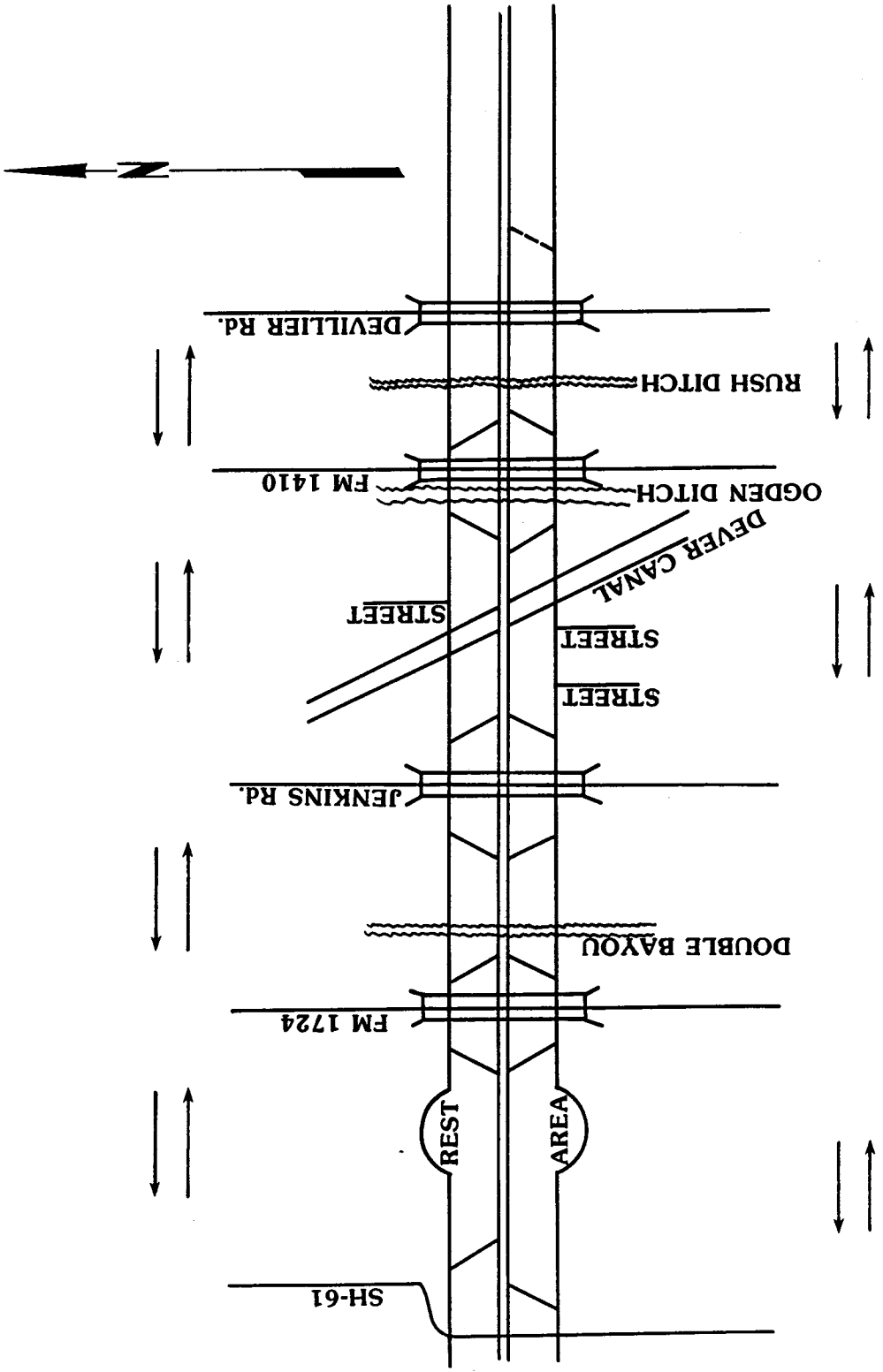


Figure 10. Candidate Section Two (13 miles)

3.2 Implementation

3.2.1 General

The potential design options of constructing an exclusive truck facility within the existing right-of-way have been discussed earlier in this report. The discussion of these design options concluded the best exclusive truck facility alternative was a one-way, two-lane, roadway on both sides of the freeway. The facility would be located in the outer separation of the roadway and encroaching on one lane of the frontage road. This section examines the cross-section requirements and the operational affects of an exclusive truck facility within that existing right-of-way on each candidate section.

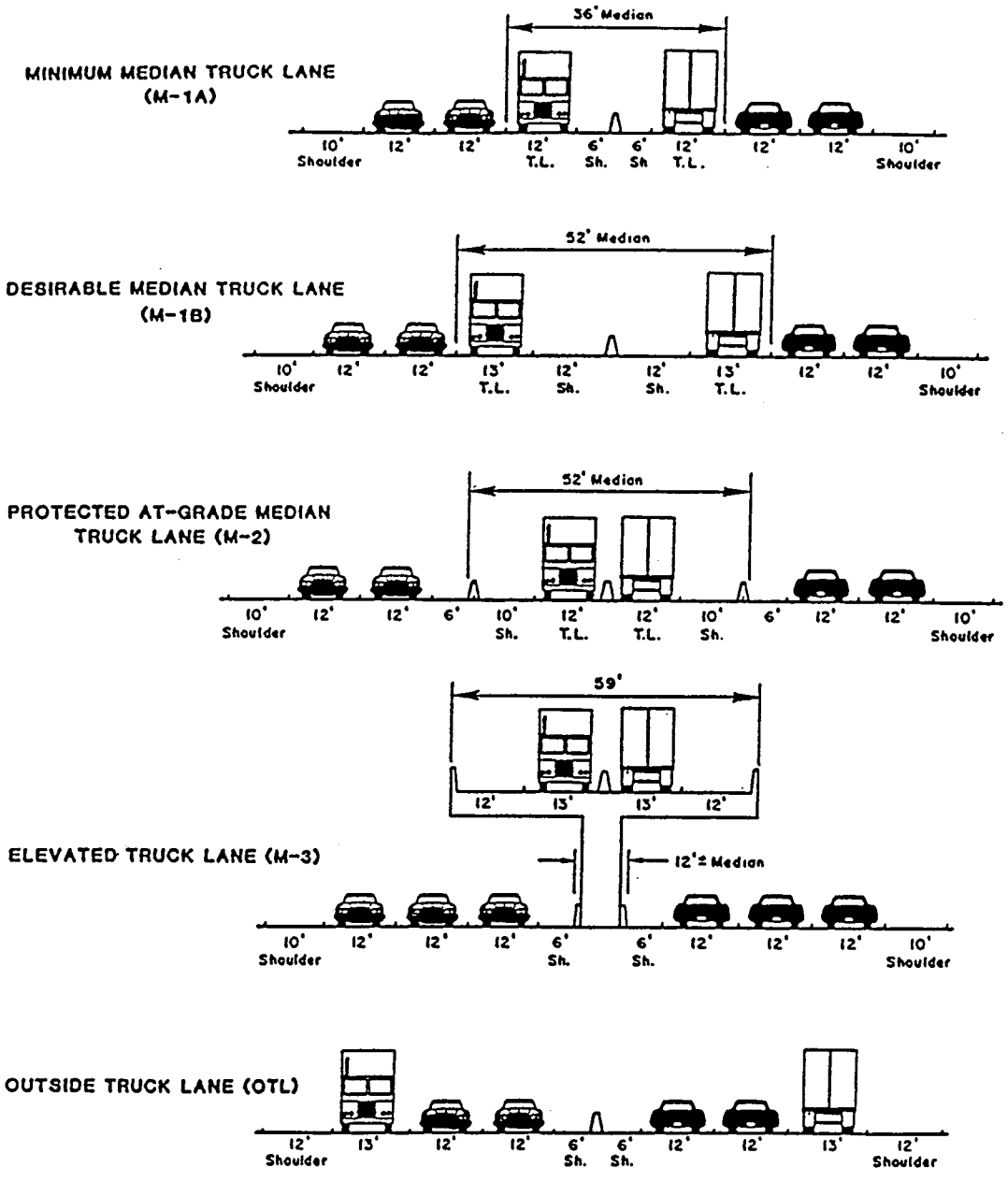
3.2.2 Existing and Proposed Cross-Section Requirements

Previous studies by the Texas Transportation Institute have described typical truck lane cross-sections which may be constructed within an existing right-of-way (2). Figure 11 illustrates these basic cross-sections. Although this study concentrated on truck lane designs within the median to freeway right-of-way, these truck lane design standards can be applied to the outer separation - frontage road area. The Texas Transportation Institute report noted a minimum cross-section, in rural segments, should have travel lanes of 12 feet wide with shoulder widths of only 5 feet for the exclusive truck facility (2). Figure 12 illustrates the minimum cross-section requirements.

A second option, Figure 13, depicts the desirable cross-section, using 13 foot travel lanes and 10 to 12 foot shoulders, to allow for 1 to 2 foot clearance between stopped vehicles and the pavement edge (2).

3.2.3 Frontage Road Operations

The existing cross-section in the two candidate sections, as shown previously in Figure 7, has inadequate right-of-way in the outer separation of the roadway to accommodate an exclusive truck facility. To make-up for this lack of right-of-way the inside frontage road lane can be reconstructed and utilized for the truck facility.



Source: (2).

Figure 11. Typical Truck Lane Cross-Sections

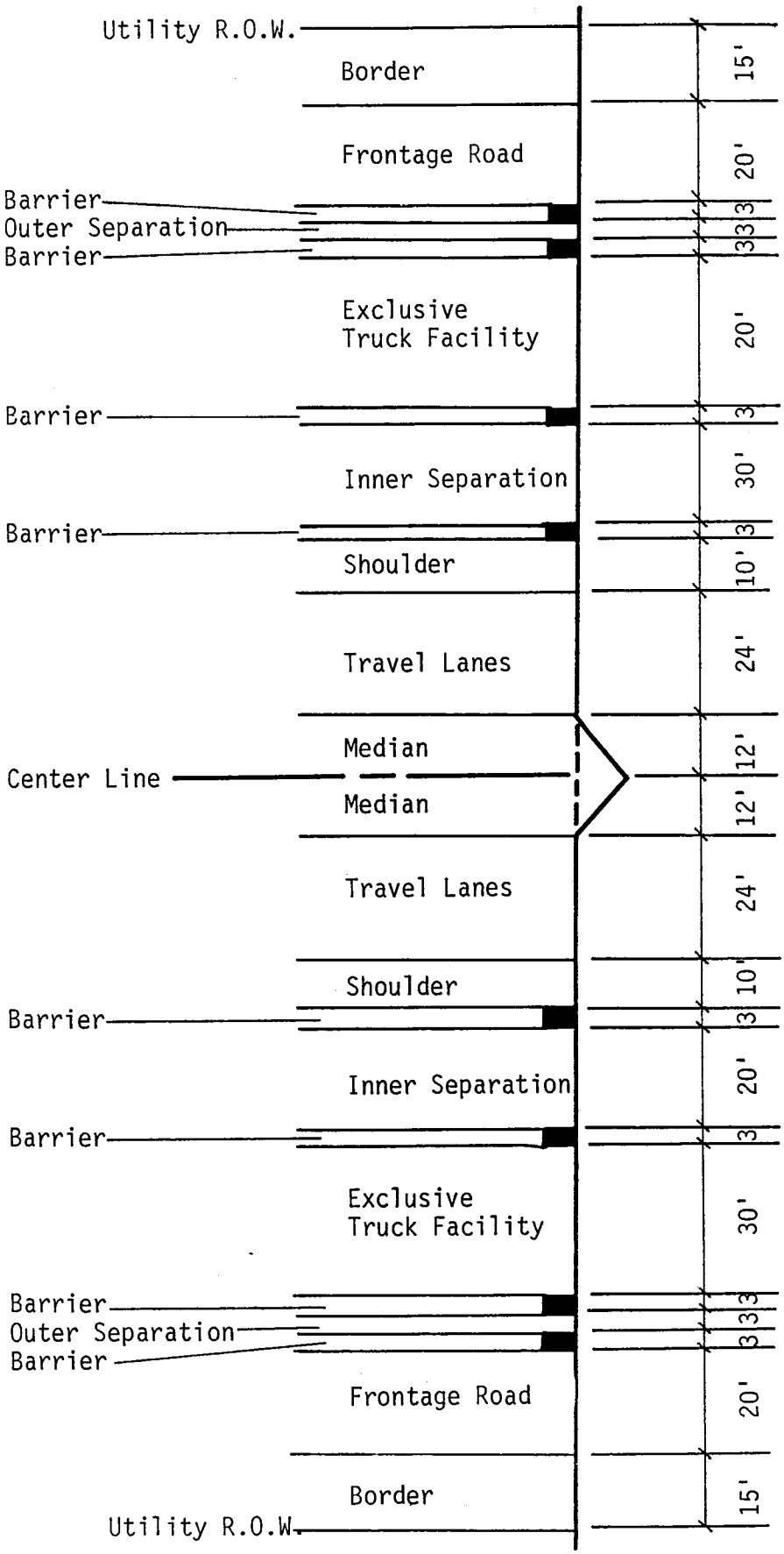


Figure 12. Minimum Exclusive Truck Facility Cross-Section

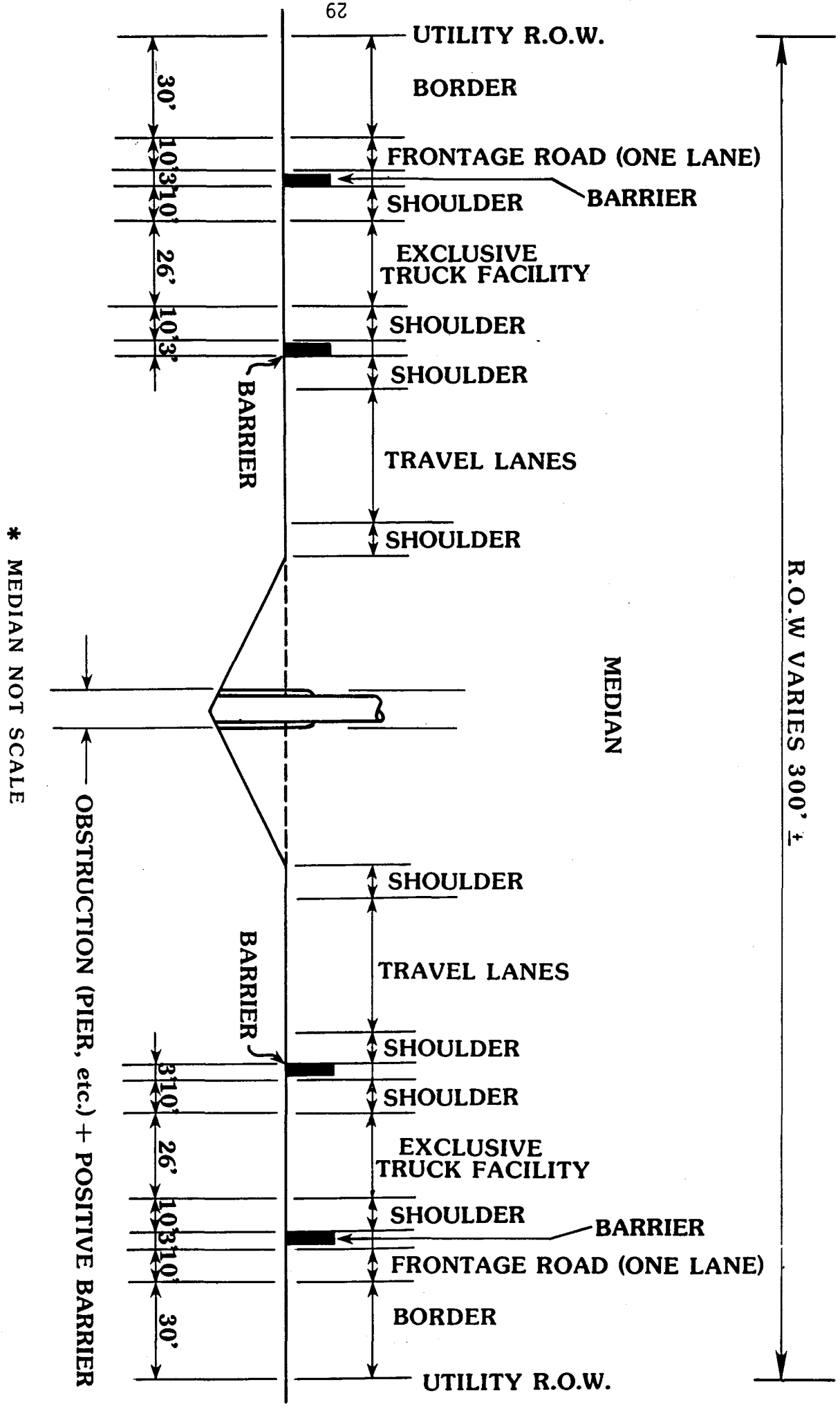


Figure 13. Desirable Exclusive Truck Facility Cross-section

In I-10 urban areas, where predominately one-way, two-lane frontage road operations exist, access to those frontage roads is not critical to the east-west movement of traffic. However, in rural area, where two-way, two-lane operations exist, frontage roads may serve as the principal facility to move traffic in an east-west direction. Thus, removal of the inside frontage road lane would deny access to one direction of travel in rural areas. The removal of the inside lane from an urban one-way, two-lane operation would have an affect on capacity but not directional access as shown in Figures 14 and 15.

Options to avoid access problems for rural residents where two-way, two-lane frontage road operations previously existed include:

1. Do nothing.

2. Construction of bridges over the mainlanes connecting westbound traffic north of I-10 to eastbound traffic south of I-10, as shown in Figures 16 and 17.

3. Provide other access for east-west movement of traffic.

4. Businesses that would be adversely impacted by the change in traffic access would have to be compensated.

An additional potential operational problem, when constructing a parallel exclusive truck facility within the existing highway right-of-way is at frontage road intersections. The ability to accommodate truck traffic safety and efficiently through intersections depends largely on what arrangement is provided for handling intersection traffic. The greatest efficiency, safety and capacity are attained when intersecting through-traffic lanes are separated in grades (1). In order to accommodate the through-truck-facility-traffic, avoid unnecessary user-delay and provide for safety grade separated fly-over ramps would be constructed at frontage road intersections as shown in Figure 18.

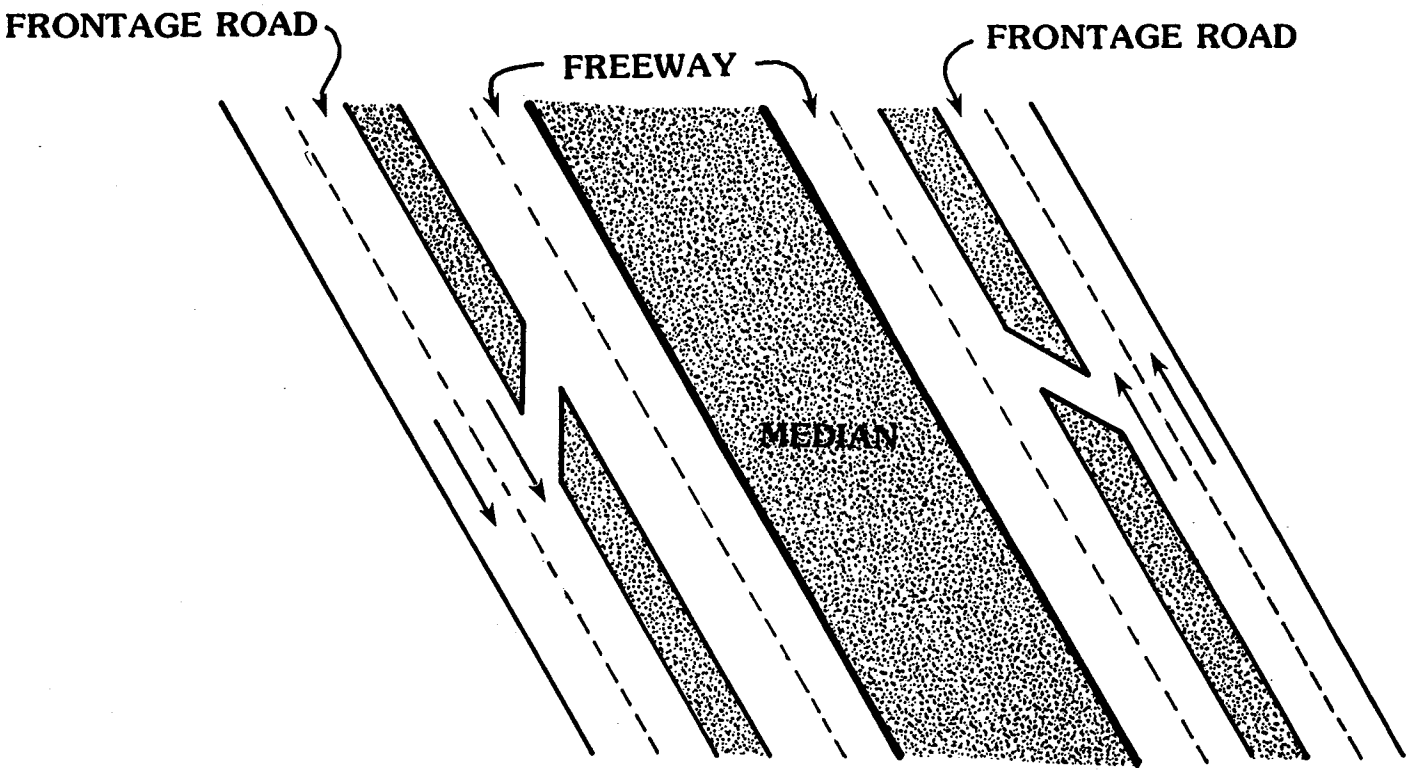


Figure 14. Existing One-way, Two-lane Frontage Road

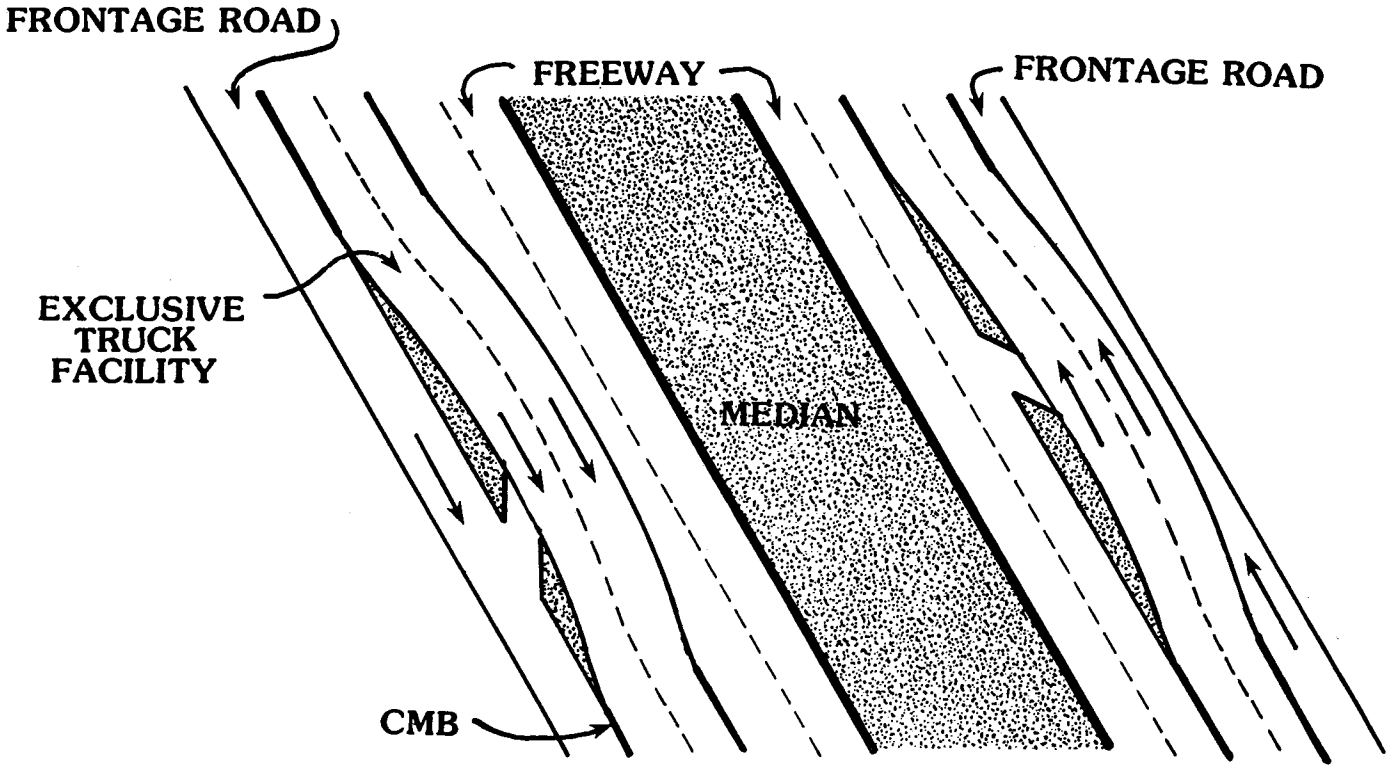


Figure 15. Proposed One-way, One-lane Frontage Road with Exclusive Truck Facility

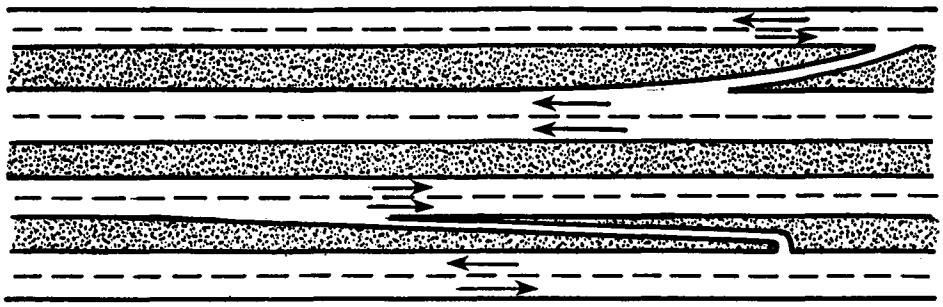


Figure 16. Existing Two-way Two-lane Frontage Roads

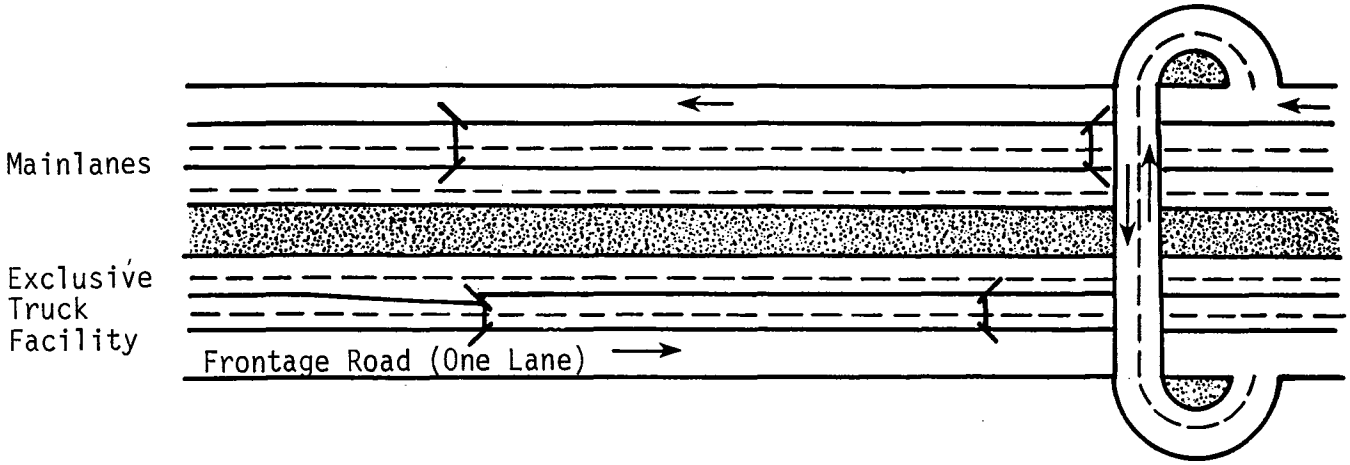


Figure 17. Proposed One-way One-lane Frontage Road with Exclusive Truck Facility

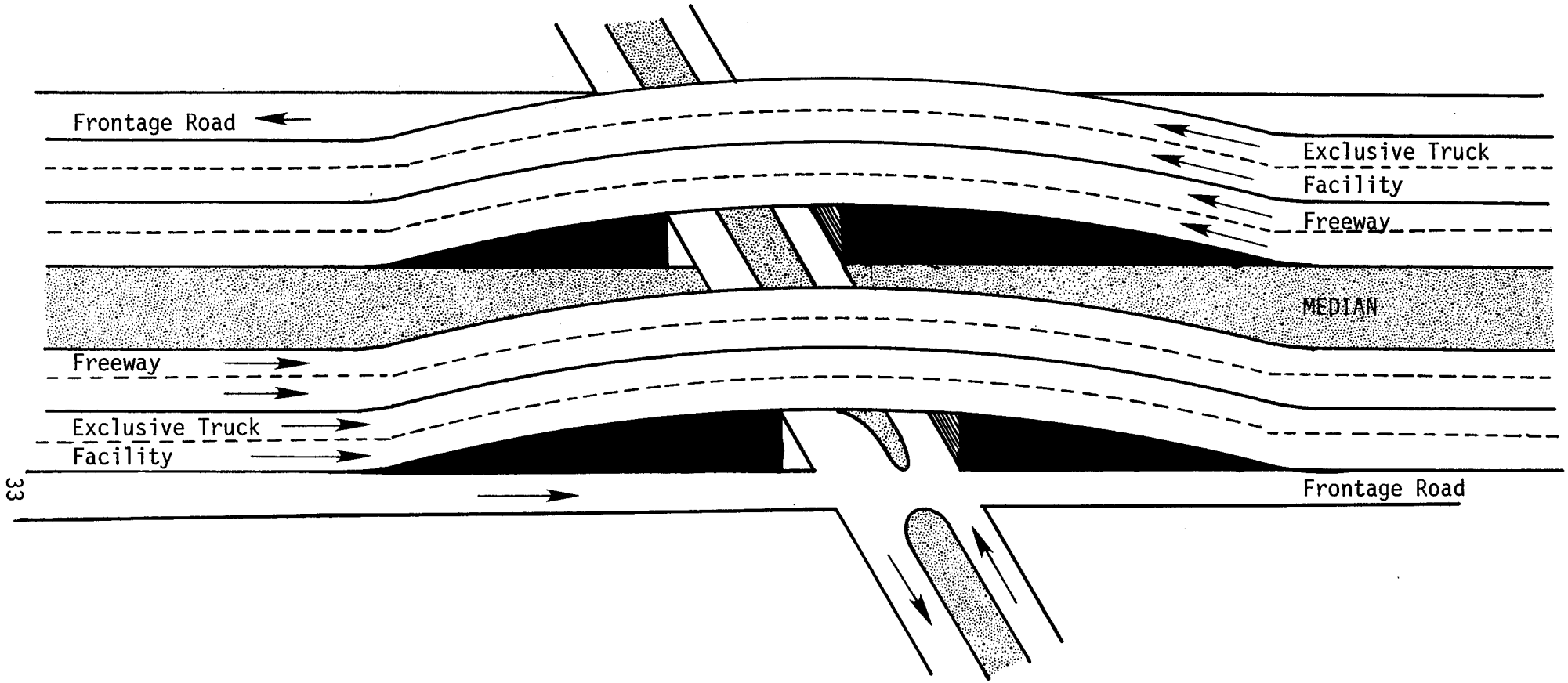


Figure 18. Frontage Road Intersection with Exclusive Truck Facility

Another less costly way of accommodating exclusive truck facility traffic at frontage road intersections is placing trucks back into mixed flow on the mainlanes. Implementing this might be necessary where extremely costly long grade separations are required. Additional locations might include major interchanges or natural barriers such as Trinity River.

3.3 Accidents

The accident experience along the two thirteen mile candidate section is summarized in Table 7.

A further breakdown of the accident data reveals that a majority of frontage road accidents in each candidate section are intersection or intersection related, as shown in Table 8. Although not listed in the table the percentage of trucks involved in intersection or intersection related accidents could be significant. The potential intersection or intersection related truck accidents in each of the candidate section is as follows:

1. Candidate Section One
   - Eastbound 14%
   - Westbound 26%

2. Candidate Section Two
   - Eastbound 10%
   - Westbound 23%

Therefore, an exclusive truck facility that provides for grade separated flyover ramps at intersections would be expected to have fewer intersection and intersection related truck accidents.

Table 7. Potential Exclusive Truck Facility Section Accident Experience

Section	1983 Total	1983 Truck[a]	1983 % Total	1984 Total	1984 Truck[a]	1984 % Total	1985 Total	1985 Truck[a]	1985 % Total	Total Accidents
Candidate Section One										
Wade to FM 565 (13 miles)										
Eastbound	21	2	10%	24	5	21%	18	2	11%	63
Westbound	20	7	4%	24	6	25%	22	4	18%	66
Candidate Section Two										
SH-61 to Devillier Road (13 miles)										
Eastbound	6	1	17%	3	0	-	1	0	-	10
Westbound	11	2 13	18%	1	1	100%	1	0	-	13

[a] Large trucks (over 10,000 pounds)

Source: Texas Department of Public Safety Accident Files (1983, 1984, 1985)

Table 8. I-10 Frontage Road Intersection Related Accidents, 1983-1985

	Intersection	Intersection Related	Driveway Access	Non-Intersection	Total
Candidate Section					
Wade Road to FM 565					
Eastbound	31	25	3	4	63
Westbound	33	23	4	6	66
SH-61 to Devillier					
Eastbound	5	2	0	3	10
Westbound	8	1	1	3	13

Intersections within each candidate section which have experienced a high number of accidents and could potentially benefit most by constructing a frontage road intersection grade separated flyover ramp are shown in Table 9.

Table 9. High Accident Intersection Locations, 1983-1985

Candidate Section	Location	Number of Accidents
Wade Rd. to FM 565	SH-146	38
SH-61 to Devillier	Devillier	12

3.4 Proposed Improvements to Candidate Sections

Improvements to candidate sections for an exclusive truck facility by SDHPT are as follows:

1. Candidate Section One - widen from 4 to 6 mainlanes, concrete pavement repair, raise shoulders on mainlanes and reconstruction of SH-146 interchange

2. Candidate Section Two - widen bridges and concrete overlay

4. COST ESTIMATES

Conservative estimates by the State Department of Highways and Public Transportation (SDHPT) design engineers have calculated exclusive truck facility grade separated flyover ramps travelling over the I-10 entrance and exit ramps to be $1.0 million each. The same cost figure can be applied to the bridges providing cross access for frontage road traffic north and south of the I-10 mainlanes.

Cost estimates for grade separating an intersection for exclusive truck facility traffic is $1.2 million. A 50 mph design speed was used to arrive at the cost estimates. If a 70 mph design speed was selected for exclusive truck facility traffic, these figures would increase to $1.2 and $1.5 million respectively.

A cost estimate of each potential exclusive truck facility section would have to include grade-separation fly-over ramps at freeway entrance and exit ramps, frontage intersections, creeks or bayous and railroad lines. An inventory of candidate section one shows 27 entrance or exit ramps, 6 frontage road intersections, 1 bayou and 1 railroad line that would need flyover structures to provide for an exclusive truck facility on the frontage road or $42.3 million. The cost of additional pavement for heavy truck traffic for the 13 mile section is estimated to be $3.0 million per mile for a 30 foot width, brings the total cost to $81.3 million.

An inventory of candidate section two shows 14 entrance/exit ramps, no frontage road intersections, creeks and railroad lines for which flyover structures would be required. The grade separations for this section would cost $16.8 million, and additional pavement for heavy truck traffic would cost $39 million for a total cost of $55.8 million.

For the study corridor, there are 76 ramps and 31 intersections on one side of the freeway. This averages out to approximately 1 intersection and 2 ramps per 2 miles of freeway.

For an average cost of $3.0 million per mile of roadway 30 feet wide that accommodates trucks, and structure costs of $1.0 million each for grade separating the intersection and ramps, the average cost per mile for a truck facility would be $4.5 million. This would provide a one-way truck facility 30 feet wide with 1 travel lane, 1 shoulder/passing lane, 3 foot clearance on both sides. Width of the structure would be slightly narrower - 24 to 27 feet.

5. PROBLEMS

Although the suggested desirable cross-section could be constructed in the outer-separation and one lane of the frontage road in some segments of the I-10 corridor right-of-way may be a difficulty. In that case, an option not previously explored would be to relocate the mainlanes, actually shift them toward the median. This would provide for greater right-of-way for the truck facility. In certain areas constructing a grade separated flyover ramp at a frontage road intersection may be physically or economically infeasible. A solution to that dilemma would be to merge the truck facility traffic back into the mixed flow of the mainlanes.

In addition to the operational and physical considerations previously outlined, a number of legal, economic, and user-related issues may have significant implications regarding the feasibility of a truck facility. For example, if a separate truck facility were to be constructed, it is not clear whether trucks could be required to use such a facility. That is, in the absence of clearly demonstrated operational and safety benefits, it may be illegal to deny trucks access to the Interstate Highway System. Consequently, it may be necessary to offer truckers an incentive to use the exclusive facility. An obvious incentive would be to provide them a superior operating environment, thereby reducing their travel times. However, these considerations must be balanced against costs associated with the provision of such incentives.

6. SUMMARY AND RECOMMENDATIONS

This study has examined the feasibility of converting the I-10 frontage road to an exclusive truck facility in the Houston-Beaumont corridor. It has analyzed the physical and operational problems associated with constructing an at-grade truck facility within the I-10 right-of-way. Specific issues that have been examined include:

1. Optional designs for using freeway frontage roads as a truck facility.

2. Exclusive truck facility cross-section requirements.

3. An assessment of the adequacy of existing right-of-way to physically accommodate the truck facility.

4. Proposed improvements to the I-10 corridor.

5. Identification of potential operational problems associated with implementation of the truck facility (e.g. potential intersection/interchange problems, frontage road operation and access problems and natural barriers).

6. Cost of exclusive truck facility construction.

Based on the results of this study, implementation of an one-way two-lane exclusive truck facility located in the outer separation and one lane of the frontage road, within the I-10 ROW, would appear to be the most feasible alternative considered. However, the cost of a Houston to Beaumont exclusive truck facility with grade separated flyover structures, over entrance and exit ramps, frontage road intersections, bayous, canals or rivers, railroad lines or connecting discontinuous frontage road sections and bridges connnecting frontage roads north and south of I-10 would make construction economically infeasible. Furthermore, exclusive truck facility construction will be hampered by the loss of existing right-of-way when proposed I-10 corridor

construction efforts begin by the State Department of Highways and Public Transportation. In addition, a number of legal and economic issues must be investigated in detail prior to making a final determination of what, if any, improvements should be considered for implementation.

REFERENCES

1. A Policy of Design of Urban Highways and Arterial Streets, American Association of State Highways and Transportation Officials, Page 152.

2. Operational and Geometric Evaluation of Exclusive Truck Lanes, J.M. Mason, D.R. Middleton and H.L. Peterson, Texas Transportation Institute, Research Report 331-3F, November 1985.