PROJECT DESCRIPTION AND JUSTIFICATION
INNER-KATY CONNECTOR

NORTHWEST FREEWAY TRANSITWAY

Prepared for
Metropolitan Transit Authority
of Harris County

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

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INNER-KATY CONNECTOR

Technical Memorandum
Work Order 4-C
Revision No. 2

Prepared for

Metropolitan Transit Authority
of Harris County

Texas Transportation Institute
The Texas A&M University System
College Station, Texas 77843-3135

September 1990

TEXAS TRANSPORTATION INSTITUTE

URBAN MOBILITY PROGRAM

Area Code 713
Telephone 686 • 2971
TexAn 850 • 1390
FAX: 686 • 5396

September 26, 1990

Gordon Zwillenberg
Metropolitan Transit Authority
P.O. Box 61429
Houston, Texas 77208-1429

Subject: Contract #E80054C, Work Order #4-C: Final Report Northwest/Inner Katy Connector

Dear Mr. Zwillenberg:

As per your request, enclosed are five copies of the subject report. The major sections of this technical memorandum document our initial analyses of the economic feasibility and cost effectiveness of one-way operation of the proposed connector. Additional analyses for the one-way project configuration and preliminary estimates of benefit-cost ratios for two-way operation of the proposed connector are presented in Appendix B (Addenda). This final report will be added to the Transitway Library.

If we can be of further assistance, please feel free to call us.

Sincerely,

Robert W. Stokes

Robert W. Stokes

701 NORTH POST OAK • SUITE 430 HOUSTON, TX 77024

SUMMARY

The benefit-cost evaluation shows that the construction of the Inner-Katy Connector will result in roughly 1,000,000 person hours of travel time savings and will reduce bus operating costs approximately by $900,000 over the analysis period. The value of travel time savings in terms of dollars is significantly greater than the anticipated project cost. So much so, in fact, that the benefit-cost ratio of this project is 1.67. It must be noted that this figure does not include the disbenefits of increased private vehicle operating costs which result from the higher average travel speeds that the connector allows.

In any event, the benefits of this project are more that one and one-half times as great as the costs, indicating that this project is justified. Because of the large dollar value of travel time savings, the project cost is significantly reduced when borne out over the increased ridership generated by the project's travel time savings. The results of the cost effectiveness evaluation show that the cost of the project per new rider is a nominal 23 cents.

The major sections of this technical memorandum document initial analyses of the economic feasibility and cost effectiveness of one-way operation of the proposed connector. Additional analyses for the one-way project configuration and preliminary estimates of benefit-cost ratios for two-way operation of the proposed connector are presented in Appendix B (Addenda).

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

The US 290 Northwest Freeway Transitway began operations over an initial 9.5 segment from West Little York to the proposed Northwest Transit Center on August 29, 1988. The complete transitway to FM 1960 is expected to be completed by mid-1989. The termination of the transitway near the transit center will increase the traffic congestion along Old Katy Road and Washington Avenue. METRO is considering constructing a direct ramp from the Northwest Transitway which will merge with the proposed eastern extension of the I-10 Katy Freeway Transitway east of I-610 West Loop. METRO has requested that the Texas Transportation Institute (TTI) complete a project description and justification analysis for the implementation of this Northwest Inner-Katy Connector.

This technical memorandum attempts to justify the Northwest Inner-Katy Connector on its own merits. The report contains the following information as it applies to the proposed connection.

- Annual Benefits;
- Benefit to Cost Ratio;
- Cost-Effectiveness Analysis according to UMTA methodology;
- Potential Increases in Northwest Transitway Demands due to implementation of the connection;
- Estimate the traffic demands necessary for which initial operation of the Northwest Inner-Katy Connection would be required; and
- Comparison of traffic within the Northwest Transit Center with and without the proposed connection.

The major sections of this technical memorandum document initial analyses of the economic feasibility and cost effectiveness of one-way operation of the proposed connector. Additional analyses for the one-way project configuration and preliminary estimates of benefit-cost ratios for two-way operation of the proposed connector are presented in Appendix B (Addenda).

PROJECT DESCRIPTION

The Inner-Katy Connector is a 0.6 mile connector ramp which is designed to carry high-occupancy vehicles from the Northwest Transit Center to the proposed eastern extension of the I-10 Katy Transitway (Figure 1). The proposed connector ramp will allow transitway users the option of accessing the Northwest Transit Center and the US 290 Northwest Freeway Transitway from I-10 Katy Freeway without detouring via the local streets. Completion of the one-way reversible ramp will provide travel time savings to users and reduce further traffic congestion along the surface streets near the Transit Center. A more detailed project description is included in Appendix A.

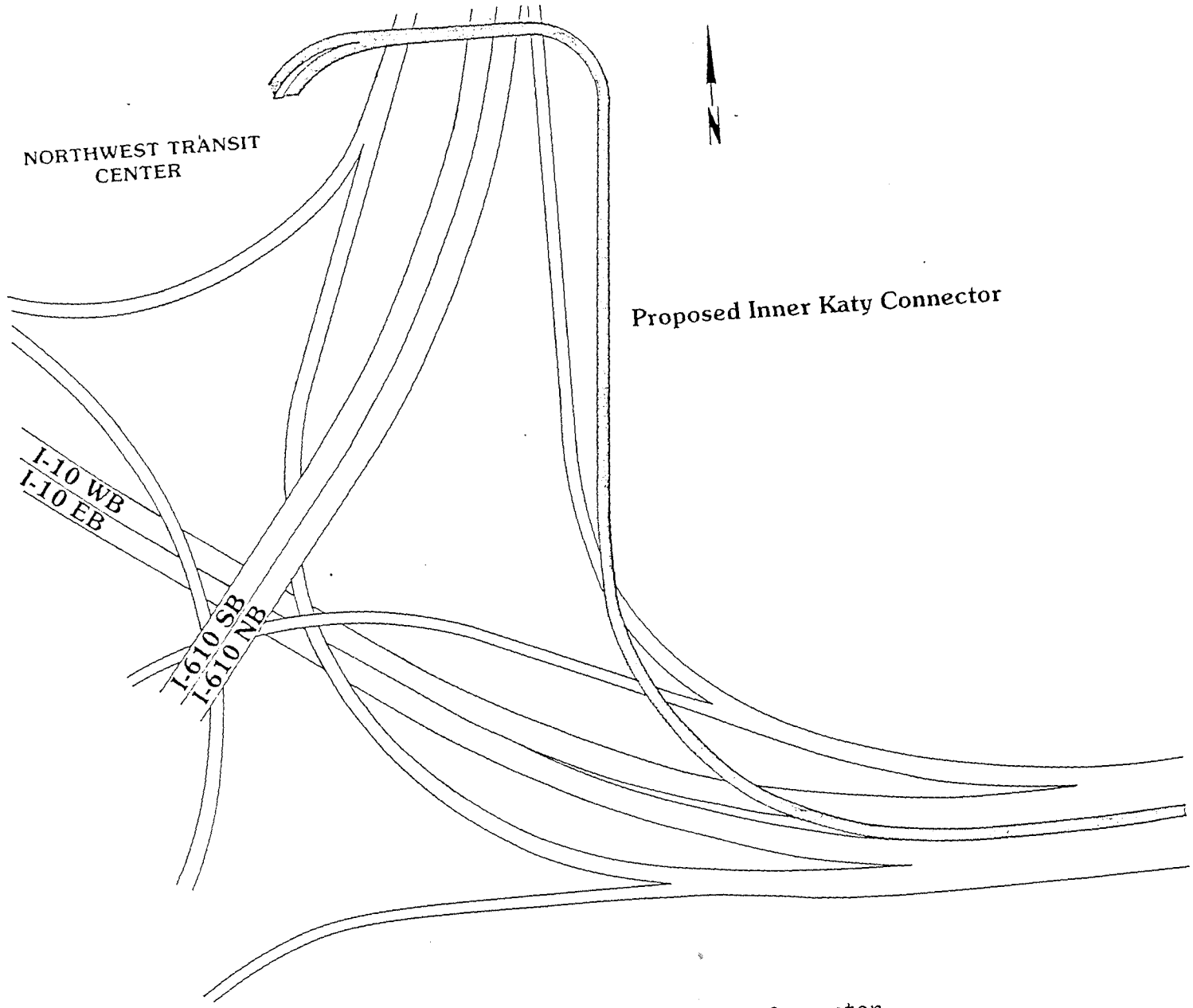


Figure 1. Schematic Layout of Proposed Inner-Katy Connector

TRAFFIC DEMANDS

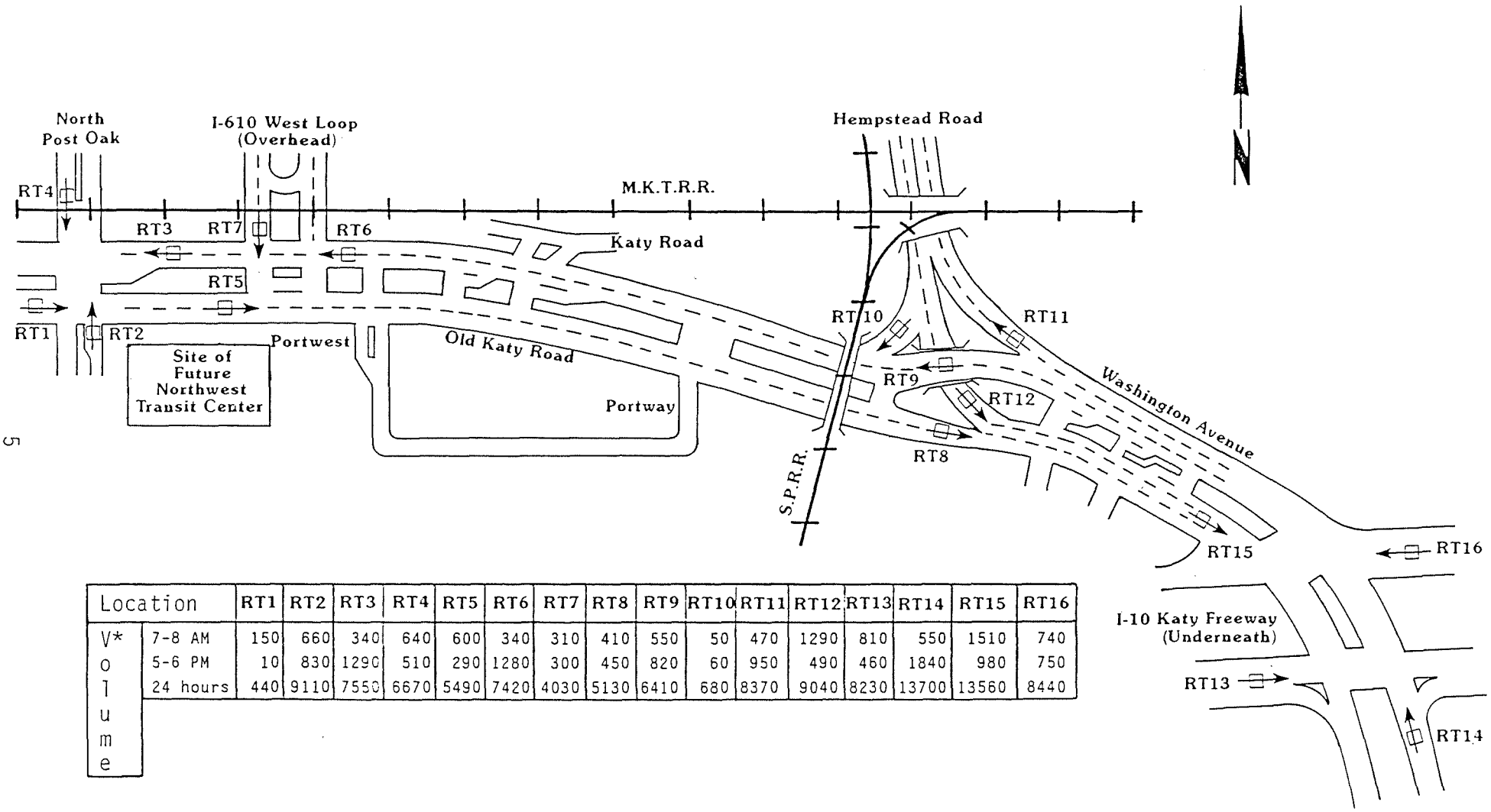
Surface Street System

Traffic volume data collected in August 1986 was used as the basis for the existing traffic conditions. Figure 2 presents the data as determined for a previous study (1). Of particular concern for this analysis are those existing at the I-10 at Washington Avenue intersection. If the Inner Katy Connector is not implemented, vehicles from the Northwest Transitway must use this intersection to access the Katy Freeway. Figure 3 presents the existing turning movements at this intersection during AM and PM peak hours. Traffic demands at the intersection are expected to increase by 4.2% (eastbound) and 3.0% (westbound) per year between 1986 and 2007 (2). Increases beyond 2007 are assumed at 2% per year.

Northwest Transitway

Candidates for using the proposed connector are those buses, vanpools, and carpools using the US 290 Northwest Transitway with destinations of I-10 Katy Freeway. Several local and express bus routes using the Northwest Transit Center could also benefit by using the connector. Estimated travel time savings for these trips via the Inner-Katy Connector compared with a similar trip along the adjacent surface street system will be examined in another section of this report.

The majority of the potential trips on the connector will be generated by the 2+ unauthorized carpool demand from the Northwest Transitway. In its existing 9.5 mile segment, approximately 435 such carpools use the transitway during a typical AM peak hour (Source: TTI Surveys - September 1988). It is anticipated that this will increase as the facility is extended to its full length in 1989. TTI has previously completed estimates for the completed facility (3). The completion of the proposed connector will increase the total year 2005 demands for the Northwest Transitway by approximately six percent.



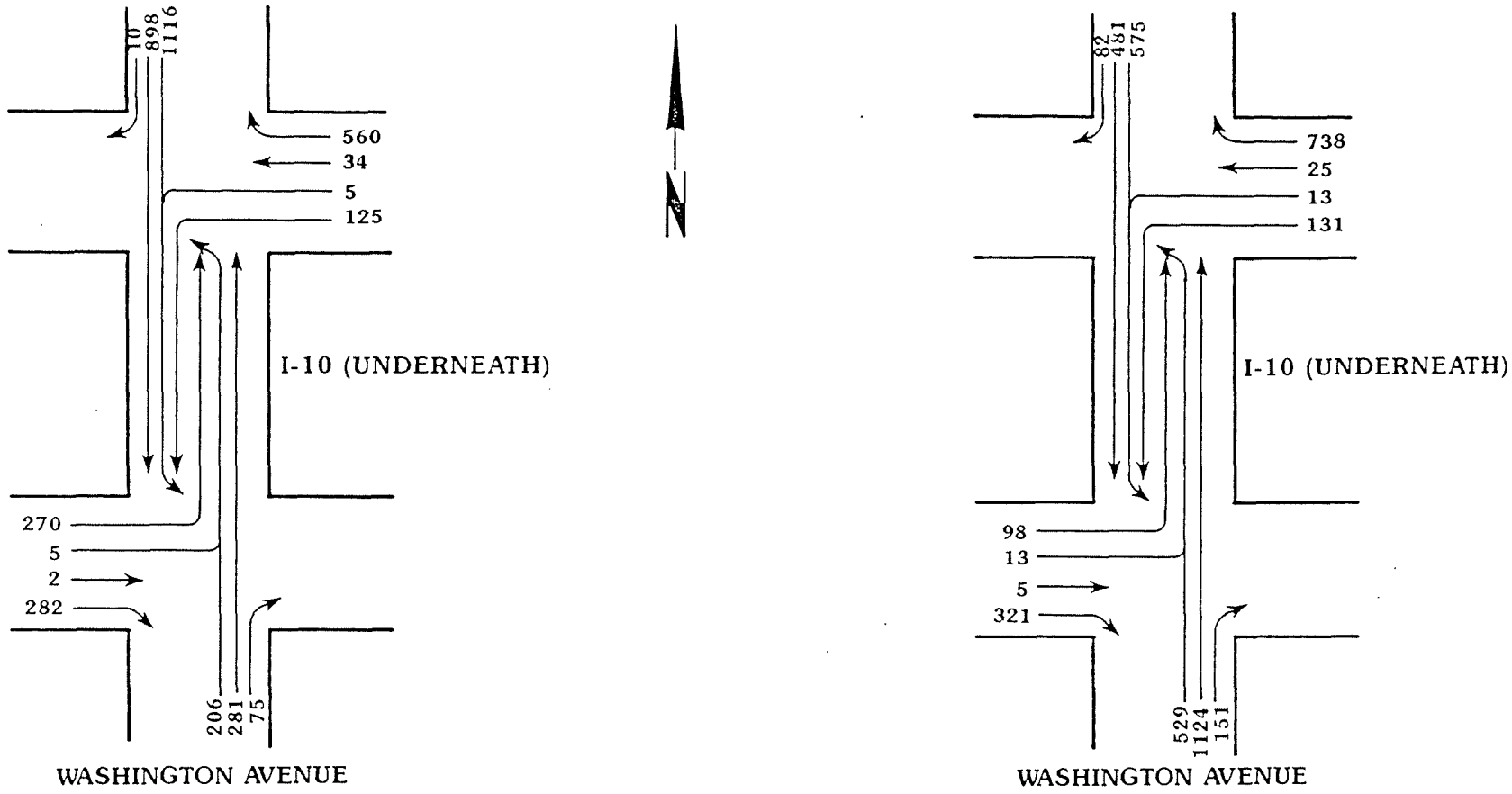
Location		RT1	RT2	RT3	RT4	RT5	RT6	RT7	RT8	RT9	RT10	RT11	RT12	RT13	RT14	RT15	RT16
V*	7-8 AM	150	660	340	640	600	340	310	410	550	50	470	1290	810	550	1510	740
o	5-6 PM	10	830	1290	510	290	1280	300	450	820	60	950	490	460	1840	980	750
l	24 hours	440	9110	7550	6670	5490	7420	4030	5130	6410	680	8370	9040	8230	13700	13560	8440
u																	
m																	
e																	

* Average Volume

Count Location/Direction

Source: Reference (1).

Figure 2. Existing Surface Street Volumes - August 1986



AM PEAK HOUR (7-8 AM)

PM PEAK HOUR (5-6 PM)

Source: Reference (1).

Figure 3. 1986 Turning Movements - I-10 at Washington Avenue

Table 1 presents 1986 and 2005 AM peak hour unauthorized 2+ carpool demand for the Northwest Transitway with and without implementation of the proposed connector. Demands for the PM peak hour are assumed to be the same as the AM peak hour demands.

Table 1. Unauthorized 2+ Carpool Demand for the Movement from the Northwest Transitway to the Katy Freeway and the S.P.R.R. - AM Peak Hour

Transitway Entrance	2+ Peak-Hour Carpool Volume Entering the Transitway Destined to I-10 @ the S.P.R.R.			
	1986		2005	
	w/o Connector	w/Connector	w/o Connector	w/Connector
FM 1960	220	228	410	430
N.W. Station	70	73	140	148
W. Little York	165	172	290	309
Pinemont	165	175	220	240
Dacoma	35	39	55	63
TOTAL	655	Approx. 690	1115	Approx. 1190

The remaining portion of the potential trips on the connector will be produced by bus demand from the Northwest and Katy Transitways as well as a few local bus routes. It is anticipated that peak hour bus demands on the Northwest Transitway will increase as the transitway is completed to its ultimate length. Northwest Transit Center opening day bus demands have been estimated at 20, 22 and 4 buses from the Northwest Transitway, Katy Transitway, and local buses destined for the CBD during the AM peak hour (4). METRO has provided year 2000 demands of 35 buses from the Northwest Transitway, 40 buses from the Katy Transitway, and 14 buses for local routes during the AM peak hour (5). Demands for the PM peak hour are assumed to match AM peak hour demands.

Table 2 presents 1986 and 2005 AM peak hour bus demands for the Northwest Transitway, Katy Transitway, and local routes. Year 2005 demands were calculated by assuming that bus demands would remain constant after the year 2000. Demands for the PM peak hour are assumed to match AM peak hour demands.

Table 2. Bus Demand Associated with the Inner-Katy Connector, Northwest and Katy Transitways and Local Routes - AM Peak Hour

From		To I-10 @ S.P.R.R.			
		w/o Connector		w/Connector	
		1986	2005	1986	2005
Northwest Transitway	N.W. Station	8	13	8	14
	Pinemont	12	19	12	21
Katy Transitway	S.H. 6	10	17	10	18
	Addicks	9	15	9	16
	Gessner	3	6	3	6
Local	Northbound-Post Oak	0	2	1	2
	Southbound-Post Oak	4	7	4	8
	Eastbound-Katy Frontage	0	4	1	4
TOTAL		46	83	Approx. 46	Approx. 89

Tables 1 and 2 show that carpool and bus demands associated with implementation of the proposed connector are higher than the demands that would exist if the proposed connector is not constructed. In order to estimate percent change in demand due to travel time savings, a travel time elasticity factor was applied to the percent change in travel time. A travel time elasticity factor, obtained from a previous TTI analysis (6), of -0.45 was applied in the analysis.

VALUE OF TIME

The value of time is a necessary component of the cost-effectiveness and benefit-to-cost analyses. The cost-effectiveness procedure as defined by UMTA provides costs of $4 (work) and $2 (non-work) per hour as a value of travel time. These 1984 dollar values were updated to May 1988 values of $4.70 (work) and $2.35 (non-work). The benefit-to-cost analysis does not specify a value of time; it was assumed at $9.22 per person-hour. It was obtained from the HEEM computer model (7) and updated to May 1988 dollars (8).

ANNUAL BENEFITS

As part of the justification analysis of the proposed inner-connector ramp it was necessary to identify the consequences of the ramp that could occur to the users of the facility and/or METRO which would be considered beneficial. After reviewing the potential consequences, it was determined that reductions in travel time of the users would be considered benefits of the proposed ramp. Similarly, an increase in this item would be viewed as a disbenefit of the project.

Estimates of the travel time savings were completed for each year between 1986 and 2005 for trips made by buses and carpools on the Northwest Transitway, by buses on the Katy Transitway as well as buses traveling on North Post Oak Road and the Katy Freeway Frontage Road to the CBD via the proposed connector ramp compared to the same trip via the surface street system. The trip along the transitway routes assumed beginning points corresponding to the various access points of the Northwest and Katy Transitways and ending points at the Katy (I-10W) Freeway at the SPRR overpass. The trip corresponding the local bus routes began at North Post Oak Road and Hempstead Road for southbound North Post Oak buses, Woodway at North Post Oak Lane for northbound North Post Oak buses, and Silber at the I-10 eastbound frontage road for the eastbound routes.

Transitway Travel With Connector

The travel time from the various access points of the transitways to the Katy (I-10W) Freeway at the SPRR overpass was estimated based on the following assumptions:

- Transitway access point to transit center at 55 mph;
- Four hundred (400) feet at 25 mph along curve of connector;
- Twenty-two hundred (2200) feet along connector to accelerate to 55 mph; and
- Remaining distance to I-10 at SPRR at 55 mph.

This estimation assumes the travel time would remain constant for the entire analysis period.

Transitway Travel Without Connector

The travel time from the access points of the transitway to the Katy (I-10W) Freeway at the SPRR overpass via the surface street system was estimated based on the following:

- Transitway access point to transit center at 55 mph;
- 1.0 miles along Old Katy Road at 40 mph;
- 0.7 miles along Washington Avenue at 35 mph; and
- 0.3 miles to I-10 at SPRR overpass as vehicle accelerate to 55 mph.

An additional component of travel without the connector is the delay incurred at the intersection of I-10 at Washington Avenue. Due to projected increases in traffic volumes at the intersection, a delay for each year of the analysis was calculated and added to the travel time from the other components of the trip. The estimated delays ranged from 16 and 23 seconds per vehicle respectively for the AM and PM peak hour in 1986 to 35 and 40 seconds per vehicle for the AM and PM hour respectively in 2005.

Tables 3 and 4 present the estimated travel times and savings for both the Northwest and Katy Transitways from the access points along the transitways during the AM and PM peak hours.

Local Travel With Connector

The travel time on the local bus routes destined to the CBD via the connector was estimated based on the following:

- North Post Oak Road at Hempstead Road to Transit Center at posted speed (southbound buses only);
- North Post Oak Lane at Woodway to Transit Center at posted speed (northbound buses only);

Table 3. Travel Times (minutes) Associated with the Inner-Katy Connector, Northwest Transitway - AM and PM Peak Hour

From Entrance to Transitway	To I-10 @ S.P.R.R.						% Change			
	w/o Connector				w/Connector*					
	1986		2005		1986	2005	1986		2005	
	AM	PM	AM	PM			AM	PM	AM	PM
FM 1960	18.4	18.5	19.1	19.2	17.0	17.0	- 7.6%	- 8.1%	-11.0%	-11.5%
N.W. Station	16.8	16.9	17.5	17.6	15.4	15.4	- 8.3%	- 8.9%	-12.0%	-12.5%
W. Little York	14.1	14.2	14.8	14.9	12.7	12.7	- 9.9%	-10.6%	-14.2%	-14.8%
Pinemont	9.9	10.0	10.6	10.7	8.5	8.5	-14.1%	-15.0%	-19.8%	-20.6%
Dacoma	5.8	5.9	6.5	6.6	4.4	4.4	-24.1%	-25.4%	-32.3%	-33.3%

* AM travel time = PM travel time.

Table 4. Travel Times (minutes) Associated with the Inner-Katy Connector, Katy Transitway - AM and PM Peak Hour

From Entrance to Transitway	To I-10 @ S.P.R.R.						% Change			
	w/o Connector				w/Connector*					
	1986		2005		1986	2005	1986		2005	
	AM	PM	AM	PM			AM	PM	AM	PM
S.H. 6	16.8	16.9	17.1	17.2	15.4	15.4	- 8.3%	- 8.9%	- 9.9%	-10.5%
Addicks	15.8	15.9	16.1	16.2	14.5	14.5	- 8.2%	- 8.8%	- 9.9%	-10.5%
Gessner	9.2	9.3	9.5	9.6	7.8	7.8	-15.2%	-16.1%	-17.9%	-18.8%

* AM travel time - PM travel time.

- Silber at I-10 EB frontage road to Transit Center at posted speed (eastbound buses only);
- Four hundred (400) feet at 25 mph along curve of connector;
- Twenty-two hundred (2200) feet along connector to accelerate to 55 mph; and
- Remaining distance to I-10 at SPRR.

As with the transitway travel, this estimation assumes that the travel time would remain constant for the entire analysis period.

Local Travel Without Connector

Travel times of the local bus routes destined to the CBD via the surface streets were estimated based on:

- North Post Oak Road at Hempstead Road to Transit Center at posted speed (southbound buses only);
- North Post Oak Lane at Woodway to Transit Center at posted speed;
- Silber at I-10 EB frontage road to Transit Center at posted speed (eastbound buses only);
- 1.0 miles along Old Katy Road at 40 mph;
- 0.7 miles along Washington Avenue at 35 mph;
- 0.3 miles to I-10 at SPRR overpass as vehicle accelerates to 55 mph; and
- Intersection delay at Washington Avenue at I-10.

Table 5 presents the estimated travel times for local bus routes to I-10 at SPRR during the AM peak hour.

Table 5. Travel Times (minutes) Associated with the Inner-Katy Connector, Local Bus Travel - AM and PM Peak Hour

From	To I-10 @ S.P.R.R.						% Change			
	w/o Connector				w/Connector					
	1986		2005		1986	2005	1986		2005	
	AM	PM	AM	PM			AM	PM	AM	PM
N. Post Oak @ Hempstead Rd	5.8	6.0	6.1	6.2	4.5	4.5	-22.4%	-25.0%	-26.2%	-27.4%
N. Post Oak @ Woodway	6.3	6.5	6.6	6.7	5.0	5.0	-20.6%	-23.1%	-24.2%	-25.4%
Silber @ I-10 EB Frontage Rd	5.5	5.7	5.8	5.9	4.2	4.2	-23.6%	-26.3%	-27.6%	-28.8%

The delay savings presented in the preceding tables should be considered as an average savings for that route over the entire peak hour. The actual savings for a specific trip may actually be greater during the peak 15 minutes. As the traffic demands at the Washington and I-10 intersection increase, the peak hour is expected to also increase in duration. Hence, the travel time savings estimated for the peak hour may occur throughout the entire peak period.

Annual travel time savings was estimated by multiplying time savings per trip for each movement by the base year demand for the movement and the assumed vehicle occupancy. Vehicle occupancies of 40 persons per bus and 2.2 persons per carpool were utilized in this calculation. The base year demands were utilized because of the fact that new users of the facility, generated by the travel time savings, did not previously make the trip. Therefore, they would not experience the time savings that the base year users would experience. The carpool and bus demands were converted to annual demands by the following procedure:

- AM Peak Hour * 2 = AM Peak Period
- PM Peak Hour * 2 = PM Peak Period
- AM Peak Period + PM Peak Period = Daily Demand
- Daily Demand * 250 = Annual Demand

Table 6 presents the present value in terms of time of travel time costs for the years 1986 through 2005 for travel on the Northwest and Katy Transitways and local bus routes with and without implementation of the inner-connector.

Table 6. Present Value Travel Time Costs Associated with Inner-Katy Connector

From	To I-10 @ S.P.R.R.	
	w/o Connector (person-hrs)	w/Connector (person-hrs)
Northwest Transitway	5,969,168	5,302,286
Katy Transitway	2,780,076	2,506,107
Local Bus	324,079	241,588
TOTAL	9,073,323	8,049,981

TRAFFIC ANALYSIS

The last portion of this report provides for a traffic analysis which compares the traffic within the Northwest Transit Center with and without the connector. An analysis was previously completed which looked at this in more detail (4). That analysis assumed that the Inner-Katy Connector was in operation. It is also anticipated that the traffic within the bus loading area would not be directly influenced by the connector. Therefore, this analysis concentrates on the intersection of the transit center access road with Old Katy Road. The analysis assumes that the eastern extension of the Katy Transitway is operational and 2+ carpool demands of Table 1. Scenarios are examined for 1986 and 2005, with and without the proposed connector, and considers signalized and unsignalized control at the access road. The analysis also assumes that the vanpools and carpools using the Northwest Transitway are provided separate access to Old Katy Road, lessening the impact on bus operations. TTI has completed a previous analysis of the intersection in its temporary configuration for the Phase I Northwest Transitway (9).

A major input to the analysis is the proportion of traffic from the Northwest Transitway desiring to turn left at the intersection. This was assumed at 20% for all scenarios. Transitway demands during the PM peak hour were assumed as the reverse of the AM demands. It was also assumed that the left turning traffic would remain constant throughout the analysis period. An assumed 10% of the total transitway traffic was considered to turn right at the intersection for scenarios with a completed connector. The Highway Capacity Software (10) was used to evaluate the level-of-service for the unsignalized scenarios. For the signalized intersection scenario, the PASSER II-84 optimization model was used to determine the level-of-service at the intersection with the optimum signal timing. Tables 7 and 8 present the results of this analysis for the AM and PM peak hours, respectively. It should also be considered that the intersection analysis was completed independently of that required for the cost-effectiveness and benefit-to-cost analysis.

Table 7. Level-of-Service - Old Katy Road at Northwest Transit Center, Critical Movements during AM Peak Hour

Movement	Unsignalized LOS		Signalized LOS	
	1986	2007	1986	2007
NB LT (w/o Connector)	E	F	A	C
NB LT (w/Connector)	E	F	A	D
NB RT (w/o Connector)	B	F	A	E
NB RT (w/Connector)	A	C	A	D

Table 8. Level-of-Service - Old Katy Road at Northwest Transit Center, Critical Movements during PM Peak Hour

Movement	Unsignalized LOS		Signalized LOS	
	1986	2007	1986	2000
WB LT (w/o Connector)	C	F	A	E
WB LT (w/Connector)	A	D	A	D

BENEFIT-COST RATIO

Having identified which aspects of the project are to be considered beneficial/disbeneficial, it was necessary to determine their relationship to project costs in order to provide a monetary justification for the project. Project costs were assumed to be 1) construction costs; 2) bus operating costs; and 3) annual maintenance costs. For this analysis it was necessary to convert the travel time savings benefits/disbenefits to dollar amounts. All amounts and thus the benefit-cost ratio are presented in terms of present value.

This benefit-cost analysis is based on the following:

1. Construction costs are stated at their nominal value (i.e. are assumed to have been expensed at the time the inner-connector became operational). The present value of the residual value of the structure at the end of the analysis period, if any, was used to offset the construction cost to give a net construction cost. A construction cost figure of $6.5 million was supplied by METRO.
2. Bus operating costs were determined by multiplying the bus demand at each transitway entrance point or the assumed local route starting point by the average travel time for a trip from that point to I-10 and at the SPRR overpass via the connector or via the surface street system to give total bus hours of travel for both the build and no-build alternative. This figure was multiplied by the METRO supplied figure for bus operating costs of $90 per revenue hour to give total value of bus operating costs for both alternatives. Table 9 presents values of bus operating costs for both alternatives for the years 1986 through 2005.
3. Bus volumes used in the above calculation were increased annually from a base amount taken from source (4) to the year 2000 volumes supplied by METRO. It was assumed that volume would remain constant between the years 2000 and 2005.
4. Annual maintenance costs of $5,000 per year, as provided by METRO were assumed to remain constant.

5. Annual travel delay savings benefits were converted to dollar amounts using a value of $9.22 per person-hour.
6. A discount rate of 10% is assumed for the analysis period.

Table 9. Present Value of Bus Operating Costs Associated with the Inner-Katy Connector

From	To I-10 @ S.P.R.R.	
	w/o Connector	w/Connector
N.W. Transitway	$ 4,609,687	$ 4,215,531
Katy Transitway	6,255,170	5,868,472
Local	723,746	594,248
TOTAL	$11,588,603	$10,678,301

Table 10 presents total project benefits and costs for the build alternative as compared to the no-build alternative for the analysis period 1986 through 2005.

Table 10. Estimated Benefits-Costs of Northwest Inner-Katy Connector

Benefit or Cost Component	Present Value (Millions of May 1988 Dollars)	
Benefits:		
Travel Time Savings	$ 9.43	
Total Benefits		$ 9.43
Costs:		
Construction Cost (Net)	$ 6.50	
Increased Bus Operating Costs	-0.91	
Maintenance	0.04	
Total Costs		$ 5.63
Benefit-Cost Ratio	1.67*	

*Does not consider an increase in private vehicles operating costs due to increased average travel speed.

Table 10 shows that the reduced travel time due to the connector reduces bus operating cost and thereby reduces total cost of the project. Cost are reduced to a point that the project benefits are 1.67 times as great as project costs.

Cost Effectiveness

In order to provide a measure of federal evaluation of the Northwest Inner-Katy Connector Ramp project, an UMTA cost-effectiveness measurement technique was applied using the benefit and cost figures that were calculated for the benefit-cost analysis. The cost effectiveness index measure that was chosen is a per-trip index that uses the change in ridership due to the project as the measure of the effectiveness. UMTA also has set forth a per-hour index that can also be used to calculate cost-effectiveness. However, the data required to calculate cost-effectiveness using this per-hour index is more extensive than that required for the per-trip index. Additionally, to our knowledge, UMTA has not issued a change to interim guidelines pertaining to their Major Investment Policy, which allows use of the per-trip index in calculating the cost-effectiveness of projects. The equation below represents the index used:

$$\text{Total Cost-Effectiveness} = \frac{\Delta\text{Capital Cost} + \Delta\text{Operating/Maintenance Costs} - \Delta\text{Travel Time Savings}}{\Delta\text{ Patronage}}$$

The capital and maintenance costs were obtained from the previous benefit-cost data. In order to calculate travel time savings, patronage data had to be separated into work and non-work trips. It was assumed that 12.5% of the peak period trips are non-work related. A dollar value of work and non-work travel time savings was obtained by applying a work trip value of time of $4.70 and a non-work value of time of $2.35 to the work and non-work patronage. These values represent the May 1988 values of $4.00 for work and $2.00 for non-work trips which were originally presented in 1984 by UMTA. The change in patronage was calculated by comparing the bus and carpool demands without the connector in place and demand with the connector in place. The difference was then multiplied by the assumed bus and carpool

occupancies to give the change in patronage due to the construction of the inner-connector. Table 11 presents the patronage data for the Northwest and Katy Transitway users as well as local bus users for the year 2000.

Table 11. Patronage Associated with the Inner Katy Connector - Year 2000

From Entrance to Transitway	To I-10 @ S.P.R.R.				Difference (riders)
	w/o Connector		w/Connector		
	Bus	Carpool	Bus	Carpool	
	(riders)		(riders)		
N.W. Transitway	1,280,000	2,123,000	1,400,000	2,263,800	260,800
Katy Transitway	1,520,000	-	1,600,000	-	80,000
Local	520,000	-	560,000	-	40,000
TOTAL	5,443,000		5,823,800		380,800

Table 12 presents the cost-effectiveness data and index.

Table 12. Estimated Cost-Effectiveness of Northwest Inner Katy Connector

Cost Effective Measures	Value in May 1988 Dollars
Capital Cost[a] ($)	763,490
Maintenance Costs[b] ($)	5,000
Travel Times Savings[b] ($)	658,690
Patronage[b] (riders)	380,800
Total CE	$\frac{763,490 + 5,000 - 658,690}{380,800} = 0.2883$

a: 6.5 million cost annualized at 10% over a 20-year period.
b: Year 2000 value.

CONCLUSIONS

The benefit-cost evaluation shows that the construction of the Inner-Katy Connector will result in roughly 1,000,000 person hours of travel time savings and will reduce bus operating costs approximately by $900,000 over the analysis period. The value of travel time savings in terms of dollars is significantly greater than the anticipated project cost. So much so, in fact, that the benefit-cost ratio of this project is 1.67. It must be noted that this figure does not include the disbenefits of increased private vehicle operating costs which result from the higher average travel speeds that the connector allows.

In any event, the benefits of this project are more that one and one-half times as great as the costs, indicating that this project is justified. Because of the large dollar value of travel time savings, the project cost is significantly reduced when borne out over the increased ridership generated by the project's travel times savings. The results of the cost effectiveness evaluation show that the cost of the project per new rider is a nominal 23 cents.

REFERENCES

1. Old Katy Road/Washington Avenue Traffic Analysis, Technical Memorandum prepared for Metropolitan Transit Authority of Harris County, Work Order 2D, Texas Transportation Institute, April 1988.

2. Houston-Galveston Regional Transportation Study Traffic Forecast Map.

3. Texas Transportation Institute, unpublished carpool projections.

4. METRO Northwest Transit Center Master Plan, Submittal No. 3, Georgia A. Wilson, Inc. and Michael Baker, Jr., Inc., July 1987.

5. Metropolitan Transit Authority of Harris County, Planning Analysis Division.

6. TTI Research Report 339-15F.

7. Memmott, J.L. and J.L. Buffington, Revised Highway Economic Evaluation Model (HEEMII), Texas Transportation Institute, TTI Research Report 225-28F, November 1983.

8. Consumer Price Index as prepared by the U.S. Department of Labor.

9. Demand and Capacity Analysis for the Northwest Freeway Transitway, August 1988 to May 1988 (Draft), Technical Memorandum prepared for Metropolitan Transit Authority of Harris County, Work Order 4B, Texas Transportation Institute, July 1988.

10. Highway Capacity Software, Release 1.30, U.S. Department of Transportation, Federal Highway Administration.

APPENDIX A

PROJECT DESCRIPTION

METRO

Metropolitan Transit Authority
500 Jefferson Street
P.O. Box 61429
Houston, Texas 77208-1429

713 739-4000

August 3, 1988

Mr. Darrell W. Borchardt
Assistant Research Engineer
Texas Transportation Institute
333 West Loop South
Suite 116
Houston, Texas 77024

Subject: Contract E80054C
Work Order #4C

Dear Darrell:

In response to your memo of July 27, 1988, we have gathered the following information:

1) Enclosed for your use, is a revised project description. Please disregard the previous description, that I delivered to you last week.

2) Since the property is on SDHPT Right-of-Way, there will be no property acquisition costs.

3) Maintenance costs will be accrued by SDHPT for the bridge structure and roadway on SDHPT Right-of-Way. Kindly check with SDHPT on the cost of maintaining a similar type bridge structure and roadway.

By next week, I will have the additional information that you requested. Please contact me, if I can assist you further.

Sincerely,

Gordon D. Zwillenberg

Gordon D. Zwillenberg
Project Manager II

Enclosures

xc: Gary W. Lemley
Mary L. Groves

2/23315/073 CO

METRO
CONNECTOR RAMP
FROM THE NORTHWEST TRANSIT CENTER
TO THE KATY HIGH OCCUPANCY VEHICLE LANE
PROJECT DESCRIPTION

The proposed 0.6 mile connector ramp project is designed to carry authorized buses and other high occupancy vehicles from the Northwest Transit Center (NWTC) to the proposed east extension of the Katy Freeway Transitway - located in the median of I.H. 10 about 0.5 mile east of I.H. 610. The proposed connector ramp will merge with the I.H. 10 HOV lane east extension that is presently under construction. The Katy East Extension is scheduled to be completed in July, 1989. This connector ramp will allow High Occupancy Vehicle (HOV) lane users the option to access between the Katy Freeway (I.H. 10) and the Northwest Transit Center/Northwest HOV lane without detouring via the local streets. A travel time savings of about three minutes is estimated. The proposed HOV ramp will operate as a one-way reversible facility. This HOV connector ramp will also prevent further traffic congestion on Washington Avenue from Old Katy Road that would otherwise use these local streets.

The Northwest HOV lane (U.S. 290), which terminates at the NWTC, will have the first 9.5 miles (Little York to NWTC) operational in August, 1988. The proposed HOV ramp will be configured to begin at the northeast portion of the transit center and serve as the connector between the transit center access streets and the I.H. 10 HOV lane extension.

The proposed ramp will have a 22 feet wide HOV lane which will include an adequate width for a breakdown shoulder. Beginning from the NWTC, the ramp is planned as an at-grade section that crosses under the existing I.H. 610 bridge. The at-grade ramp then continues south between the I.H. 610 northbound bridge and the existing Right-of-Way (R.O.W.) to north of I.H. 10. The major additions for this portion include: full depth pavement, retaining walls along I.H. 610, lighting, and signage.

In the inbound direction, the proposed HOV lane and ramp continues as a curved bridge structure (total bridge length approximately 850 feet) over the existing I.H. 10 westbound connector ramp to I.H. 610, and over the existing I.H. 10 westbound mainlanes. The connector ramp then connects at-grade with the I.H. 10 median with the proposed HOV connector ramp located along the south side of the I.H. 10 HOV extension. The proposed ramp bridge will terminate at this location. In this section, the bridge structure and installation of lights and signage will be similar to the preceding segment. The Connector will be fully barrier separated between the mainlanes and the I.H. 10 HOV lane.

Continuing in the inbound direction, the proposed HOV lane will merge with the I.H. 10 HOV lane extension. In this section, the I.H. 10 at-grade roadway widening will be completed under the previous contract for the I.H. 10 HOV

extension and all necessary pavement for the connector lane extension will be existing. The proposed HOV connector ramp will terminate with the supporting abutment and retaining walls. Relocation of I.H. 10 concrete median barriers and striping will be required in the merge area between the proposed HOV connector ramp and the I.H. 10 HOV lane extension.

The purpose of this project is to move more people to their destinations in a shorter period of time. No additional right-of-way will be required for this project. Conceptual capital costs for the project are estimated to be 6.0 million in 1987 constant dollars. Escalated day of expenditure dollars, capital costs would be approximately 6.5 million.

APPENDIX B

ADDENDA

TEXAS TRANSPORTATION INSTITUTE

FREEWAY DESIGN AND OPERATIONS PROGRAM

Area Code 713
Telephone: 686 • 2971
TexAn: 850 • 1390
FAX: 713 • 686 • 5396

August 16, 1989

Mr. Gordon Zwillenberg
Project Manager II
Metropolitan Transit Authority
P.O. Box 61429
Houston, TX 77208-1429

Dear Sir:

As per your recent requests, we have re-estimated the Benefit-to-Cost ratios and Cost-Effectiveness of the proposed Inner Katy Connector. The work was previously submitted in report form as Revision No. 1 for Work Order #4-C entitled "Project Description and Justification, Inner Katy Connector." Attached are tables similar to those included in the report as well as a brief explanation of each. If you require that these be incorporated into the report as well as a resubmission, please contact me at 713/686-2971.

Very truly yours,

Darrell Borchardt

Darrell W. Borchardt
Assistant Research Engineer

xc: Andy Mullins
Dennis Christiansen

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BENEFIT-COST ANALYSIS

The benefit-cost analysis was completed with only one major change in the assumptions. A discount rate of 4% was used as per standard procedures (Reference: A Manual for User Benefit Analysis of Highway and Bus Transit Improvements, AASHTO, 1977). The analysis was completed for project durations of 15, 18, and 20 years. The tables presented below are updates of Table 10 (page 19) of the previous report.

Table 10A. Estimated Benefits-Cost of Northwest Inner-Katy Connector for a 15-Year Project Life

Benefit or Cost Component		Present Value (Millions of May 1988 Dollars)
Benefits:		
Travel Time Savings	$11.76	
Total Benefits		$11.76
Costs:		
Construction Cost (Net)	$ 4.22	
Increased Bus Operating Costs	-1.11	
Maintenance	0.04	
Total Costs		$ 3.15
Benefit-Cost Ratio	3.73*	

*Does not consider an increase in private vehicles operating costs due to increased average travel speed.

Table 10B. Estimated Benefits-Cost of Northwest Inner-Katy Connector for a 18-Year Project Life

Benefit or Cost Component		Present Value (Millions of May 1988 Dollars)
Benefits:		
Travel Time Savings	$13.96	
Total Benefits		$13.96
Costs:		
Construction Cost (Net)	$ 4.22	
Increased Bus Operating Costs	-1.33	
Maintenance	0.04	
Total Costs		$ 2.93
Benefit-Cost Ratio	4.76*	

*Does not consider an increase in private vehicles operating costs due to increased average travel speed.

Table 10C. Estimated Benefits-Cost of Northwest Inner-Katy Connector for a 20-Year Project Life

Benefit or Cost Component		Present Value (Millions of May 1988 Dollars)
Benefits:		
Travel Time Savings	$15.33	
Total Benefits		$15.33
Costs:		
Construction Cost (Net)	$ 4.22	
Increased Bus Operating Costs	-1.47	
Maintenance	0.04	
Total Costs		$ 2.79
Benefit-Cost Ratio	5.49*	

*Does not consider an increase in private vehicles operating costs due to increased average travel speed.

COST-EFFECTIVENESS ANALYSIS

The cost-effectiveness analysis was also re-examined using UMTA supplied values of $4.00 for work trips and $2.00 for non-work trips. These 1984 values are the most updated values that are available. The analysis was completed for 15, 18, and 20 years. The Total CE as presented in Table 12 (page 21) as updated is included below.

Project Life	Total Cost-Effectiveness
15 years	0.7851
18 years	0.6223
20 years	0.5460

TEXAS TRANSPORTATION INSTITUTE

URBAN MOBILITY PROGRAM

Area Code 713
Telephone 686 • 2971
TexAn 850 • 1390
FAX: 686 • 5396

June 12, 1990

Mr. Gordon D. Zwillenberg
Project Manager II
Metropolitan Transit Authority
1201 Louisiana
P.O. Box 61429
Houston, Texas 77208-1429

Subject: Contract #E80054C, Work Order #4-C: Estimated Marginal Benefit-Cost Ratio for Two-Way Operation of Inner Katy Connector

Dear Gordon:

As per your request, we have prepared a preliminary estimate of the marginal benefit-cost ratio for two-way operation of the Inner-Katy Connector (Figure 1). The analyses assume an 85/15 peak-period directional split in person movement on the Connector. The basis for this assumption is documented in our Technical Memorandum concerning Projected Travel Time Savings and Estimated Demand for the Proposed Eastex Transitway (1). The analyses also assume that the peak and off-peak direction travel times on the highway/transitway network used in this study are identical. This assumption is based on travel time data from the 1989 HGRTS Travel Time and Speed Survey (2). The benefit-cost ratio is based on a discount rate of 4% and a project life of 20 years. The marginal cost estimates assume a base year construction cost of $8,101,000 and a maintenance cost of $6,250 per year. These estimates were provided by METRO. All other assumptions used in this analysis are identical to those used in our previous studies concerning one-way operation of the Connector (3, 4).

Table 1 summarizes the benefit-cost ratio presented in our previous submittal (4) concerning one-way operation of the Connector. The benefit-cost ratio in Table 1 is based on a discount rate of 4% and a project life of 20 years.

Table 2 shows our preliminary estimates of the marginal benefits and costs associated with two-way operation of the Connector. As shown in Table 2, our preliminary estimate indicates that the marginal benefits exceed the marginal costs by less than 20% (B/C Ratio = 1.18), indicating that additional analyses concerning the economic feasibility of this alternative may be warranted.

If you require additional information, or more detailed documentation of our analyses, please contact me at (713) 686-2971.

Sincerely,

Robert W. Stokes

Robert W. Stokes

xc: Dennis Christiansen
Darrell Borchardt

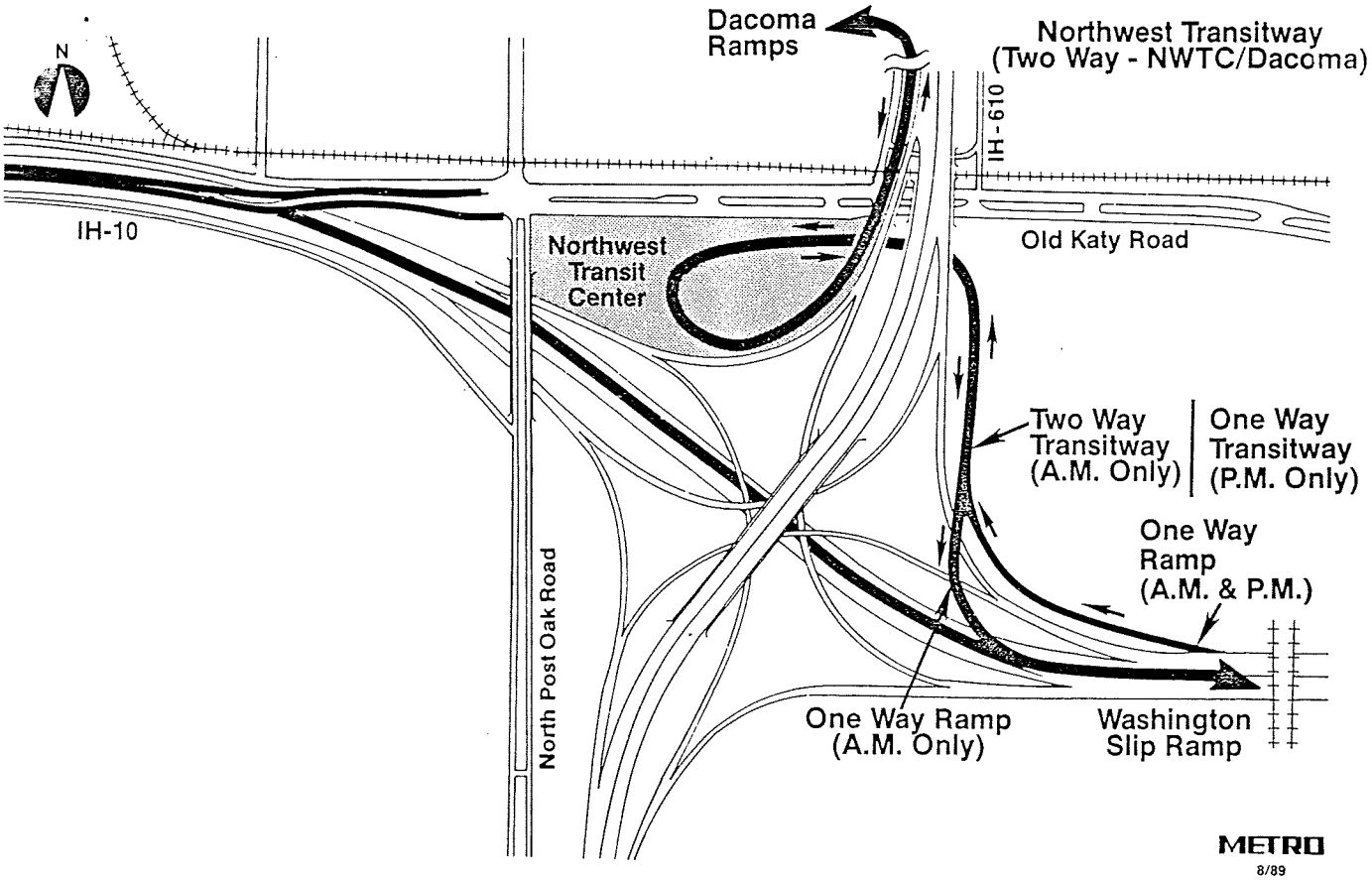

Figure 1. Katy/Northwest Inner Connector (A.M. Two-Way Option)

Table 1. Estimated Benefits-Costs for One-Way Operation of Northwest Inner-Katy Connector for a 20-Year Project Life

Benefit or Cost Component	Present Value (Millions of May 1988 Dollars)	
Benefits:		
Travel Time Savings	$15.33	
Total Benefits		$15.33
Costs:		
Construction Cost (Net)	$ 4.22	
Increased Bus Operating Costs	-1.47	
Maintenance	0.07	
Total Costs		$ 2.82
Benefit-Cost Ratio	5.44[a]	

[a]Does not consider an increase in private vehicle operating costs due to increased average travel speed.

Source: Ref. (4).

Table 2. Estimated Marginal Benefits-Costs for Two-Way Operation of Northwest Inner-Katy Connector for a 20-Year Project Life

Benefit or Cost Component	Present Value (Millions of May 1988 Dollars)	
Marginal Benefits:		
Travel Time Savings	$ 2.76	
Total Benefits		$ 2.76
Marginal Costs:		
Construction Cost (Net)	$ 2.59	
Increased Bus Operating Costs	-0.27	
Maintenance	0.02	
Total Costs		$ 2.34
Marginal Benefit-Cost Ratio	1.18[a]	

[a]The marginal benefit-cost ratio is the ratio of the change in benefits to the change in costs for two-way versus one-way operation of the connector.

REFERENCES

1. Texas Transportation Institute. Proposed Eastex Freeway Transitway: Projected Travel Time Savings and Estimated Demand. Technical Memorandum prepared for Metropolitan Transit Authority of Harris County. April 1990.

2. Texas Transportation Institute. Houston-Galveston Regional Transportation Study Travel Time and Speed Survey. July 1989.

3. Texas Transportation Institute. Project Description and Justification Inner-Katy Connector. Technical Memorandum prepared for Metropolitan Transit Authority of Harris County. March 1989.

4. Borchardt, D.W. Re-estimated Benefit-Cost Ratios and Cost-Effectiveness of Inner-Katy Connector. Correspondence submitted to Gordon D. Zwillenberg, Metropolitan Transit Authority of Harris County. August 16, 1989.

TEXAS TRANSPORTATION INSTITUTE

URBAN MOBILITY PROGRAM

Area Code 713
Telephone 686 • 2971
TexAn 850 • 1390
FAX: 686 • 5396

September 10, 1990

Mr. Gary W. Lemley
Manager of Transit Projects
Metropolitan Transit Authority
1201 Louisiana
P.O. Box 61429
Houston, Texas 77208-1429

Re: Contract #E80054C, Work Order #4-C: Estimated Benefit-Cost Ratios for Two-Way Operation of Inner Katy Connector

Dear Mr. Lemley:

My June 12, 1990 letter report to Gordon Zwillenberg presented the estimated marginal benefit-cost ratio for two-way operation of the Inner Katy Connector. In our telephone conversation of September 7, 1990, you requested a revised analysis of the Connector based on the following adjustments:

1) Assume no salvage value.

2) Use 1990 present value.

3) The 1990 cost of the full project cost has been correctly assumed at $8,101,000. The construction cost for only the two-way element used in Table 2 should be corrected with a 1990 cost of $2,800,000. This represents the portion of the $8,101,000 which is for two-way operation and which is exclusive of the one-way reversible portion cost.

4) Table 1 gives an analysis of only the one-way reversible plan. Instead of this, Table 1 should be corrected (or another Table added) to consider the total Project Benefit-Cost Ratio using total benefits with the total construction cost of $8,101,000.

The results of the analyses are summarized in Tables 1-3. The analyses are based on a 20-year project life and a discount rate of 4%. With the exception of the adjustments outlined in items 1) through 4) above, all assumptions are identical to those documented in our previous submittals for this project.

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Tables 1 and 2 show the revised benefit-cost ratio for one-way operation and the revised marginal benefit-cost ratio for two-way operations, respectively. The estimated total benefit-cost ratio for two-way operation of the Connector is shown in Table 3. As shown in Table 3, the benefit-cost ratio for the two-way alternative is 2.80. However, the marginal benefits for the two-way alternative are only slightly greater than the marginal costs (B/C ratio = 1.08).

If you require additional assistance, or more detailed documentation of our analyses, please call be at (713) 686-2971.

Sincerely,

Robert W. Stokes

xc: D.L. Christiansen
D.W. Borchardt

Table 1. Estimated Benefits-Costs for One-Way Operation of Northwest Inner-Katy Connector for a 20-Year Project Life

Benefit or Cost Component	Present Value (Millions of 1990 Dollars)	
Benefits:		
Travel Time Savings	$15.33	
Total Benefits		$15.33
Costs:		
Construction Cost (Net)	5.30	
Increased Bus Operating Costs	-1.47	
Maintenance	0.07	
Total Costs		$ 3.90
Benefit-Cost Ratio	3.93[a]	

[a]Does not consider an increase in private vehicle operating costs due to increased average travel speed.

Table 2. Estimated Marginal Benefits-Costs for Two-Way Operation of Northwest Inner-Katy Connector for a 20-Year Project Life

Benefit or Cost Component	Present Value (Millions of 1990 Dollars)	
Marginal Benefits:		
Travel Time Savings	$ 2.76	
Total Benefits		$ 2.76
Marginal Costs:		
Construction Cost (Net)	$ 2.80	
Increased Bus Operating Costs	-0.27	
Maintenance	0.02	
Total Costs		$ 2.55
Marginal Benefit-Cost Ratio	1.08[a]	

[a]The marginal benefit-cost ratio is the ratio of the change in benefits to the change in costs for two-way versus one-way operation of the connector.

Table 3. Estimated Total Benefits-Costs for Two-Way Operation of Northwest Inner-Katy Connector for a 20-Year Project Life

Benefit or Cost Component	Present Value (Millions of 1990 Dollars)	
Benefits:		
Travel Time Savings	$18.09	
Total Benefits		$18.09
Costs:		
Construction Cost (Net)	$ 8.10	
Increased Bus Operating Costs	-1.74	
Maintenance	0.09	
Total Costs		$ 6.45
Benefit-Cost Ratio	2.80	