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# PRELIMINARY ASSESSMENT OF THE FEASIBILITY OF AN EXCLUSIVE TRUCK FACILITY FOR BEAUMONT-HOUSTON CORRIDOR


Robert W. Stokes
Stephen Albert



TTI Research Report 393-2

TTI Research Study 2-10-85-393

conducted for

Texas State Department of Highways
and Public Transportation

in cooperation with

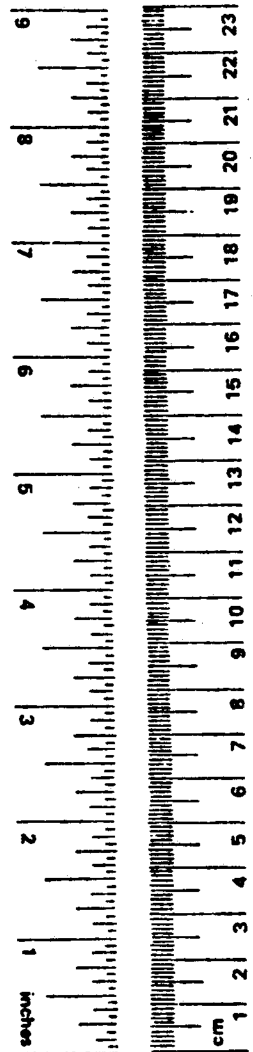
Federal Highway Administration

September 1986



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

# METRIC CONVERSION FACTORS



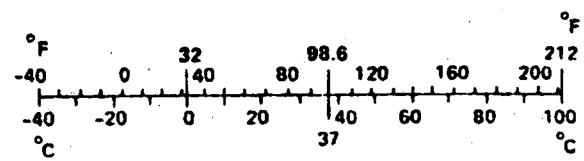

## Approximate Conversions to Metric Measures

| 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 |

*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.

## 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 |



# ABSTRACT

This report examines, in general terms, the feasibility of several truck facility options in the Beaumont-Houston corridor. Specific attention is given to the feasibility of exclusive truck facilities on or adjacent to I-10E and US 90.

# IMPLEMENTATION STATEMENT

The procedures reported 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

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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 on exclusive lanes on existing roadways, or by constructing new facilities intended exclusively for 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 substantially reduce maintenance costs on the truck facility and the facility from which trucks would be excluded. Furthermore, many of the more heavily travelled highways are due for extensive rehabilitation. The rehabilitation 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.

This technical memorandum examines, in general terms, the feasibility of several truck facility options in the Beaumont-Houston corridor (Figure 1). Specific attention is given to the feasibility of exclusive truck facilities on or adjacent to I-10E and US90.

## 1.2 OBJECTIVES

The overall objective of this technical memorandum is to examine three general truck facility options for the Beaumont-Houston corridor. Specific options examined include:

1) Construct an exclusive truck facility within the existing I-10E right-of way (ROW);

2) Construct an exclusive truck facility immediately adjacent to the I-10E freeway outside the existing ROW; and

3) Construct an exclusive truck facility on, or immediately adjacent to, an existing roadway which parallels I-10E (e.g., US90).

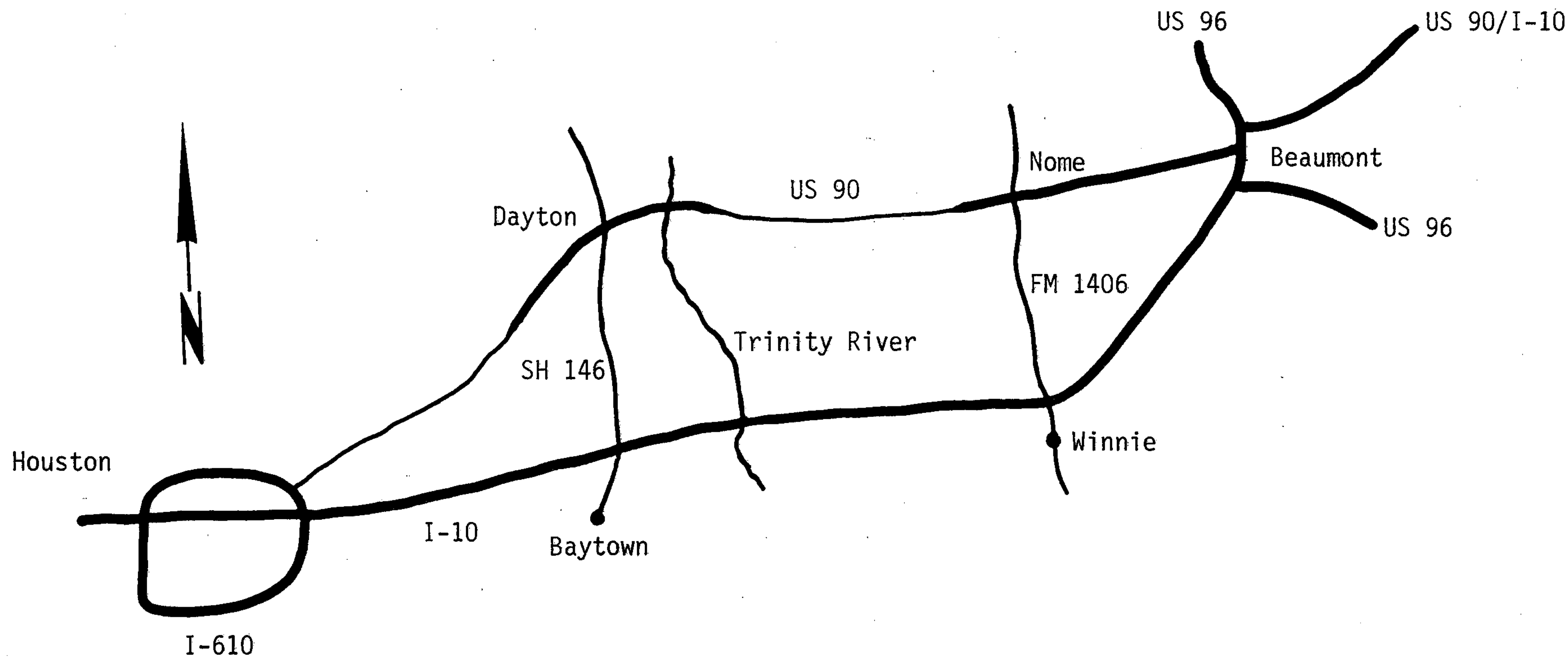



Figure 1. Beaumont-Houston Study Corridor

These options were evaluated in terms of the following issues:

1) Physical and design requirements for upgrading an existing facility and/or constructing a new facility to accommodate high truck volumes;

2) Implementation issues such as costs, lead times, and regulatory/legal problems; and

3) Impacts of the options on users and non-users of the facilities (i.e., the operational, safety, economic, social, and environmental benefits and costs of the facilities).

## 1.3 RELATED RESEARCH

### 1.3.1 Georgia/Florida Study

In April 1979, the Florida and Georgia Departments of Transportation jointly proposed construction of a two-lane, 444-mile long exclusive heavy vehicle facility on I-75 and I-475 from Atlanta to Tampa (1). The objectives of the project were to investigate the following (1).

1) Improvements in safety and operating characteristics which might be realized by separating trucks, buses, and other heavy vehicles from lighter traffic using the interstate system;

2) Improvements in energy consumption and highway capacity which might be realized if preferential heavy vehicle lanes are constructed on the interstate system;

3) The extension of the lifetime of the interstate facility which might be realized by effective management of the traffic and improved construction, rehabilitation, and maintenance procedures;

4) The suitability of construction materials and improvements to design and operating techniques under actual traffic conditions to handle current and projected traffic on the interstate system; and

5) The accurate identification of the impacts of trucks, buses, and other heavy vehicles on the interstate system.

It was proposed that in Florida the exclusive heavy vehicle lane project be developed on Interstate 75 between Tampa and the Georgia State line (approximately 209 mi.). At that time, the facility had two traffic lanes in each direction separated by at least a 64 foot median. The facility, primarily through rural areas, had 1978 average daily traffic ranging between 10,000 and 25,000 vehicles. Truck traffic was frequently more than 20% of the total traffic. Traffic projection, based on past trends along the facility, indicated that the year 2000 traffic could be between 35,000 to 65,000 vehicles per day (1).

Two lanes would be constructed in the median from Tampa north to the Georgia line. From the intersection of the Interstate with the Florida Turnpike, north to the Georgia line, the exclusive heavy vehicle lanes would be operated on the median side of the facility. The construction and evaluation of a variety of test sections under heavy truck loadings would permit the accurate determination of the impact of the heavy vehicles on these new sections and ascertain what potential design changes might be appropriate to accommodate these loadings (1).

South of the Florida Turnpike, the exclusive heavy vehicle lanes would be operated in the outside lane. This would permit a comparative assessment of the operational characteristics with exclusive lanes on both the inside (northern segment) and outside (southern segment). Placing the preferential heavy vehicle lanes on the outside lanes south of the Florida Turnpike would also permit the research offices to develop methodologies to properly handle heavy vehicles on rehabilitated existing pavements (1).

It was proposed that in Georgia, the preferential heavy vehicle lanes project be developed on Interstates 75 and 475 between the Florida State line and Interstate 285, south of Atlanta (235 mi). The facility would have two traffic lanes in each direction separated by a 40 to 64 foot or greater median. The facility, primarily through rural areas, had 1978 average daily traffic ranging between 19,000 and 76,000 vehicles (1).

Truck traffic on some segments exceeded 20% of the total traffic. Projections based on past trends along the facility, indicated that the year 2000 traffic could be between 35,000 to 163,200 vehicles per day (1).

Two lanes would be constructed in the median for the entire route in Georgia. The preferential heavy vehicle lanes would be operated in the median lanes from the Florida State line to I-475 and on the outside from I-475 to I-285 (1).

The estimated costs for the project are summarized in Table 1. The data in Table 1 suggest an average roadway cost of $1.4 million/mile for the proposed two-lane truck facility.

**Table 1. Estimated Costs Georgia/Florida Exclusive Truck Lanes**

| | |
|---|---|
| Florida's I-75 Cost Measures, Tampa to Florida/Georgia Line[a] | |
| Cost Measures - Including Engineering and Contingencies | |
| Right-of-Way | None |
| Bridges | $ 33,660,000 |
| Roadway | $303,980,000 |
| Total Initial Cost | $337,640,000 |
| Annual Cost | |
| Right-of-Way | None |
| Bridges (40 yrs. at 7%) | $ 2,520,000 |
| Roadway (20 yrs. at 7%) | $ 28,690,000 |
| Total Annual Cost | $ 31,210,000 |
| Georgia's I-75 and I-475 Cost Measures, Florida/Georgia Line to Atlanta[b] | |
| Cost Measures - Including Engineering and Contingencies | |
| Right-of-Way | None |
| Bridges | $ 30,000,000 |
| Roadway | $300,000,000 |
| Total Initial Cost | $330,000,000 |
| Annual Cost | |
| Right-of-Way | None |
| Bridges (40 yrs. at 7%) | $ 2,435,000 |
| Roadway (20 yrs. at 7%) | $ 28,314,000 |
| Total Annual Cost | $ 30,749,000 |

[a] Length = 209 mi., no. of lanes = 2.

[b] Length = 235 mi., no. of lanes = 2.

Source: (1).

### 1.3.2 National Network Study

In 1979, Hansen and Associates conducted a study (2) on 15 representative links of a national freight network for the purposes of identifying truck traffic problems and evaluating several types of improvements oriented toward improving traffic operations and safety. Improvements analyzed on the selected links included (2):

1) Lane reservation for trucks during peak hours, off-peak hours, or full-time on existing facilities;

2) One additional lane for each direction of travel;

3) One additional lane for each direction and its reservation for trucks during peak periods, off-peak periods and full-time (3 conditions);

4) Construction of a separate 4-lane truckway;

Costs and benefits used in the analyses were limited to the following (2):

1) Cost of constructing, implementing and maintaining the modifications;

2) Vehicle operations costs due to either changes in operating speed or level of service;

3) Highway user time savings due to reduced travel time; and

4) Accident costs.

Table 2 summarizes the initial cost estimates for the truck facility options evaluated by Hansen and Associates. Of particular interest to the present study are the cost estimates given for the "add one lane" and "separate truck facility" options. The data in Table 2 suggest average construction costs of $1.0 million and $2.2 million per mile, respectively, for these two options.

Table 3 shows the present worth of total costs and benefits of the options considered for five representative links in the nationwide network. Based on the benefit/cost analysis, Hansen (2) drew the following general conclusions:

Table 2. Initial Per-Mile Cost[a] Estimates of Modifications (Thousands of 1979 Dollars)

| States / Terrain | One Additional Lane in Each Direction | | Separate Truck Facility | | Maintenance (Per Lane) | Reservation Cost |
|---|---|---|---|---|---|---|
| | Flat | Rolling | Flat | Rolling | | |
| Wisconsin | 641 | 775 | 1285 | 1378 | 8.357 | 22 |
| Washington | 1500 | 1500 | 3650 | 3650 | 10.098 | 22 |
| Illinois | 860 | 882 | 3500 | 3500 | 19.615 | 22 |
| Indiana | 443 | 526 | 2060 | 2210 | 8.009 | 22 |
| Texas | 650 | 650 | 1330 | 1330 | 5.107 | 22 |
| Florida | 1600 | 1600 | 3200 | 3200 | 7.428 | 22 |
| Georgia | 717 | 868 | 1438 | 1543 | 5.455 | 22 |
| So. Carolina | 712 | 712 | 3000 | 3000 | 3.946 | 22 |
| No. Carolina | 919 | 1109 | 1838 | 1972 | 4.875 | 22 |
| Virginia | 1217 | 1472 | 2441 | 2619 | 9.986 | 22 |
| Massachusetts | 959 | 959 | 1796 | 1927 | 18.222 | 22 |
| Connecticut | 1200 | 1200 | 2500 | 2500 | 16.249 | 22 |
| New Hampshire | 841 | 1017 | 1687 | 1809 | 11.258 | 22 |
| Maine | 1440 | 1440 | 1000 | 1000 | 9.634 | 22 |
| New York | 1155 | 1397 | 2316 | 2484 | 4.875 | 22 |
| Pennsylvania | 1246 | 1508 | 2500 | 2682 | 15.553 | 22 |
| Average | 1006 | | 2220 | | | |

[a]Costs include construction, maintenance, administrative, and terminal value.

Source: (2).

Table 3. Total Benefits and Costs for Cost-Effective Links (Present Worth in Thousands of Dollars for 20 Year Period at 10% Interest)

| Link | Mileage[a] | Reserve One Existing Lane[b] | | | | Add One Lane Each Direction With No Reservation | | Add One Lane Each Direction And Reserve One Lane | | | | Add One Lane Each Direction And Reserve Two Lanes[b] | | | | Construct Separate 4-Lane Truckway | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Peak Hour Reser-vation | Off-Peak Reser-vation | Full Time Reser-vation | | | | Peak Hour Reser-vation | Off-Peak Reser-vation | Full Time Reser-vation | | Peak Hour Reser-vation | Off-Peak Reser-vation | Full Time Reser-vation | | |
| | | Cost | Benefit | Benefit | Benefit | Cost | Benefit | Cost | Benefit | Benefit | Benefit | Cost | Benefit | Benefit | Benefit | Cost | Benefit |
| Atlanta to Chattanooga | 73.3 | N/A | N/A | N/A | N/A | 65,750 | 124,025 | 68,022 | 111,517 | 124,025 | 111,517 | N/A | N/A | N/A | N/A | 109,584 | 130,600 |
| Atlanta to I-10 & I-75 | 210.9 | 139 (4.2) | -6,135 (4.2) | 0 (4.2) | 6,135 (4.2) | 183,493 | 438,369 | 190,068 | 401,182 | 435,698 | 398,540 | 4,032 (4.2) | 3,060 (4.2) | 11,945 (4.2) | 1,616 (4.2) | 333,513 | 448,904 |
| Dallas to Houston | 128.2 | 400 (11.1) | -40,153 (11.1) | 1,898 (11.1) | -38,255 (11.1) | 86,663 | 110,603 | 90,766 | 110,646 | 110,603 | 110,646 | 8,203 (11.1) | -29,057 (11.1) | 18,367 (11.1) | -29,871 (11.1) | 177,301 | 150,713 |
| Richmond to Alexandria | 79.0 | 1,088 (32) | -24,950 (32) | 0 (32) | -24,950 (32) | 118,188 | 238,159 | 120,646 | 230,221 | 238,159 | 230,221 | 48,506 (32) | 84,780 (32) | 124,206 (32) | 76,956 (32) | 213,524 | 285,538 |
| Greensboro to Atlanta | 156.8 | 971 (28.1) | -17,763 (28.1) | -1,381 (28.1) | -19,143 (28.1) | 160,439 | 530,208 | 165,382 | 523,353 | 528,069 | 521,251 | 36,769 (28.1) | 63 (28.1) | 44,890 (28.1) | -3,467 (28.1) | 286,153 | 573,241 |

[a] Mileage shown and used in calculations is for rural sections only.

[b] Numbers in parentheses represent mileage over which the modification is possible, and for which benefits and costs were calculated.

Source: (2).

1) The most cost-effective type of improvement involved the addition of two new lanes--one in each direction--without full-time reservation during peak hours.

2) Reservation of the additional lanes full-time or during peak hours provided essentially the same cost-effectiveness values. In each case, such reservation reduced the cost-effectiveness of additional lanes but still left this type of improvement second in general cost-effectiveness.

3) Separate truckways on new rights-of-way were cost-effective on 4 of the 5 links showing cost-effectiveness with additional lanes. However, the cost-effectiveness of separate truckways was substantially less than additional lanes in every case.

4) Reservation of existing lanes, full-time or during peak or off-peak hours, was consistently not cost-effective.

5) Typically, changes in accident costs were as follows:

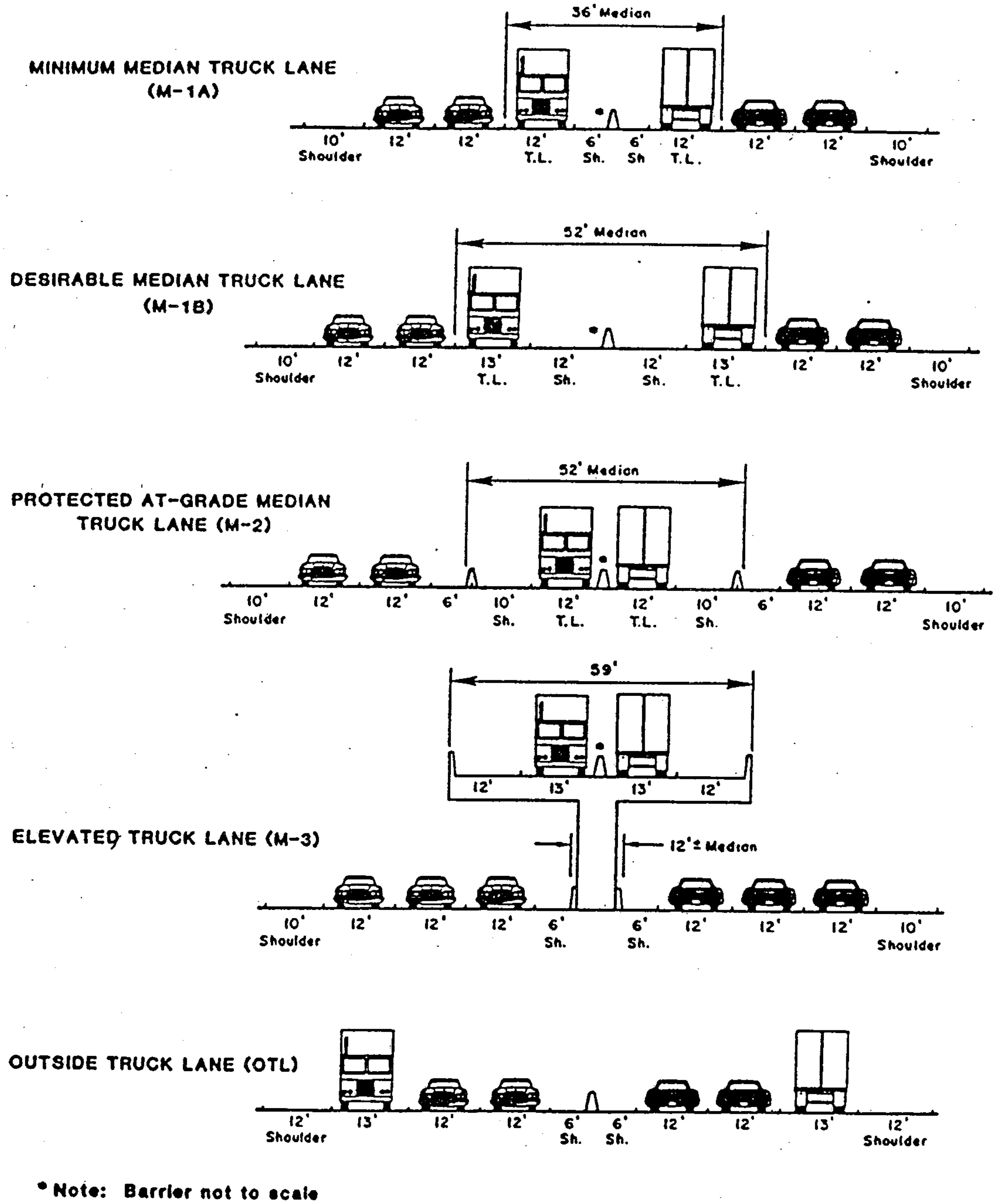
- a slight increase when an additional lane was added; and
- a small decrease for a separate truckway.

### 1.3.3 Texas Studies

Mason et al. (3) have described five typical truck lane cross-sections which may be constructed within an existing right-of-way (ROW). Figure 2 illustrates these basic cross-sections. The first two place trucks in the median area, with the only difference in the two being the lane and shoulder widths. The first (designated M-1A) exhibits minimum widths while the second (M-1B) shows desirable widths. These two configurations do not physically separate trucks from other traffic by positive barriers. Special lane designations and unique raised pavement markers could be used to define the authorized lane. Option (M-2) in Figure 2 shows trucks separated from other traffic by barriers thereby controlling access to the truck lanes. Cross-section (M-3) and the outside truck lane (OTL) pertain to urban areas with restricted right-of-way.

#### 1.3.3.1 Authorized At-Grade Median Truck Lane, M-1A and M-1B

To accommodate the continuous "through" truck nature of traffic along rural segments, cross-sections M-1A and B and M-2 appear feasible. The first




Source: (3).

Figure 2. Typical Truck Lane Cross-Sections

two cross-sections shown in Figure 2 are best suited for rural areas with effective median widths of 36 feet or greater. M-1A should be considered as a minimum cross-section. The travel lanes are 12 feet wide with shoulder widths of only about 5 feet. The second option, M-1B, depicts the desirable cross-section, using 13 foot travel lanes and 12 foot shoulders. Both are separated by a positive barrier. The designer should consider the use of taller, more sturdy barriers to withstand the impact of large vehicles (3).

One advantage of this cross-section is its application in narrow medians. Further, the pavement structure would be specifically designed to carry the anticipated truck traffic. The existing travel lanes would experience a longer service life due to the reduced heavy axle load repetitions. This option is the most economical in comparison to the other alternative schemes (3).

Disadvantages include: (1) limited control of entering/exiting maneuvers, (2) no provision for truck passing maneuvers, (3) insufficient inside shoulder for a stalled truck, and (4) long weaving distances necessary near interchanges.

**1.3.3.2 Separated At-Grade Median Truck Lane, M-2**

Separation of trucks from smaller vehicles is achieved by positive barriers on each side of the exclusive truck facility as shown in Figure 2. Again, the designer should consider the use of the taller barrier to withstand impact by these larger vehicles. Minimum travel lanes and shoulders are 12 feet and 10 feet, respectively; 13 feet and 12 feet widths are desirable (3).

Advantages of this option include: (1) total control of entering/exiting movements; and (2) this option can be easily used with the separate truck intersection or interchange and with the elevated truck lane, M-3 (3).

Disadvantages include: (1) greater required median width; and (2) insufficient clear width for some wide loads (3).

#### 1.3.3.3 Elevated Median Truck Lane, M-3

In urban areas where available median width is at a premium, this cross-section is a viable option. Cost effectiveness is the primary consideration. However, the facility could also be used by line-haul transit or by express bus from outlying park-and-ride lots. Buses have operating characteristics which are compatible with large trucks. Special consideration must be given pavement drainage, lighting and vertical clearance for vehicles at ground level, and the problem of icing during winter months. A combination of this cross-section and M-2 is appropriate near the urban fringe (3).

Advantages of M-3 are: (1) minimum median width required; (2) control of access by large vehicles; (3) potential use by transit vehicles; and (4) compatibility with the M-2 cross-section (3).

Disadvantages are: (1) high cost; (2) difficulty in future expansion; (3) icing in winter months; (4) insufficient clearance for wide loads; and (5) noise problems near environmentally sensitive areas (3).

#### 1.3.3.4 Authorized Outside At-Grade Truck Lane, OTL

In this case, the median is not used for trucks per se, but autos are shifted toward the median so that trucks can be accommodated in the outside lane(s). This is a suitable arrangement for both urban and rural settings and is particularly beneficial in urban areas in that trucks are not required to weave across two or more lanes of heavy traffic to enter or exit the truck lane as in M-1. Since some trucks move slower than autos, this arrangement allows slower vehicles to remain to the right; faster trucks have the opportunity to pass slower vehicles where appropriate (3).

Advantages include: (1) lower cost than M-2 or M-3; (2) smoother operation of traffic with slower vehicles to the right; (3) overall weaving is minimized; (4) median barrier can be the standard safety shape for autos; and (5) wide loads can be accommodated without special provisions (3).

Disadvantages to the outside truck lane configuration include: (1) existing pavement design may be insufficient for total truck loading; (2) enforcement problems due to trucks using unauthorized lanes for passing; (3) lack of capacity near interchange ramps for all trucks plus entering/exiting traffic; and (4) generally provides a small incremental improvement in operations (3).

### 1.3.4 Summary

A review of the limited number of studies conducted on exclusive truck facilities provided some general information relevant to the objectives of this study. The key findings of the literature review are summarized below.

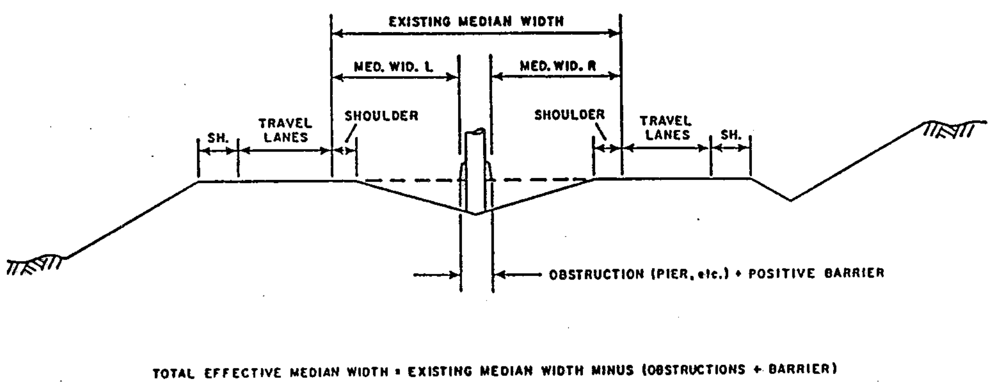
1) In terms of the costs associated with the construction of truck facilities, only some very general values were found. The Florida/Georgia study (1) reported an average roadway cost of $1.4 million/mile for a proposed two-lane truck facility located within an existing freeway ROW. Hansen Associates (2) reported a comparable cost of $1.0 million/mile for a similar facility (one lane per direction). Hansen Associates (2) estimate the cost of a four-lane truck facility located in a separate ROW as $2.2 million/mile. However, it appears that the Hansen Associates' estimate for separate facilities does not include ROW costs. It should be noted that the Florida/Georgia and the Hansen Associates cost estimates are in 1979 dollars. Discussions with SDHPT construction engineers, and a review of construction costs for recent transitway projects in Houston, suggest that a more realistic estimate of the costs of truck lanes would be in the range of $3-$5 Million/lane mile.

2) The limited information available on the potential cost-effectiveness of various truck facility options suggests that the addition of two new lanes for the exclusive use of trucks during peak hours is the most cost-effective means of improving truck operations and safety (2). The cost-effectiveness of separate truck facilities was found to be lower than the provision of additional lanes within the existing cross-section (2). Reservation of existing lanes for use by trucks was consistently not cost-effective (2).

3) There appears to be very little information regarding the design and operational requirements for exclusive truck facilities located in a separate

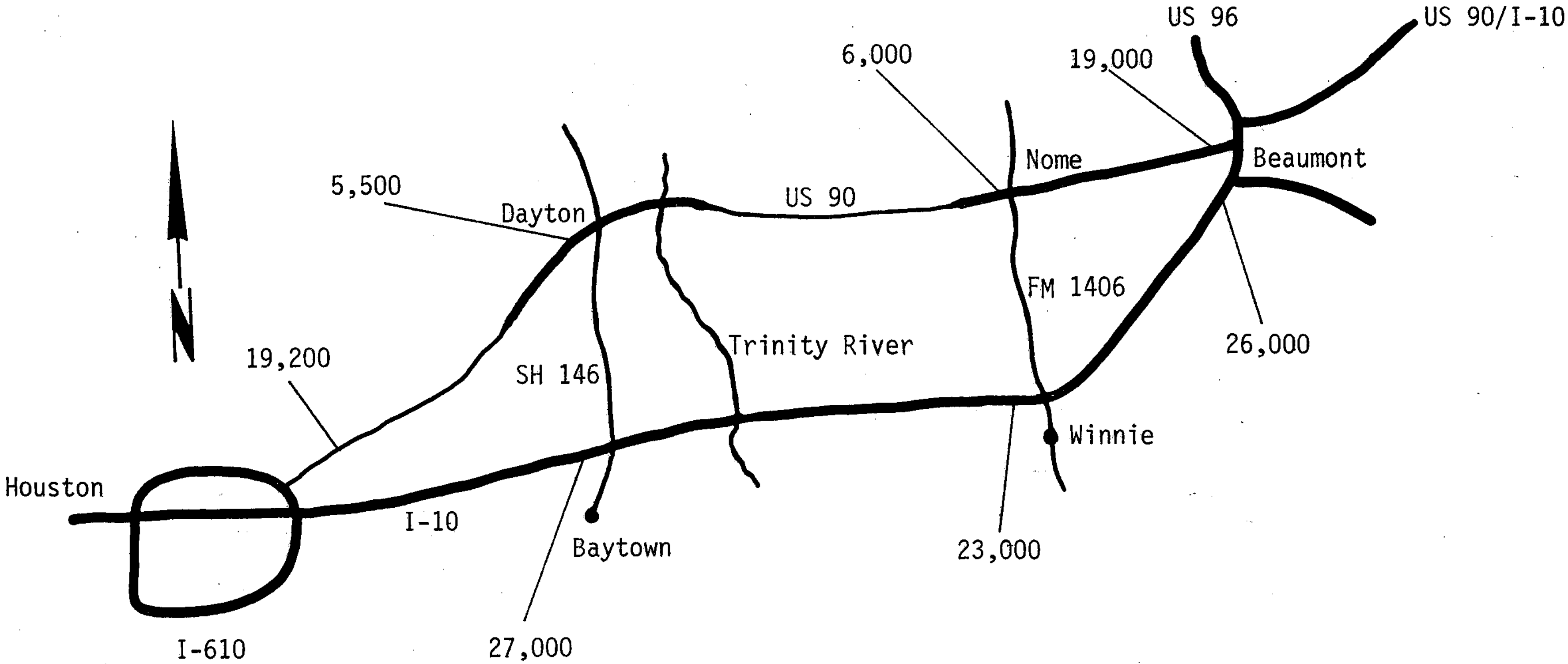
ROW. However, Mason et al. (4) suggest that lane widths for exclusive truck facilities should be at least 12 ft in width, preferably 13 ft. The wider lane widths may be used if sufficient funds permit the increased costs associated with increased pavement widths. Shoulder widths should be about 10 to 12 ft where possible to allow 1 to 2 ft of clearance between a stopped vehicle and the pavement edge. These criteria would appear to be applicable to exclusive truck facilities in general. Additionally, it would seem reasonable to assume that in order to serve existing travel demands and needs, exclusive truck facilities constructed in a separate ROW should parallel the roadway(s) they are intended to replace. The option of a "parallel facility" has the advantage that, in the case of interstate roadways, the existing ROW may be sufficient to accommodate the exclusive truck facility. A disadvantage of this option is that closely paralleling an existing roadway may require construction of elaborate and expensive grade separated interchanges at roadways which intersect with the truck facility.

4) Mason et al. (3) note that a key consideration when evaluating the feasibility of a truck lane in an existing ROW is the minimum "effective median width". The effective median width is the available clear width of median measured from the nearest edge of each inside travel lane. Any barriers such as piers for overhead structures are subtracted from this clear width. The width of a positive barrier such as the concrete "safety shape" is also subtracted from the total median width to establish the effective median width. Figure 3 illustrates these measurements (3).




Source: (3).

**Figure 3. Effective Median Width**




Source: District Highway Traffic Maps, SDHPT.

Figure 4. Annual Average 24-Hour Traffic Volumes (1984)

# 2. STUDY CORRIDOR

## 2.1 GENERAL

The study corridor extends from I-610 in Houston to Beaumont; a distance of approximately 75 miles. Travel demands in the corridor are served by US90 and I-10E (See Figure 1). Interstate 10 East is a typical 4-lane divided interstate highway. The US90 cross-section consists of 2-lane sections along the western and central segments of the facility, and 4-lane divided sections on the central and eastern segments of the facility.

The Northeast area of Houston has a large number of freight-related facilities, and as might be expected, both I-10E and US90 serve relatively large volumes of truck traffic. As a result, a number of measures oriented toward improving truck operations and safety in the corridor have been discussed in recent years. One alternative for improving safety and capacity along heavily traveled truck corridor is to provide exclusive truck facilities. While no widely accepted warrants concerning the need for exclusive truck facilities exist, safety and capacity would certainly appear to be key considerations in assessing the need for such facilities.

This section of the report presents a general overview of the traffic and safety conditions along the two roadways located in the study corridor. Subsequent sections will assess, in general terms, how the various exclusive truck facility options under consideration might effect traffic and operating conditions within the corridor.

## 2.2 TRAFFIC VOLUMES

Average daily traffic volumes at several locations on I-10E and US 90 are shown on Figure 4. Traffic volumes on I-10E between Houston and Beaumont are fairly uniform, with average daily traffic volumes in the range of 23-27,000 vehicles per day (vpd). Average daily traffic volumes on US 90 range from a low of 5500-6000 vpd on rural segments, to a high of 19-19,500 vpd on those segments near Houston and Beaumont.

Preliminary surveys by the Texas Transportation Institute (TTI) suggest that trucks may account for roughly one-third of the total daily traffic on I-10E (Table 4). In terms of directional and hourly characteristics, eastbound truck traffic on I-10E tends to peak in the mid- to late afternoon hours (Figure 5). Westbound truck traffic on I-10E tends to peak in early morning and late night hours.

"Spot checks" on US 90 suggest that on those segments of US 90 near Houston, trucks may account for about 15 percent of peak-hour traffic (Table 5). Notice that the peak-hour truck volumes observed on US 90 near I-610 are not substantially lower than the hourly truck volumes observed on I-10E (Figure 5). Truck traffic on US 90 near Dayton and Beaumont appears to constitute 4-6 percent of peak-hour traffic.

## 2.3 ACCIDENTS

Table 6 summarizes 1984 truck accident data for the study corridor and all Interstate and US/State highways in the state. Table 7 presents the results of preliminary statistical analyses of the accident data. The basic rationale of the statistical tests summarized in Table 7 is that the ratio of

**Table 4. 24-Hour Traffic Volumes I-10E (1985)**

| Location and Direction | Total Traffic | Truck[a] Traffic Number | Truck[a] Traffic % 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).

Table 5. Peak-Hour Traffic Volumes US 90 (1986)

| Location | Peak Hour Vehicles (Total) | Truck[a] Traffic | |
|---|---|---|---|
| | | Number | % Total |
| East of I-610 | 1,450 | 210 | 15% |
| West of Dayton | 710 | 45 | 6% |
| West of Beaumont | 1,400 | 50 | 4% |

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

Source: TTI Surveys (2/86).

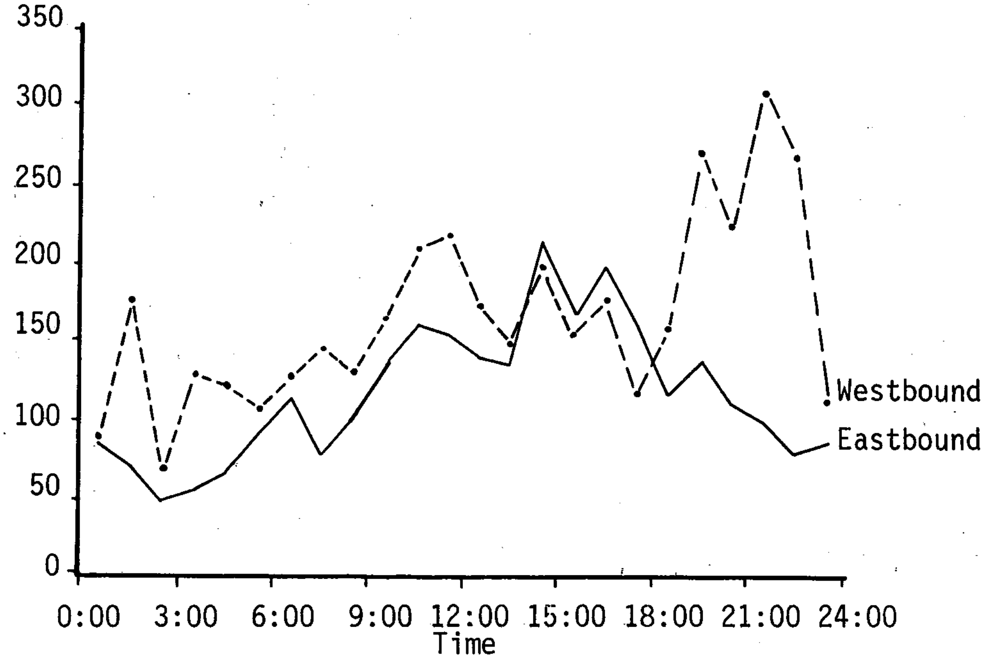
Table 6. Truck Accidents for Rural Sections of I-10E, US 90, and All Interstate and US/State Highways in Texas (1984)

| Roadway | Truck[a] Accidents | Annual Vehicle Miles of Travel (VMT) (Millions) | Accidents per Million VMT |
|---|---|---|---|
| I-10E | 120 | 522 | 0.23 |
| US 90 | 44 | 137 | 0.32 |
| Subtotal | 164 | 659 | 0.25 |
| | | | |
| All Interstates | 972 | 10,802 | 0.09 |
| All US/State | 3521 | 23,999 | 0.15 |
| Total | 4493 | 34,801 | 0.13 |

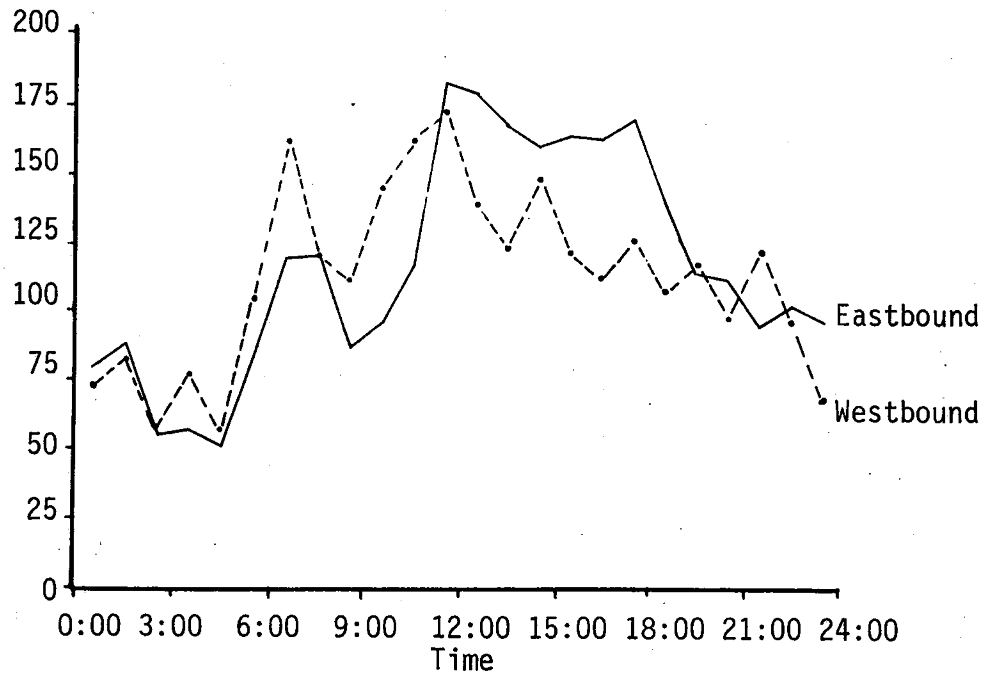
[a] Large trucks (over 10,000 pounds, excludes vans and pickups).

Source: Texas DPS Accident Files (1984) and District Highway Traffic Maps (1984).

corridor accidents to statewide accidents (accident ratio) should not be significantly different than the ratio of corridor VMT to statewide VMT (VMT ratio). For example, I-10E accounted for only 5 percent of the statewide Interstate VMT in 1984, but accounted for over 12 percent of the statewide




(a) Baytown




(b) Winnie

Figure 5. Hourly Truck Traffic Volumes I-10E (1985)

Table 7. Statistical Test of Hypothesis $p = p_0$

| Roadway | Accident Ratio[a] (p) | VMT Ratio[b] ($p_0$) | Z Statistic[c] |
|---|---|---|---|
| I-10E | 0.123 | 0.048 | 10.938[d] |
| US90 | 0.012 | 0.006 | 6.000[d] |

[a] $p$ = corridor accidents/statewide accidents.

[b] $p_0$ = corridor VMT/Statewide VMT.

[c] $Z = (p-p_0)/(p_0(1-p_0)/N)^{1/2}$; where N = total number of accidents.

[d] Significant at 5% level.

Interstate truck accidents. As shown in Table 7, the accident ratios for the two roadways in the study corridor are significantly larger than would be expected on the basis of their contributions to the statewide VMT.

## 2.4 EXISTING MEDIAN WIDTHS

The opportunities and constraints offered by the existing cross-section are key considerations in assessing the feasibility of an exclusive truck facility within existing rights-of-way. This section of the study examines the effective median widths of the two roadways in the study corridor. This examination should be particularly useful in assessing the feasibility of median truck lanes.

Mason et al. (3) recommend a minimum effective median width of 36 feet for a median truck lane (see Figures 2 and 3, pp. 10 and 14). Tables 8 and 9 summarize the existing effective median widths for I-10E and US 90.

An examination of the data in Table 8 indicates that along I-10E only about 34 miles of the facility have sufficient minimum median widths to accommodate a truck lane. This is less than one-half the total length of the study section. Also, those sections of I-10E which do have sufficient median widths are not contiguous sections.

Table 8. **Effective Median Widths[a] I-10E**

| Mile Posts | Distance (Miles) | Effective Median Width (ft) | Sufficient[b] for Median Truck Lane |
|---|---|---|---|
| 34.0–46.5 | 12.5 | 17–21 | No |
| 47.0–61.0 | 14.0 | 42–55 | Yes |
| 61.5–66.0 | 4.5 | 9 | No |
| 66.5–74.5 | 8.0 | 37 | Yes |
| 75.0–85.0 | 10.0 | 34 | No |
| 85.5–87.5 | 2.0 | 36–38 | Yes |
| 88.0–94.5 | 6.5 | 34 | No |
| 95.0–105.0 | 10.0 | 38 | Yes |
| 105.5–111.0 | 5.5 | 0–5 | No |

[a] See Figure 3, p. 14 for definition.

[b] Minimum sufficient median width = 36 ft (see Figure 2, p. 10).

**Table 9. Effective Median Widths[a] US 90**

| Mile Posts | Distance (Miles) | Effective Median Width (ft) | Sufficient[b] for Median Truck Lane |
|---|---|---|---|
| 22.5–46.0 | 23.5 | 0 | No |
| 46.5–53.0 | 6.5 | 57 | Yes |
| 53.5–55.0 | 1.5 | 11–75 | No |
| 55.5–61.0 | 5.5 | 45–57 | Yes |
| 61.5–81.5 | 20.0 | 0 | No |
| 82.0–82.5 | 0.5 | 53 | Yes |
| 83.0–83.5 | 0.5 | 7 | No |
| 84.0–97.0 | 13.0 | 37–53 | Yes |
| 97.5–101.5 | 4.0 | 0 | No |

[a] See Figure 3, p. 14 for definition.

[b] Minimum sufficient median width = 36 ft (see Figure 2, p. 10).

In the case of US90, only about one-third of the total length of the study section has sufficient median width to accommodate a median truck lane (Table 9).

## 2.5 PROPOSED IMPROVEMENTS

The only substantial improvement currently being considered for the corridor is the proposed Northeast Freeway. The proposed "new" US 90 would extend from the junction of I-10E and I-610 in Houston northeast to the existing US 90 at SH 146 in Dayton (Figure 6 ). The total length of the project is 21.5 miles. About 14 miles of the proposed facility would be constructed in a new right-of-way (5).

The proposed new US 90 would have four main traffic lanes in each direction from Loop 610 to the proposed Beltway 8. From the proposed Beltway 8 interchange to the Liberty County line, the proposed freeway would have 2-main lanes in each direction. Two lanes of frontage roads would be provided in both directions from the Loop 610 to Miller Road Number 3 (east of the proposed Beltway 8 East), and immediately west of Crosby-Lynchburg Road (FM 2100) to the Liberty County line. The usual right-of-way width would be 420 feet, with appropriate widening at the various interchanges. The entire project is designed to be a controlled access freeway (5).

A wide median (a minimum of 100 feet east of Beltway 8 East), would be provided to establish room for a vehicle leaving the roadway to regain control without colliding with oncoming traffic or a concrete median barrier. Bridge columns for overpasses would be installed at least 30 feet away from the pavement and sign foundations near the roadway would be placed on breakaway mounts. Where the freeway is next to the railroad, future major streets interchanging with US 90 would be carried over or under the railroad, thereby eliminating the existing danger of at-grade crossings of tracks and pavement. Interchanges are designed so that there will be minimum conflict between frontage road traffic and ramp traffic. Whenever possible ramps will connect the freeway and major thoroughfare only, thus permitting two-way traffic on the frontage roads (5).

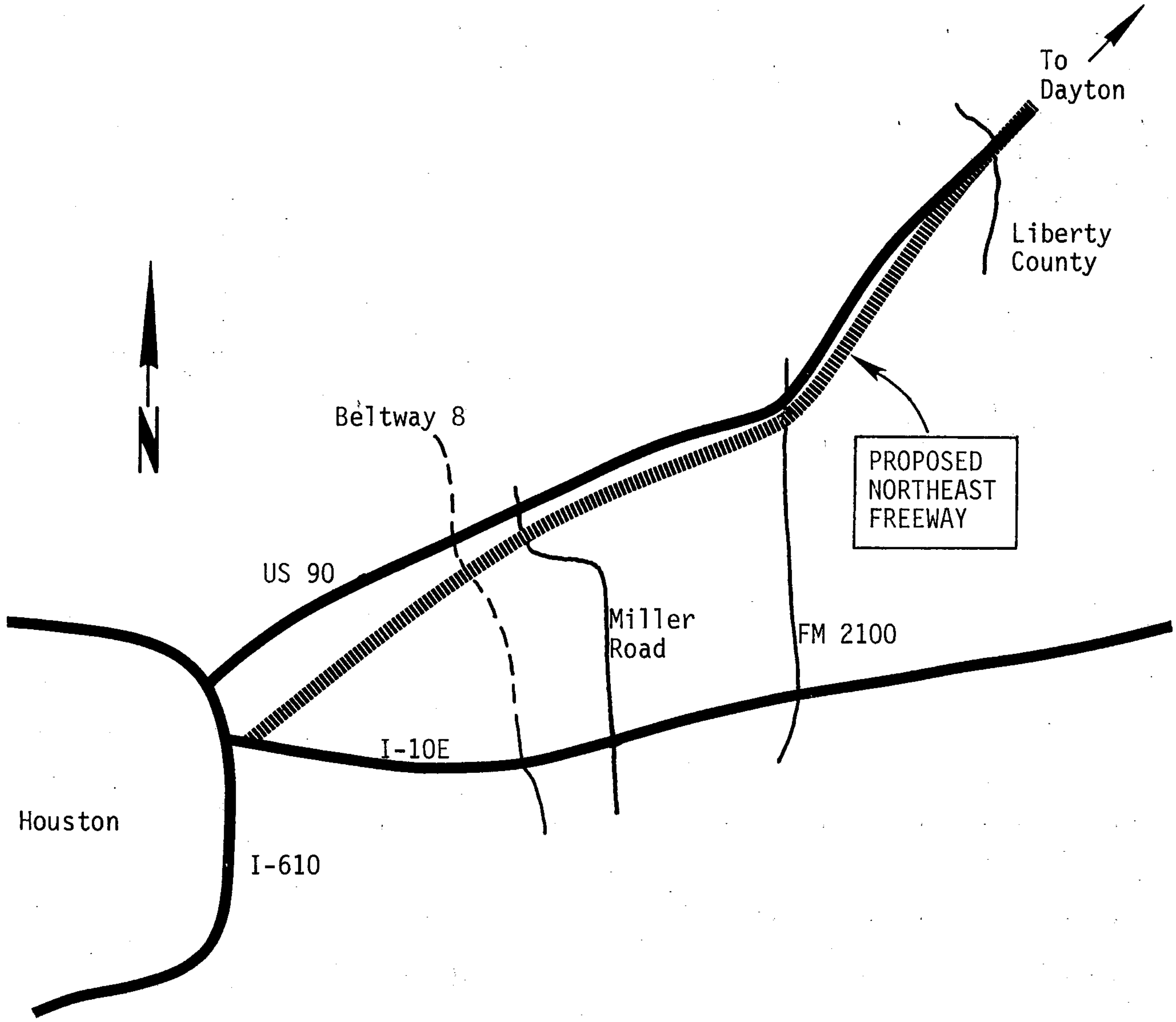



Figure 6. General Alignment of Proposed Northeast Freeway.

An additional two-lane bridge is currently being added next to the 24-foot wide truss bridge on existing US 90 where it crosses the San Jacinto River. This will provide a great improvement in safety and convenience by separating the directional traffic, but it will still not accommodate the predicted future traffic if the proposed freeway facility is not built. Also, the proposed crossing of the San Jacinto River by the Northeast Freeway will have a separate two-lane span for each direction, thus allowing safe, unrestricted traffic flow across the river. Turnaround lanes will be provided at each side of the river (5).

The estimated costs (1975) for the proposed facility are summarized below (5):

| | |
|---|---|
| Construction | $124,523,500 |
| Right-of-Way and Improvements | 12,746,000 |
| Relocation Assistance | 125,000 |
| Utility Adjustments | 5,000,000 |
| Total Cost | $142,394,500 |

# 3. PRELIMINARY SCREENING OF ALTERNATIVES

## 3.1 FEASIBILITY ASSESSMENT

The three basic truck facility options considered in this study were: 1) Construct an exclusive truck facility within the existing I-10E ROW; 2) Construct an exclusive truck facility immediately adjacent to I-10E, outside the existing ROW; and 3) Construct an exclusive truck facility on, or immediately adjacent to, an existing roadway which parallels I-10E (e.g., US90). In terms of the general need for and feasibility of these options, the results of this rather limited study suggest the following:

1) The high truck volumes and truck accident experiences of the two roadways in the study corridor indicate a need to implement measures oriented toward improving truck operations and safety;

2) The effective median widths of the two roadways in the study corridor are not sufficient to accommodate median truck lanes. Extensive reconstruction and/or use of elevated truck lanes would be required to implement this alternative. While the proposed Northeast Freeway may offer additional possibilities for an exclusive truck facility, the length of the proposed facility (22 miles) is not sufficient to permit the construction of a truck facility, which would traverse the entire study corridor.

3) Previous research (2) suggests that separate truck facilities are generally less cost-effective than facilities which would accommodate truck traffic within an existing ROW.

Based on these considerations, the most feasible options would appear to be the construction of an exclusive truck lane within the existing I-10E ROW. Given the lack of sufficient median widths, implementation of an "Authorized Outside At-Grade Truck Lane" (Figure 2) would appear to merit consideration. In this case, the median is not used for trucks per se, but autos are shifted toward the median so that trucks can be accommodated in the outside lane(s). This is a suitable arrangement for both urban and rural settings and is particularly beneficial in urban areas in that trucks are not required to weave across two or more lanes of heavy traffic to enter or exit the truck lane as in the at-grade median truck lane design. Since some trucks move slower than autos, this arrangement allows slower vehicles to remain to the right; faster trucks have the opportunity to pass slower vehicles where appropriate (3).

Advantages include: 1) lower cost than the at-grade median or elevated median designs; 2) smoother operation of traffic with slower vehicles to the right; 3) overall weaving is minimized; 4) median barrier can be the standard safety shape for autos; and 5) wide loads can be accommodated without special provisions (3).

Disadvantages to the outside truck lane configuration include: (1) existing pavement design may be insufficient for total truck loading; (2) enforcement problems due to trucks using unauthorized lanes for passing; (3)

lack of capacity near interchange ramps for all trucks plus entering/exiting traffic; and (4) generally provides a small incremental improvement in operations (3).

A more definitive assessment of the ultimate feasibility of the "outside truck lane" option will, of course, require a more detailed investigation.

### 3.2 IMPLEMENTATION ISSUES

In addition to the operational and physical considerations outlined above, 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 the costs associated with the provision of such incentives.

## 4. SUMMARY AND RECOMMENDATIONS

### 4.1 SUMMARY

This study has examined in general terms the need for an exclusive truck facility in the Beaumont-Houston Corridor. Based on an examination of truck traffic volumes and accident statistics for the corridor, it appears that there exists a need to consider implementing measures directed toward improving truck operations and safety. Based on the results of this limited study, implementation of an "outside at-grade truck lane" within the I-10E ROW would appear to be the most feasible alternative considered. However, a number of physical, operational, 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.

## 4.2 RECOMMENDATIONS

Given the limited scope of this study, only general recommendations can be offered at this time. The high truck volumes and the safety problems which may be the results of these high volumes suggest that segregation of truck traffic may improve roadway safety and operations within the study corridor. Specifically, implementation of an at-grade outside truck lane within the I-10E ROW should be investigated in greater detail. In this regard, the following general recommendations for future research are offered.

1) The physical and operational problems associated with constructing an at-grade outside truck lane within the I-10E ROW should be investigated. Specific issues to be examined should include 1) an assessment of the adequacy of the existing ROW to physically accommodate the truck lane, and 2) identification of potential operational problems associated with implementation of the truck lane (e.g., enforcement, potential intersection/interchange problems and treatments).

2) The potential for an exclusive truck lane on I-10E to divert traffic from US90 should be investigated. Specific issues to be addressed should include the legal and operational effects of requiring all truck traffic in the corridor to use an exclusive truck facility along I-10E.

3) A detailed benefit/cost analysis of an at-grade outside truck lane within the I-10E ROW should be performed. The analysis should be directed at quantifying the operational, safety, economic and environmental benefits and costs of the facility for users and non-users.

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