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16. Abstract

This report evaluates the full costs of transportation alternatives on the Houston-Harte Corridor in San Angelo, Texas. The alternatives examined include those considered by the San Angelo District of the Texas Department of Transportation, which are: (1) the continuation of the existing frontage lanes-only configuration and (2) the construction of the mainlanes for completion of the facility. In addition, this study considers each of the above alternatives with transit service along the corridor, resulting in the third and fourth scenarios. The results of MODECOST — a computer model developed by a Center for Transportation Research (CTR) team — indicate that the addition of mainlanes to the Houston-Harte Corridor is both feasible and cost effective.

The case studies conducted as part of this project show that, in many cases, the costs borne by users are equally or more significant than the facility cost in determining the cost implications of various transportation alternatives. The external costs, depending on the volumes of traffic expected along the corridor, may also be substantial. Demonstrating this complex relationship, this case study showed that the capital-intensive Houston-Harte project was, over time, more cost effective than no facility.

This study also shows that full-cost analysis is an effective tool for comparing transportation alternatives. Full-cost analysis provides a value for each alternative that may be used as an assessment indicator to policy-makers and transportation professionals.

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by

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José Weissmann
Mark A. Euritt
Michael Martello

Research Report Number 1356-4

Research Project 0-1356
Development of an Urban Transportation Investment Model

conducted for the

TEXAS DEPARTMENT OF TRANSPORTATION

in cooperation with the

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

by the

CENTER FOR TRANSPORTATION RESEARCH
Bureau of Engineering Research
THE UNIVERSITY OF TEXAS AT AUSTIN

April 1996

IMPLEMENTATION STATEMENT

This report is one of the six case studies demonstrating the application of full-cost analysis for urban passenger transportation investments. Here the MODECOST model developed by the Center for Transportation Research has been applied to evaluate different transportation improvement alternatives for the Houston-Harte Expressway in San Angelo, Texas. Because full-cost analysis provides a quantitative measurement, it represents a useful evaluation tool for transportation planners, engineers, and decision makers.

Prepared in cooperation with the Texas Department of Transportation and the U.S. Department of Transportation, Federal Highway Administration.

DISCLAIMERS

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration or the Texas Department of Transportation. This report does not constitute a standard, specification, or regulation.

NOT INTENDED FOR CONSTRUCTION,
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SUMMARY

This report evaluates the full costs of transportation alternatives on the Houston-Harte corridor in San Angelo, Texas. The alternatives examined are those considered by the San Angelo District of the Texas Department of Transportation, which include: (1) the continuation of the existing frontage lanes-only configuration and (2) the construction of the mainlanes for completion of the facility. In addition, this study considers each of the above alternatives with transit service along the corridor, resulting in the third and fourth scenarios. The results of MODECOST — a computer model developed by a Center for Transportation Research (CTR) team — indicate that the addition of mainlanes to the Houston-Harte corridor is both feasible and cost effective.

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CHAPTER 1. INTRODUCTION

1.1 THE CONCEPT OF FULL-COST ANALYSIS

Traditional transportation planning regards highway projects and transit projects as separate issues. For the most part, the two types of transportation (and others such as bicycle and pedestrian projects) were never compared with each other. This approach arose from two somewhat related factors. First, the past four decades of federal funding for highways were the result of and perpetuated the idea that "free"-ways were necessary to the nation's economic health and security concerns. This meant that transportation planning was biased toward roadway and personal vehicle solutions in efforts to resolve community transportation needs.

The second reason that highway and transit projects have been rarely considered jointly is the lack of an appropriate methodology for such an evaluation. That is, the methods of evaluating highway projects rely on measures of level-of-service (LOS) improvement (LOS improvement depends on speed, volume, and capacity of a facility), the number of accidents that an improvement might prevent, and savings to the users of the highway; by contrast, transit projects are evaluated in terms of increases in transit ridership and travel time savings for users.[1] These measures of effectiveness are applicable to each mode uniquely, not to all modes universally, and are thus inadequate for making critical planning decisions.

The need to develop a methodology for comparing the different modes has arisen as a result of several changes. Funding sources for transportation, both federal and local, are dwindling; as a consequence, community leaders are finding it more difficult to decide which projects to pursue. They want more and better information in order to make these decisions (or at least to justify the decisions they have already made). Also prompting the need to compare different transportation modes is the moderation of the federal commitment to a national "free" highway system. This may be the result of other funding choices having higher priority; it may be complacency by leaders who don't remember a time without the interstate system or who judge it to be sufficient in its current condition; or it may be that leaders are more concerned with the now enormous task of maintaining and rehabilitating the existing system. Finally, recent federal legislation has indicated a growing awareness of the importance of roadway alternatives in solving transportation problems.

To address these concerns, the Center for Transportation Research (CTR) of The University of Texas at Austin has developed MODECOST, a computer software program that calculates the full life-cycle costs of different modes operating on a particular corridor. Using MODECOST, planning agencies can now evaluate cost information that is unbiased toward any particular mode.

Thus, this report (1) documents the selection of San Angelo, Texas, as a site appropriate for a case study and (2) discusses analysis results.

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[1]DeCorla-Souza, Patrick, and Ronald Jensen-Fisher. "Comparing Multimodal Alternatives in Major Travel Corridors." *Transportation Research Record 1429*, Transportation Research Board, 1994.

1.2 THE MODECOST MODEL

1.2.1 Introduction

Two reports from this project discuss full-cost modal analysis in more detail. Report 1356-1 reviews the literature and current practice with regard to full-cost transportation models. Report 1356-2 provides a technical description of the operation and implementation of MODECOST.

The MODECOST model incorporates aspects of modal costs that have not traditionally been accounted for. For example, many of the external costs, such as air pollution and accident costs, are not usually included in decision matrices for transportation expenditures. For personal vehicles, often the roadway facility cost will be looked at, but not the personal vehicle cost. By taking costs such as these into account, full-cost models are measuring the cost of each mode to *society*, not merely the marginal cost of individual projects as they are recorded in governmental budgets.

In brief, MODECOST is a full-cost model that attempts to calculate the total cost for each of three modes — private vehicles, bus, and rail — along a particular corridor within a given community. Figures 1, 2, and 3 illustrate the costs that are included for each mode in MODECOST. The costs are grouped into facility, external, and personal vehicle costs; the model calculates subset costs for each of these groups.

1.2.2 Cost Components in MODECOST

The agency cost, also called the facility cost, is calculated on the basis of both capital and non-capital costs to the agency (usually governmental but occasionally private) responsible for the facility. In the case of roadway facilities, capital costs include the expense of right-of-way acquisition, construction, and rehabilitation of the facility. Non-capital costs include the costs of routine maintenance, administration and safety, and debt service, if applicable. These non-capital costs (including the inevitable costs for facility rehabilitation) may not always be considered in traditional new-facility need assessments, yet clearly they add up over time.

The external costs associated with different transportation modes have received increasing attention over the last few decades, as awareness of environmental impacts of transportation has increased. The MODECOST model includes these and other environmental impacts. In addition, the model addresses as external costs the travel time, incident delay, and accident costs. Because these additional costs can vary significantly between modes, their inclusion in the decision-making process is required in order to address the efficiency and safety of different modes within a particular corridor.

The last group of costs to be calculated is the operational cost of each of the alternatives. For bus and rail facilities, the operational costs are those traditionally considered. With regard to roadways, this group of costs is rarely, if ever, included in the decision-making process, except to acknowledge the varying ability of different groups within a population to afford certain modes of transportation. The MODECOST model does not attempt to address this equity question directly. However, by identifying the full cost of a transportation alternative, model results can be used to select the least-cost option. That is, for roadway facilities, the model does provide decision-makers information about the cost borne by citizens by calculating their ownership and operating costs.

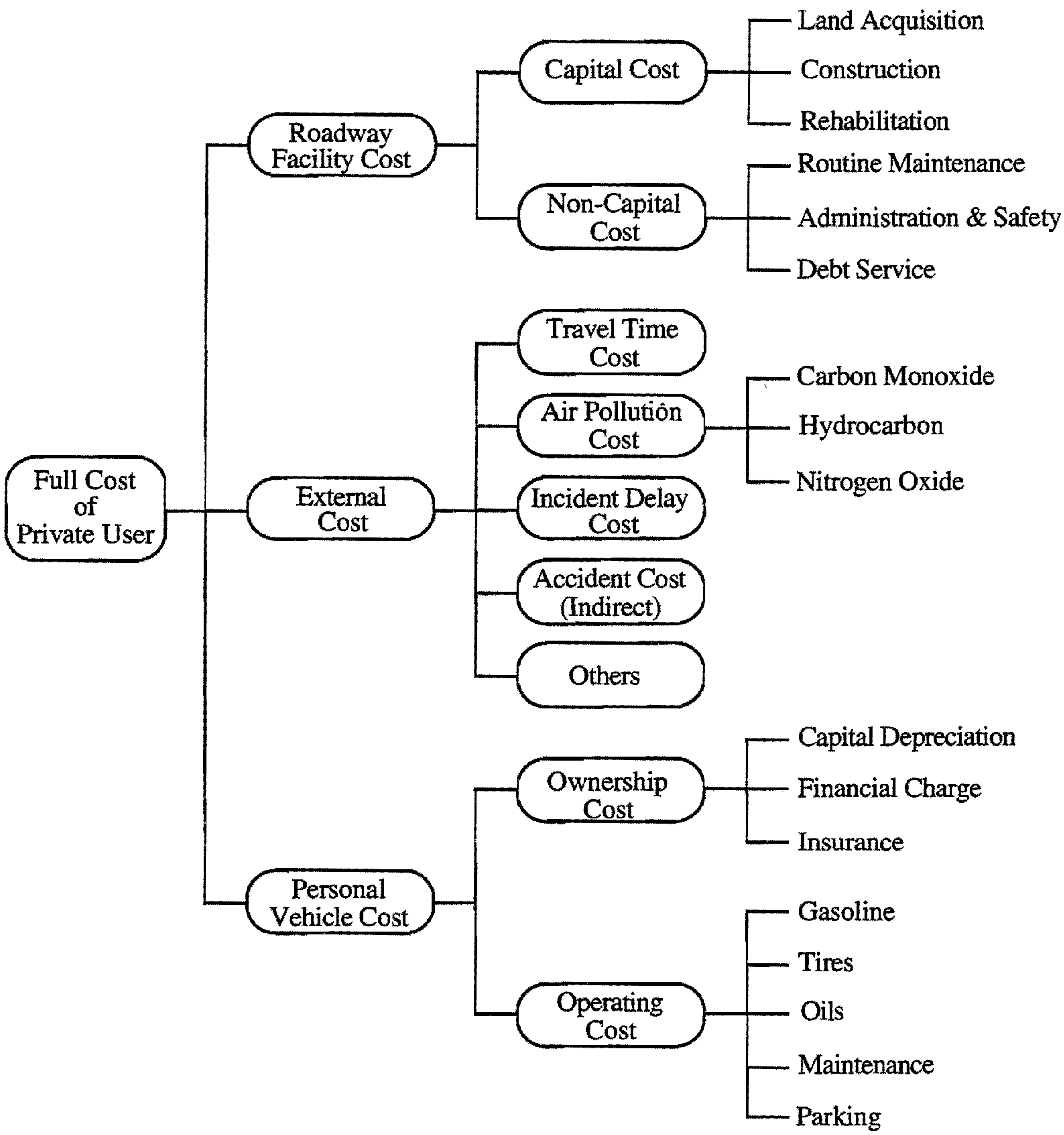

Figure 1. Elements of full-costs of private users

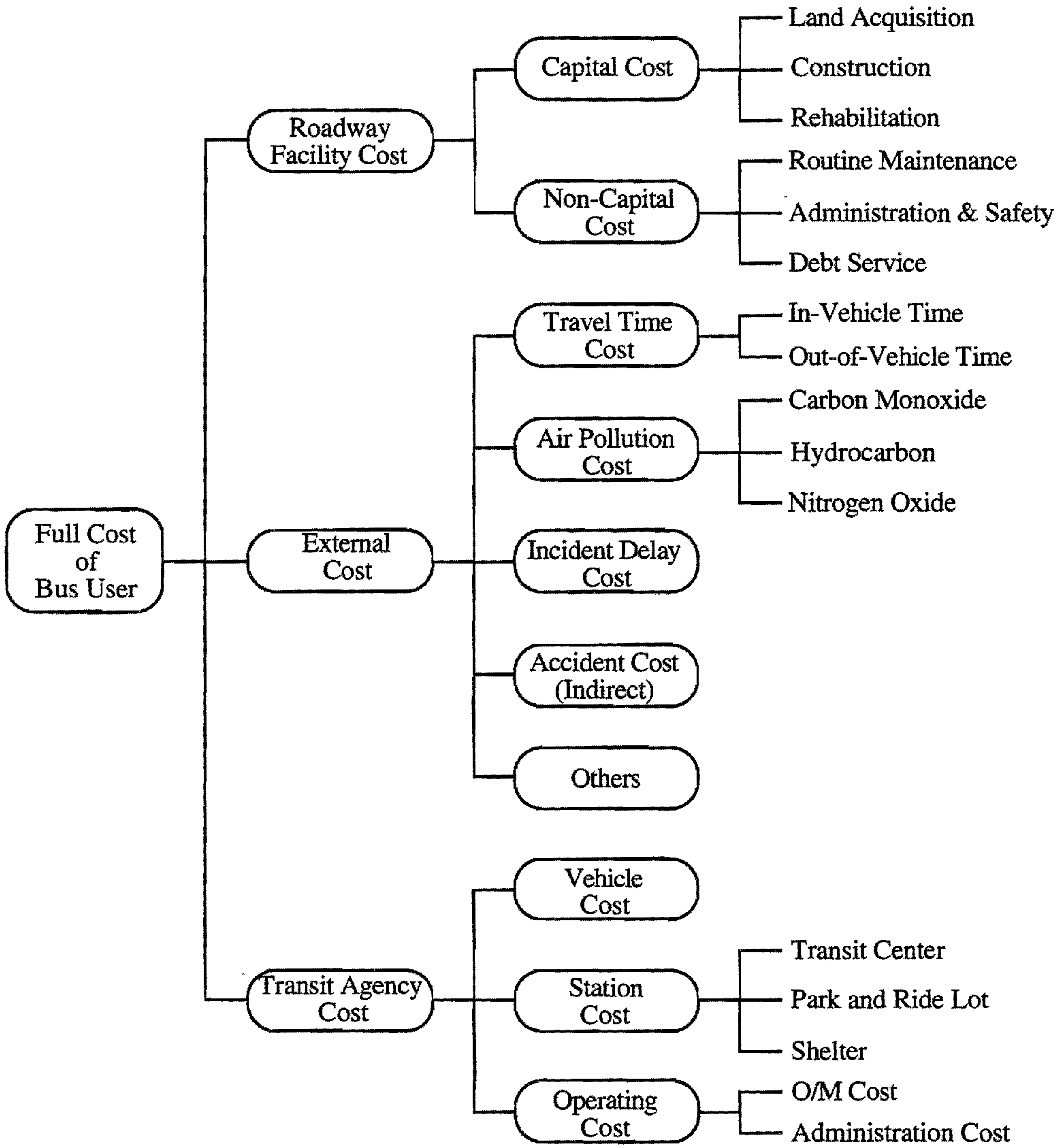

Figure 2. Elements of full-costs of bus users

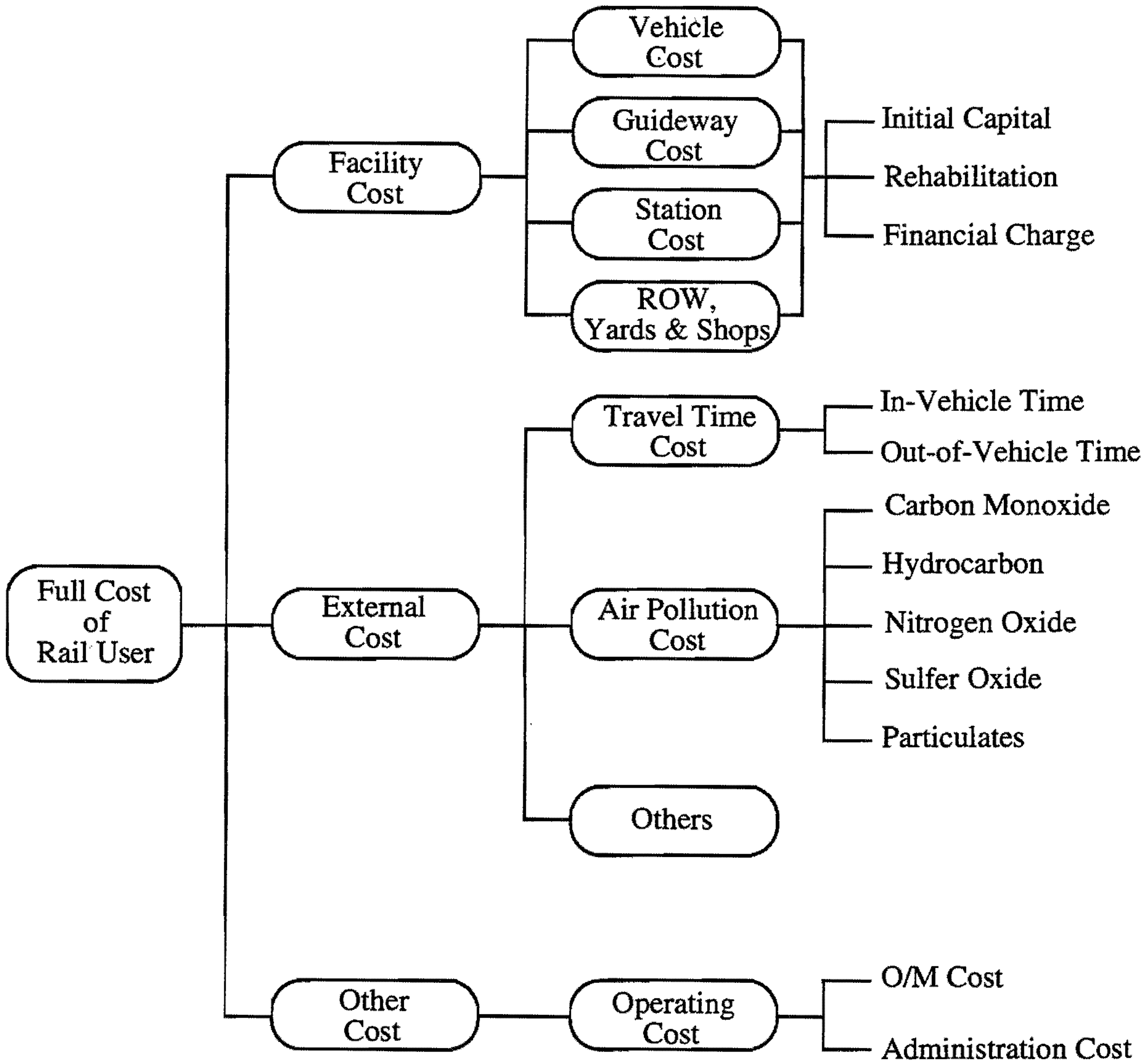

Figure 3. Elements of full-costs of rail users

1.2.3 Life-Cycle Accounting in MODECOST

The calculation of costs on a life-cycle basis is a significant component of the MODECOST model. First, because most transportation structures operate over an extended period of time, their often substantial initial costs should be allocated over their expected lifetime, rather than in one lump sum at their inception. In addition, life-cycle costing takes into account other costs that accrue throughout the life of a structure, such as maintenance, operation costs, user costs, and external costs. In general, the life-cycle cost approach involves both the acquisition and operation stages. This aspect of the MODECOST model is discussed in more detail in Research Report 1356-2.

CHAPTER 2. OVERVIEW OF CASE STUDY SITE

2.1 A BRIEF INTRODUCTION TO THE CITY OF SAN ANGELO

2.1.1 Location and History

San Angelo is located in west-central Texas at the intersection of US Highways 87 and 67, between the Texas Hill Country to the southeast and the Rolling Plains to the northwest. Interstate Highway 20 runs approximately 105 km to the north, while Interstate Highway 10 is accessible 100 km to the south. By the most direct routes, the city is 320 km from Austin, the state capital, and 340 km from metropolitan San Antonio. These distances are relatively close in Texas terms, but great enough to minimize external traffic. These features render San Angelo a good candidate for a transportation study.

San Angelo was first established as a village outside of Fort Concho in the latter half of the 1800s. The village attracted the trade of area farmers and ranchers as it grew, and subsequently acquired a reputation as a medical center, primarily owing to its dry climate that benefited tuberculosis victims. As of 1995, San Angelo had a population of around 88,000 and a diverse economy supported by agriculture, petroleum, communications, education, retail, tourism, medical, and retirement activities.

2.1.2 Population and Economic Characteristics

The population of the San Angelo Metropolitan Statistical Area (which comprises all of Tom Green County) in 1990 was 98,458 situated on a total land area of 2500 square km. As shown in Table 1, the population has increased steadily over the last two decades, up by 19.3 percent from 1970 to 1980 and by 16.1 percent from 1980 to 1990. The number of households in 1985 was estimated at 35,400, with 2.64 persons per household.[2] The population is predominantly white (55 percent), with Hispanic (26 percent), black (4 percent), and other (14 percent) populations represented as well.[3]

Table 1. San Angelo MSA population and density[4]

Characteristic/Year	1990	1980	1970
Population	98,458	84,784	71,047
Population per square kilometer	40.2	34.6	29.0
% Increase over Previous Decade	16.1	19.3	-

[2]*State and Metropolitan Area Data Book 1991*. U.S. Department of Commerce, Bureau of the Census, issued August 1991.
[3]*Texas Almanac, 1996-1997*. Dallas Morning News, Inc., 1995.
[4]*State and Metropolitan Area Data Book 1991*.

The economic profile of the San Angelo Metropolitan Statistical Area is primarily service-oriented, with 24 percent of total earnings coming from the general service industry and 21 percent coming from the governmental sector. Goods-related industry contributes a mere 22 percent of earnings, with 12.4 percent of that derived from manufacturing. The unemployment rate holds fairly steady at around 6 percent. Personal income per capita in 1988 was recorded at $13,964.[5]

2.1.3 Land Use of the City

Given San Angelo's current population of 88,000 within the city limits, it is clear that most of the population of the county is urban, with urban land use therefore an important indicator of area traffic patterns. San Angelo's layout appears to be more sprawled than compact. Although the city covers 80 square km, resulting in a population density within the city limits of 1,045 persons per square km,[6] and although government, medical, and professional offices are located near the center of the city, outlying suburbs provide a variety of shopping centers and retail businesses. The city has a convention center, a coliseum, a city auditorium, and a Museum of Fine Arts. Other city attractions include Angelo State University (enrollment approximately 6,300) and the Goodfellow Air Force Base (employment 3,800). Average costs for both new and existing houses are below the national average.

The city of San Angelo was selected by the Texas Legislature to be the site of the $26-million emergency computer back-up system for the state's computers, with completion scheduled for 1996. The facility will be located on the Angelo State University campus and will be operated under a partnership with the State Department of Information Resources.

2.2 GENERAL TRANSPORTATION ISSUES AND ALTERNATIVES

San Angelo provides the regional transportation access necessary to Texas towns. The city is located at the junction of US Highways 87 and 67, and Highways 208 and 584, which access Interstate Highways 20 and 10 to the north and south of the city, respectively. Loop 306, a four-lane roadway with controlled access and no traffic lights, complements these roadways downtown and in the southern portion of the city.

The distribution of land use activities within the city, as described above, is supported by the roadway infrastructure: motorists can travel from one side to the other within 20 minutes or less via US 67, US 87/Bryant Boulevard, or Loop 306.

San Angelo enjoys a variety of transportation services. The city has shown recent support for the pedestrian mode: the Celebration Bridge, linking downtown with the RiverState area, was completed July 4, 1993, with thousands of private contributions covering half the cost. San Angelo is the site of the main yard of the South Orient Railroad, which presides over one of the seven rail crossings into Mexico through Texas. Ten motor (roadway) freight companies serve San Angelo. San Angelo's Mathis Field is served by American and Delta airlines commuters, predominantly with connections through Dallas-Fort Worth.

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[5]State and Metropolitan Area Data Book 1991.
[6]*San Angelo Metropolitan Transportation Plan, 1995-2015.*

2.3 FOCUS ON THE HOUSTON-HARTE CORRIDOR

As shown in Figure 4, the Houston-Harte corridor runs through the center of the city, roughly parallel to Business Route US 67, which runs diagonally from the southwest to the northeast. If constructed, the Houston-Harte Expressway would significantly impact traffic flow through its provision of fewer intersections, greater speed, and greater capacity. The corridor already links industrial, retail, recreational, and residential areas. Certain areas along the corridor already show further development.

The Houston-Harte Expressway project began in 1968 with the issuance of Texas Transportation Commission Minute Order 60827. The project has progressed slowly, but doggedly, in the intervening years, as shown in Table 2.

Table 2. Houston-Harte time line

Year	Action
1968	Commission Minute Order 60827
1971	Schematics, public hearing, environmental impact statement (EIS), design public hearing, preparation of right-of-way (ROW) data, capital improvement bonds passed for $3 million to fund the city's portion
1972	Preliminary engineering began, as did the process of relocating 350 families in the proposed expressway's path
1982	Completed frontage roads from Van Buren Street to Main Street
1983	Completed frontage roads from US 67 west of San Angelo to Van Buren Street
1986	Completed frontage roads from Main Street to US 67 east of town
1991	Both east and west interchanges of the Houston-Harte completed
1995	Contract let to construct mainlane overpass structures over the Concho River, US 87 (Bryant Blvd.), and a railroad crossing, as well as construct connecting ramps

At the present time, the frontage roads are complete, but mainlanes are not yet funded. The resulting present-day configuration is two frontage lanes running east and two running west, as shown in Figure 4. This present-day scenario is the base year scenario to be considered as Alternative 1.

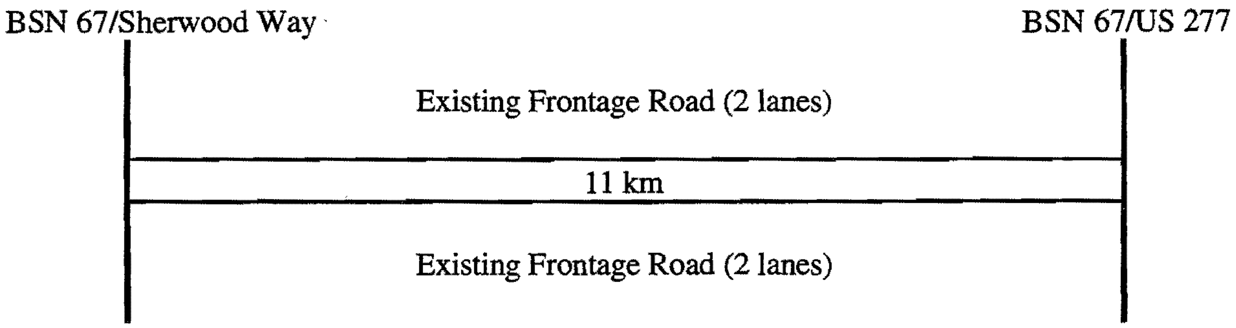

Figure 5. Alternative 1 — Existing configuration

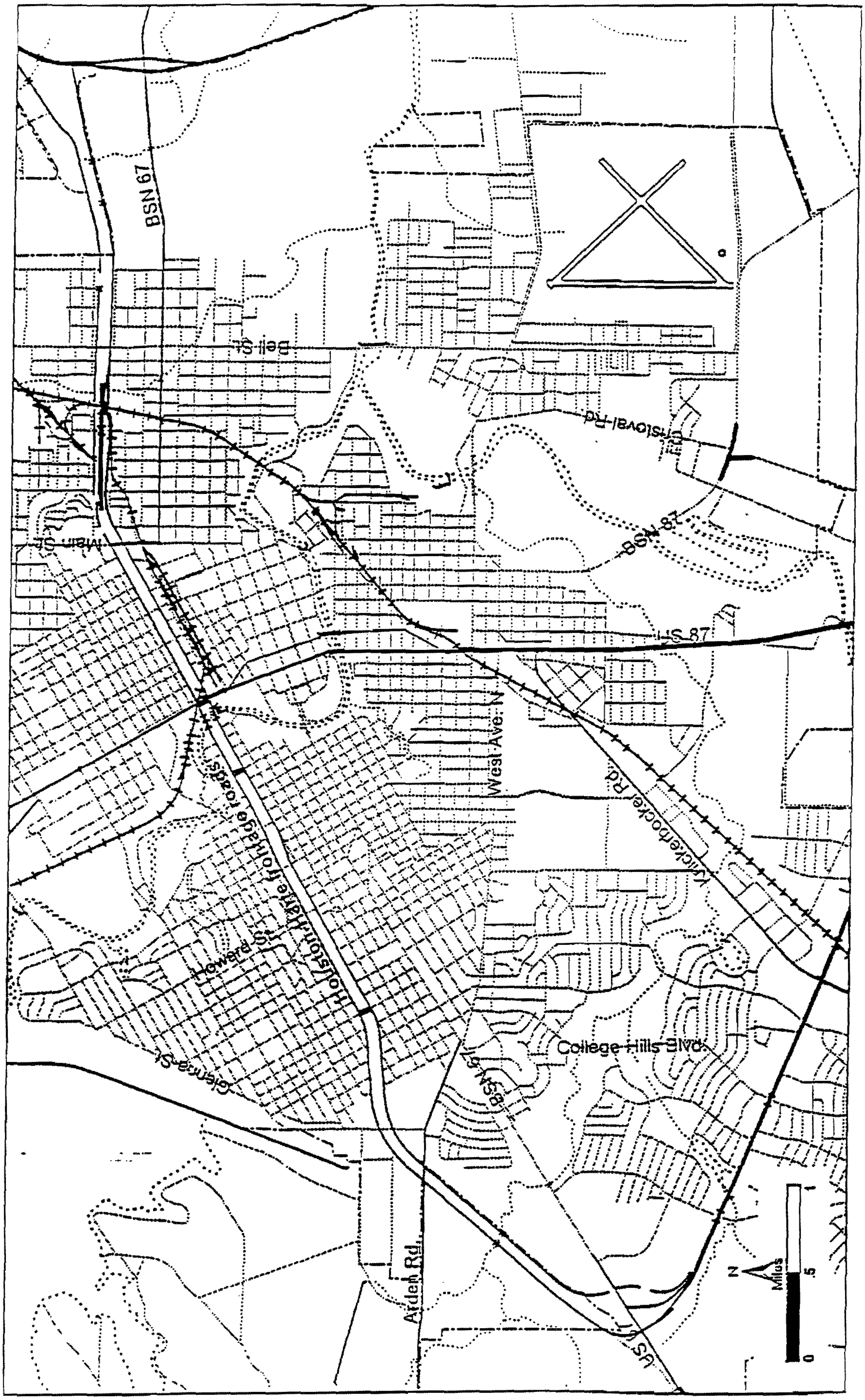

Figure 4. Map of the Houston-Harte Corridor

A review of the average daily traffic counts for the frontage roads since their completion in 1986 reveals an average annual growth rate of 5 percent. In planning for the completion of the Houston-Harte Expressway, TxDOT has calculated that, with construction of the mainlanes, the facility will experience the same annual growth rate of 5 percent in travel demand. This mainlane scenario is represented as Alternative 2, shown in Figure 6.

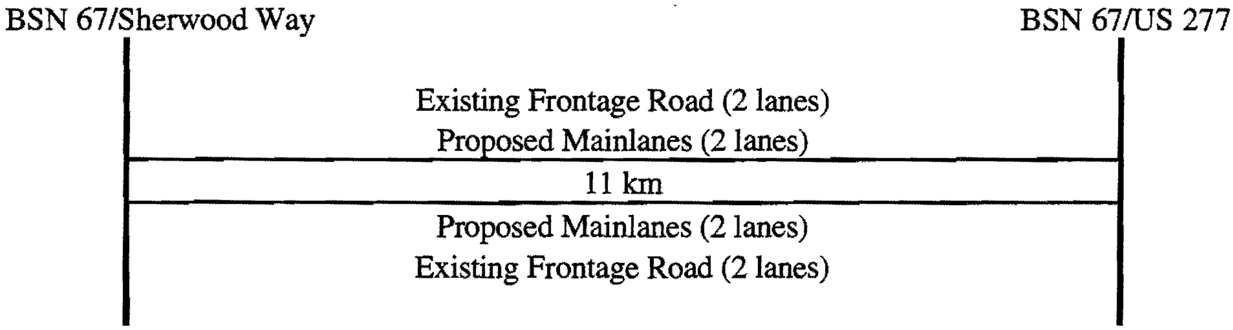

Figure 6. Alternative 2 — Construct mainlanes

The two scenarios shown in Figure 5 and Figure 6 above address the alternatives being considered by TxDOT. Because the flexibility of the MODECOST model allows for the consideration of additional modal alternatives, two additional alternatives for the Houston-Harte corridor have been presented. As shown in Figure 7, Alternative 3 considers the existing configuration with the addition of transit service in both directions. Figure 8 shows Alternative 4, which addresses the construction of the mainlanes, also with additional transit service in each direction. Of the four scenarios, then, Alternatives 1 and 3 model the existing frontage roads-only configuration without and with transit service, respectively; Alternatives 2 and 4 model the proposed mainlanes-with-frontage-roads configuration without and with transit service.

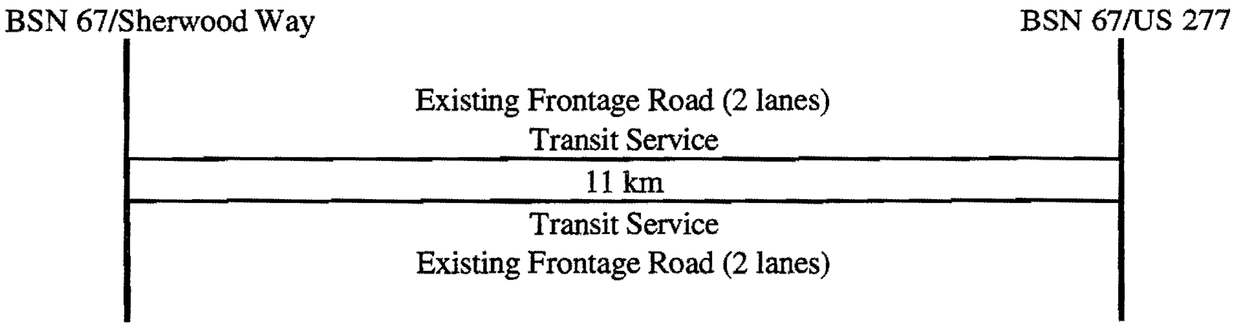

Figure 7. Alternative 3 — Existing configuration with transit service

BSN 67/Sherwood Way — BSN 67/US 277

Existing Frontage Road (2 lanes)
Proposed Mainlanes (2 lanes)
Transit Service

11 km

Transit Service
Proposed Mainlanes (2 lanes)
Existing Frontage Road (2 lanes)

Figure 8. Alternative 4 — Construct mainlanes with transit service

The City of San Angelo made a financial commitment to the project with the issuance of $3 million in bonds in 1971. Perhaps even more significant, the residents committed the shape of their city to this project: the right-of-way for the Houston-Harte cuts a sizable swath between the north and south sections of the city, the result of 350 families selling their homes and relocating during the 1970s. Further information on the feasibility and necessity for taking the final steps toward completion of the mainlanes may enable San Angeloans to better evaluate that next step.

CHAPTER 3. DESCRIPTION OF INPUT DATA

The objective of this study is to determine the transportation alternative in the Houston-Harte corridor that best serves the community of San Angelo at the least cost. This study covers the period from 1995 to 2025. Flexible pavement, as was employed for the construction of the frontage roads, would be used to construct the 11 km[7] of mainlanes. The remainder of data input into the model for this study is recorded below.

3.1 PERSON-TRIP DEMAND

The average number of daily person-trips was calculated from the average figure of 19,500 vehicle-trips per day.[8] For weekdays, this figure was translated into 23,136 person trips. The corresponding weekend figure is 19,281 person trips. These figures assume an average auto occupancy of 1.13 and a traffic distribution of 75 percent during weekdays and 25 percent on weekends.[9]

The average annual growth rate of traffic along the Houston-Hart corridor without the addition of mainlanes was derived through examination of the growth trend since 1988 (the frontage roads were completed in 1986, but count information is available only along the entire corridor since 1988). By weighting the growth rates according to the heavier-traveled count segments, a growth rate of 5 percent resulted (the auto occupancy was assumed to be constant over this period). Notably, this figure is higher than the growth rate projected by the San Angelo Metropolitan Planning Organization for the city's entire roadway network over the next 20 years.[10] Because the MPO's figure accounts for a variety of facility types over the area, and because the growth rate over a more recent period of 1991 to 1994 is actually above 8 percent, the 5 percent figure is assumed to be more realistic for the high-volume Houston-Harte corridor even without the addition of mainlanes (and possible capacity constraints).

The average annual growth rate of traffic along the Houston-Harte corridor with the addition of mainlanes was provided by TxDOT. This figure is also 5 percent. This similarity between the scenarios will serve to facilitate comparison for the purpose of this study. Nonetheless, higher capacity in general attracts higher demand, so that this similarity may be unrealistic. Again, the growth rate over the recent period of 1991 to 1994 for the frontage roads was above 8 percent. For the purpose of this study, and because of the source of the figure, 5 percent is assumed to be appropriate for the mainlanes scenarios.

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[7]Model inputs follow the U.S. Customary System.

[8]According to the draft Delegation Appearance Report to the Texas Transportation Commission, dated August 31, 1995, provided by the San Angelo District Office of the Texas Department of Transportation.

[9]A TxDOT traffic count at a site on US 67 4.5 km southwest of FM 2388 (STA S006) for 1993 demonstrates a 70-30% split, but a second count site south of town at US 277 and US 87 (STA S051) demonstrates a 75-25% split. The 75-25% split was chosen because it more closely follows the typical behavior of weekdays demonstrating slightly higher traffic in general than weekend traffic, i.e, as shown in Table 11.1 in the *ITE Transportation Planning Handbook*, 1992. A traffic count of an entire week at the site would determine this split with greater confidence than do these two cited counts on the outskirts of the urban area.

[10]Calculated using Trip Statistical Data from the *1994 San Angelo Metropolitan Transportation Plan*.

3.2 FREIGHT TRUCK DEMAND AND MIX

The portion of traffic demand attributable to truck traffic is assumed to be 8.1 percent[11] for both scenarios and was distributed between weekday (1,874) and weekend (1,562) person trips according to the same ratio for auto traffic. This figure was provided by TxDOT for the scenario of the construction of the mainlanes. No better information was available for the corridor without the mainlanes.

Within this figure of 8.1 percent for freight truck traffic, the distribution among different truck categories was allotted according to the distribution observed by the TxDOT count station on US 67 4.5 km southwest of FM 2388 (STA S006) in 1993. This distribution is shown in Table 3.

Table 3. Freight truck mix

Truck Category	Percentage (%)
Other 2-Axle Single Unit	61
3-Axle Single Unit	14
3-Axle Semi-Trailer	6
4-Axle Semi-Trailer	4
5-Axle Semi-Trailer	11
6-Axle Semi-Trailer	2
5-Axle Full-Trailer	0
6+-Axle Full-Trailer	2

3.3 TRAFFIC DISTRIBUTION BETWEEN THE FRONTAGE AND MAINLANES

For Alternatives 1 and 3, the percentage of person trips occurring along the frontage roads is — owing to the absence of mainlanes — clearly 100 percent. For Alternatives 2 and 4, the distribution of traffic between the frontage roads and mainlanes is problematic.

Mainlanes typically accommodate through traffic. It is likely that with the construction of the Houston-Harte mainlanes, much of the through traffic traveling along the east-west US 67 corridor will use these lanes. The frontage roads, which typically provide local access and often act as major arterials for the purpose of local travel, will represent some share of person trips, though these trips will tend to be shorter.

Taking these considerations into account, and in the absence of better information, a distribution of 90 percent mainlane and 10 percent frontage road is assumed for the purpose of this study.

[11] According to the draft Delegation Appearance Report to the Texas Transportation Commission, dated August 31, 1995.

3.4 MODE SPLIT ON MAINLANE (AUTO AND BUS)

For Alternatives 1 and 3, the mode split is assumed to be 100 percent auto. Currently, no transit route runs along the frontage roads. The average auto occupancy is assumed to remain constant at the average figure of 1.13. The percentage of automobiles that are operated by non-commercial users is assumed to be 99 percent. The total yearly vehicle-miles traveled in the City of San Angelo is 520 million.[12] The percentage of this total that occurs on expressway facilities in the city is assumed to be 6 percent. The mode splits for Scenarios 3 and 4 are discussed in Section 4.4.

3.5 TRAFFIC DISTRIBUTION DURING PEAK AND NON-PEAK PERIOD

The most reliable data on peak and non-peak period traffic distribution again come from the rural TxDOT count station located on US 67 near FM 2288.[13] This distribution was used to represent the traffic distribution along the Houston-Harte corridor (two lanes in each direction) on both weekdays and weekends under all three scenarios. The distribution is shown in Table 4.

Table 4. Traffic distribution during peak and non-peak periods

	Weekday		Weekend	
Period	Person-Trips in One Direction (%)	Period Duration (hours)	Person-Trips in One Direction (%)	Period Duration (hours)
AM Peak	6	2	-	-
PM Peak	12	3	-	-
Day	21	7	37	9
Night	11	12	13	15
Total	50	24	50	24

Because the Houston-Harte corridor runs east-west from one side of San Angelo to the other, and because of the absence of more reliable data, the directional distribution is assumed to be 50-50 percent. Although the model provides for the designation of AM and PM peak periods on the weekend, the count site distribution does not demonstrate these peaks. Note that this same distribution has also been applied to freight truck traffic.

3.6 FACILITY COST

Unit costs (in most cases on a unit-cost-per-mile basis in MODECOST) for the calculation of the facility cost have been derived from TxDOT internal documentation for General Guidelines for Estimates. These unit costs are provided as default data in the MODECOST model.

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[12] *Highway Statistics, 1992.* U.S. Department of Transportation, Government Printing Office, Report Number FHWA-TL-93-023.

[13] Calculated using the hourly distribution of traffic according to a TxDOT count at a site on US 67 4.5 km southwest of FM 2388 for 1993. (Note that this site, being just outside the urbanized area, may not adequately reflect the hourly distribution of traffic inside the urbanized area. Traffic counts along the Houston-Harte frontage roads would be a better indicator.)

3.7 CAPITAL AND OPERATING DATA FOR PERSONAL VEHICLES

Capital and operating data that are specific to a certain locality are difficult to acquire. For the purpose of this study, figures from a national study were applied, as recorded in Table 5. The figure for parking (nationally $360) was judged to be inappropriate in the case of San Angelo, which did not appear to have many pay-parking facilities.

Table 5. Capital and operating data for personal vehicles[14]

Cost Category	Cost
Average Vehicle Price ($)	13,534
Average Pickup and Van Price ($)	15,813
Percent Financed (%)	75
Loan Period (year)	5
Loan Rate (%)	10.0
Salvage Value ($)	1,000
Vehicle Life (year)	12
Percent of Pickups and Vans (%)	20
Average Annual Miles Driven (miles)	10,700
Annual Scheduled Maintenance ($)	232
Annual Unscheduled Maintenance ($)	195
Annual Oil Change ($)	59
Annual Tire Change ($)	97
Annual Insurance ($)	600
Annual Parking ($)	-
Enhanced I/M ($)	55
Average Gasoline Price w/out Taxes ($)	0.70

3.8 TRANSIT DATA

The following information for transit capital and operating costs was provided by the San Angelo Metropolitan Planning Organization.[15] The average bus occupancy is 3.87 persons per vehicle, according to surveys performed by the MPO. Bus overhaul expenses are assumed to be included in the operation and maintenance budget.

[14]*Cost of Owning & Operating Automobiles, Vans & Light Trucks 1991.* U.S. Department of Transportation, Washington, D.C., 1992.
[15]Conversations with Mr. J. D. Reyes, Summer 1995.

Table 6. Capital and operating data for transit

Cost Category	Cost
Bus Vehicle Price ($)	260,000
Bus Vehicle Salvage Price ($)	900
Vehicle Life (year)	10
Annual Miles Traveled (miles)	39,336
Bus Station Cost ($)[16]	1,168,967
Expected Station Life (yr.)	30
Bus Shelter Price ($)	3,000
Number of Bus Shelters	12
Expected Shelter Life (yr.)	30
Transit User Average Trip Length (mile)	4.06
Bus Stop Spacing (mile)	0.98
Headway (minutes)	60
User Travel Time -- Bus to Destination (min.)	3.5
Operation/Maintenance Percentage of Total Cost	0.6099

Placing a value on time is both necessary and difficult. It is necessary in order to account for time delays experienced under different scenarios, and it is difficult because there is very little agreement on estimations of the value of time. For the purpose of this study, in comparing the different modes, the same figure has been used in each of the scenarios, that of $3.00 per hour.[17]

3.9 EMISSION VALUES

The values placed on pollutant damage for this study are those provided in the MODECOST model as default data: hydrocarbons (HC) $2.00 per Kg, nitrous oxides (Nox) $3.90 per Kg, sulfur oxides (Sox) $1.60 per Kg, and particulates (PM) $2.90 per Kg.

In relation to these values, the truck and bus equivalent factors were input at 1.70 and 1.50 per passenger vehicle, respectively. Again, these are default factors provided with the MODECOST model.

3.10 EXTERNAL COST DATA

Other costs were included in this case study to reflect additional external costs to transportation. These figures are based on studies cited in Report 1356-1: local government cost

[16]San Angelo received ISTEA Transportation Enhancement funding to renovate an existing facility into a bus station; this is the figure used for Bus Station Cost.
[17]An hourly wage rate of $9.10 was calculated from the average weekly wage documented by the Texas Employment Commission for the 4th quarter of 1991 through the 1st of 1992 (1996-1997 Texas Almanac). The figure of $3.00 represents one third of this rate according to Peter L. Watson, *The Values of Time: Behavioral Models of Modal Choice*, Lexington Books, 1974.

was estimated to be equal to \$0.0275/person-mile traveled; noise cost, to \$0.0014/PMT; water pollution, to \$0.0013/PMT; and energy security, to \$0.03/PMT.

3.11 OTHER DATA

Population density for the City of San Angelo was calculated to be 1,045 persons per square km.[18] The rainfall and snowfall rates are both below average.[19] Based on government documents, a discount rate of 10 percent was applied to bring all costs into 1995 dollars.

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[18]Derived using 1991 population and land use information from Tables 4.1.1-1 and 4.1.2-1 from the *San Angelo Metropolitan Transportation Plan, 1995-2015.*
[19]*1996-7 Texas Almanac.*

CHAPTER 4. FULL-COST COMPARISON OF ALTERNATIVES

4.1 INTRODUCTION

The primary objective of this report is to identify and evaluate the alternatives available to the San Angelo community with regard to the Houston-Harte corridor. This full-cost analysis allows decision-makers to objectively weigh the alternatives and provides perspective with which to make their decision.

As explained previously, there are two alternatives currently under consideration. The first is to continue to operate under the frontage-lanes-only configuration indefinitely. The second is to fund and complete the construction of the mainlanes of this 11-km facility. Two additional scenarios are considered in this case study. Essentially, they are the same as the two above, but with the additional consideration of transit service along the Houston-Harte corridor. In this chapter these alternatives are considered in the following sections:

Section 4.2 Scenario 1: Existing Configuration Only
Section 4.3 Scenario 2: Construct Mainlanes
Section 4.4 Scenario 3: Existing Configuration with Transit Service
Section 4.5 Scenario 4: Construct Mainlanes with Transit Service
Section 4.6 addresses comparison of the results of each of these four scenarios.

The results are compared on the basis of each of the cost categories as derived through application of MODECOST. Section 4.6 also addresses the traditional decision-making factor of up-front lump sum cost versus the annualized cost consideration proposed by the authors of MODECOST and discussed previously.

4.2 SCENARIO 1: EXISTING CONFIGURATION

The first step in the full-cost analysis of the Houston-Harte corridor is the base case scenario, i.e., continued operation on the current configuration of frontage roads with no mainlanes, as shown in Figure 9.

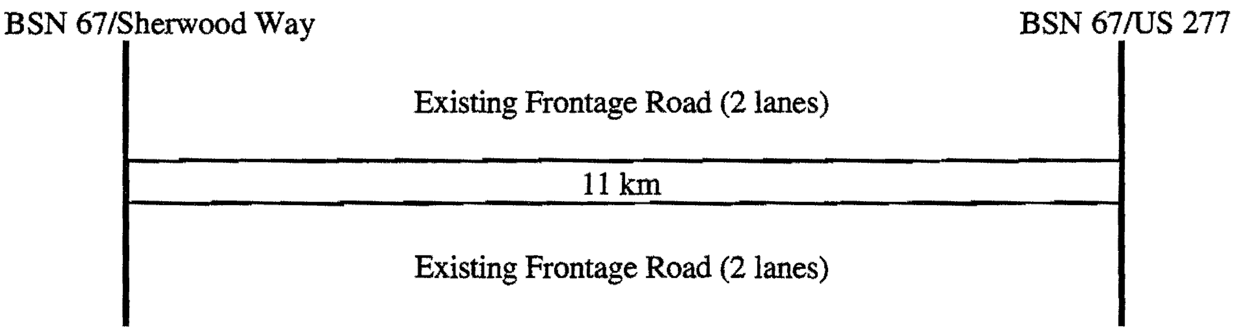

Figure 9. Scenario 1— Existing configuration

The model results for the base case existing scenario are summarized in Table 7. The findings reveal that with the existing Houston-Harte configuration of completed frontage roads acting as arterials, the users (or drivers) pay the highest cost — $38.2 million per year. The annual cost to the agency responsible for building and maintaining the frontage roads, in this case the Texas Department of Transportation's San Angelo District, is small in comparison, at $2.5 million. The annual external costs are $7.1 million.

Table 7. Results for Scenario 1

Cost Category	Million $
Annual Agency Cost	**2.5**
Highway Facility	2.5
Annual User Cost	**38.2**
Auto Traveler's Time & Delay	10.2
Auto User Other Costs	27.2
Commercial Truck Time & Delay	0.8
Annual External Cost	**7.1**
Auto Pollution	0.6
Auto Other Externality	5.4
Auto Accident	0.8
Truck Accident	0.1
Truck Pollution	0.3
Annual Total Cost	**47.8**

Figure 10 demonstrates how the costs in Table 7 are distributed. As shown, auto user cost represents the largest portion at 56.9 percent, or $27.2 million. This figure includes ownership and operating costs inherent to the private vehicle mode of transportation: capital depreciation, finance and insurance charges, gasoline, tires, oil, and maintenance. Travel time and delay, most of it representing cost to auto users, represents the next largest portion at 23.0 percent, or $11.0 million. This travel and delay cost reflects the fact that the frontage road facility includes 12 intersections and operates with the capacity of an arterial. The agency cost, for the construction and maintenance of the highway facility, represents only 5.2 percent of the total cost, at $2.5 million. The distribution of these costs as shown in Figure 10 demonstrates the importance of considering the other costs of transportation beyond facility cost.

Because of the life-cycle cost dimension of MODECOST, these annual cost figures take into account the increasing costs of the facility to the San Angelo community over time. This aspect of cost is not always considered in the traditional transportation planning approach. As shown in Figure 11, the total annual cost of the facility steadily increases throughout the study period.

A crucial question for understanding the cost implications of this base case scenario regards the factors contributing to these costs. For the Houston-Harte frontage roads, two factors drive the cost trend, neither of which is the facility cost that figures so highly in the traditional decision-making approach. Figure 11 demonstrates that the facility, accident, incident delay, and air pollution costs remain relatively constant over the 30-year life of the facility. Over the same period, the external cost increases steadily, while time delay cost and user costs figure most prominently.

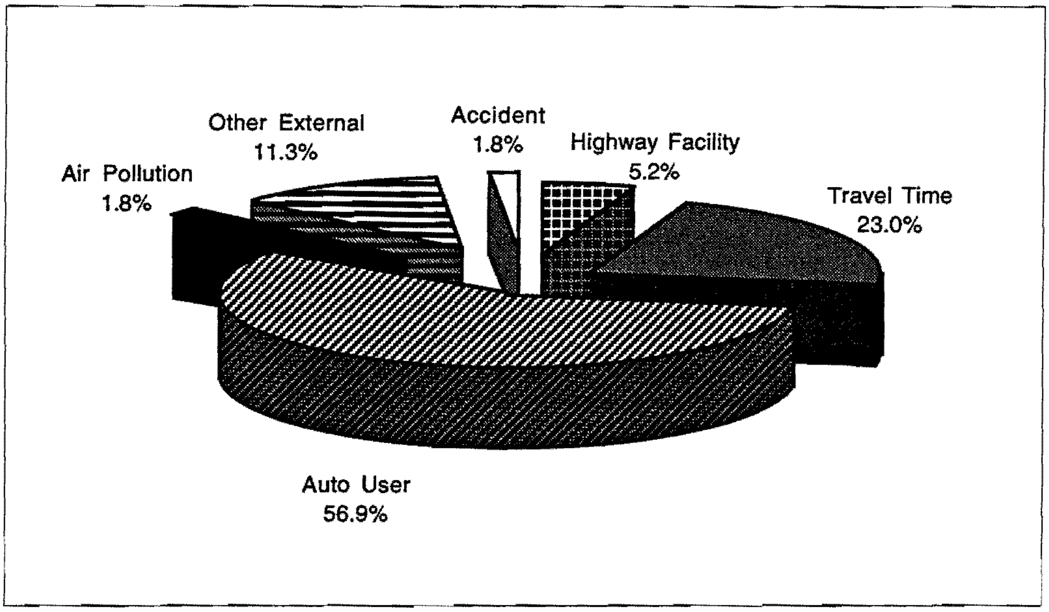

Figure 10. Annual cost distribution under Scenario 1

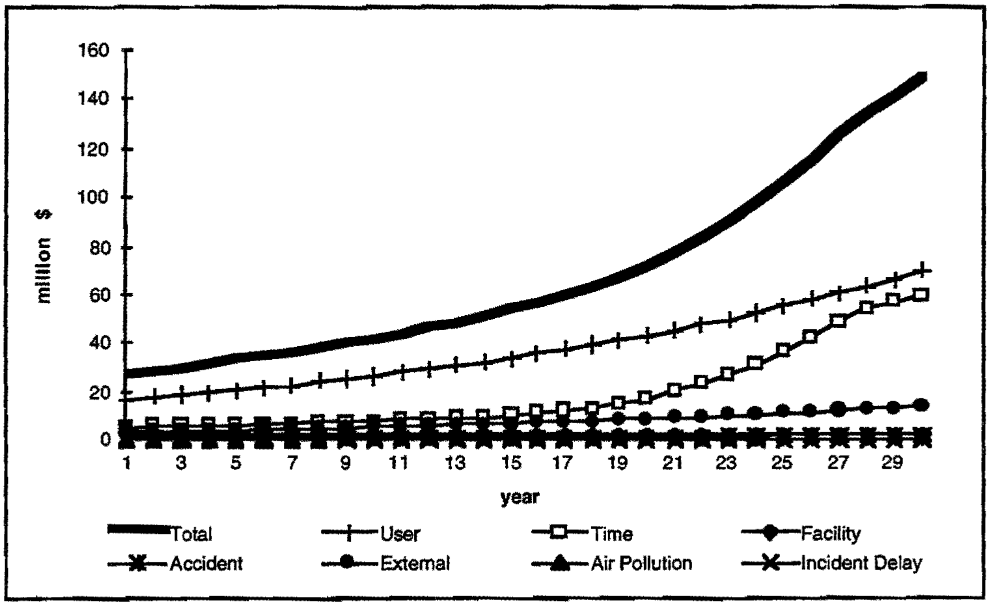

Figure 11. Factors underlying increased cost of existing facility over time for Scenario 1

4.3 SCENARIO 2: CONSTRUCT MAINLANES

The next step in the full-cost analysis of the Houston-Harte corridor is to evaluate the cost implications of constructing the mainlanes. For this scenario, the MODECOST model was run twice to calculate costs for both the mainlanes and the frontage roads, with the results then added. Much of the base data for this scenario is the same as those used for Scenario 1. The traffic was distributed between the mainlanes and frontage roads according to an 90-10 percent split.

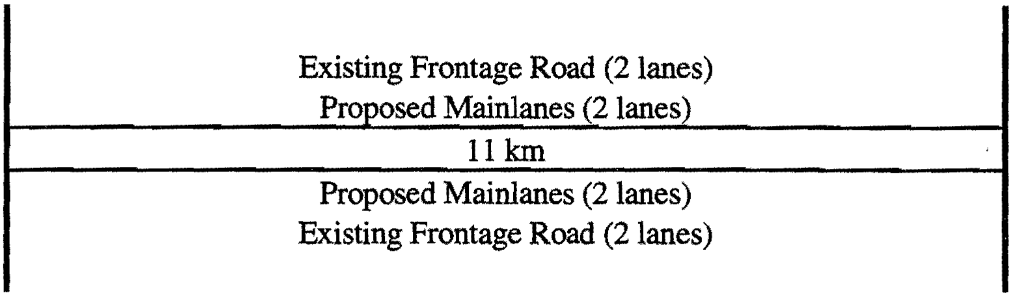

Figure 12. Scenario 2: Construct mainlanes

The model results for Scenario 2 are summarized in Table 8. MODECOST results demonstrate that with construction of the Houston-Harte facility and with the expected 5 percent growth of traffic demand, the total annual cost of the facility is $46.5 million. Of this amount, $32.3 million is due to user costs, $6.9 million to agency costs, and $7.3 million to external costs. The proportions between these costs are illustrated in Figure 13.

The figure of $6.9 million represents the annual cost to the agency for the entire Houston-Harte corridor, assuming that the mainlanes are constructed. Note that MODECOST's lump sum estimate of the cost of constructing the mainlanes is higher than the estimate provided by TxDOT. MODECOST's figure, which can be derived from output data for this scenario, is $32.2 million for the initial lump sum cost (without right-of-way cost because it has already been acquired and TxDOT did not include it in its figure). The San Angelo District calculated a figure of $29 million, a difference of 11 percent.

Figure 13 demonstrates how the costs in Table 8 are distributed. As shown, auto user cost represents the largest portion at 58.5 percent. Travel time and delay is still significant at 11.0 percent, though in this scenario that figure represents a smaller portion of total cost than facility cost, which represents 14.9 percent.

Figure 14 shows how the substantial annual cost figures take into account the increasing costs of the facility to the San Angelo community over time. The cost in millions steadily increases throughout the period. Like Scenario 1, it is again the user costs that form the bulk of the total cost of the facility. In this second scenario, however, the addition of the mainlanes reduces the impact of the time and delay cost to the same moderate level of the external cost. The facility cost remains constant and barely above the remaining cost categories.

Table 8. Results for Scenario 2

Cost Category	Million $
Annual Agency Cost	**6.9**
Highway Facility	6.9
Annual User Cost	**32.3**
Auto Traveler's Time & Delay	4.7
Auto User Other Costs	27.2
Commercial Truck Time & Delay	0.4
Annual External Cost	**7.3**
Auto Pollution	0.6
Auto Other Externality	5.4
Auto Accident	0.8
Truck Accident	0.1
Truck Pollution	0.4
Annual Total Cost	**46.5**

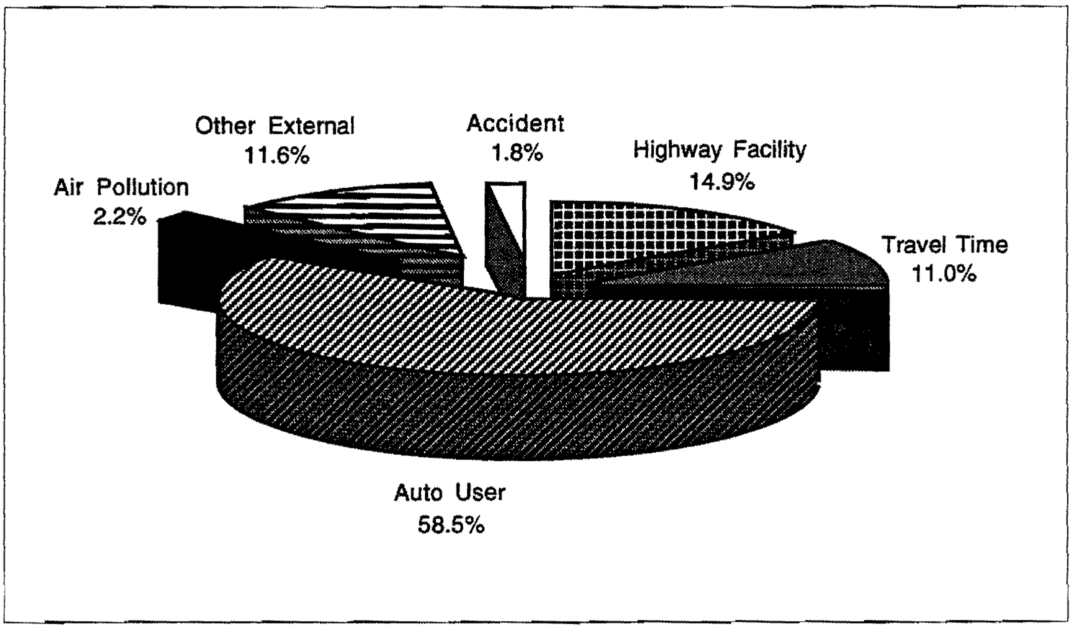

Figure 13. Annual cost distribution for Scenario 2

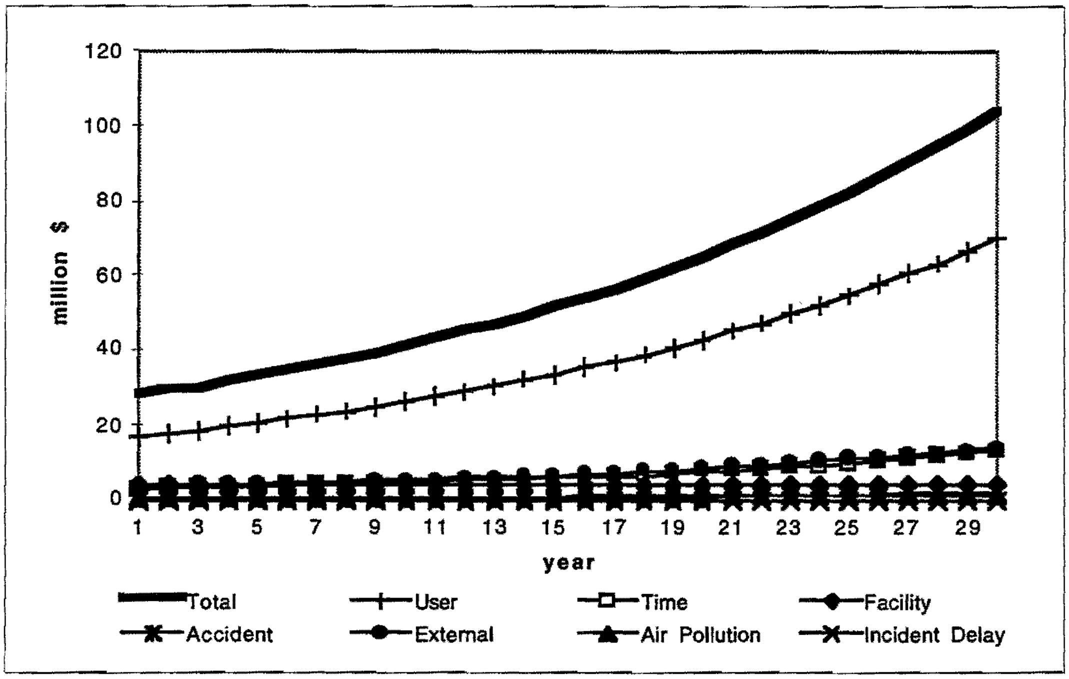

Figure 14. Factors underlying cost of mainlane scenario over time for Scenario 2

4.4 SCENARIO 3: EXISTING CONFIGURATION WITH TRANSIT SERVICE

The final two scenarios considered in this case study are not presently being considered by TxDOT, that of including transit service along the corridor without (Scenario 3) and with (Scenario 4) the construction of mainlanes. TxDOT has not traditionally considered transit as a factor in the decision-making process for highway projects. Nonetheless, a full-cost comparison of alternatives makes the consideration of various modes, including transit, practical.

Currently, there is no transit service offered along the existing frontage roads of the Houston-Harte corridor. This third scenario demonstrates the impact of adding transit service along this corridor by allowing a comparison of the three other possible scenarios in this case study: the existing configuration and operation without transit service in Scenario 1, the proposed mainlanes configuration without transit service in Scenario 2, and the proposed mainlanes configuration with transit service, which will be addressed in Scenario 4. The results of the four scenarios will be compared in Section 4.6. This scenario is shown in Figure 15.

For Scenario 3, much of the base data for this scenario is the same as those used for the previous scenarios. Whereas for the two previous scenarios the mode split for the Houston-Harte corridor was 100 percent for automobiles and trucks and 0 percent for the transit mode, Scenarios 3 and 4 demonstrate the cost impact of operating transit service along the Houston-Harte. The mode splits used for these two scenarios are the same and are shown in Table 9.

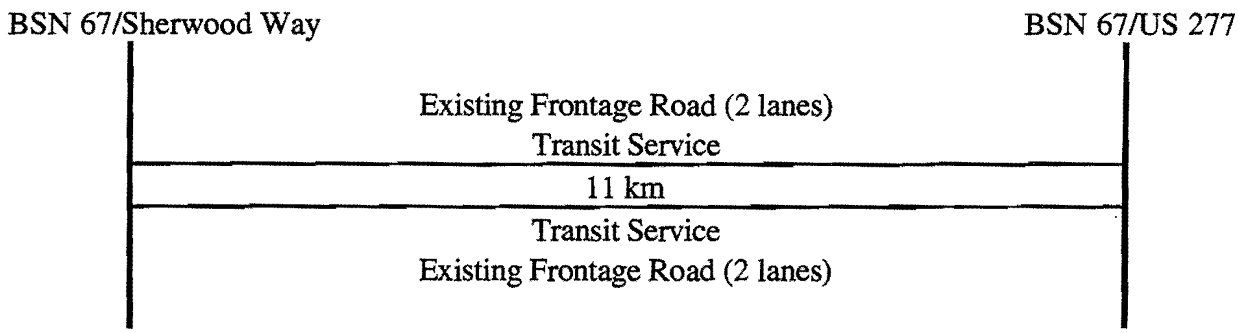

Figure 15. Scenario 3: Existing configuration with transit service

Table 9. Mode splits used in Scenarios 3 and 4

Study Years	Mode Split (%)				Average Occupancy	
	Weekday		Weekend			
	Auto/ Truck	Bus Transit	Auto/ Truck	Bus Transit	Auto/ Truck	Bus Transit
1-4	99.5	0.5	99.5	0.5	1.13	7.5
5-9	99.5	0.5	99.5	0.5	1.13	10.0
10-14	99.3	0.7	99.5	0.5	1.13	12.5
15-19	99.0	1.0	99.3	0.7	1.13	17.5
20-30	99.0	1.0	99.0	1.0	1.13	17.5

Although the mode split may seem conservative, for the community of San Angelo it is rather optimistic. The percentage of total yearly vehicle-miles traveled within the community of San Angelo and occurring by transit is calculated to be 0.05 percent. The seven trolleys that the city currently owns and operates offer a maximum seating capacity of 24 and on each route currently in service runs only hourly. The average occupancy rate for current bus service routes is 3.87. For these reasons, the transit split was restrained to a conservative 1 percent at its highest. This low split would nonetheless represent a significant bus service increase within the corridor because of the expected growth in travel demand over the study period. It is assumed that weekends will demonstrate lower bus transit splits because of the absence of commuter traffic.

The average auto occupancy is maintained at the same level as that used for Scenarios 1 and 2. For the purpose of this case study, the average occupancy for bus transit is assumed to increase steadily in order to accommodate the increasing transit split. Even with the average occupancy rates of the buses steadily rising through the study period, bus service to accommodate the assumed increase in transit split (as well as the increased total demand) will have to increase to 2, then to 3 or 4, buses per hour by the later years of the study period.

The model results for this scenario are summarized in Table 10. These MODECOST results demonstrate that with continued operation of the existing configuration of frontage lanes only, but with the provision of bus transit service, the total annual cost of the facility is $48.0 million. Of this amount, $38.2 million is due to user cost, $2.7 million to agency cost, and $7.1 million to external costs.

Table 10. Results for Scenario 3

Cost Category	Million $
Annual Agency Cost	**2.7**
Highway Facility	2.5
Bus Station	0.1
Bus Vehicle	0.1
Bus Operating	0.1
Annual User Cost	**38.2**
Auto Traveler's Time & Delay	10.1
Auto User Other Costs	27.0
Bus Traveler Time & Delay	0.4
Commercial Truck Time & Delay	0.8
Annual External Cost	**7.1**
Auto Pollution	0.6
Auto Other Externality	5.4
Auto Accident	0.8
Truck Accident	0.1
Truck Pollution	0.3
Annual Total Cost	**48.0**

The distribution of these costs as shown in Table 10 is illustrated in Figure 16. Auto user cost represents the largest portion at 56.2 percent. Travel time and delay is substantial at 26.4 percent. The third largest cost group is the other external cost, representing 11.2 percent. The highway facility cost lags behind at 5.2 percent.

As shown in Figure 17, the total annual cost follows an upward trend through the study period. This increase results primarily from increases in user cost and time cost. The external cost increases only slightly over the period.

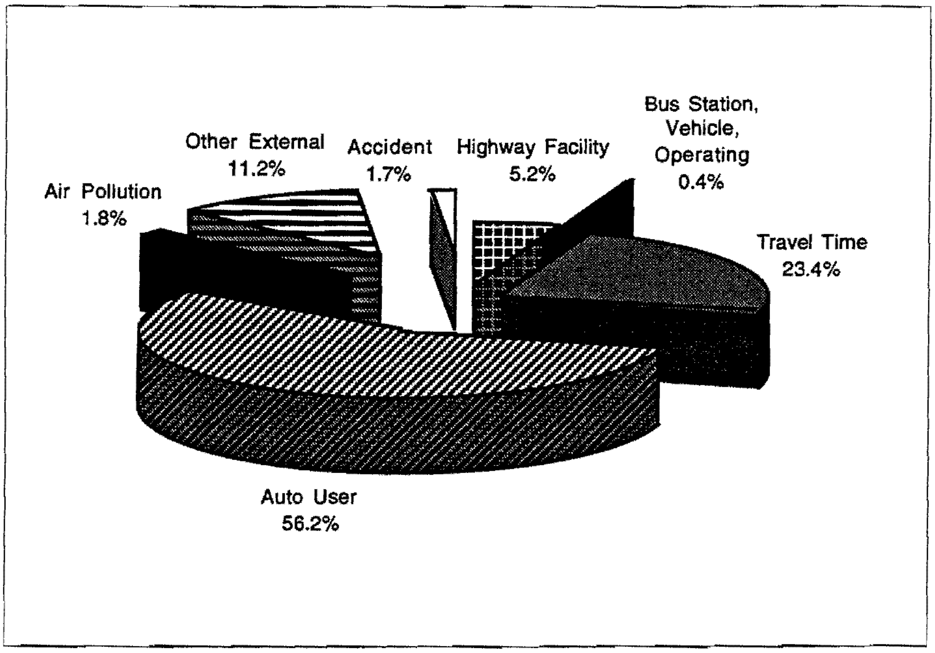

Figure 16. Annual cost distribution for Scenario 3

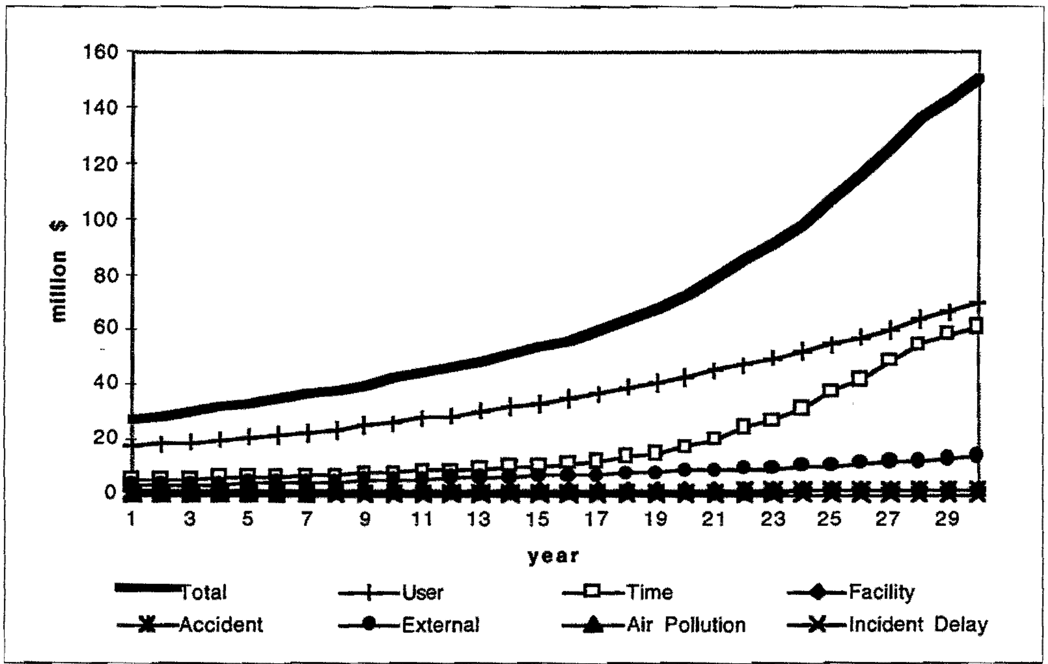

Figure 17. Factors underlying cost over time of Scenario 3

4.5 SCENARIO 4: CONSTRUCT MAINLANES WITH TRANSIT SERVICE

Scenario 4, the final scenario considered by this case study, addresses the impact of adding transit service along the Houston-Harte corridor with mainlanes. This scenario is shown in Figure 18.

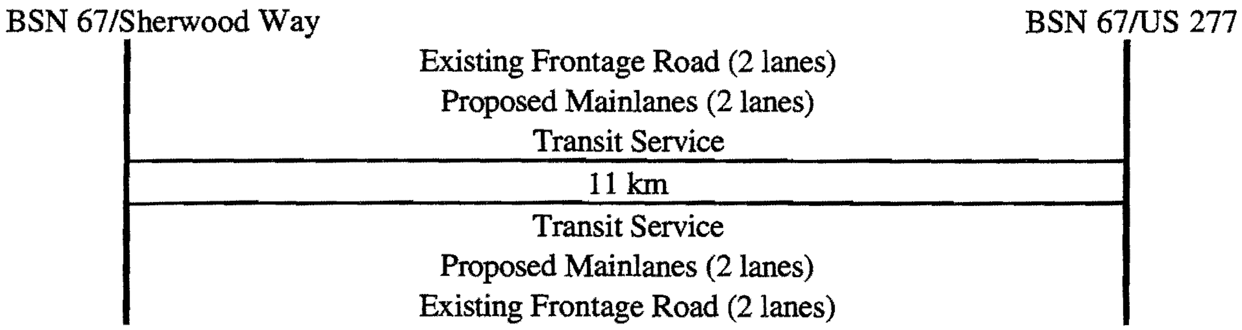

Figure 18. Scenario 4: Construct mainlanes with transit service

For this scenario, the MODECOST model was run twice to calculate costs for both the mainlanes (including transit service) and the frontage roads, with the results then added. Again, much of the base data for this scenario is the same as those data used for the previous scenarios. The traffic was distributed between the mainlanes and frontage roads according to an 90-10 percent split.

The model results for this scenario are summarized in Table 11. These MODECOST results demonstrate that with construction of the Houston-Harte facility and the provision of bus transit service, the total annual cost of the facility is $47.8 million. Of this amount, $32.4 million represents user cost, $7.1 million represents agency cost, and $7.2 million represents external costs.

Figure 19 demonstrates how the costs in Table 11 are distributed. As shown, auto user cost represents the largest portion at 56.5 percent. Facility cost represents the next largest portion at 14.5 percent, closely followed by other external costs at 13.4 percent. Travel time and delay are the last relatively significant figure at 13.1 percent.

Figure 20 charts the factors influencing the increasing costs of the facility to the San Angelo community over time. The user cost makes up the bulk of the total cost of the facility, with time and delay costs and external cost lagging behind.

4.6 COMPARISON OF SCENARIO RESULTS

The significance of the Houston-Harte corridor to the City of San Angelo has already been addressed. As previously shown, the Houston-Harte runs through the center of the city, roughly parallel to Business Route US 67, which runs diagonally from the southwest to the northeast. If constructed, the addition of mainlanes, offering greater speed and capacity, would significantly impact traffic flow through the corridor.

Table 11. Results for Scenario 4

Cost Category	Million $
Annual Agency Cost	**7.1**
Highway Facility	6.9
Bus Station	0.1
Bus Vehicle	0.1
Bus Operating	0.1
Annual User Cost	**32.4**
Auto Traveler's Time & Delay	4.7
Auto User Other Costs	27.0
Bus Traveler Time & Delay	0.4
Commercial Truck Time & Delay	0.4
Annual External Cost	**7.2**
Auto Pollution	0.6
Auto Other Externality	5.4
Auto Accident	0.8
Truck Accident	0.1
Truck Pollution	0.4
Annual Total Cost	**47.8**

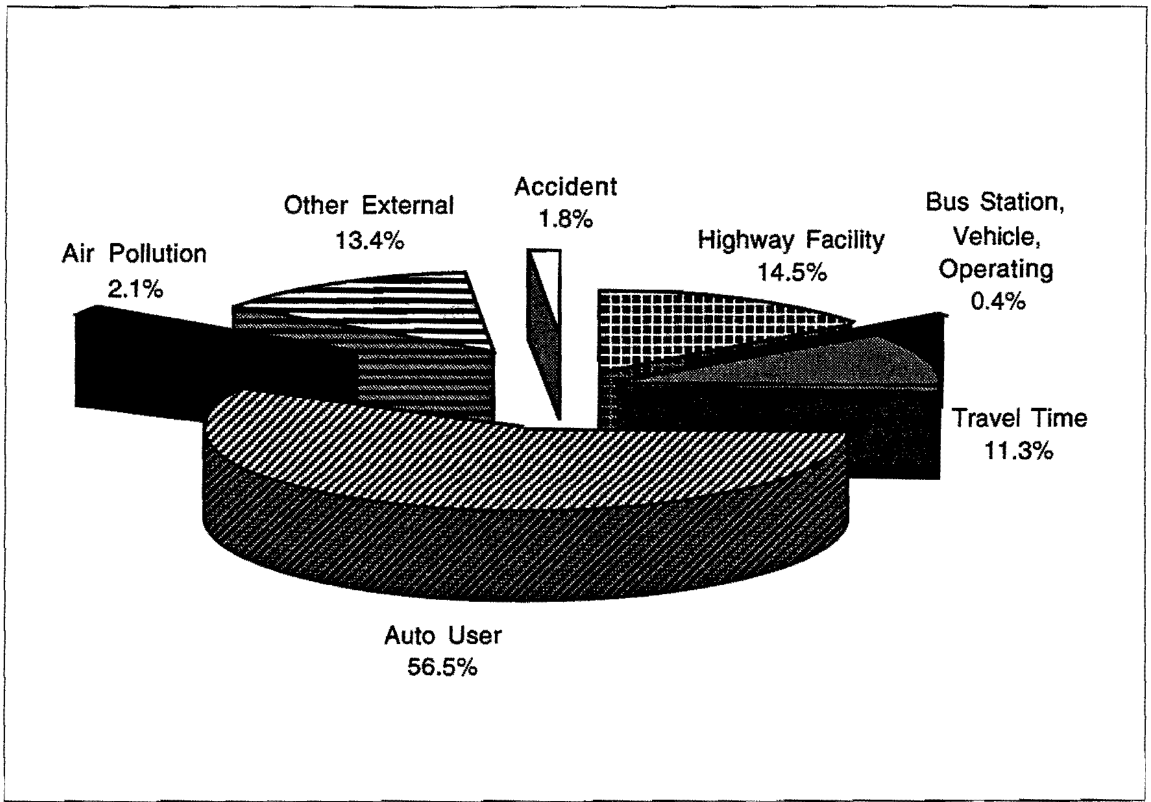

Figure 19. Annual cost distribution for Scenario 4

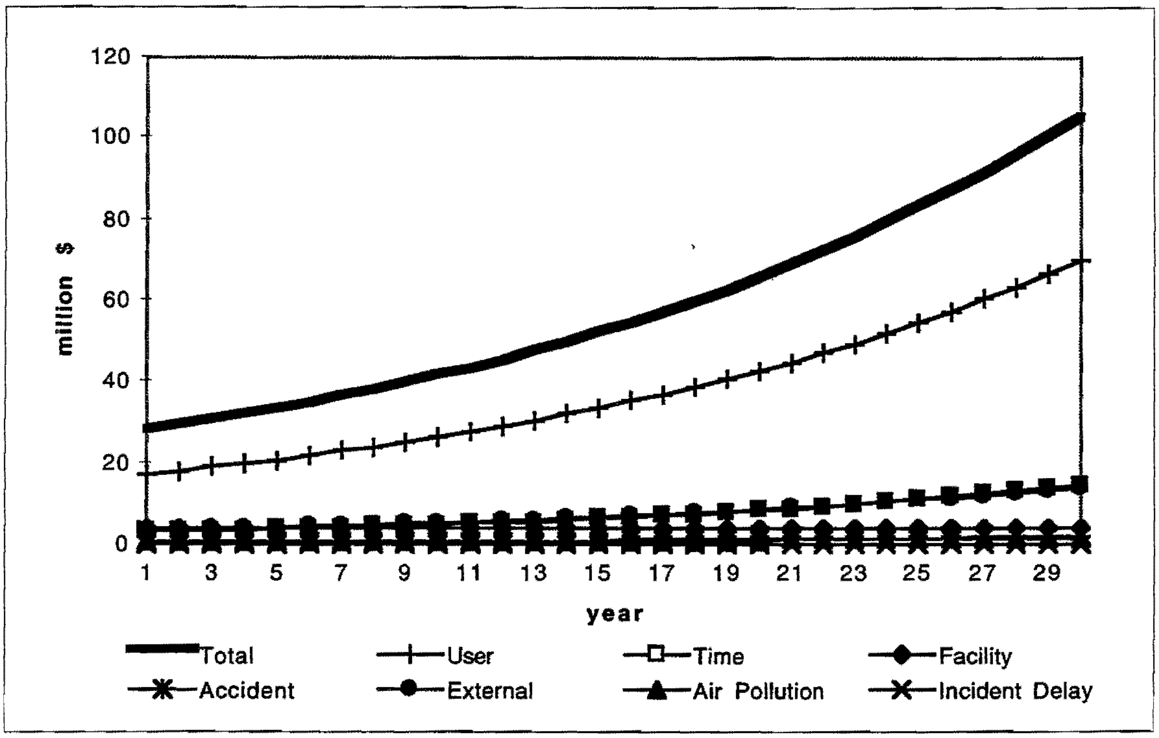

Figure 20. Factors underlying cost over time of Scenario 4

The Houston-Harte Expressway mainlanes, not yet funded, would entail significant capital costs to the Texas Department of Transportation. The City of San Angelo made a financial commitment to the entire project with the issuance of $3 million in bonds in 1971. Furthermore, 350 San Angelo families relocated when the project was first begun. These reasons, though substantial, may not in themselves be sufficient to justify the further expense of completing the facility.

Instead, this case study provides decision-makers information on the anticipated total annual cost of each scenario over the 30-year study period. Scenario 1 presents the cost of the existing configuration of frontage roads only. Scenario 2 demonstrates the cost if the mainlanes were constructed. The two additional alternatives, presented in Scenarios 3 and 4, provide decision makers with valuable information about transit's possible impacts within the corridor as well.

The results of each of the scenarios are shown in Table 12, followed by a discussion of the implications of this comparison.

Table 12. Comparison of the four scenarios

Configuration of the Houston-Harte corridor (11 km)	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**
	Existing Frontage Roads (2 lanes)	Existing Frontage Roads (2 lanes) Proposed Mainlanes (2 lanes)	Transit Service Existing Frontage Roads (2 lanes)	Transit Service Existing Frontage Roads (2 lanes) Proposed Mainlanes (2 lanes)
	Existing Frontage Roads (2 lanes)	Proposed Mainlanes (2 lanes) Existing Frontage Roads (2 lanes)	Existing Frontage Roads (2 lanes) Transit Service	Proposed Mainlanes (2 lanes) Existing Frontage Roads (2 lanes) Transit Service
Cost Category	Cost (million $)			
Annual Agency	**2.5**	**6.9**	**2.7**	**7.1**
Cost	2.5	6.9	2.5	6.9
Highway	-	-	0.1	0.1
Facility	-	-	0.1	0.1
Bus Station	-	-	0.1	0.1
Bus Vehicle				
Bus Operating				
Annual User Cost	**38.2**	**32.3**	**38.2**	**32.4**
Auto	10.2	4.7	10.0	4.7
Time/Delay	0.8	0.4	0.8	0.4
Truck	-	-	0.4	0.4
Time/Delay	27.2	27.2	27.0	27.0
Bus Time &				
Delay				
Auto User				
Other				
Annual External	**7.1**	**7.3**	**7.1**	**7.2**
Cost	0.6	0.6	0.6	0.6
Auto Pollution	0.3	0.4	0.3	0.4
Truck Pollution	5.4	5.4	4.8	5.4
Auto Other	-	-	0.0	0.1
Extern.	0.8	0.8	0.8	0.8
Bus Other	0.1	0.1	0.1	0.1
Extern.				
Auto Accident				
Truck Accident				
Annual Total Cost	**47.8**	**46.5**	**48.0**	**47.8**
Additional Highway Facility Investment[20] ($)	frontage lanes: 16.5	mainlanes: 32.2 frontage lanes: 16.5	frontage lanes: 16.5	mainlanes: 32.2 frontage lanes: 16.5

The key comparison concerns the total annual cost of each scenario. For the four scenarios being considered, these figures are fairly close, owing to the balance between different costs. That

[20] Note that, as discussed earlier, this lump sum estimate of the cost to construct the mainlanes exceeds the estimate made by TxDOT by 11 percent.

is, for Scenarios 2 and 4, the Average Annual Agency Cost is higher than that for the other two scenarios because of the additional expense of constructing the mainlanes. At the same time, however, the Average Annual User Cost is lower in each of these two scenarios, primarily because of the cost savings to automobile travelers' time and delay. The remaining costs contribute to the total cost figures for each of the four scenarios, but these two factors just described are the primary indicators of cost.

According to this full-cost matrix, the four scenarios rank in order of least-cost preference in the following order:

1st:	Construct Mainlanes (Scenario 2)	\$46.5 million/year
2nd (tie):	Existing Configuration Only (Scenario 1)	\$47.8 million/year
2nd (tie):	Construct Mainlanes with Transit Service (Scenario 4)	\$47.8 million/year
4th:	Existing Configuration with Transit Service (Scenario 3)	\$48.0 million/year

Again, these figures are fairly close relative to their magnitude. Regardless, the alternative that would cost the least annually to the community of San Angelo is that of constructing the mainlanes of the Houston-Harte, Scenario 2.

As shown in Table 12, the construction of the mainlanes results in a lower average annual cost because the additional capacity of the facility addresses the cost of time and delay under the existing configuration. That is, with the increase in travel demand projected along the Houston-Harte corridor over the 30-year study period, the existing frontage road configuration results in increased travel time costs for both autos and trucks. The construction of the mainlanes, while equaling a higher facility investment, results in a lower overall cost to the community.

The results in Table 12 also demonstrate the impact of adding transit service along the Houston-Harte corridor. According to MODECOST, under the assumptions made for the purpose of this case study, transit service does not decrease the cost of transportation along the corridor. These results reflect the assumed low transit split for the corridor, and yet higher estimates would be unrealistic, as discussed previously. The low volume for the corridor overall (relative to highly congested corridors in larger cities) also affects the relative ability of transit to impact such external costs as air pollution.

It should be noted with regard to the agency cost that for each scenario the cost of constructing the facility was included in MODECOST calculations. That is, despite the fact that the frontage roads of the Houston-Harte are complete and the right-of-way already purchased, these costs are included to show the entire cost of the facility to the San Angelo community. Of course, this also aids the comparison between the scenarios.

In relation to the above facet of MODECOST calculations, Table 12, the final row, includes the lump sum estimate by MODECOST of the facility investment alone. This row demonstrates the importance of looking beyond facility cost to the larger picture of user and external costs and to the longer picture of a facility's lifetime cost. For example, Scenario 2, according to the lump sum figure, costs \$48.7 million (mainlanes and frontage roads). A comparison of this scenario to Scenario 1, which costs only \$16.5 million for the frontage roads alone, indicates that Scenario 1 (to not construct the mainlanes) is the better option for the community. Yet MODECOST results indicate the opposite: over the next 30 years, the frontage-road-only facility will cost the community $47.8 million annually (all costs included), while the facility with mainlanes would cost *less*, at $46.5 million annually. The difference, as explained previously, is that MODECOST includes the user and external costs of facility operation and that it calculates all costs over a 30-year span.

CHAPTER 5. CONCLUSION

The objective of this case study is to provide to policy-makers information rather than recommendations. The discussion of results in Section 4.6 provides insight into the process of evaluating the full costs of transportation decisions, in this case the decision whether to complete the Houston-Harte facility. Nonetheless, the definitive answer to that question can only come from decision makers themselves.

As previously mentioned, decision makers must weigh a variety of factors with regard to any transportation choice. Not all of these factors pertain to costs that can be measured in dollars. The MODECOST model, for instance, does not presently and may never be able to place a dollar value on the already significant commitment of the San Angelo community toward completion of this facility. Nor does MODECOST address disruption costs of constructing the mainlanes.

In addition, the model output can only be as reliable as the input data. The expected traffic for an unbuilt facility, for instance, is a figure derived through a series of educated guesses about traffic behavior. The predicted growth rate of 5 percent annually, which has a significant impact on the total cost (due to both time and delay and other user cost increases, as shown in Figure 14) is again subject to debate. Similarly, the expected growth rate for the existing roadway configuration may not be reliable. These are only a few of the inputs used by the MODECOST model to evaluate total cost.

The final caveat pertains to the MODECOST method of calculating total cost. As discussed earlier, Report 1356-2 describes how the MODECOST model evaluates costs. The results of the model are only as good as this method, and decision makers must understand this process when they use MODECOST results to make transportation choices.

Nonetheless, this application of the MODECOST model demonstrates several key points. The most important is that information traditionally provided to decision makers with regard to the relative costs of transportation alternatives has been incomplete. As shown in this case study, for instance, the cost to users, both in delay and other costs, is a significant impact for each of the scenarios. In fact, the cost to users mitigates the cost to the agency of the added mainlanes.

As discussed in the introduction to this case study, the traditional method for evaluating transportation alternatives has been to focus upon the need for a facility (usually measured in travel demand and level-of-service projections) and the predicted up-front agency cost for constructing the facility. In recent years, communities have begun to include environmental, safety, and long-term maintenance implications in their decision matrices, though often not specifically in terms of cost.

The findings for this base case scenario suggest that facility cost represents less of the total cost than the traditional decision-making method would imply. In fact, this case study demonstrates that in order to address the best interests of the community as a whole, both the cost to users and the external costs of facility operation should be considered. Likewise, and not surprisingly, the importance of the time delay factor in the total cost of a facility supports the continued consideration of level of service. MODECOST is a tool that allows the inclusion of these cost implications in the decision-making process. The result is greater confidence and more responsible transportation decisions.

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APPENDIX A.

SENSITIVITY ANALYSIS ON THE DISCOUNT RATE

APPENDIX A. SENSITIVITY ANALYSIS ON THE DISCOUNT RATE

Several factors had to be assumed for the purpose of this case study, as noted previously. One of the factors that has a particularly significant impact with regard to future year costs is the discount rate. For the analysis of Scenarios 1-4 above, a rate of 10 percent was assumed. Here discount rates of 5 percent and 10 percent are employed to test the sensitivity of the MODECOST model and San Angelo data to this factor.

Figures 21, 22, and 23 demonstrate the impact of different discount rates upon the full-cost comparison exercise. Figure 21 shows the results with a 5 percent discount rate. This rate, lower than the 10 percent figure used for the primary analysis above, exaggerates the differences in cost between the four scenarios. Scenario 2 is favored under this discount rate, just as under the 10 percent rate, shown in Figure 22. Figure 23 demonstrates the scenario comparison with a 15 percent discount rate. As shown, with this higher discount rate Scenario 1 (frontage lanes only) is preferable, followed by Scenario 3 (frontage lanes with transit service), and then Scenario 2 and Scenario 4.

The tables following these figures detail the scenario results with each of the three different discount rates. The changes in cost for the scenarios under each of these discount rates demonstrates the role that the discount rate plays in determining the cost impact of capital-intensive projects over time. That is, a lower discount rate will tend to spread out the benefit of an expensive investment over time. In the same manner, a higher rate will lessen the importance of a project's long-term benefit because benefits in these later years are discounted at a higher rate.

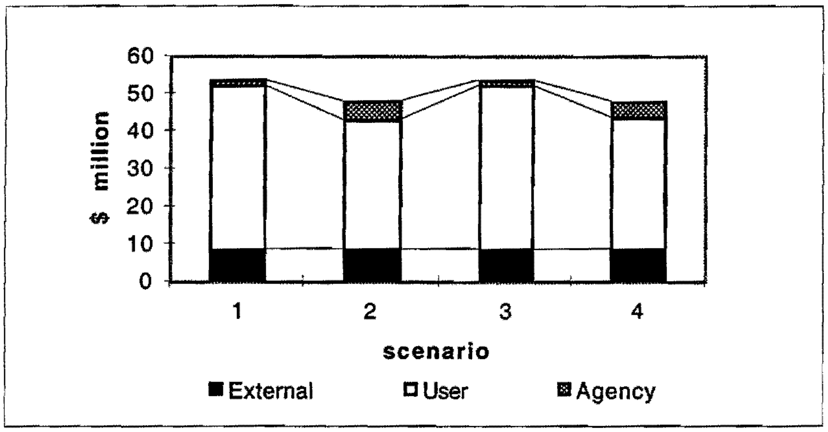

Figure 21. Scenario costs with 5 percent discount rate

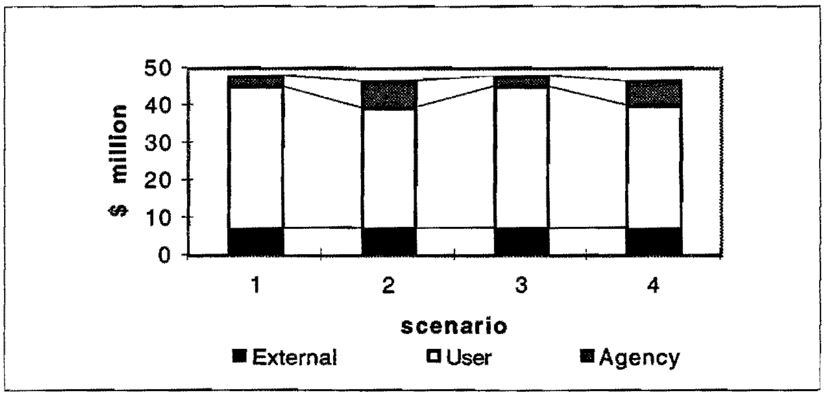

Figure 22. Scenario costs with 10 percent discount rate

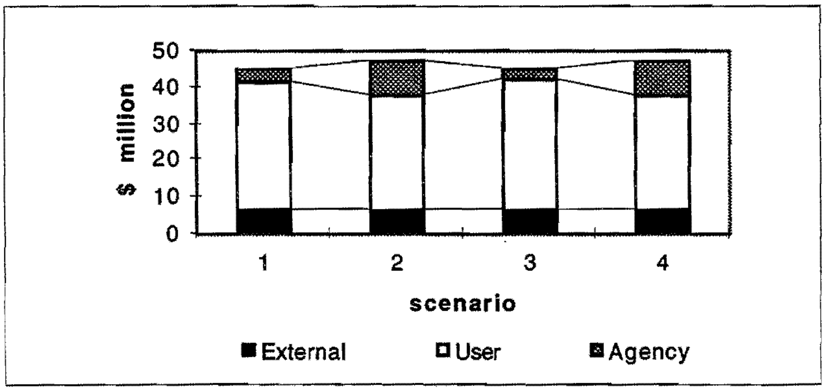

Figure 23. Scenario costs with 15 percent discount rate

Table 13. Scenario 1 results with different discount rates

Cost Category	Cost (million $)		
	5% Discount Rate	**10% Discount Rate**	**15% Discount Rate**
Annual Agency Cost	**1.8**	**2.5**	**3.4**
Highway Facility	1.8	2.5	3.4
Bus Station	-	-	-
Bus Vehicle	-	-	-
Bus Operating	-	-	-
Annual User Cost	**43.5**	**38.2**	**35.3**
Auto Time & Delay	13.7	10.2	8.1
Truck Time & Delay	1.1	0.8	0.7
Bus Time & Delay	-	-	-
Auto User Other	28.6	27.2	26.6
Annual External Cost	**8.3**	**7.1**	**6.3**
Auto Pollution	0.7	0.6	0.5
Truck Pollution	0.4	0.3	0.3
Auto Other Extern.	6.3	5.4	4.8
Bus Other Extern.	-	-	-
Auto Accident	0.9	0.8	0.7
Truck Accident	0.1	0.1	0.1
Annual Total Cost	**53.5**	**47.8**	**45.0**

Table 14. Scenario 2 results with different discount rates

Cost Category	Cost (million $)		
	5% Discount Rate	**10% Discount Rate**	**15% Discount Rate**
Annual Agency Cost	**4.7**	**6.9**	**9.5**
Highway Facility	4.7	6.9	9.5
Bus Station	-	-	-
Bus Vehicle	-	-	-
Bus Operating	-	-	-
Annual User Cost	**34.6**	**32.3**	**31.1**
Auto Time & Delay	5.6	4.7	4.2
Truck Time & Delay	0.5	0.4	0.3
Bus Time & Delay	-	-	-
Auto User Other	28.6	27.2	26.6
Annual External Cost	**8.5**	**7.3**	**6.5**
Auto Pollution	0.7	0.6	0.6
Truck Pollution	0.4	0.4	0.4
Auto Other Extern.	6.3	5.4	4.8
Bus Other Extern.	-	-	-
Auto Accident	0.9	0.8	0.7
Truck Accident	0.1	0.1	0.1
Annual Total Cost	**47.8**	**46.5**	**47.1**

Table 15. Scenario 3 results with different discount rates

Cost Category	Cost (million $)		
	5% Discount Rate	**10% Discount Rate**	**15% Discount Rate**
Annual Agency Cost	**2.0**	**2.7**	**3.6**
Highway Facility	1.8	2.5	3.4
Bus Station	0.1	0.1	0.1
Bus Vehicle	0.1	0.1	0.1
Bus Operating	0.1	0.1	0.1
Annual User Cost	**43.5**	**38.2**	**35.4**
Auto Time & Delay	13.5	10.0	8.0
Truck Time & Delay	0.1	0.8	0.7
Bus Time & Delay	0.6	0.4	0.3
Auto User Other	28.4	27.0	26.4
Annual External Cost	**8.3**	**7.1**	**6.3**
Auto Pollution	0.7	0.6	0.5
Truck Pollution	0.4	0.3	0.3
Auto Other Extern.	6.2	5.4	4.8
Bus Other Extern.	0.1	0.1	0.1
Auto Accident	0.9	0.8	0.7
Truck Accident	0.1	0.1	0.1
Annual Total Cost	**53.8**	**48.0**	**45.0**

Table 16. Scenario 4 results with different discount rates

Cost Category	Cost (million $)		
	5% Discount Rate	**10% Discount Rate**	**15% Discount Rate**
Annual Agency Cost	**4.9**	**7.1**	**9.7**
Highway Facility	4.7	6.9	9.5
Bus Station	0.1	0.1	0.1
Bus Vehicle	0.1	0.1	0.1
Bus Operating	0.1	0.1	0.1
Annual User Cost	**34.8**	**32.4**	**31.2**
Auto Time & Delay	5.5	4.7	4.2
Truck Time & Delay	0.5	0.4	0.3
Bus Time & Delay	0.5	0.4	0.3
Auto User Other	28.4	27.0	26.4
Annual External Cost	**8.4**	**7.2**	**6.5**
Auto Pollution	0.7	0.6	0.6
Truck Pollution	0.4	0.4	0.4
Auto Other Extern.	6.2	5.4	4.8
Bus Other Extern.	0.1	0.1	0.1
Auto Accident	0.9	0.8	0.7
Truck Accident	0.1	0.1	0.1
Annual Total Cost	**48.2**	**47.8**	**47.3**

APPENDIX B.

INPUT AND OUTPUT FOR SCENARIO 1

APPENDIX B. INPUT AND OUTPUT FOR SCENARIO 1

INPUT (C:\MODECOST\ALT1.OUT)

1. Roadway Facility & Demand Data

Roadway Type:	Arterial without HOV Lanes
Pavement Type:	Flexible
Section Length:	7.00 Miles
No. of Intersections/Interchanges:	12
Weekday (Daily) Person-Trips:	23136
Weekend (Daily) Person-Trips:	19281
Demand Growth Rate:	5.00 %

2. Mode Split & Vehicle Occupancy

	Weekday (Weekend)					Occupancy			
Yr	Auto	AutoHOV	Bus	BusHOV	Rail	SOV	HOV	Bus	Rail
1-30	100.0(100.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	0.0	0.0

3. Different Period Traffic Distribution/Duration

Mainlane

	Weekday		Weekend	
	Dir 1(2 Ln)	Dir 2(2 Ln)	Dir 1(2 Ln)	Dir 2(2 Ln)
AM Peak	6.0/ 2.0	6.0/ 2.0	0.0/ 0.0	0.0/ 0.0
PM Peak	12.0/ 3.0	12.0/ 3.0	0.0/ 0.0	0.0/ 0.0
Day	21.0/ 7.0	21.0/ 7.0	37.0/ 9.0	37.0/ 9.0
Night	11.0/ 12.0	11.0/ 12.0	13.0/ 15.0	13.0/ 15.0

3. Truck Demand, Distribution, and Mix

	Weekday		Weekend	
Daily Demand:	1874		1562	
	Direction 1	Direction 2	Direction 1	Direction 2
AM Peak	6.0	6.0	0.0	0.0
PM Peak	12.0	12.0	0.0	0.0
Day	21.0	21.0	37.0	37.0
Night	11.0	11.0	13.0	13.0

Other 2-Axle Single Unit:	61.0%
3-Axle Single Unit:	14.0%
3-Axle Semi-Trailer:	6.0%
4-Axle Semi-Trailer:	4.0%
5-Axle Semi-Trailer:	11.0%
6-Axle Semi-Trailer:	2.0%
5-Axle Full-Trailer:	0.0%
6-Axle Full-Trailer:	2.0%

4. Auto Capital & Operating Data

Average Car Price:	$ 13,534
Average Pick-up and Van Price:	$ 15,813
Percent being Financed:	75.00 %
Loan Period:	5.0 Year

Loan Rate:	10.00 %
Salvage Value at End:	$ 1,000
Vehicle Life:	12.0 Year
Average Annual Driven Miles:	10,700 Miles
Percent of Pick-ups and Vans:	20.00 %
Annual Scheduled Maintenance:	$ 232
Annual Unxcheduled Maintenance:	$ 195
Annual Oil Change:	$ 59
Annual Tire Change:	$ 97
Annual Insurance:	$ 600
Annual Parking:	$ 0
Fuel Price:	$ 0.70 per Gallon
Enahanced I/M:	$ 55

15. Auto Other External Cost Data (in $/PMT)

Local Government:	$ 0.0275
Noise:	$ 0.0014
Building Damage:	$ 0.0000
Aesthetics:	$ 0.0000
Water Pollution:	$ 0.0013
Weather Change:	$ 0.0000
Wetland:	$ 0.0000
Property Value:	$ 0.0000
Land Loss:	$ 0.0000
Energy Security:	$ 0.0300

17. Other Data

Population Density:	1,682 Persons/sq. mi.
Discount Rate:	10.00%
Areawide Total VMT by Vehicles:	520,000,000
Percent of Areawide VMT on Expressway:	6.00 %
Percent of Areawide VMT by Bus:	0.05 %
Value of Time (Private):	$ 3.00 per Hour
Value of Time (Commercial):	$ 3.00 per Hour
Percentage of Private Vehicles:	99.00%
Pollutant Damage Value:	
CO:	$ 0.00 per Kg
HC:	$ 2.00 per Kg
NOx:	$ 3.90 per Kg
SOx:	$ 1.60 per Kg
PM:	$ 2.90 per Kg
Truck Equivalent Factor:	1.70 Passenger Vehicles
Bus Equivalent Factor:	1.50 Passenger Vehicles
Weather Condition:	
Rain Fall:	Below Average
Snow Fall:	Below Average

OUTPUT (C:\MODECOST\ALT1.OUT)

1. Auto and/or Bus

Roadway Section (Mainlane):

Annual Cost (in $/yr) by Modes

Mode	Auto & Pickup	Bus	Truck	Total
Facility Cost	1,419,488	0	1,079,179	2,498,667
Travel Time Cost	10,153,799	0	822,484	10,976,283
Air Pollution Cost	562,254	0	297,120	859,374
Incident Delay Cost	0	0	0	0
Accident Cost	771,877	0	70,652	842,529
Other External Cost	5,407,592	0	0	5,407,592
User/Agency Cost	27,199,178	0	0	27,199,178

Highway Facility Cost

	Annual Cost ($/yr)	Initial Lump-Sum ($)
Right-of-way	82,648	779,117
Cost of Preparing Roadway-Bed	127,719	1,204,000
Shoulder, Sewer, Signage, Lighting	1,039,577	9,800,000
Cost of Interchange/Intersection	63,648	600,000
Pavement Cost	435,998	4,110,118
Rehabilitation Cost	124,433	-
Annual Maintenance Cost	280,000	-
Cost of Administration, Safety, etc.	344,644	-

Travel Time Cost (in $/yr) of Different Periods (Unit Cost: $/PMT)

Period (Direction)	Auto & Pickup	Bus	Truck
Weekday AM Peak (1)	446,685 (0.080)	0 (0.000)	36,181 (0.080)
Weekday PM Peak (1)	1,137,562 (0.102)	0 (0.000)	92,142 (0.102)
Weekday Day (1)	1,563,399 (0.080)	0 (0.000)	126,634 (0.080)
Weekday Night (1)	639,314 (0.062)	0 (0.000)	51,784 (0.062)
Weekend AM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (1)	1,036,440 (0.089)	0 (0.000)	83,965 (0.089)
Weekend Night (1)	253,498 (0.062)	0 (0.000)	20,536 (0.062)
Weekday AM Peak (2)	446,685 (0.080)	0 (0.000)	36,181 (0.080)
Weekday PM Peak (2)	1,137,562 (0.102)	0 (0.000)	92,142 (0.102)
Weekday Day (2)	1,563,399 (0.080)	0 (0.000)	126,634 (0.080)
Weekday Night (2)	639,314 (0.062)	0 (0.000)	51,784 (0.062)
Weekend AM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (2)	1,036,440 (0.089)	0 (0.000)	83,965 (0.089)
Weekend Night (2)	253,498 (0.062)	0 (0.000)	20,536 (0.062)

Pollution Cost (in $/yr) of Different Periods (Unit Cost: $/PMT)

Period (Direction)	Auto & Pickup	Bus	Truck
Weekday AM Peak (1)	25,120 (0.004)	0 (0.000)	13,269 (0.029)
Weekday PM Peak (1)	55,251 (0.005)	0 (0.000)	28,052 (0.031)
Weekday Day (1)	87,921 (0.004)	0 (0.000)	46,442 (0.029)

Weekday Night (1)	41,838 (0.004)	0 (0.000)	23,307 (0.028)
Weekend AM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (1)	54,380 (0.005)	0 (0.000)	28,218 (0.030)
Weekend Night (1)	16,617 (0.004)	0 (0.000)	9,272 (0.028)
Weekday AM Peak (2)	25,120 (0.004)	0 (0.000)	13,269 (0.029)
Weekday PM Peak (2)	55,251 (0.005)	0 (0.000)	28,052 (0.031)
Weekday Day (2)	87,921 (0.004)	0 (0.000)	46,442 (0.029)
Weekday Night (2)	41,838 (0.004)	0 (0.000)	23,307 (0.028)
Weekend AM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (2)	54,380 (0.005)	0 (0.000)	28,218 (0.030)
Weekend Night (2)	16,617 (0.004)	0 (0.000)	9,272 (0.028)

Cost (million $) by year and by categories: Auto Mainlane

Year	Facility	Time	Air Pollut	Inci Delay	Accident	External	User/Age
1	1.419	4.918	0.320	0.000	0.484	3.388	17.041
2	1.419	5.173	0.336	0.000	0.508	3.557	17.893
3	1.419	5.441	0.353	0.000	0.533	3.735	18.788
4	1.419	5.725	0.372	0.000	0.560	3.922	19.727
5	1.419	6.026	0.391	0.000	0.588	4.118	20.713
6	1.419	6.343	0.411	0.000	0.617	4.324	21.749
7	1.419	6.680	0.432	0.000	0.648	4.540	22.837
8	1.419	7.038	0.454	0.000	0.680	4.767	23.978
9	1.419	7.419	0.478	0.000	0.714	5.006	25.177
10	1.419	7.825	0.503	0.000	0.750	5.256	26.436
11	1.419	8.261	0.529	0.000	0.788	5.519	27.758
12	1.419	8.731	0.558	0.000	0.827	5.795	29.146
13	1.419	9.242	0.588	0.000	0.868	6.084	30.603
14	1.419	9.804	0.621	0.000	0.912	6.389	32.133
15	1.419	10.435	0.656	0.000	0.957	6.708	33.740
16	1.419	11.170	0.696	0.000	1.005	7.043	35.427
17	1.419	12.072	0.741	0.000	1.056	7.396	37.198
18	1.419	13.254	0.794	0.000	1.108	7.765	39.058
19	1.419	14.870	0.857	0.000	1.164	8.154	41.011
20	1.419	17.090	0.931	0.000	1.222	8.561	43.062
21	1.419	20.142	1.021	0.000	1.283	8.989	45.215
22	1.419	23.594	1.121	0.000	1.347	9.439	47.476
23	1.419	26.715	1.221	0.000	1.415	9.911	49.849
24	1.419	31.088	1.343	0.000	1.485	10.406	52.342
25	1.419	36.730	1.485	0.000	1.560	10.927	54.959
26	1.419	41.903	1.617	0.000	1.638	11.473	57.707
27	1.419	48.647	1.769	0.000	1.720	12.047	60.592
28	1.419	54.303	1.905	0.000	1.806	12.649	63.622
29	1.419	57.027	2.001	0.000	1.896	13.281	66.803
30	1.419	59.888	2.101	0.000	1.991	13.945	70.143

APPENDIX C.

INPUT AND OUTPUT FOR SCENARIO 2

APPENDIX C. INPUT AND OUTPUT FOR SCENARIO 2

INPUT (C:\MODECOST\ALT2MAIN.OUT)

1. Roadway Facility & Demand Data

Roadway Type:	Expressway without HOV Lanes
Pavement Type:	Flexible
Section Length:	7.00 Miles
No. of Intersections/Interchanges:	0
Weekday (Daily) Person-Trips:	20822
Weekend (Daily) Person-Trips:	17353
Demand Growth Rate:	5.00 %

2. Mode Split & Vehicle Occupancy

	Weekday (Weekend)					Occupancy			
Yr	Auto	AutoHOV	Bus	BusHOV	Rail	SOV	HOV	Bus	Rail
1-30	100.0(100.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	0.0	0.0

3. Different Period Traffic Distribution/Duration

Mainlane

	Weekday		Weekend	
	Dir 1(2 Ln)	Dir 2(2 Ln)	Dir 1(2 Ln)	Dir 2(2 Ln)
AM Peak	6.0/ 2.0	6.0/ 2.0	0.0/ 0.0	0.0/ 0.0
PM Peak	12.0/ 3.0	12.0/ 3.0	0.0/ 0.0	0.0/ 0.0
Day	21.0/ 7.0	21.0/ 7.0	37.0/ 9.0	37.0/ 9.0
Night	11.0/ 12.0	11.0/ 12.0	13.0/ 15.0	13.0/ 15.0

3. Truck Demand, Distribution, and Mix

	Weekday		Weekend	
Daily Demand:	1687		1406	
	Direction 1	Direction 2	Direction 1	Direction 2
AM Peak	6.0	6.0	0.0	0.0
PM Peak	12.0	12.0	0.0	0.0
Day	21.0	21.0	37.0	37.0
Night	11.0	11.0	13.0	13.0

Other 2-Axle Single Unit:	61.0%
3-Axle Single Unit:	14.0%
3-Axle Semi-Trailer:	6.0%
4-Axle Semi-Trailer:	4.0%
5-Axle Semi-Trailer:	11.0%
6-Axle Semi-Trailer:	2.0%
5-Axle Full-Trailer:	0.0%
6-Axle Full-Trailer:	2.0%

4. Auto Capital & Operating Data

Average Car Price:	$ 13,534
Average Pick-up and Van Price:	$ 15,813
Percent being Financed:	75.00 %
Loan Period:	5.0 Year

Loan Rate:	10.00 %
Salvage Value at End:	$ 1,000
Vehicle Life:	12.0 Year
Average Annual Driven Miles:	10,700 Miles
Percent of Pick-ups and Vans:	20.00 %
Annual Scheduled Maintenance:	$ 232
Annual Unxcheduled Maintenance:	$ 195
Annual Oil Change:	$ 59
Annual Tire Change:	$ 97
Annual Insurance:	$ 600
Annual Parking:	$ 0
Fuel Price:	$ 0.70 per Gallon
Enahanced I/M:	$ 55

15. Auto Other External Cost Data (in $/PMT)

Local Government:	$ 0.0275
Noise:	$ 0.0014
Building Damage:	$ 0.0000
Aesthetics:	$ 0.0000
Water Pollution:	$ 0.0013
Weather Change:	$ 0.0000
Wetland:	$ 0.0000
Property Value:	$ 0.0000
Land Loss:	$ 0.0000
Energy Security:	$ 0.0300

17. Other Data

Population Density:	1,682 Persons/sq. mi.
Discount Rate:	10.00%
Areawide Total VMT by Vehicles:	520,000,000
Percent of Areawide VMT on Expressway:	6.00 %
Percent of Areawide VMT by Bus:	0.05 %
Value of Time (Private):	$ 3.00 per Hour
Value of Time (Commercial):	$ 3.00 per Hour
Percentage of Private Vehicles:	99.00%
Pollutant Damage Value:	
CO:	$ 0.00 per Kg
HC:	$ 2.00 per Kg
NOx:	$ 3.90 per Kg
SOx:	$ 1.60 per Kg
PM:	$ 2.90 per Kg
Truck Equivalent Factor:	1.70 Passenger Vehicles
Bus Equivalent Factor:	1.50 Passenger Vehicles
Weather Condition:	
Rain Fall:	Below Average
Snow Fall:	Below Average

OUTPUT (C:\MODECOST\ALT2MAIN.OUT)

1. Auto and/or Bus

Roadway Section (Mainlane):

Annual Cost (in $/yr) by Modes

Mode	Auto & Pickup	Bus	Truck	Total
Facility Cost	2,517,101	0	1,913,649	4,430,750
Travel Time Cost	3,963,488	0	321,126	4,284,614
Air Pollution Cost	583,518	0	360,667	944,184
Incident Delay Cost	0	0	0	0
Accident Cost	694,680	0	63,601	758,281
Other External Cost	4,866,768	0	0	4,866,768
User/Agency Cost	24,478,948	0	0	24,478,948

Highway Facility Cost

	Annual Cost ($/yr)	Initial Lump-Sum ($)
Right-of-way	175,294	1,652,482
Cost of Preparing Roadway-Bed	130,690	1,232,000
Shoulder, Sewer, Signage, Lighting	2,673,197	25,200,000
Cost of Interchange/Intersection	0	0
Pavement Cost	435,998	4,110,118
Rehabilitation Cost	124,433	-
Annual Maintenance Cost	280,000	-
Cost of Administration, Safety, etc.	611,138	-

Travel Time Cost (in $/yr) of Different Periods (Unit Cost: $/PMT)

Period (Direction)	Auto & Pickup	Bus	Truck
Weekday AM Peak (1)	178,615 (0.035)	0 (0.000)	14,471 (0.035)
Weekday PM Peak (1)	366,745 (0.036)	0 (0.000)	29,714 (0.036)
Weekday Day (1)	625,153 (0.035)	0 (0.000)	50,650 (0.035)
Weekday Night (1)	312,632 (0.034)	0 (0.000)	25,330 (0.034)
Weekend AM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (1)	374,732 (0.036)	0 (0.000)	30,362 (0.036)
Weekend Night (1)	123,868 (0.034)	0 (0.000)	10,036 (0.034)
Weekday AM Peak (2)	178,615 (0.035)	0 (0.000)	14,471 (0.035)
Weekday PM Peak (2)	366,745 (0.036)	0 (0.000)	29,714 (0.036)
Weekday Day (2)	625,153 (0.035)	0 (0.000)	50,650 (0.035)
Weekday Night (2)	312,632 (0.034)	0 (0.000)	25,330 (0.034)
Weekend AM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (2)	374,732 (0.036)	0 (0.000)	30,362 (0.036)
Weekend Night (2)	123,868 (0.034)	0 (0.000)	10,036 (0.034)

Pollution Cost (in $/yr) of Different Periods (Unit Cost: $/PMT)

Period (Direction)	Auto & Pickup	Bus	Truck
Weekday AM Peak (1)	25,906 (0.005)	0 (0.000)	16,080 (0.039)
Weekday PM Peak (1)	49,743 (0.005)	0 (0.000)	31,213 (0.038)
Weekday Day (1)	90,672 (0.005)	0 (0.000)	56,280 (0.039)

Weekday Night (1)	51,822 (0.006)	0 (0.000)	31,291 (0.042)
Weekend AM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (1)	52,834 (0.005)	0 (0.000)	32,956 (0.039)
Weekend Night (1)	20,782 (0.006)	0 (0.000)	12,514 (0.042)
Weekday AM Peak (2)	25,906 (0.005)	0 (0.000)	16,080 (0.039)
Weekday PM Peak (2)	49,743 (0.005)	0 (0.000)	31,213 (0.038)
Weekday Day (2)	90,672 (0.005)	0 (0.000)	56,280 (0.039)
Weekday Night (2)	51,822 (0.006)	0 (0.000)	31,291 (0.042)
Weekend AM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (2)	52,834 (0.005)	0 (0.000)	32,956 (0.039)
Weekend Night (2)	20,782 (0.006)	0 (0.000)	12,514 (0.042)

Cost (million $) by year and by categories: Auto Mainlane

Year	Facility	Time	Air Pollut	Inci Delay	Accident	External	User/Age
1	2.517	2.408	0.385	0.000	0.435	3.049	15.337
2	2.517	2.532	0.403	0.000	0.457	3.202	16.104
3	2.517	2.663	0.422	0.000	0.480	3.362	16.909
4	2.517	2.801	0.442	0.000	0.504	3.530	17.754
5	2.517	2.946	0.462	0.000	0.529	3.706	18.642
6	2.517	3.100	0.483	0.000	0.555	3.892	19.574
7	2.517	3.261	0.506	0.000	0.583	4.086	20.553
8	2.517	3.432	0.529	0.000	0.612	4.290	21.580
9	2.517	3.612	0.553	0.000	0.643	4.505	22.659
10	2.517	3.802	0.578	0.000	0.675	4.730	23.792
11	2.517	4.002	0.604	0.000	0.709	4.967	24.982
12	2.517	4.214	0.631	0.000	0.744	5.215	26.231
13	2.517	4.437	0.659	0.000	0.782	5.476	27.543
14	2.517	4.674	0.688	0.000	0.821	5.750	28.920
15	2.517	4.924	0.718	0.000	0.862	6.037	30.366
16	2.517	5.188	0.749	0.000	0.905	6.339	31.884
17	2.517	5.468	0.782	0.000	0.950	6.656	33.478
18	2.517	5.764	0.815	0.000	0.998	6.989	35.152
19	2.517	6.078	0.850	0.000	1.047	7.338	36.910
20	2.517	6.411	0.886	0.000	1.100	7.705	38.755
21	2.517	6.765	0.923	0.000	1.155	8.090	40.693
22	2.517	7.140	0.962	0.000	1.213	8.495	42.727
23	2.517	7.539	1.001	0.000	1.273	8.920	44.864
24	2.517	7.964	1.042	0.000	1.337	9.366	47.107
25	2.517	8.417	1.084	0.000	1.404	9.834	49.462
26	2.517	8.900	1.128	0.000	1.474	10.326	51.936
27	2.517	9.417	1.173	0.000	1.548	10.842	54.532
28	2.517	9.970	1.219	0.000	1.625	11.384	57.259
29	2.517	10.563	1.267	0.000	1.706	11.953	60.122
30	2.517	11.202	1.316	0.000	1.791	12.551	63.128

INPUT (C:\MODECOST\ALT2FRNT.OUT)

1. Roadway Facility & Demand Data

Roadway Type:	Arterial without HOV Lanes
Pavement Type:	Flexible
Section Length:	7.00 Miles
No. of Intersections/Interchanges:	12
Weekday (Daily) Person-Trips:	2314
Weekend (Daily) Person-Trips:	1928
Demand Growth Rate:	5.00 %

2. Mode Split & Vehicle Occupancy

	Weekday(Weekend)					Occupancy			
Yr	Auto	AutoHOV	Bus	BusHOV	Rail	SOV	HOV	Bus	Rail
1-30	100.0(100.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	0.0	0.0

3. Different Period Traffic Distribution/Duration

Mainlane

	Weekday		Weekend	
	Dir 1(2 Ln)	Dir 2(2 Ln)	Dir 1(2 Ln)	Dir 2(2 Ln)
AM Peak	6.0/ 2.0	6.0/ 2.0	0.0/ 0.0	0.0/ 0.0
PM Peak	12.0/ 3.0	12.0/ 3.0	0.0/ 0.0	0.0/ 0.0
Day	21.0/ 7.0	21.0/ 7.0	37.0/ 9.0	37.0/ 9.0
Night	11.0/ 12.0	11.0/ 12.0	13.0/ 15.0	13.0/ 15.0

3. Truck Demand, Distribution, and Mix

	Weekday		Weekend	
Daily Demand:	187		156	
	Direction 1	Direction 2	Direction 1	Direction 2
AM Peak	6.0	6.0	0.0	0.0
PM Peak	12.0	12.0	0.0	0.0
Day	21.0	21.0	37.0	37.0
Night	11.0	11.0	13.0	13.0

Other 2-Axle Single Unit:	61.0%
3-Axle Single Unit:	14.0%
3-Axle Semi-Trailer:	6.0%
4-Axle Semi-Trailer:	4.0%
5-Axle Semi-Trailer:	11.0%
6-Axle Semi-Trailer:	2.0%
5-Axle Full-Trailer:	0.0%
6-Axle Full-Trailer:	2.0%

4. Auto Capital & Operating Data

Average Car Price:	$ 13,534
Average Pick-up and Van Price:	$ 15,813
Percent being Financed:	75.00 %
Loan Period:	5.0 Year
Loan Rate:	10.00 %
Salvage Value at End:	$ 1,000

Vehicle Life:	12.0 Year
Average Annual Driven Miles:	10,700 Miles
Percent of Pick-ups and Vans:	20.00 %
Annual Scheduled Maintenance:	$ 232
Annual Unxcheduled Maintenance:	$ 195
Annual Oil Change:	$ 59
Annual Tire Change:	$ 97
Annual Insurance:	$ 600
Annual Parking:	$ 0
Fuel Price:	$ 0.70 per Gallon
Enahanced I/M:	$ 55

15. Auto Other External Cost Data (in $/PMT)

Local Government:	$ 0.0275
Noise:	$ 0.0014
Building Damage:	$ 0.0000
Aesthetics:	$ 0.0000
Water Pollution:	$ 0.0013
Weather Change:	$ 0.0000
Wetland:	$ 0.0000
Property Value:	$ 0.0000
Land Loss:	$ 0.0000
Energy Security:	$ 0.0300

17. Other Data

Population Density:	1,682 Persons/sq. mi.
Discount Rate:	10.00%
Areawide Total VMT by Vehicles:	520,000,000
Percent of Areawide VMT on Expressway:	6.00 %
Percent of Areawide VMT by Bus:	0.05 %
Value of Time (Private):	$ 3.00 per Hour
Value of Time (Commercial):	$ 3.00 per Hour
Percentage of Private Vehicles:	99.00%
Pollutant Damage Value:	
CO:	$ 0.00 per Kg
HC:	$ 2.00 per Kg
NOx:	$ 3.90 per Kg
SOx:	$ 1.60 per Kg
PM:	$ 2.90 per Kg
Truck Equivalent Factor:	1.70 Passenger Vehicles
Bus Equivalent Factor:	1.50 Passenger Vehicles
Weather Condition:	
Rain Fall:	Below Average
Snow Fall:	Below Average

OUTPUT (C:\MODECOST\ALT2FRNT.OUT)

1. Auto and/or Bus

Roadway Section (Mainlane):

Annual Cost (in $/yr) by Modes

Mode	Auto & Pickup	Bus	Truck	Total
Facility Cost	1,419,488	0	1,079,179	2,498,667
Travel Time Cost	769,799	0	62,229	832,028
Air Pollution Cost	50,625	0	28,269	78,895
Incident Delay Cost	0	0	0	0
Accident Cost	77,197	0	7,052	84,248
Other External Cost	540,822	0	0	540,822
User/Agency Cost	2,720,235	0	0	2,720,235

Highway Facility Cost

	Annual Cost ($/yr)	Initial Lump-Sum ($)
Right-of-way	82,648	779,117
Cost of Preparing Roadway-Bed	127,719	1,204,000
Shoulder, Sewer, Signage, Lighting	1,039,577	9,800,000
Cost of Interchange/Intersection	63,648	600,000
Pavement Cost	435,998	4,110,118
Rehabilitation Cost	124,433	-
Annual Maintenance Cost	280,000	-
Cost of Administration, Safety, etc.	344,644	-

Travel Time Cost (in $/yr) of Different Periods (Unit Cost: $/PMT)

Period (Direction)	Auto & Pickup	Bus	Truck
Weekday AM Peak (1)	34,569 (0.062)	0 (0.000)	2,794 (0.062)
Weekday PM Peak (1)	69,226 (0.062)	0 (0.000)	5,594 (0.062)
Weekday Day (1)	120,990 (0.062)	0 (0.000)	9,777 (0.062)
Weekday Night (1)	63,216 (0.062)	0 (0.000)	5,109 (0.062)
Weekend AM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (1)	71,767 (0.062)	0 (0.000)	5,807 (0.062)
Weekend Night (1)	25,133 (0.062)	0 (0.000)	2,034 (0.062)
Weekday AM Peak (2)	34,569 (0.062)	0 (0.000)	2,794 (0.062)
Weekday PM Peak (2)	69,226 (0.062)	0 (0.000)	5,594 (0.062)
Weekday Day (2)	120,990 (0.062)	0 (0.000)	9,777 (0.062)
Weekday Night (2)	63,216 (0.062)	0 (0.000)	5,109 (0.062)
Weekend AM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (2)	71,767 (0.062)	0 (0.000)	5,807 (0.062)
Weekend Night (2)	25,133 (0.062)	0 (0.000)	2,034 (0.062)

Pollution Cost (in $/yr) of Different Periods (Unit Cost: $/PMT)

Period (Direction)	Auto & Pickup	Bus	Truck
Weekday AM Peak (1)	2,273 (0.004)	0 (0.000)	1,269 (0.028)
Weekday PM Peak (1)	4,549 (0.004)	0 (0.000)	2,537 (0.028)
Weekday Day (1)	7,956 (0.004)	0 (0.000)	4,441 (0.028)

Weekday Night (1)	4,162 (0.004)	0 (0.000)	2,326 (0.028)
Weekend AM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (1)	4,718 (0.004)	0 (0.000)	2,636 (0.028)
Weekend Night (1)	1,655 (0.004)	0 (0.000)	926 (0.028)
Weekday AM Peak (2)	2,273 (0.004)	0 (0.000)	1,269 (0.028)
Weekday PM Peak (2)	4,549 (0.004)	0 (0.000)	2,537 (0.028)
Weekday Day (2)	7,956 (0.004)	0 (0.000)	4,441 (0.028)
Weekday Night (2)	4,162 (0.004)	0 (0.000)	2,326 (0.028)
Weekend AM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (2)	4,718 (0.004)	0 (0.000)	2,636 (0.028)
Weekend Night (2)	1,655 (0.004)	0 (0.000)	926 (0.028)

Cost (million $) by year and by categories: Auto Mainlane

Year	Facility	Time	Air Pollut	Inci Delay	Accident	External	User/Age
1	1.419	0.482	0.032	0.000	0.048	0.339	1.704
2	1.419	0.506	0.033	0.000	0.051	0.356	1.790
3	1.419	0.531	0.035	0.000	0.053	0.374	1.879
4	1.419	0.558	0.037	0.000	0.056	0.392	1.973
5	1.419	0.586	0.039	0.000	0.059	0.412	2.072
6	1.419	0.615	0.040	0.000	0.062	0.432	2.175
7	1.419	0.646	0.042	0.000	0.065	0.454	2.284
8	1.419	0.678	0.045	0.000	0.068	0.477	2.398
9	1.419	0.712	0.047	0.000	0.071	0.501	2.518
10	1.419	0.748	0.049	0.000	0.075	0.526	2.644
11	1.419	0.785	0.052	0.000	0.079	0.552	2.776
12	1.419	0.825	0.054	0.000	0.083	0.580	2.915
13	1.419	0.866	0.057	0.000	0.087	0.609	3.061
14	1.419	0.909	0.060	0.000	0.091	0.639	3.214
15	1.419	0.955	0.063	0.000	0.096	0.671	3.374
16	1.419	1.003	0.066	0.000	0.101	0.704	3.543
17	1.419	1.053	0.069	0.000	0.106	0.740	3.720
18	1.419	1.106	0.073	0.000	0.111	0.777	3.906
19	1.419	1.162	0.076	0.000	0.116	0.815	4.102
20	1.419	1.220	0.080	0.000	0.122	0.856	4.307
21	1.419	1.282	0.084	0.000	0.128	0.899	4.522
22	1.419	1.346	0.088	0.000	0.135	0.944	4.748
23	1.419	1.414	0.093	0.000	0.141	0.991	4.986
24	1.419	1.485	0.098	0.000	0.149	1.041	5.235
25	1.419	1.559	0.102	0.000	0.156	1.093	5.497
26	1.419	1.638	0.108	0.000	0.164	1.147	5.771
27	1.419	1.720	0.113	0.000	0.172	1.205	6.060
28	1.419	1.807	0.119	0.000	0.181	1.265	6.363
29	1.419	1.898	0.125	0.000	0.190	1.328	6.681
30	1.419	1.994	0.131	0.000	0.199	1.395	7.015

APPENDIX D.

INPUT AND OUTPUT FOR SCENARIO 3

APPENDIX D. INPUT AND OUTPUT FOR SCENARIO 3

INPUT (C:\MODECOST\ALT3.OUT)

1. Roadway Facility & Demand Data

Roadway Type:	Arterial without HOV Lanes
Pavement Type:	Flexible
Section Length:	7.00 Miles
No. of Intersections/Interchanges:	12
Weekday (Daily) Person-Trips:	23136
Weekend (Daily) Person-Trips:	19281
Demand Growth Rate:	5.00 %

2. Mode Split & Vehicle Occupancy

	Weekday(Weekend)					Occupancy			
Yr	Auto	AutoHOV	Bus	BusHOV	Rail	SOV	HOV	Bus	Rail
1	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	7.5	0.0
2	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	7.5	0.0
3	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	7.5	0.0
4	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	7.5	0.0
5	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	10.0	0.0
6	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	10.0	0.0
7	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	10.0	0.0
8	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	10.0	0.0
9	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	10.0	0.0
10	99.3(99.5)	0.0(0.0)	0.7(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	12.5	0.0
11	99.3(99.5)	0.0(0.0)	0.7(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	12.5	0.0
12	99.3(99.5)	0.0(0.0)	0.7(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	12.5	0.0
13	99.3(99.5)	0.0(0.0)	0.7(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	12.5	0.0
14	99.3(99.5)	0.0(0.0)	0.7(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	12.5	0.0
15	99.0(99.3)	0.0(0.0)	1.0(0.7)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
16	99.0(99.3)	0.0(0.0)	1.0(0.7)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
17	99.0(99.3)	0.0(0.0)	1.0(0.7)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
18	99.0(99.3)	0.0(0.0)	1.0(0.7)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
19	99.0(99.3)	0.0(0.0)	1.0(0.7)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
20	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
21	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
22	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
23	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
24	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
25	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
26	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
27	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
28	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
29	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
30	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0

3. Different Period Traffic Distribution/Duration

Main Lane

	Weekday		Weekend	
	Dir 1(2 Ln)	Dir 2(2 Ln)	Dir 1(2 Ln)	Dir 2(2 Ln)
AM Peak	6.0/ 2.0	6.0/ 2.0	0.0/ 0.0	0.0/ 0.0
PM Peak	12.0/ 3.0	12.0/ 3.0	0.0/ 0.0	0.0/ 0.0
Day	21.0/ 7.0	21.0/ 7.0	37.0/ 9.0	37.0/ 9.0
Night	11.0/ 12.0	11.0/ 12.0	13.0/ 15.0	13.0/ 15.0

3. Truck Demand, Distribution, and Mix

	Weekday		Weekend	
Daily Demand:	1874		1562	
	Direction 1	Direction 2	Direction 1	Direction 2
AM Peak	6.0	6.0	0.0	0.0
PM Peak	12.0	12.0	0.0	0.0
Day	21.0	21.0	37.0	37.0
Night	11.0	11.0	13.0	13.0

Other 2-Axle Single Unit:	61.0%
3-Axle Single Unit:	14.0%
3-Axle Semi-Trailer:	6.0%
4-Axle Semi-Trailer:	4.0%
5-Axle Semi-Trailer:	11.0%
6-Axle Semi-Trailer:	2.0%
5-Axle Full-Trailer:	0.0%
6-Axle Full-Trailer:	2.0%

4. Auto Capital & Operating Data

Average Car Price:	$ 13,534
Average Pick-up and Van Price:	$ 15,813
Percent being Financed:	75.00 %
Loan Period:	5.0 Year
Loan Rate:	10.00 %
Salvage Value at End:	$ 1,000
Vehicle Life:	12.0 Year
Average Annual Driven Miles:	10,700 Miles
Percent of Pick-ups and Vans:	20.00 %
Annual Scheduled Maintenance:	$ 232
Annual Unxcheduled Maintenance:	$ 195
Annual Oil Change:	$ 59
Annual Tire Change:	$ 97
Annual Insurance:	$ 600
Annual Parking:	$ 0
Fuel Price:	$ 0.70 per Gallon
Enahanced I/M:	$ 55

5. Bus Vehicle Data

Vehicle Purchase Price:	$ 260,000 per Vehicle
Loan Period:	0.0 Year
Loan Rate:	0.00 %

Vehicle Life: 10.0 Year
Vehicle Salvage Value at End: $ 900 per Vehicle
Average Annual Driven Miles: $ 39,336 per Vehicle
Total Time Before Overhaul: 0.0 Year
Overhaul Cost: $ 0 per Vehicle

6. Bus Station Data

Transit Center Cost: $ 1,168,967 per Station
No. of Transit Center: 1 Station(s)
Transit Center Life: 30.0 Year
Transit Center Salvage Value: $ 100,000 per Station
Transit Center Rehabilitation Year: 0.0 Year
Transit Center Rehabilitation Cost: $ 0 per Station
Parking Ride Lot Cost: $ 0 per Station
No. of Parking Ride Lot: 0 Station(s)
Parking Ride Lot Life: 0.0 Year
Parking Ride Lot Salvage Value: $ 0 per Station
Parking Ride Lot Rehabilitation Year: 0.0 Year
Parking Ride Lot Rehabilitation Cost: $ 0 per Station
Shelter Cost: $ 3,000 per Station
No. of Shelter: 12 Station(s)
Shelter Life: 30.0 Year
Shelter Lot Salvage Value: $ 0 per Station
Loan Period: 0.0 Year
Loan Rate: 0.00 %

7. Bus Operating Data

Average Passenger Trip Length: 4.1 Miles
Station Spacing: 1.0 Miles
Bus Headway: 60.0 Minutes
Operating and Maintenance Cost: $ 609,900
Administration Cost: $ 0
User Time from Origin to Station: 3.5 Minutes
User Time from Station to Destination: 3.5 Minutes

15. Auto Other External Cost Data (in $/PMT)

Local Government: $ 0.0275
Noise: $ 0.0014
Building Damage: $ 0.0000
Aesthetics: $ 0.0000
Water Pollution: $ 0.0013
Weather Change: $ 0.0000
Wetland: $ 0.0000
Property Value: $ 0.0000
Land Loss: $ 0.0000
Energy Security: $ 0.0300

17. Other Data

Population Density:	1,682 Persons/sq. mi.
Discount Rate:	10.00%
Areawide Total VMT by Vehicles:	520,000,000
Percent of Areawide VMT on Expressway:	6.00 %
Percent of Areawide VMT by Bus:	0.05 %
Value of Time (Private):	$ 3.00 per Hour
Value of Time (Commercial):	$ 3.00 per Hour
Percentage of Private Vehicles:	99.00%
Pollutant Damage Value:	
CO:	$ 0.00 per Kg
HC:	$ 2.00 per Kg
NOx:	$ 3.90 per Kg
SOx:	$ 1.60 per Kg
PM:	$ 2.90 per Kg
Truck Equivalent Factor:	1.70 Passenger Vehicles
Bus Equivalent Factor:	1.50 Passenger Vehicles
Weather Condition:	
Rain Fall:	Below Average
Snow Fall:	Below Average

OUTPUT (C:\MODECOST\ALT3.OUT)

1. Auto and/or Bus

Roadway Section (Main Lane):

Annual Cost (in $/yr) by Modes

Mode	Auto & Pickup	Bus	Truck	Total
Facility Cost	1,388,259	54,971	1,055,437	2,498,667
Travel Time Cost	10,010,420	402,825	817,766	11,231,011
Air Pollution Cost	556,667	5,059	296,745	858,471
Incident Delay Cost	0	0	0	0
Accident Cost	766,107	0	70,652	836,759
Other External Cost	5,367,166	38,522	0	5,405,688
User/Agency Cost	26,995,850	206,900	0	27,202,750

Highway Facility Cost

	Annual Cost ($/yr)	Initial Lump-Sum ($)
Right-of-way	82,648	779,117
Cost of Preparing Roadway-Bed	127,719	1,204,000
Shoulder, Sewer, Signage, Lighting	1,039,577	9,800,000
Cost of Interchange/Intersection	63,648	600,000
Pavement Cost	435,998	4,110,118
Rehabilitation Cost	124,433	-
Annual Maintenance Cost	280,000	-
Cost of Administration, Safety, etc.	344,644	-

Travel Time Cost (in $/yr) of Different Periods (Unit Cost: $/PMT)

Period (Direction)	Auto & Pickup	Bus	Truck
Weekday AM Peak (1)	439,301 (0.079)	18,866 (0.324)	35,900 (0.079)
Weekday PM Peak (1)	1,119,024 (0.101)	40,555 (0.348)	91,513 (0.101)

Weekday Day (1)	1,537,553 (0.079)	66,032 (0.324)	125,649 (0.079)
Weekday Night (1)	634,214 (0.062)	32,600 (0.305)	51,778 (0.062)
Weekend AM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (1)	1,023,258 (0.089)	32,802 (0.352)	83,509 (0.089)
Weekend Night (1)	251,861 (0.062)	10,556 (0.322)	20,535 (0.062)
Weekday AM Peak (2)	439,301 (0.079)	18,866 (0.324)	35,900 (0.079)
Weekday PM Peak (2)	1,119,024 (0.101)	40,555 (0.348)	91,513 (0.101)
Weekday Day (2)	1,537,553 (0.079)	66,032 (0.324)	125,649 (0.079)
Weekday Night (2)	634,214 (0.062)	32,600 (0.305)	51,778 (0.062)
Weekend AM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (2)	1,023,258 (0.089)	32,802 (0.352)	83,509 (0.089)
Weekend Night (2)	251,861 (0.062)	10,556 (0.322)	20,535 (0.062)

Pollution Cost (in $/yr) of Different Periods (Unit Cost: $/PMT)

Period (Direction)	Auto & Pickup	Bus	Truck
Weekday AM Peak (1)	24,843 (0.004)	236 (0.004)	13,247 (0.029)
Weekday PM Peak (1)	54,626 (0.005)	476 (0.004)	28,002 (0.031)
Weekday Day (1)	86,950 (0.004)	825 (0.004)	46,364 (0.029)
Weekday Night (1)	41,507 (0.004)	429 (0.004)	23,307 (0.028)
Weekend AM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (1)	53,897 (0.005)	418 (0.004)	28,181 (0.030)
Weekend Night (1)	16,510 (0.004)	145 (0.004)	9,272 (0.028)
Weekday AM Peak (2)	24,843 (0.004)	236 (0.004)	13,247 (0.029)
Weekday PM Peak (2)	54,626 (0.005)	476 (0.004)	28,002 (0.031)
Weekday Day (2)	86,950 (0.004)	825 (0.004)	46,364 (0.029)
Weekday Night (2)	41,507 (0.004)	429 (0.004)	23,307 (0.028)
Weekend AM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (2)	53,897 (0.005)	418 (0.004)	28,181 (0.030)
Weekend Night (2)	16,510 (0.004)	145 (0.004)	9,272 (0.028)

Cost (million $) by year and by categories: Auto Main Lane

Year	Facility	Time	Air Pollut	Inci Delay	Accident	External	User/Age
1	1.388	4.893	0.318	0.000	0.481	3.371	16.956
2	1.388	5.146	0.335	0.000	0.505	3.540	17.804
3	1.388	5.413	0.352	0.000	0.531	3.717	18.694
4	1.388	5.696	0.370	0.000	0.557	3.902	19.628
5	1.388	5.994	0.389	0.000	0.585	4.098	20.610
6	1.388	6.310	0.409	0.000	0.614	4.302	21.640
7	1.388	6.645	0.430	0.000	0.645	4.518	22.722
8	1.388	7.001	0.452	0.000	0.677	4.743	23.859
9	1.388	7.380	0.475	0.000	0.711	4.981	25.051
10	1.388	7.771	0.499	0.000	0.745	5.222	26.264
11	1.388	8.203	0.526	0.000	0.783	5.483	27.578
12	1.388	8.668	0.554	0.000	0.822	5.757	28.957
13	1.388	9.173	0.584	0.000	0.863	6.045	30.404
14	1.388	9.729	0.616	0.000	0.906	6.347	31.925
15	1.388	10.315	0.649	0.000	0.949	6.646	33.428

16	1.388	11.029	0.688	0.000	0.996	6.978	35.100
17	1.388	11.897	0.732	0.000	1.046	7.327	36.854
18	1.388	13.024	0.784	0.000	1.098	7.694	38.697
19	1.388	14.560	0.845	0.000	1.153	8.078	40.632
20	1.388	16.544	0.913	0.000	1.207	8.456	42.535
21	1.388	19.403	0.999	0.000	1.267	8.879	44.661
22	1.388	23.054	1.101	0.000	1.331	9.323	46.894
23	1.388	25.984	1.197	0.000	1.397	9.789	49.239
24	1.388	30.076	1.314	0.000	1.467	10.279	51.701
25	1.388	35.753	1.456	0.000	1.541	10.793	54.286
26	1.388	40.619	1.585	0.000	1.618	11.332	57.000
27	1.388	46.993	1.732	0.000	1.698	11.899	59.850
28	1.388	53.635	1.882	0.000	1.783	12.494	62.843
29	1.388	56.326	1.976	0.000	1.873	13.119	65.985
30	1.388	59.151	2.075	0.000	1.966	13.775	69.284

Cost (million $) by year and by categories: Bus Main Lane

Year	Facility	Time	Air Pollut	Inci Delay	Accident	External	User/Age
1	0.055	0.158	0.004	0.000	0.000	0.016	0.147
2	0.055	0.166	0.004	0.000	0.000	0.017	0.154
3	0.055	0.175	0.004	0.000	0.000	0.018	0.162
4	0.055	0.183	0.004	0.000	0.000	0.019	0.170
5	0.055	0.193	0.003	0.000	0.000	0.020	0.134
6	0.055	0.202	0.003	0.000	0.000	0.021	0.140
7	0.055	0.213	0.004	0.000	0.000	0.022	0.147
8	0.055	0.223	0.004	0.000	0.000	0.023	0.155
9	0.055	0.235	0.004	0.000	0.000	0.024	0.163
10	0.055	0.320	0.004	0.000	0.000	0.032	0.177
11	0.055	0.337	0.005	0.000	0.000	0.034	0.186
12	0.055	0.354	0.005	0.000	0.000	0.036	0.196
13	0.055	0.372	0.005	0.000	0.000	0.038	0.205
14	0.055	0.391	0.005	0.000	0.000	0.039	0.216
15	0.055	0.585	0.006	0.000	0.000	0.059	0.230
16	0.055	0.616	0.006	0.000	0.000	0.062	0.242
17	0.055	0.650	0.006	0.000	0.000	0.065	0.254
18	0.055	0.687	0.006	0.000	0.000	0.068	0.266
19	0.055	0.729	0.007	0.000	0.000	0.072	0.280
20	0.055	1.029	0.010	0.000	0.000	0.100	0.389
21	0.055	1.105	0.010	0.000	0.000	0.105	0.408
22	0.055	1.192	0.011	0.000	0.000	0.110	0.429
23	0.055	1.270	0.011	0.000	0.000	0.116	0.450
24	0.055	1.364	0.012	0.000	0.000	0.121	0.473
25	0.055	1.479	0.012	0.000	0.000	0.127	0.496
26	0.055	1.592	0.013	0.000	0.000	0.134	0.521
27	0.055	1.727	0.014	0.000	0.000	0.140	0.547
28	0.055	1.869	0.015	0.000	0.000	0.147	0.575
29	0.055	1.963	0.015	0.000	0.000	0.155	0.603
30	0.055	2.061	0.016	0.000	0.000	0.163	0.634

APPENDIX E.

INPUT AND OUTPUT FOR SCENARIO 4

APPENDIX E. INPUT AND OUTPUT FOR SCENARIO 4

INPUT (C:\MODECOST\ALT4MAIN.OUT)

1. Roadway Facility & Demand Data

Roadway Type:	Expressway without HOV Lanes
Pavement Type:	Flexible
Section Length:	7.00 Miles
No. of Intersections/Interchanges:	0
Weekday (Daily) Person-Trips:	20822
Weekend (Daily) Person-Trips:	17353
Demand Growth Rate:	5.00 %

2. Mode Split & Vehicle Occupancy

	Weekday (Weekend)					Occupancy			
Yr	Auto	AutoHOV	Bus	BusHOV	Rail	SOV	HOV	Bus	Rail
1	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	7.5	0.0
2	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	7.5	0.0
3	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	7.5	0.0
4	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	7.5	0.0
5	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	10.0	0.0
6	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	10.0	0.0
7	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	10.0	0.0
8	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	10.0	0.0
9	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	10.0	0.0
10	99.3(99.5)	0.0(0.0)	0.7(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	12.5	0.0
11	99.3(99.5)	0.0(0.0)	0.7(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	12.5	0.0
12	99.3(99.5)	0.0(0.0)	0.7(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	12.5	0.0
13	99.3(99.5)	0.0(0.0)	0.7(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	12.5	0.0
14	99.3(99.5)	0.0(0.0)	0.7(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	12.5	0.0
15	99.0(99.3)	0.0(0.0)	1.0(0.7)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
16	99.0(99.3)	0.0(0.0)	1.0(0.7)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
17	99.0(99.3)	0.0(0.0)	1.0(0.7)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
18	99.0(99.3)	0.0(0.0)	1.0(0.7)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
19	99.0(99.3)	0.0(0.0)	1.0(0.7)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
20	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
21	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
22	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
23	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
24	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
25	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
26	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
27	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
28	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
29	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
30	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0

3. Different Period Traffic Distribution/Duration

Main Lane

	Weekday		Weekend	
	Dir 1(2 Ln)	Dir 2(2 Ln)	Dir 1(2 Ln)	Dir 2(2 Ln)
AM Peak	6.0/ 2.0	6.0/ 2.0	0.0/ 0.0	0.0/ 0.0
PM Peak	12.0/ 3.0	12.0/ 3.0	0.0/ 0.0	0.0/ 0.0
Day	21.0/ 7.0	21.0/ 7.0	37.0/ 9.0	37.0/ 9.0
Night	11.0/ 12.0	11.0/ 12.0	13.0/ 15.0	13.0/ 15.0

3. Truck Demand, Distribution, and Mix

	Weekday		Weekend	
Daily Demand:	1687		1406	
	Direction 1	Direction 2	Direction 1	Direction 2
AM Peak	6.0	6.0	0.0	0.0
PM Peak	12.0	12.0	0.0	0.0
Day	21.0	21.0	37.0	37.0
Night	11.0	11.0	13.0	13.0

Other 2-Axle Single Unit:	61.0%
3-Axle Single Unit:	14.0%
3-Axle Semi-Trailer:	6.0%
4-Axle Semi-Trailer:	4.0%
5-Axle Semi-Trailer:	11.0%
6-Axle Semi-Trailer:	2.0%
5-Axle Full-Trailer:	0.0%
6-Axle Full-Trailer:	2.0%

4. Auto Capital & Operating Data

Average Car Price:	$ 13,534
Average Pick-up and Van Price:	$ 15,813
Percent being Financed:	75.00 %
Loan Period:	5.0 Year
Loan Rate:	10.00 %
Salvage Value at End:	$ 1,000
Vehicle Life:	12.0 Year
Average Annual Driven Miles:	10,700 Miles
Percent of Pick-ups and Vans:	20.00 %
Annual Scheduled Maintenance:	$ 232
Annual Unxcheduled Maintenance:	$ 195
Annual Oil Change:	$ 59
Annual Tire Change:	$ 97
Annual Insurance:	$ 600
Annual Parking:	$ 0
Fuel Price:	$ 0.70 per Gallon
Enahanced I/M:	$ 55

5. Bus Vehicle Data

Vehicle Purchase Price:	$ 260,000 per Vehicle
Loan Period:	0.0 Year
Loan Rate:	0.00 %

Vehicle Life:	10.0 Year
Vehicle Salvage Value at End:	$ 900 per Vehicle
Average Annual Driven Miles:	$ 39,336 per Vehicle
Total Time Before Overhaul:	0.0 Year
Overhaul Cost:	$ 0 per Vehicle

6. Bus Station Data

Transit Center Cost:	$ 1,168,967 per Station
No. of Transit Center:	1 Station(s)
Transit Center Life:	30.0 Year
Transit Center Salvage Value:	$ 100,000 per Station
Transit Center Rehabilitation Year:	0.0 Year
Transit Center Rehabilitation Cost:	$ 0 per Station
Parking Ride Lot Cost:	$ 0 per Station
No. of Parking Ride Lot:	0 Station(s)
Parking Ride Lot Life:	0.0 Year
Parking Ride Lot Salvage Value:	$ 0 per Station
Parking Ride Lot Rehabilitation Year:	0.0 Year
Parking Ride Lot Rehabilitation Cost:	$ 0 per Station
Shelter Cost:	$ 3,000 per Station
No. of Shelter:	12 Station(s)
Shelter Life:	30.0 Year
Shelter Lot Salvage Value:	$ 0 per Station
Loan Period:	0.0 Year
Loan Rate:	0.00 %

7. Bus Operating Data

Average Passenger Trip Length:	4.1 Miles
Station Spacing:	1.0 Miles
Bus Headway:	60.0 Minutes
Operating and Maintenance Cost:	$ 609,900
Administration Cost:	$ 0
User Time from Origin to Station:	3.5 Minutes
User Time from Station to Destination:	3.5 Minutes

15. Auto Other External Cost Data (in $/PMT)

Local Government:	$ 0.0275
Noise:	$ 0.0014
Building Damage:	$ 0.0000
Aesthetics:	$ 0.0000
Water Pollution:	$ 0.0013
Weather Change:	$ 0.0000
Wetland:	$ 0.0000
Property Value:	$ 0.0000
Land Loss:	$ 0.0000
Energy Security:	$ 0.0300

17. Other Data

Population Density:	1,682 Persons/sq. mi.
Discount Rate:	10.00%
Areawide Total VMT by Vehicles:	520,000,000
Percent of Areawide VMT on Expressway:	6.00 %
Percent of Areawide VMT by Bus:	0.05 %
Value of Time (Private):	$ 3.00 per Hour
Value of Time (Commercial):	$ 3.00 per Hour
Percentage of Private Vehicles:	99.00%
Pollutant Damage Value:	
CO:	$ 0.00 per Kg
HC:	$ 2.00 per Kg
NOx:	$ 3.90 per Kg
SOx:	$ 1.60 per Kg
PM:	$ 2.90 per Kg
Truck Equivalent Factor:	1.70 Passenger Vehicles
Bus Equivalent Factor:	1.50 Passenger Vehicles
Weather Condition:	
Rain Fall:	Below Average
Snow Fall:	Below Average

OUTPUT (C:\MODECOST\ALT4MAIN.OUT)

1. Auto and/or Bus

Roadway Section (Main Lane):

Annual Cost (in $/yr) by Modes

Mode	Auto & Pickup	Bus	Truck	Total
Facility Cost	2,461,784	97,479	1,871,594	4,430,856
Travel Time Cost	3,931,551	305,329	320,964	4,557,844
Air Pollution Cost	579,647	4,411	360,860	944,917
Incident Delay Cost	0	0	0	0
Accident Cost	689,487	0	63,601	753,088
Other External Cost	4,830,388	34,669	0	4,865,057
User/Agency Cost	24,295,950	186,207	0	24,482,158

Highway Facility Cost

	Annual Cost ($/yr)	Initial Lump-Sum ($)
Right-of-way	175,294	1,652,482
Cost of Preparing Roadway-Bed	130,690	1,232,000
Shoulder, Sewer, Signage, Lighting	2,673,197	25,200,000
Cost of Interchange/Intersection	0	0
Pavement Cost	436,090	4,110,978
Rehabilitation Cost	124,433	-
Annual Maintenance Cost	280,000	-
Cost of Administration, Safety, etc.	611,153	-

Travel Time Cost (in $/yr) of Different Periods (Unit Cost: $/PMT)

Period (Direction)	Auto & Pickup	Bus	Truck
Weekday AM Peak (1)	177,101 (0.036)	14,385 (0.275)	14,464 (0.035)
Weekday PM Peak (1)	363,506 (0.036)	28,861 (0.275)	29,688 (0.036)

Weekday Day (1)	619,852 (0.036)	50,347 (0.275)	50,622 (0.035)
Weekday Night (1)	310,132 (0.034)	26,234 (0.273)	25,326 (0.034)
Weekend AM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (1)	372,119 (0.036)	24,342 (0.290)	30,346 (0.036)
Weekend Night (1)	123,065 (0.034)	8,495 (0.288)	10,035 (0.034)
Weekday AM Peak (2)	177,101 (0.036)	14,385 (0.275)	14,464 (0.035)
Weekday PM Peak (2)	363,506 (0.036)	28,861 (0.275)	29,688 (0.036)
Weekday Day (2)	619,852 (0.036)	50,347 (0.275)	50,622 (0.035)
Weekday Night (2)	310,132 (0.034)	26,234 (0.273)	25,326 (0.034)
Weekend AM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (2)	372,119 (0.036)	24,342 (0.290)	30,346 (0.036)
Weekend Night (2)	123,065 (0.034)	8,495 (0.288)	10,035 (0.034)

Pollution Cost (in $/yr) of Different Periods (Unit Cost: $/PMT)

Period (Direction)	Auto & Pickup	Bus	Truck
Weekday AM Peak (1)	25,729 (0.005)	206 (0.004)	16,090 (0.039)
Weekday PM Peak (1)	49,416 (0.005)	412 (0.004)	31,239 (0.038)
Weekday Day (1)	90,051 (0.005)	720 (0.004)	56,315 (0.039)
Weekday Night (1)	51,432 (0.006)	377 (0.004)	31,296 (0.042)
Weekend AM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (1)	52,541 (0.005)	363 (0.004)	32,974 (0.039)
Weekend Night (1)	20,653 (0.006)	128 (0.004)	12,515 (0.042)
Weekday AM Peak (2)	25,729 (0.005)	206 (0.004)	16,090 (0.039)
Weekday PM Peak (2)	49,416 (0.005)	412 (0.004)	31,239 (0.038)
Weekday Day (2)	90,051 (0.005)	720 (0.004)	56,315 (0.039)
Weekday Night (2)	51,432 (0.006)	377 (0.004)	31,296 (0.042)
Weekend AM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (2)	52,541 (0.005)	363 (0.004)	32,974 (0.039)
Weekend Night (2)	20,653 (0.006)	128 (0.004)	12,515 (0.042)

Cost (million $) by year and by categories: Auto Main Lane

Year	Facility	Time	Air Pollut	Inci Delay	Accident	External	User/Age
1	2.462	2.395	0.383	0.000	0.433	3.034	15.260
2	2.462	2.519	0.401	0.000	0.455	3.186	16.023
3	2.462	2.649	0.420	0.000	0.477	3.345	16.824
4	2.462	2.786	0.440	0.000	0.501	3.512	17.665
5	2.462	2.931	0.460	0.000	0.526	3.688	18.549
6	2.462	3.084	0.481	0.000	0.553	3.872	19.476
7	2.462	3.245	0.503	0.000	0.580	4.066	20.450
8	2.462	3.414	0.526	0.000	0.609	4.269	21.472
9	2.462	3.593	0.550	0.000	0.640	4.482	22.546
10	2.462	3.776	0.574	0.000	0.671	4.700	23.638
11	2.462	3.975	0.600	0.000	0.704	4.934	24.820
12	2.462	4.185	0.627	0.000	0.740	5.181	26.061
13	2.462	4.407	0.655	0.000	0.777	5.440	27.364
14	2.462	4.642	0.684	0.000	0.815	5.712	28.732
15	2.462	4.876	0.712	0.000	0.854	5.981	30.085

16	2.462	5.137	0.743	0.000	0.896	6.280	31.589
17	2.462	5.414	0.775	0.000	0.941	6.594	33.169
18	2.462	5.707	0.808	0.000	0.988	6.924	34.827
19	2.462	6.018	0.843	0.000	1.038	7.270	36.568
20	2.462	6.327	0.876	0.000	1.086	7.611	38.281
21	2.462	6.675	0.913	0.000	1.141	7.991	40.195
22	2.462	7.045	0.951	0.000	1.198	8.391	42.204
23	2.462	7.439	0.991	0.000	1.258	8.810	44.315
24	2.462	7.857	1.031	0.000	1.320	9.251	46.530
25	2.462	8.303	1.073	0.000	1.386	9.713	48.857
26	2.462	8.779	1.116	0.000	1.456	10.199	51.300
27	2.462	9.287	1.161	0.000	1.529	10.709	53.865
28	2.462	9.831	1.207	0.000	1.605	11.245	56.558
29	2.462	10.415	1.254	0.000	1.685	11.807	59.386
30	2.462	11.042	1.303	0.000	1.770	12.397	62.355

Cost (million $) by year and by categories: Bus Main Lane

Year	Facility	Time	Air Pollut	Inci Delay	Accident	External	User/Age
1	0.097	0.127	0.003	0.000	0.000	0.015	0.132
2	0.097	0.134	0.003	0.000	0.000	0.015	0.139
3	0.097	0.141	0.003	0.000	0.000	0.016	0.146
4	0.097	0.148	0.004	0.000	0.000	0.017	0.153
5	0.097	0.155	0.003	0.000	0.000	0.018	0.120
6	0.097	0.163	0.003	0.000	0.000	0.019	0.126
7	0.097	0.171	0.003	0.000	0.000	0.020	0.133
8	0.097	0.180	0.003	0.000	0.000	0.020	0.139
9	0.097	0.189	0.003	0.000	0.000	0.022	0.146
10	0.097	0.257	0.004	0.000	0.000	0.029	0.160
11	0.097	0.270	0.004	0.000	0.000	0.031	0.168
12	0.097	0.284	0.004	0.000	0.000	0.032	0.176
13	0.097	0.298	0.004	0.000	0.000	0.034	0.185
14	0.097	0.313	0.005	0.000	0.000	0.036	0.194
15	0.097	0.468	0.005	0.000	0.000	0.053	0.207
16	0.097	0.492	0.005	0.000	0.000	0.056	0.217
17	0.097	0.516	0.005	0.000	0.000	0.059	0.228
18	0.097	0.542	0.006	0.000	0.000	0.061	0.240
19	0.097	0.570	0.006	0.000	0.000	0.065	0.252
20	0.097	0.793	0.008	0.000	0.000	0.090	0.350
21	0.097	0.833	0.009	0.000	0.000	0.094	0.368
22	0.097	0.875	0.009	0.000	0.000	0.099	0.386
23	0.097	0.919	0.010	0.000	0.000	0.104	0.405
24	0.097	0.965	0.010	0.000	0.000	0.109	0.426
25	0.097	1.014	0.011	0.000	0.000	0.115	0.447
26	0.097	1.066	0.011	0.000	0.000	0.120	0.469
27	0.097	1.120	0.012	0.000	0.000	0.126	0.493
28	0.097	1.177	0.012	0.000	0.000	0.133	0.517
29	0.097	1.237	0.013	0.000	0.000	0.139	0.543
30	0.097	1.300	0.014	0.000	0.000	0.146	0.570

1. Roadway Facility & Demand Data

Roadway Type:	Arterial without HOV Lanes
Pavement Type:	Flexible
Section Length:	7.00 Miles
No. of Intersections/Interchanges:	12
Weekday (Daily) Person-Trips:	2314
Weekend (Daily) Person-Trips:	1928
Demand Growth Rate:	5.00 %

2. Mode Split & Vehicle Occupancy

	Weekday (Weekend)					Occupancy			
Yr	Auto	AutoHOV	Bus	BusHOV	Rail	SOV	HOV	Bus	Rail
1	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	7.5	0.0
2	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	7.5	0.0
3	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	7.5	0.0
4	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	7.5	0.0
5	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	10.0	0.0
6	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	10.0	0.0
7	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	10.0	0.0
8	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	10.0	0.0
9	99.5(99.5)	0.0(0.0)	0.5(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	10.0	0.0
10	99.3(99.5)	0.0(0.0)	0.7(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	12.5	0.0
11	99.3(99.5)	0.0(0.0)	0.7(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	12.5	0.0
12	99.3(99.5)	0.0(0.0)	0.7(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	12.5	0.0
13	99.3(99.5)	0.0(0.0)	0.7(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	12.5	0.0
14	99.3(99.5)	0.0(0.0)	0.7(0.5)	0.0(0.0)	0.0(0.0)	1.1	0.0	12.5	0.0
15	99.0(99.3)	0.0(0.0)	1.0(0.7)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
16	99.0(99.3)	0.0(0.0)	1.0(0.7)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
17	99.0(99.3)	0.0(0.0)	1.0(0.7)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
18	99.0(99.3)	0.0(0.0)	1.0(0.7)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
19	99.0(99.3)	0.0(0.0)	1.0(0.7)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
20	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
21	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
22	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
23	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
24	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
25	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
26	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
27	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
28	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
29	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0
30	98.7(99.0)	0.0(0.0)	1.3(1.0)	0.0(0.0)	0.0(0.0)	1.1	0.0	17.5	0.0

3. Different Period Traffic Distribution/Duration

Main Lane

	Weekday		Weekend	
	Dir 1(2 Ln)	Dir 2(2 Ln)	Dir 1(2 Ln)	Dir 2(2 Ln)
AM Peak	6.0/ 2.0	6.0/ 2.0	0.0/ 0.0	0.0/ 0.0
PM Peak	12.0/ 3.0	12.0/ 3.0	0.0/ 0.0	0.0/ 0.0
Day	21.0/ 7.0	21.0/ 7.0	37.0/ 9.0	37.0/ 9.0
Night	11.0/ 12.0	11.0/ 12.0	13.0/ 15.0	13.0/ 15.0

3. Truck Demand, Distribution, and Mix

	Weekday		Weekend	
Daily Demand:	187		156	
	Direction 1	Direction 2	Direction 1	Direction 2
AM Peak	6.0	6.0	0.0	0.0
PM Peak	12.0	12.0	0.0	0.0
Day	21.0	21.0	37.0	37.0
Night	11.0	11.0	13.0	13.0

Other 2-Axle Single Unit:	61.0%
3-Axle Single Unit:	14.0%
3-Axle Semi-Trailer:	6.0%
4-Axle Semi-Trailer:	4.0%
5-Axle Semi-Trailer:	11.0%
6-Axle Semi-Trailer:	2.0%
5-Axle Full-Trailer:	0.0%
6-Axle Full-Trailer:	2.0%

4. Auto Capital & Operating Data

Average Car Price:	$ 13,534
Average Pick-up and Van Price:	$ 15,813
Percent being Financed:	75.00 %
Loan Period:	5.0 Year
Loan Rate:	10.00 %
Salvage Value at End:	$ 1,000
Vehicle Life:	12.0 Year
Average Annual Driven Miles:	10,700 Miles
Percent of Pick-ups and Vans:	20.00 %
Annual Scheduled Maintenance:	$ 232
Annual Unxcheduled Maintenance:	$ 195
Annual Oil Change:	$ 59
Annual Tire Change:	$ 97
Annual Insurance:	$ 600
Annual Parking:	$ 0
Fuel Price:	$ 0.70 per Gallon
Enahanced I/M:	$ 55

5. Bus Vehicle Data

Vehicle Purchase Price:	$ 260,000 per Vehicle
Loan Period:	0.0 Year
Loan Rate:	0.00 %
Vehicle Life:	10.0 Year
Vehicle Salvage Value at End:	$ 900 per Vehicle
Average Annual Driven Miles:	$ 39,336 per Vehicle
Total Time Before Overhaul:	0.0 Year
Overhaul Cost:	$ 0 per Vehicle

6. Bus Station Data

Transit Center Cost:	$ 1,168,967 per Station
No. of Transit Center:	1 Station(s)
Transit Center Life:	30.0 Year
Transit Center Salvage Value:	$ 100,000 per Station
Transit Center Rehabilitation Year:	0.0 Year
Transit Center Rehabilitation Cost:	$ 0 per Station
Parking Ride Lot Cost:	$ 0 per Station
No. of Parking Ride Lot:	0 Station(s)
Parking Ride Lot Life:	0.0 Year
Parking Ride Lot Salvage Value:	$ 0 per Station
Parking Ride Lot Rehabilitation Year:	0.0 Year
Parking Ride Lot Rehabilitation Cost:	$ 0 per Station
Shelter Cost:	$ 3,000 per Station
No. of Shelter:	12 Station(s)
Shelter Life:	30.0 Year
Shelter Lot Salvage Value:	$ 0 per Station
Loan Period:	0.0 Year
Loan Rate:	0.00 %

7. Bus Operating Data

Average Passenger Trip Length:	4.1 Miles
Station Spacing:	1.0 Miles
Bus Headway:	60.0 Minutes
Operating and Maintenance Cost:	$ 609,900
Administration Cost:	$ 0
User Time from Origin to Station:	3.5 Minutes
User Time from Station to Destination:	3.5 Minutes

15. Auto Other External Cost Data (in $/PMT)

Local Government:	$ 0.0275
Noise:	$ 0.0014
Building Damage:	$ 0.0000
Aesthetics:	$ 0.0000
Water Pollution:	$ 0.0013
Weather Change:	$ 0.0000
Wetland:	$ 0.0000
Property Value:	$ 0.0000
Land Loss:	$ 0.0000
Energy Security:	$ 0.0300

17. Other Data

Population Density:	1,682 Persons/sq. mi.
Discount Rate:	10.00%
Areawide Total VMT by Vehicles:	520,000,000
Percent of Areawide VMT on Expressway:	6.00 %
Percent of Areawide VMT by Bus:	0.05 %
Value of Time (Private):	$ 3.00 per Hour
Value of Time (Commercial):	$ 3.00 per Hour
Percentage of Private Vehicles:	99.00%

Pollutant Damage Value:		
CO:	$ 0.00	per Kg
HC:	$ 2.00	per Kg
NOx:	$ 3.90	per Kg
SOx:	$ 1.60	per Kg
PM:	$ 2.90	per Kg
Truck Equivalent Factor:	1.70	Passenger Vehicles
Bus Equivalent Factor:	1.50	Passenger Vehicles
Weather Condition:		
Rain Fall:	Below Average	
Snow Fall:	Below Average	

OUTPUT (C:\MODECOST\ALT4FRNT.OUT)

1. Auto and/or Bus

Roadway Section (Main Lane):

Annual Cost (in $/yr) by Modes

Mode	Auto & Pickup	Bus	Truck	Total
Facility Cost	1,388,318	54,973	1,055,482	2,498,772
Travel Time Cost	764,023	38,045	62,227	864,295
Air Pollution Cost	50,246	502	28,269	79,018
Incident Delay Cost	0	0	0	0
Accident Cost	76,620	0	7,052	83,671
Other External Cost	536,779	3,853	0	540,632
User/Agency Cost	2,699,898	20,693	0	2,720,591

Highway Facility Cost

	Annual Cost ($/yr)	Initial Lump-Sum ($)
Right-of-way	82,648	779,117
Cost of Preparing Roadway-Bed	127,719	1,204,000
Shoulder, Sewer, Signage, Lighting	1,039,577	9,800,000
Cost of Interchange/Intersection	63,648	600,000
Pavement Cost	436,090	4,110,978
Rehabilitation Cost	124,433	-
Annual Maintenance Cost	280,000	-
Cost of Administration, Safety, etc.	344,658	-

Travel Time Cost (in $/yr) of Different Periods (Unit Cost: $/PMT)

Period (Direction)	Auto & Pickup	Bus	Truck
Weekday AM Peak (1)	34,296 (0.062)	1,792 (0.308)	2,793 (0.062)
Weekday PM Peak (1)	68,680 (0.062)	3,584 (0.308)	5,594 (0.062)
Weekday Day (1)	120,037 (0.062)	6,271 (0.308)	9,777 (0.062)
Weekday Night (1)	62,720 (0.062)	3,284 (0.308)	5,109 (0.062)
Weekend AM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (1)	71,307 (0.062)	3,028 (0.325)	5,807 (0.062)
Weekend Night (1)	24,972 (0.062)	1,064 (0.325)	2,034 (0.062)
Weekday AM Peak (2)	34,296 (0.062)	1,792 (0.308)	2,793 (0.062)
Weekday PM Peak (2)	68,680 (0.062)	3,584 (0.308)	5,594 (0.062)
Weekday Day (2)	120,037 (0.062)	6,271 (0.308)	9,777 (0.062)
Weekday Night (2)	62,720 (0.062)	3,284 (0.308)	5,109 (0.062)
Weekend AM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (2)	71,307 (0.062)	3,028 (0.325)	5,807 (0.062)
Weekend Night (2)	24,972 (0.062)	1,064 (0.325)	2,034 (0.062)

Pollution Cost (in $/yr) of Different Periods (Unit Cost: $/PMT)

Period (Direction)	Auto & Pickup	Bus	Truck
Weekday AM Peak (1)	2,255 (0.004)	23 (0.004)	1,269 (0.028)
Weekday PM Peak (1)	4,513 (0.004)	47 (0.004)	2,537 (0.028)
Weekday Day (1)	7,893 (0.004)	82 (0.004)	4,441 (0.028)
Weekday Night (1)	4,130 (0.004)	43 (0.004)	2,326 (0.028)

Weekend AM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (1)	4,687 (0.004)	41 (0.004)	2,636 (0.028)
Weekend Night (1)	1,644 (0.004)	15 (0.004)	926 (0.028)
Weekday AM Peak (2)	2,255 (0.004)	23 (0.004)	1,269 (0.028)
Weekday PM Peak (2)	4,513 (0.004)	47 (0.004)	2,537 (0.028)
Weekday Day (2)	7,893 (0.004)	82 (0.004)	4,441 (0.028)
Weekday Night (2)	4,130 (0.004)	43 (0.004)	2,326 (0.028)
Weekend AM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (2)	4,687 (0.004)	41 (0.004)	2,636 (0.028)
Weekend Night (2)	1,644 (0.004)	15 (0.004)	926 (0.028)

Cost (million $) by year and by categories: Auto Main Lane

Year	Facility	Time	Air Pollut	Inci Delay	Accident	External	User/Age
1	1.388	0.479	0.032	0.000	0.048	0.337	1.696
2	1.388	0.503	0.033	0.000	0.051	0.354	1.781
3	1.388	0.528	0.035	0.000	0.053	0.372	1.870
4	1.388	0.555	0.037	0.000	0.056	0.390	1.963
5	1.388	0.583	0.038	0.000	0.058	0.410	2.061
6	1.388	0.612	0.040	0.000	0.061	0.430	2.164
7	1.388	0.642	0.042	0.000	0.064	0.452	2.273
8	1.388	0.675	0.044	0.000	0.068	0.474	2.386
9	1.388	0.708	0.047	0.000	0.071	0.498	2.505
10	1.388	0.743	0.049	0.000	0.075	0.522	2.627
11	1.388	0.780	0.051	0.000	0.078	0.548	2.758
12	1.388	0.819	0.054	0.000	0.082	0.576	2.896
13	1.388	0.860	0.057	0.000	0.086	0.605	3.041
14	1.388	0.904	0.059	0.000	0.091	0.635	3.193
15	1.388	0.946	0.062	0.000	0.095	0.665	3.343
16	1.388	0.994	0.065	0.000	0.100	0.698	3.510
17	1.388	1.044	0.069	0.000	0.105	0.733	3.686
18	1.388	1.096	0.072	0.000	0.110	0.769	3.870
19	1.388	1.151	0.076	0.000	0.115	0.808	4.064
20	1.388	1.205	0.079	0.000	0.121	0.846	4.254
21	1.388	1.266	0.083	0.000	0.127	0.888	4.467
22	1.388	1.329	0.087	0.000	0.133	0.932	4.690
23	1.388	1.396	0.092	0.000	0.140	0.979	4.924
24	1.388	1.466	0.096	0.000	0.147	1.028	5.171
25	1.388	1.540	0.101	0.000	0.154	1.079	5.429
26	1.388	1.618	0.106	0.000	0.162	1.133	5.701
27	1.388	1.699	0.112	0.000	0.170	1.190	5.986
28	1.388	1.785	0.117	0.000	0.178	1.250	6.285
29	1.388	1.875	0.123	0.000	0.187	1.312	6.599
30	1.388	1.969	0.129	0.000	0.197	1.378	6.929

Cost (million $) by year and by categories: Bus Main Lane

Year	Facility	Time	Air Pollut	Inci Delay	Accident	External	User/Age
1	0.055	0.016	0.000	0.000	0.000	0.002	0.015
2	0.055	0.017	0.000	0.000	0.000	0.002	0.015
3	0.055	0.018	0.000	0.000	0.000	0.002	0.016
4	0.055	0.018	0.000	0.000	0.000	0.002	0.017
5	0.055	0.019	0.000	0.000	0.000	0.002	0.013
6	0.055	0.020	0.000	0.000	0.000	0.002	0.014
7	0.055	0.021	0.000	0.000	0.000	0.002	0.015
8	0.055	0.022	0.000	0.000	0.000	0.002	0.015
9	0.055	0.024	0.000	0.000	0.000	0.002	0.016
10	0.055	0.032	0.000	0.000	0.000	0.003	0.018
11	0.055	0.034	0.000	0.000	0.000	0.003	0.019
12	0.055	0.035	0.000	0.000	0.000	0.004	0.020
13	0.055	0.037	0.000	0.000	0.000	0.004	0.021
14	0.055	0.039	0.001	0.000	0.000	0.004	0.022
15	0.055	0.058	0.001	0.000	0.000	0.006	0.023
16	0.055	0.061	0.001	0.000	0.000	0.006	0.024
17	0.055	0.064	0.001	0.000	0.000	0.007	0.025
18	0.055	0.068	0.001	0.000	0.000	0.007	0.027
19	0.055	0.071	0.001	0.000	0.000	0.007	0.028
20	0.055	0.099	0.001	0.000	0.000	0.010	0.039
21	0.055	0.104	0.001	0.000	0.000	0.010	0.041
22	0.055	0.109	0.001	0.000	0.000	0.011	0.043
23	0.055	0.114	0.001	0.000	0.000	0.012	0.045
24	0.055	0.120	0.001	0.000	0.000	0.012	0.047
25	0.055	0.126	0.001	0.000	0.000	0.013	0.050
26	0.055	0.132	0.001	0.000	0.000	0.013	0.052
27	0.055	0.139	0.001	0.000	0.000	0.014	0.055
28	0.055	0.146	0.001	0.000	0.000	0.015	0.057
29	0.055	0.153	0.001	0.000	0.000	0.015	0.060
30	0.055	0.161	0.002	0.000	0.000	0.016	0.063