TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA/TX-91/1128-1F		

4. Title and Subtitle	5. Report Date
The HEEM-III Benefit-Cost Computer Program	Nov. 1990 (Sep. 91-rev) (Sep. 92-rev)
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
Jeffery L. Memmott	Research Report 1128-1F

9. Performing Organization Name and Address	10. Work Unit No.
Texas Transportation Institute Texas A&M University System College Station, Texas 77843-3135	11. Contract or Grant No. Study No. 2-8-89/0-1128

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Texas Department of Transportation, Transportation Planning Division P.O. Box 5051, Austin, Texas 78763	Final - Sep. 88 to Aug. 90
	14. Sponsoring Agency Code

15. Supplementary Notes

Research performed in cooperation with DOT, FHWA.
Research Study Title: Improvement of HEEM-II to Evaluate Urban Arterials and Interchanges

16. Abstract

This report documents a computer program, HEEM-III, that will analyze proposed added-capacity, bypass (new location), High Occupancy Vehicle (HOV), interchange, and railroad grade separation projects. The Program represents a completely new program as compared to the HEEM-II computer program. The major changes include use of hourly volumes to calculate speeds and user costs, inclusion of intersection and interchange delay calculations, inclusion of yearly pavement condition and maintenance costs, and separate HOV analyses for the morning and afternoon peak periods. The program calculates motorist savings in user costs over a planning period. These user costs include delay costs, vehicle operating costs, and accident costs.

HEEM-III comes in two versions, a PC version and a mainframe version. The PC version is a menu driven program that includes a data input and editing process, data analysis, output display, and procedures to save both the input and output data. The mainframe version uses batch input and produces the same output as the PC version. The mainframe version also has an option to output a single line of summary data, for use when a large number of problems are being run.

HEEM-III is designed to give the user an economic analysis of a proposed highway improvement at the planning level by calculating the benefits to the motorists and giving the results in terms of both the Net Present Value and a Benefit-Cost ratio. This can used in the project development process to define and evaluate alternatives and compare the relative merits of several proposed projects with a limited budget.

17. Key Words	18. Distribution Statement
Delay, Benefit-Cost, Interchanges, Railroad Grade Separations, Bypasses	No Restrictions. This document is available to the public through the National Information Service, 5285 Port Royal Road, Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	157	

Form DOT F 1700.7 (8-69)

THE HEEM-III BENEFIT-COST COMPUTER PROGRAM

by

Jeffery L. Memmott
Associate Research Economist

Research Report 1128-1F
Research Study Number 2-8-89/0-1128
Improvement of HEEM-II to Evaluate Urban Arterials and Intersections

Sponsored by

Texas Department of Transportation

in cooperation with

U.S. Department of Transportation
Federal Highway Administration

November 1990

METRIC (SI*) CONVERSION FACTORS

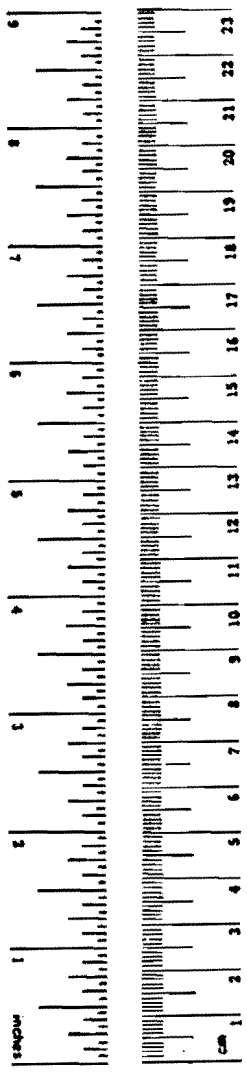
APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
in	inches	2.54	centimetres	cm
ft	feet	0.3048	metres	m
yd	yards	0.914	metres	m
mi	miles	1.61	kilometres	km
AREA				
in^2	square inches	645.2	centimetres squared	cm^2
ft^2	square feet	0.0929	metres squared	m^2
yd^2	square yards	0.836	metres squared	m^2
mi^2	square miles	2.59	kilometres squared	km^2
ac	acres	0.395	hectares	ha
MASS (weight)				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
VOLUME				
fl oz	fluid ounces	29.57	millilitres	mL
gal	gallons	3.785	litres	L
ft^3	cubic feet	0.0328	metres cubed	m^3
yd^3	cubic yards	0.0765	metres cubed	m^3

NOTE: Volumes greater than 1000 L shall be shown in m^3.

TEMPERATURE (exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

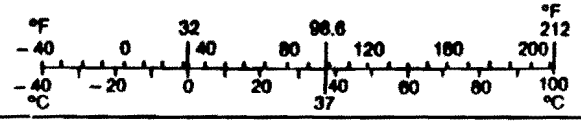


APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
mm	millimetres	0.039	inches	in
m	metres	3.28	feet	ft
m	metres	1.09	yards	yd
km	kilometres	0.621	miles	mi
AREA				
mm^2	millimetres squared	0.0016	square inches	in^2
m^2	metres squared	10.764	square feet	ft^2
km^2	kilometres squared	0.39	square miles	mi^2
ha	hectores (10 000 m^2)	2.53	acres	ac
MASS (weight)				
g	grams	0.0353	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams (1 000 kg)	1.103	short tons	T
VOLUME				
mL	millilitres	0.034	fluid ounces	fl oz
L	litres	0.264	gallons	gal
m^3	metres cubed	35.315	cubic feet	ft^3
m^3	metres cubed	1.308	cubic yards	yd^3

TEMPERATURE (exact)

°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



These factors conform to the requirement of FHWA Order 5190.1A.

* SI is the symbol for the International System of Measurements

ABSTRACT

This report documents a computer program, HEEM-III, that will analyze proposed added-capacity, bypass (new location), High Occupancy Vehicle (HOV), interchange, and railroad grade separation projects. The Program represents a completely new program as compared to the HEEM-II computer program. The major changes include use of hourly volumes to calculate speeds and user costs, inclusion of intersection and interchange delay calculations, inclusion of yearly pavement condition and maintenance costs, and separate HOV analyses for the morning and afternoon peak periods. The program calculates motorist savings in user costs over a planning period. These user costs include delay costs, vehicle operating costs, and accident costs.

HEEM-III comes in two versions, a PC version and a mainframe version. The PC version is a menu driven program that includes a data input and editing process, data analysis, output display, and procedures to save both the input and output data. The mainframe version uses batch input and produces the same output as the PC version. The mainframe version also has an option to output a single line of summary data, for use when a large number of problems are being run.

HEEM-III is designed to give the user an economic analysis of a proposed highway improvement at the planning level by calculating the benefits to the motorists and giving the results in terms of both the Net Present Value and a Benefit-Cost ratio. This can used in the project development process to define and evaluate alternatives and compare the relative merits of several proposed projects with a limited budget.

PREFACE

The author wishes to thank Gary Humes for his helpful comments, information, and suggestions during the course of the research project. Appreciation is also due to William F. McFarland, Margaret K. Chui, Thomas Urbanik, and Kay Fitzpatrick for their assistance, efforts, and suggestions during the course of the research.

The contents of this report reflect the views of the authors and 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, a specification, or a regulation. This report is not intended for construction, bidding, or permit purposes.

SUMMARY

This report is the documentation of the completely revised version of the HEEM-II computer program to analyze urban arterials and intersections. The report describes the new version, called HEEM-III, which includes a mainframe version and a PC version. The program is designed to perform a benefit-cost analysis of a wide range of highway improvement projects. The general categories of analysis cover bypasses (new location), added-capacity, interchanges, and railroad grade separations.

Several significant improvements were incorporated into HEEM-III. These include replacing ADT with hourly volumes as the basic unit for calculating speeds, delay, and motorist costs. This greatly enhances the capability of the program to analyze a much larger variety of projects. The revised program also has incorporated into the analysis specific calculations for intersections and interchanges, bringing the effects on urban arterials into the analysis. As a result of these changes, the HOV analysis was also greatly improved to model specific peak period usage. Yearly impacts of pavement condition on vehicle operating costs are also included, along with yearly maintenance/rehabilitation costs. There is also a method incorporated into the program which allows for analysis of anticipated induced traffic resulting from a proposed new location facility.

The PC version of HEEM-III provides several menus to input the necessary data to run a problem and also provides menus to edit and make changes to the default assumptions at any time. A problem is broken up into routes, with required existing and proposed routes, and an optional alternate route. Each route can be broken up into 1 to 10 segments. Each segment would generally consist of a road segment and one intersection or interchange.

The user costs are calculated for both the existing and proposed situations. From these costs a net present value and benefit-cost ratio are calculated. The user costs consist of delay costs, vehicle operating costs, and accident costs. The maintenance costs are considered an adjustment to the user costs to calculate the benefit-cost ratio. HEEM-III provides considerable flexibility to change the speed, capacity, and unit cost

assumptions used to make the calculations, and can be changed at any point after a problem is entered or read from a file.

The program also has the capability to save the input and output to a file for future use and examination and to send the information to a printer. The file created is a text file so that it can be used by a word processing package.

TABLE OF CONTENTS

LIST OF TABLES ix

LIST OF FIGURES x

INTRODUCTION 1

SETTING UP A PROBLEM 4

USING THE PC PROGRAM 9
- CHANGING SCREEN COLORS 9

USE OF THE PC MENUS 12
- MAIN MENU 12
- DATA INPUT MENU 15
- DATA EDIT MENU 17
- PROBLEM ASSUMPTIONS AND COSTS EDIT MENU 19
- ADDITIONAL PROBLEM ASSUMPTIONS EDIT MENU 22
- ROUTE DATA EDIT MENU 25
- SEGMENT DATA EDIT MENU 27
- OTHER TRAFFIC DATA MENU 29
- OTHER INTERSECTION/INTERCHANGE DATA MENU 32
- PAVEMENT CONDITION AND MAINT/REHAB COST MENU 34
- MINOR ROUTE DATA MENU 36
- HOV DATA MENU 38
- RAILROAD GRADE CROSSING DATA MENU 40

USING THE MAINFRAME VERSION 42
- HEEM-III INPUT DATA FILE FORMAT 42

CONCLUSIONS AND RECOMMENDATIONS 66

REFERENCES 67

APPENDIX A - CALCULATION OF MOTORIST COSTS AND SAVINGS 69
- CALCULATION INTERSECTION AND INTERCHANGE DELAY 70
- CALCULATION OF MOTORIST COSTS 71

APPENDIX B - SOURCE CODE FOR HEEM-III, MAINFRAME PROGRAM 76

APPENDIX C - EXAMPLE INPUT AND OUTPUT FOR HEEM-III 96

LIST OF TABLES

Table 1. Accident Rates and Costs in Texas 75

Table C1. Characteristics of State Highway 199 Proposed Alternate Routes 102

Table C2. Problem Assumptions. 103

Table C3. Estimated Construction, Right of Way and Relocation Costs of Each Route Alternative in 1992. 104

Table C4. Route Assumptions, Central Route 105

Table C5. Segment Assumptions, Central Route, Existing Conditions 106

Table C6. Segment Assumptions, Central Route, Proposed Conditions 107

Table C7. Estimated Highway User Cost Savings by Route Alternative. 108

Table C8. Benefit-Cost Ratio. 109

LIST OF FIGURES

Figure 1. Layout of Disclaimer Screen 11

Figure 2. Layout of Main Menu Screen 12

Figure 3. Layout of Data Input Menu 15

Figure 4. Layout of Data Edit Menu 17

Figure 5. Layout of Problem Assumptions and Initial Costs Menu 19

Figure 6. Layout of Additional Problem Assumptions Edit Menu 22

Figure 7. Layout of Individual Route Data Menu 25

Figure 8. Layout of Route Segment Data Menu 27

Figure 9. Layout of Other Traffic Data Menu 29

Figure 10. Layout of Other Intersection/Interchange Data Menu 32

Figure 11. Layout of Pavement Condition and Maint/Rehab Cost Menu 34

Figure 12. Layout of Minor Route Data Menu 36

Figure 13. Layout of HOV Data Menu 38

Figure 14. Layout of Railroad Grade Crossing Data Menu 40

Figure C1. Map of Alternative Proposed Routes 98

INTRODUCTION

The HEEM-II computer program [1] has been used in various applications by the Texas Department Transportation (TxDOT) since it was released in 1982. These include motorist impacts for environmental impact statements, estimation of motorist liquidated damages, evaluation of route studies, and estimation of the benefit-cost ratio of proposed major freeway projects. It has proven to be a valuable tool in a variety of situations.

There are however, several significant drawbacks to the HEEM-II program. Perhaps the most significant is the use of Average Daily Traffic (ADT) to calculate average speeds rather than hourly volumes. While the use of ADT greatly reduces the time to run the program, it is not compatible with current practice of using hourly volumes to define traffic flow performance, such as the 1985 Highway Capacity Manual [2]. In addition it is very difficult to model traffic operations which affect only certain hours of the day, such as HOV lanes and workzones.

Another weakness of HEEM-II is the lack of explicit calculation of intersection or interchange delay. It is incorporated indirectly into the ADT/speed calculation, but the size of that effect is not known and it would not be possible to adjust for specific intersection/interchange characteristics. The lack of a specific analysis of intersection delay greatly reduces the usefulness of the program. Even for a freeway improvement, there is frequently a signalized parallel facility that should be included in the analysis.

This report describes a complete revision to the HEEM-II computer program to address the issues described above, as well as numerous other more minor weaknesses. The revised program is called HEEM-III. The program is similar to past versions, in that it is designed for use on a mainframe computer, with batch input. There is also a personal computer (PC) version which allows for input data entry and edit on a PC. The general structure of the program, as well as the PC menus follow the TRIP program [3], which was developed by the author for TxDOT use in evaluating interchanges and other grade separations.

HEEM-III includes an analysis of the major motorist user costs associated with highway improvement projects including delay costs, vehicle operating costs, and

accident costs. The delay costs consist of delay traveling along a segment of highway, delay at a signed or signalized intersection or an at-grade RR crossing while a train is passing, and the delay of slowing down to cross over RR tracks. The vehicle operating costs consist of running costs traveling along a highway segment, the speed-change cycling costs of congestion, the costs of slowing down and stopping at an intersection or RR grade crossing, the idling costs while waiting in a queue, and costs of slowing down to cross RR tracks. Accident costs consist of the accident rates and costs associated with traveling along a highway section, as well as the additional accident costs of an intersection, interchange, or RR grade crossing.

The program also allows for adjustment of the calculated vehicle operating costs for changes in pavement condition. The user can input a pavement condition, Present Serviceability Index (PSI), for each year. The program uses a base of 4.5, so if the pavement condition is less than 4.5, the vehicle operating costs are increased. The opposite occurs for a pavement condition higher than 4.5. There is also the ability to input annual routine maintenance or rehabilitation costs.

The PC version HEEM-III provides an easy-to-use and flexible method of inputting and editing the data. The minimal data required to run a problem is prompted from the user. That data, along with the other assumed data, can be changed at any time through a set of data menus. The input data set can then be saved and read directly into the program in subsequent applications. The output can be displayed on the screen, sent to a printer, or saved in a file.

One important feature of the bypass (new location) analysis is the through traffic allocation. The program provides for a procedure to allocate the through traffic to an existing route, a proposed bypass, and an optional alternate route. The allocation procedure is built into the HEEM-II program. The traffic is allocated based upon an iterative process that gives traffic to each route such that the motorist user costs are the same. An important added feature is the ability to override the allocation provided by the program, the user can directly input the traffic that will remain on the existing routes and the amount to use the bypass or other new location facility. Also the traffic can be reallocated at any time, for example when some input data item has been changed. This

gives both the flexibility and control that should make it useful in a wide variety of applications.

Another important feature of the HEEM-III computer program is the ability to analyze induced traffic. Previous versions of HEEM as well as nearly all other benefit-cost computer programs require that the corridor traffic for the "do-nothing" alternative be the same as the "if-improved" alternative. There may be some diversion between the routes, but the totals must be the same. The reason for this restriction is the difficulty in calculating the benefits of new vehicles using the corridor. These additional vehicles may be diverting from some other routes outside the corridor, or may represent new trips resulting from the increased capacity and better traffic conditions. The problem is what costs to attribute to these additional trips to if the facility is not improved, the "do-nothing" alternative.

The most widely accepted method to deal with this problem comes from economic theory and is the consumer surplus approach. This approach, simplified greatly, gives the additional induced traffic half of the reduction in user costs experienced by the other drivers. This is the approach used in the HEEM-III computer program. This feature allows the user to analyze in a much more realistic fashion a planned major new location facility. In many cases the traffic on the new facility far exceeds the combined total of the alternate parallel facilities. Rather than artificially increasing the existing traffic or reducing the traffic on the new location facility, the actual anticipated volumes can be input and the program will analyze those conditions.

The following sections in the report describe the use of the program, how to set up a problem, how to enter the data through the PC, how to use the PC edit menus, and the use of the mainframe version. The delay and other user cost calculations are described in Appendix A. A program listing of the mainframe version is provided in Appendix B. An example of the input and output are shown in Appendix C.

SETTING UP A PROBLEM

Since HEEM-III offers a great deal of flexibility in analyzing a problem, some care should be taken in setting up the structure of the problem and getting the input data ready before the program is started. There are four general categories of projects which HEEM-III can analyze, (1) bypass (new location), (2) added-capacity, (3) interchange, and (4) highway-railroad grade separation. The bypass is any new location facility with an existing parallel route. The added-capacity category includes any upgrade of an existing highway. The proposed route replaces the existing route. There can also be an optional alternate parallel route. The interchange category is used when a proposed interchange is replacing an existing intersection or interchange. This would typically be when an intersection or interchange is being upgraded with a higher design structure. The railroad grade separation is used where an at-grade railroad grade crossing is being replaced with a grade separation.

In general the program compares the motorist costs of the existing situation, the "without improvement" alternative, to the motorist costs if the improvement is completed, the "with improvement" alternative. In all cases, the "without improvement" alternative includes an existing route and an optional alternate route. For all cases except new location projects, the "with improvement" alternative includes a proposed route, with an optional alternate route. The proposed route replaces the existing route. For new location projects the "with improvement" alternative includes an existing route, a proposed route, and an optional alternate route. The proposed route does not replace the existing route, though it does take some of the traffic off the existing route.

There are several categories of intersections and interchanges, two-way stop, four-way stop, signalized intersection, simple diamond interchange, three-level diamond, cloverleaf, and directional. The existing and proposed highways can use any of these intersection/interchange categories.

There are two general categories of traffic volumes, the through traffic and additional local traffic. The through traffic is the traffic traveling along the entire route, and is the same for each route segment. The additional local traffic is the additional traffic on

a specific route segment, not included in the through traffic. One important difference in the way the two types of traffic are treated is in the internal traffic allocation procedure. Only through traffic is allocated to a proposed new location facility. The local traffic is not allocated. Of course the through traffic allocation can be overridden by changing the traffic volumes for each route.

The local traffic can also be used when the traffic volumes change significantly along a route. The segment with the lowest traffic could be used as the through traffic, and the local traffic for each of the other segments would be the difference between that lowest volume and the volume for that segment. The use of local traffic does not affect the analysis within the program. The program sums the through traffic and local segment traffic to calculate the user costs for that segment. There is no distinction made internally in the program between through traffic and local traffic, except in the allocation routine described above.

These two categories of traffic volumes were designed principally for bypass projects. For added-capacity, interchange, and RR grade separations, it would generally be sufficient to specify the through traffic as the ADT for each route and set the additional local traffic to 0. For bypasses, the through traffic represents traffic that can be allocated to the proposed bypass after it is built. The additional local traffic is that traffic that is not sensitive to the bypass and will use the route regardless. In this way the bypass may pull most or all of the through traffic to the new facility, but local traffic will remain on the existing or alternate routes.

To run a problem with HEEM-III, first determine both the existing and proposed routes. An optional alternate route can also be used if desired. For a bypass project, the existing route might be the route through town, and proposed route would be the bypass. For an added-capacity project, the existing route might be an existing 4-lane freeway, and the proposed route a 6-lane freeway. For an interchange project, the existing route might be an existing signalized intersection, and the proposed route could be a diamond interchange. For the added-capacity, interchange, and RR grade separation categories of projects, the proposed route replaces the existing route when the improvement is simulated.

Each route must then be divided up into one or more segments. Each segment would generally contain at most one intersection or interchange, though the program does have the option of specifying the number of intersections. This option of specifying the number of intersections is limited, however, because the data for typical intersection would be input, and that would be applied to all intersections for that segment. For that reason, for increased accuracy it is better to limit each segment to at most one intersection or interchange.

The division of routes into multiple segments is generally to help in analyzing urban arterials or bypass projects, where there may be several intersections along a route, but it could also be used when a proposed interchange project is part of a project to widen a highway section or where more than one intersection or interchange is involved. Segments could also be used to divide up routes with significant changes in the design, such as changes in the number of lanes. Segments can also define significant changes of traffic volumes along a route. Each route can contain from 1 to 10 segments, but they do not have to match up. For example an existing route through town may have 10 segments, while the bypass may need only 4.

Only a very limited amount of data are required to analyze a problem. Most data items have default values supplied by the program. A list of the data items required to analyze a problem are given below:

For all projects,

1. Current Year
2. Total Construction Cost
3. Category of Project (bypass, added-capacity, interchange, RR grade separation)
4. Area Type (rural or urban)
5. Existing and Proposed Through Traffic Volumes for Current Year and Projected 20th Year
6. Total Number of Lanes for Existing and Proposed Route Segments
7. Type of Intersection/Interchange for Existing and Proposed Route Segments

8. Length of each Existing and Proposed Route Segment
9. Type of facility for each Existing and Proposed Route Segment (undivided, divided, freeway).

For a Route Segment with an intersection or interchange,

1. Traffic Volumes on Minor Route for Current Year and Projected 20th Year
2. Total Number of Lanes for Minor Route
3. Minor Route Facility Type

For an HOV Facility,

1. For AM and PM Peak Periods:
   a. Beginning and Ending Hour
   b. Percent Persons using HOV
   c. Car/Van and Bus Occupancy

Two of the most important optional data items are the free flow speed and the hourly capacity. These two data items are used to calculate the average running speed for a given hourly traffic demand. Since most of the motorist user costs are based on the average running speed, they should be examined, even though the program provides default values. The free flow speed is defined as the speed at level-of-service (LOS) A in the 1985 Highway Capacity Manual (HCM) [2]. For a segment with an intersection or interchange, it would be the midblock LOS A speed. The hourly capacity is also taken from the HCM. The program defaults include an adjustment for the percent trucks, assuming an average passenger car equivalent of 2 for all trucks. If a different value is desired, or if other capacity adjustments are desired, then the procedure outlined in the HCM should be utilized.

A complete list of the input data, both required and optional, are given in the section "USING THE MAINFRAME VERSION" later in this report.

In summary the following steps should be taken before running a problem with HEEM-III:

1. Select the existing route, the proposed route, and if desired, an alternate route.

2. Determine the through ADT for each of those routes. (The existing and proposed ADT would be the same if the proposed route will replace the existing route.)
3. Divide each route up into one or more segments. Each segment should contain at the most one intersection or interchange, or one intersection to represent multiple intersections. Segments should also reflect significant changes in the route, such as changes in the number of lanes and traffic volumes.
4. Assemble the necessary information on each route segment, including number of lanes, length, and additional local traffic. Information on the minor crossing road (if any) and HOV facility (if any) is also necessary. The program uses the terminology major route for the route being analyzed, and minor route for the crossing route at an intersection or interchange.

USING THE PC PROGRAM

HEEM-III has been designed to work on an IBM PC/XT/AT or compatible microcomputer. It can be used with or without a math coprocessor, though the math chip does substantially increase the speed of the analysis and is recommended.

Due to the size of the program, it is recommended that the program be used with a hard disk system. To begin, make a directory for HEEM-III, by typing "MD C:\HEEM", then change directories by typing "CD C:\HEEM". Then copy the HEEM files by inserting the HEEM diskette into Drive A and then typing "COPY A:*.*".

To start HEEM-III, simply type "HEEMPC", and hit the <RETURN>. The Disclaimer Screen will appear as shown in Figure 1. Press any key and the Data Input Menu will appear. If you want to enter data for a problem, type "1" and hit the <RETURN>. You will be prompted for the required data. A list of these required data items are given in the previous section, "GETTING STARTED." The particular items prompted for depends somewhat on the type and complexity of the problem to be analyzed.

When the data entry is complete, the main menu can be seen by selecting "3" in the Data Input Menu. At this point, the problem can be analyzed by selecting "6" in the Main Menu. The output will be displayed on the screen when complete. The output can be viewed again, sent to a printer, or saved in a file by selecting "7" in the Main Menu. The input data set can be saved for future use by selecting "8" in the Main Menu. To exit the program, select "9" or hit the escape key.

CHANGING SCREEN COLORS

When HEEM-III is run for the first time, a small file containing the default screen colors is created, named HEEMSET.COL. The screen colors displayed while using the program can be changed by editing this file. It is important to use a text editor which will not insert any formatting codes, otherwise the program will not be able to read it in subsequent applications. For monochrome displays, the colors change the intensity or brightness of the characters or background. The format of the file is given below.

Column	Format	Description
1-4	I4	Menu Heading Character Color, default - bright white
5-8	I4	Menu Heading Background Color, default - green
9-12	I4	Menu Items Character Color, default - white
13-16	I4	Menu Items Background Color, default - black
17-20	I4	Menu Items Reverse Video Character Color, default - black
21-24	I4	Menu Items Reverse Video Background Color, default - white
25-28	I4	Status Line Character Color, default - white
29-32	I4	Status Line Background Color, default - dark blue

Color codes:

4	Red Character
64	Red Background
2	Green Character
32	Green Background
1	Dark Blue Character
16	Dark Blue Background
5	Lavender Character
80	Lavender Background
6	Yellow Character
96	Yellow Background
0	Black Character
0	Black Background
3	Light Blue Character
48	Light Blue Background
7	White Character
112	White Background
15	Bright White Character

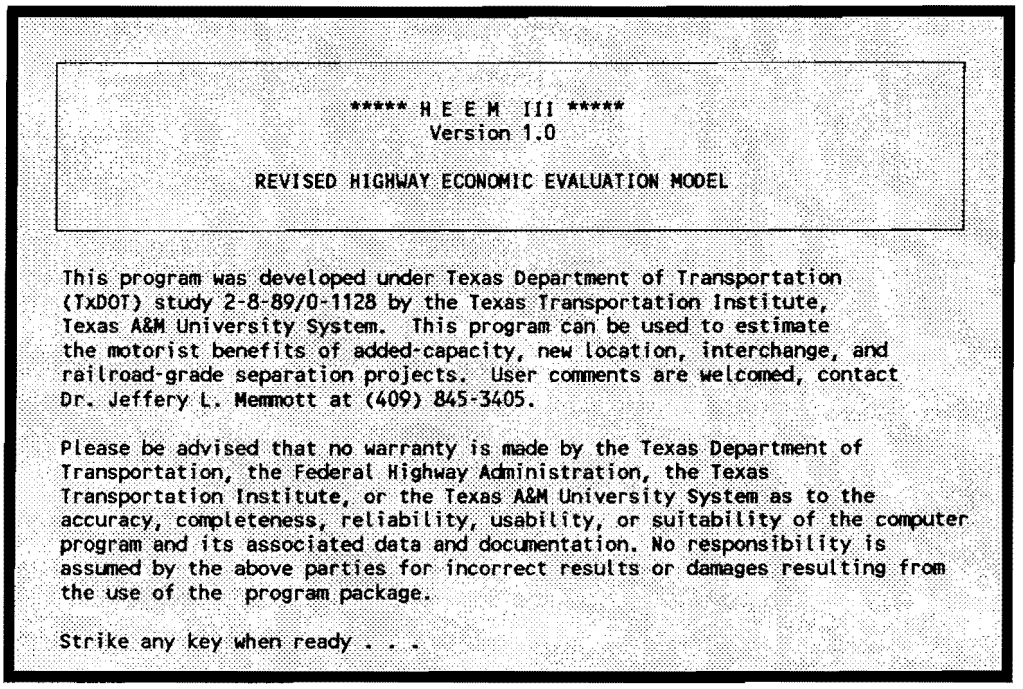


Figure 1. Layout of Disclaimer Screen

USE OF THE PC MENUS

The menus are structured in such a way that the problem data can easily be accessed and changed as needed. They also offer a variety of options to display and save both the input and output data. The menus, and their use, are discussed below.

MAIN MENU

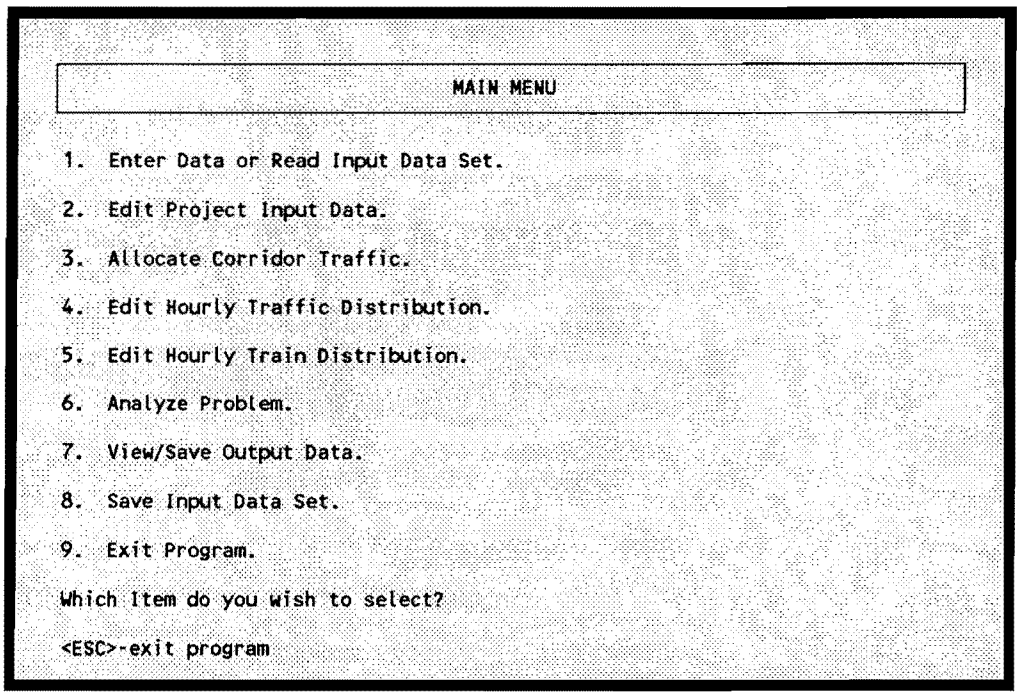


Figure 2. Layout of Main Menu Screen

The Main Menu gives the user 9 choices, as shown in Figure 2. The user must select one of these numbers to continue. The choices are explained below.

1. Enter Data or Read Input Data Set.

   When this item is chosen, the Data Input Menu is displayed, giving the choice of entering the input data or reading an input data file. (See Data Input Menu, below.)

2. Edit Project Input Data.

   When this item is chosen, the Data Entry Menu is displayed, giving choices of editing the problem, route, or segment data. (See Data Edit Menu, below.)

3. Allocate Corridor Traffic.

   This option allows the user to allocate traffic to a proposed new location bypass. The allocation is based on the motorist costs of traveling each route. If this item is chosen, the Traffic Allocation Menu is displayed, giving the option of continuing. The allocation will not be allowed if the project is not a bypass project.

4. Edit Hourly Traffic Distribution.

   This option allows the user to edit the assumed hourly traffic distribution. There is a separate default distribution for urban and rural areas. When this item is chosen, the Hourly Traffic Distribution Menu is displayed, giving the percent ADT, by hour, for a 24-hour period.

5. Edit Hourly Train Distributions.

   This option allows the user to change the assumed uniform arrivals of trains during a 24-hour period. If this item is chosen, the Hourly Train Traffic Distribution Menu is displayed, giving the percent of the daily trains arriving each hour. The objective is to allow for simulation of the interaction of the peaking patterns of vehicles with train arrivals.

6. Analyze Problem.

   This option allows the user to analyze the problem and see the output. A message will be displayed saying the problem is being analyzed. The time required to analyze a problem can vary greatly, depending on the complexity of the problem and the type of machine the problem is being run on. It can vary from several seconds to a few minutes. There is no way the program can get into an infinite loop, so please wait for the analysis to be completed. After the analysis is complete, the traffic volumes over the analysis period will be displayed. If the volumes over time are too high or

too low, the percent growth in ADT in the Problem Data Edit Menu should be changed. The next output screen shows the benefit calculations over time for delay savings, vehicle operating cost savings, and accident cost savings. Totals are also shown, along with the benefit-cost ratio. The output can be viewed again by selecting Item 7, View/Save Output Data, in the Main Menu.

7. View/Save Output Data.

   This option allows the user to display the results of a problem that has been analyzed. If this item is chosen, the Output Options Menu is displayed, and the user has the option of displaying the output on the screen, sending it to a printer, or saving it in a file.

8. Save Input Data Set.

   This option allows the user to save the input data into a file for future use. When this item is chosen, the Save Input Data Menu is displayed, giving the option of saving the data, and if so, the name of the file.

9. Exit HEEM-III.

   This option allows the user to exit the program. If a data set has been input or changed since the last save, a warning message will be given before exiting, giving the user the chance to save the data set by displaying the Save Input Data Menu.

DATA INPUT MENU

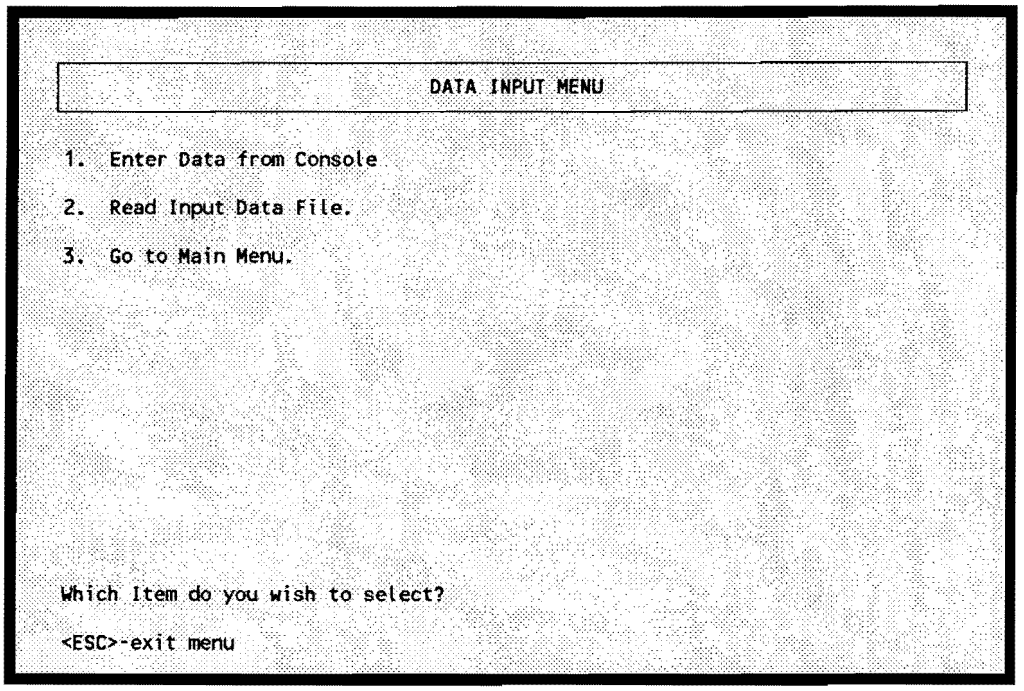


Figure 3. Layout of Data Input Menu

The choices are explained below.

1. Enter Data from Console.

   This option allows the user to enter the data for a new problem. The user will be prompted for the necessary information before returning to the main menu. The data items the program will prompt the user for are listed in the previous section, "Getting Started." If the problem is a bypass project, then traffic will also be automatically allocated to the proposed bypass. This can be overridden by entering the improved condition traffic in the Route Data Edit Menu, which can be accessed by selecting Item 2 of the Main Menu, then Item 2 of the Data Edit Menu.

2. Read Input Data File.

   This option allows the user to read in an input data file previously saved. The user is prompted for the name of the file. The name of the file, as well as the directory it is in, should be noted before running the program, since there is no file list or directory command available to look at the file names. After the file is read, the user can go to the main menu by selecting Item 3.

3. Return to Main Menu.

   This option allows the user to return to the main menu without starting the data entry process or reading a file. This is especially helpful when inputting or reading in a new data set, when there is already a data set in the program. This option allows the user to return to the main menu and save the data before it is replaced by a new data set.

DATA EDIT MENU

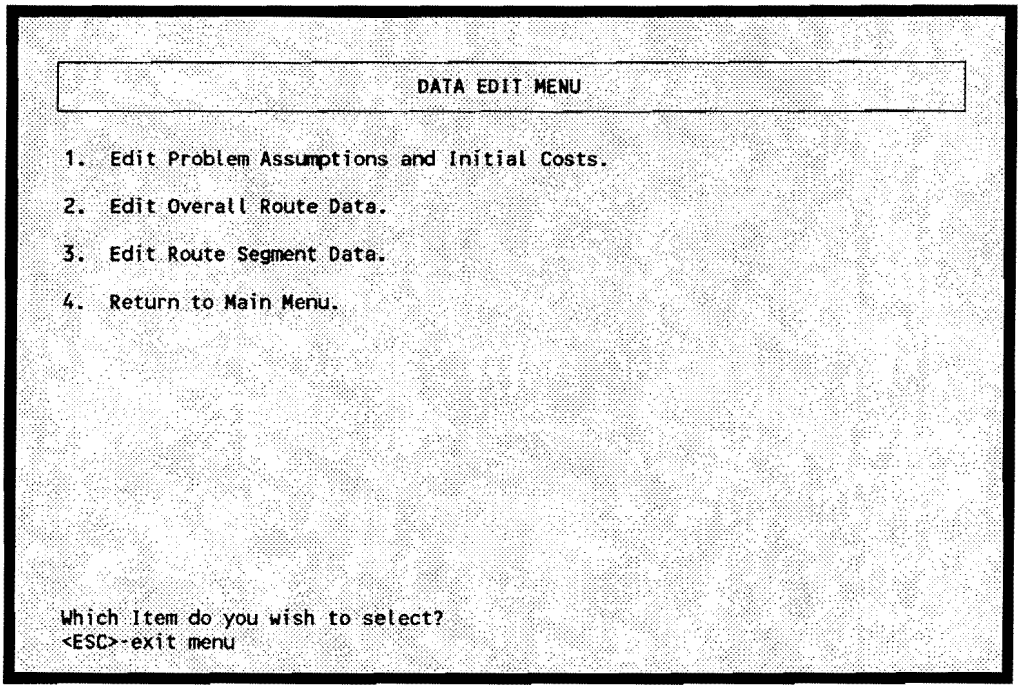


Figure 4. Layout of Data Edit Menu

The choices are explained below.

1. Edit Problem Assumptions and Initial Costs.

   This option allows the user to edit the problem assumptions, such as the project type, construction cost, and the economic assumptions. When this item is chosen, the Problem Assumptions and Costs Edit Menu is displayed, giving the data items that can be changed. (See Problem Assumptions and Costs Edit Menu, below.)

2. Edit Overall Route Data.

   This option allows the user to edit the overall route assumptions, such as the through traffic volumes for the current and improved conditions, and the number of segments in the route. When this item is chosen, the Route Data

Edit Menu is displayed, giving the route data items that can be changed. (See Route Data Edit Menu, below.)

3. Edit Route Segment Data.

   This option allows the user to edit the segment data for a particular route. These data include intersection/interchange type, number of lanes, free flow speed, length, and additional local traffic. For railroad crossings, it includes number of trains, speed, and length. When this item is chosen, if there is more than one segment, the segment number must be entered. Then the Segment Data Edit Menu is displayed, giving the segment data items that can be changed. (See Segment Data Edit Menu, below.)

4. Return to Main Menu.

   This option allows the user to return to the main menu after data editing is complete.

PROBLEM ASSUMPTIONS AND COSTS EDIT MENU

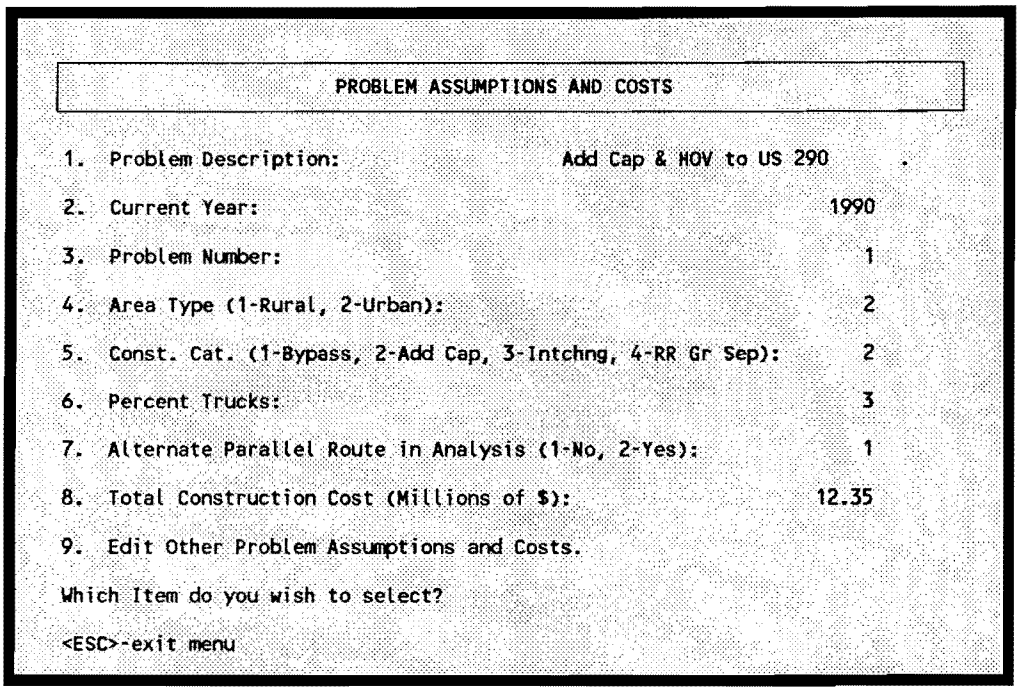


Figure 5. Layout of Problem Assumptions and Initial Costs Menu

The choices are explained below.

1. Problem Description.

   This item can be used to put a problem description in the input and output. It can be up to 30 characters long.

2. Current Year.

   The current year is used to set the time frame for the analysis. The traffic volumes are assumed to be for the current year, so if they do not match, set the current year to the year of the traffic volumes, or update the traffic volumes to the current year.

3. Problem Number.

   This item gives the problem number. The default is one. This is useful in running several different problems, by giving each a distinctive number. Or

it could also be used when running several different alternatives for the same problem.

4. Area Type (1-Rural, 2-Urban).

   This item indicates the general area the project is located in. The area affects some of the assumed default numbers and is used in the program. It will also affect the calculated speed for a given traffic volume on non-freeway highway types.

5. Construction Category (1-Bypass, 2-Added Capacity, 3-Interchange, 4-RR Grade Separation).

   This item is the general category of construction the project falls into. The category selected determines, to an extent, the data items that are prompted when entering data and some of the default values for individual routes and segments. A bypass is assumed to be on new location, and the proposed route will not replace the existing route. For the other three categories, added-capacity, interchange, and RR grade separation, the proposed route is assumed to replace the existing route.

6. Percent Trucks.

   This item is the percent of trucks, not counting pickups, in the traffic stream. This value is used for all routes, though it may be changed for any individual route segment. The default is 11 percent for rural areas and 3 percent for urban areas.

7. Alternate Parallel Route in Analysis (1-Yes, 2-No).

   This item is used to indicate if there is an alternate route to be included in the analysis. Normally this would be used for a bypass project, where the bypass would pull traffic off the existing route and an alternate parallel route. It could be used in the other categories if the proposed grade separation will pull traffic off an alternate parallel route.

8. Total Construction Cost (Millions of $).

   This item is the total construction and right-of-way costs for the proposed project, in millions of dollars.

9. Edit Other Problem Assumptions and Costs.

This option allows the user to edit additional problem assumptions, such as the type of traffic growth, year improvement completed, occupancy rates, and values of time. When this item is chosen, the Additional Problem Assumptions Edit Menu is displayed, giving the data items that can be changed. (See Additional Problem Assumptions Edit Menu, below.)

ADDITIONAL PROBLEM ASSUMPTIONS EDIT MENU

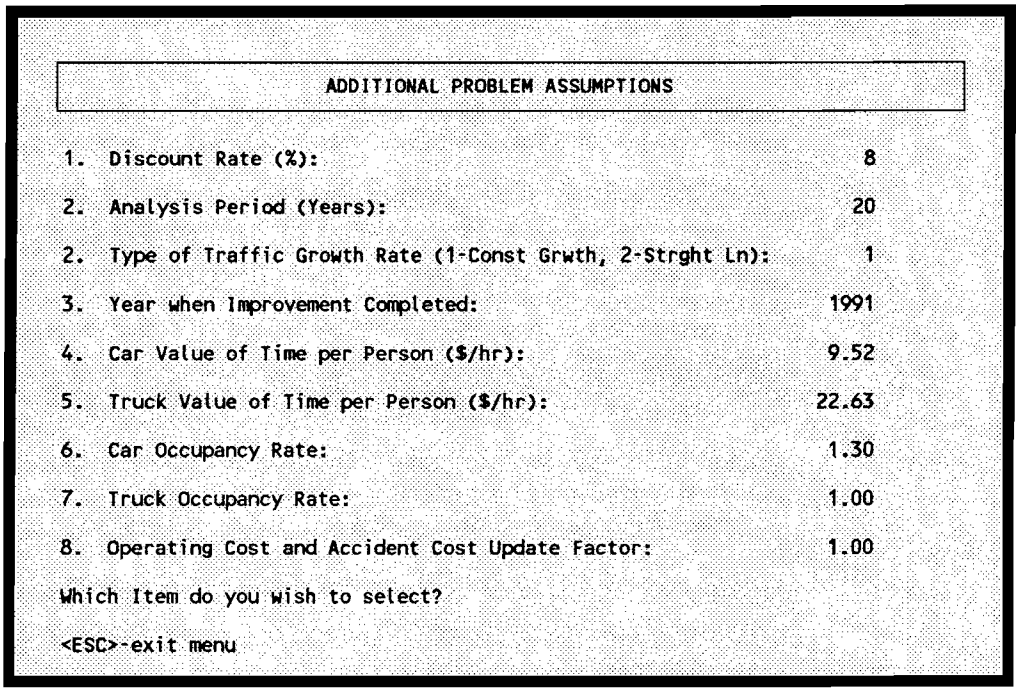


Figure 6. Layout of Additional Problem Assumptions Edit Menu

The choices are explained below.

1. Discount Rate (%).

   The discount rate is used to discount the flow of future benefits over the analysis period to present value dollars, so they can then be compared to the construction cost to give a benefit-cost ratio. The default value is 8 percent, the same as used in HEEM-II.

2. Analysis Period (Years).

   The analysis period is the period of time benefits are assumed to flow from the proposed project. The default value is 20 years, the same as used in HEEM-II.

3. Type of Traffic Growth Rate.

   The type of traffic growth rate has two options, a constant growth rate and a straight line growth. This is used to determine how the traffic grows between the current year ADT and the twenty year future ADT. The default value is the constant growth rate.

4. Year when Improvement Completed.

   This item gives the first year the improvement will be available and benefits are generated. The program begins calculating motorist benefits and costs at this year. The default is one year after the current year.

5. Car Value of Time per Person ($/hr).

   This item is the dollar value of passenger car time per person. The default is $9.52 per hour, which is updated to July 1990 from a TTI study [4]. This number should be updated periodically, using an appropriate price index such as the Consumer Price Index (CPI).

6. Truck Value of Time per Person ($/hr).

   This item is the dollar value of truck time per person. The default value is $22.63 per hour, which is updated to July 1990 from a TTI study [4]. This number should be updated periodically using an appropriate price index, such as the Producer Price Index (PPI).

7. Car Occupancy Rate.

   This item is the average number of passenger car occupants per vehicle. The default number is 1.3, which is the same from HEEM-II.

8. Truck Occupancy Rate.

   This item is the average number of truck occupants per vehicle. The default number is 1.0, which is the same from HEEM-II.

9. Operating Cost and Accident Cost Update Factor.

   This item is used to update the vehicle operating cost calculations and the accident cost calculations. The costs in the program have been updated to July 1990. The default is 1.00. Periodically this should be increased to reflect increases in vehicle and accident costs, using an appropriate price

index, such as the CPI or the fuel cost component of the CPI. The update factor can be calculated for the current year by dividing the appropriate CPI for that year by the corresponding CPI for July 1990. For example, using the overall CPI,

Update Factor = (Current Year CPI)/(130.5)

ROUTE DATA EDIT MENU

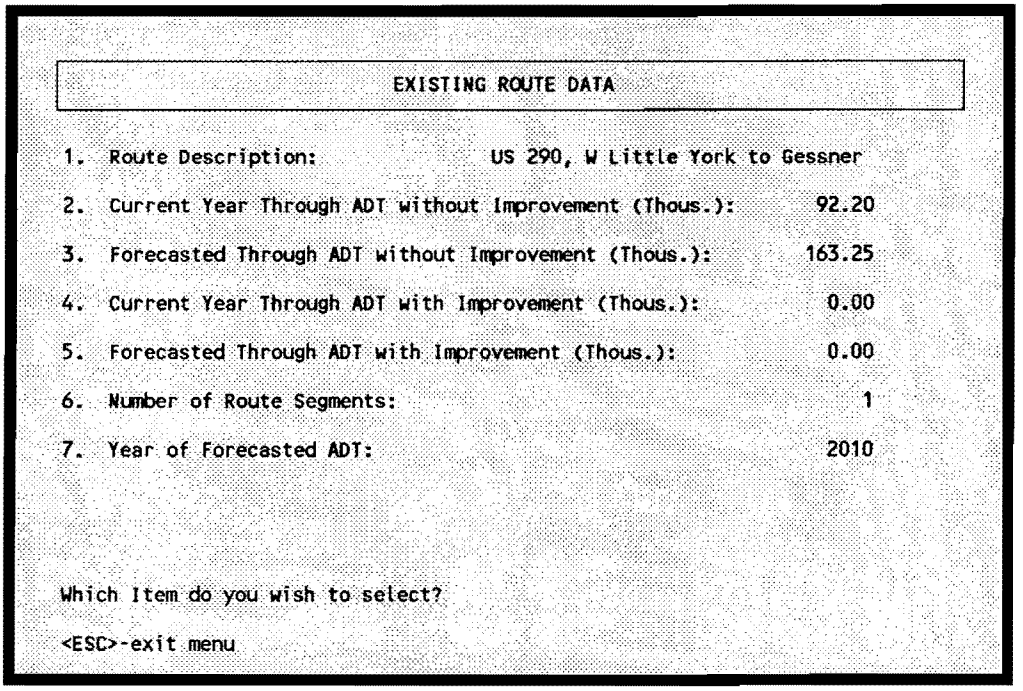


Figure 7. Layout of Individual Route Data Menu

The choices are explained below.

1. Route Description.

   This item can be used to put a route description in the input and output. It can be up to 30 characters long.

2. Current Year Average Daily THROUGH Traffic without improvement (Thous.).

   This item gives the current year average daily through traffic in thousands on this route in the current conditions, without the improvement, the "do-nothing" alternative. For an added-capacity or grade separation project, this would normally be the total ADT volume. For a bypass project, this represents the ADT on the route available for allocation to the bypass route. Any additional traffic would go to the additional local traffic in the Segment Data Edit Menu. Not shown for Proposed Route.

3. Twenty-Year Future Average Daily THROUGH Traffic without improvement (Thous.).

   This item gives the twenty-year forecasted average daily through traffic in thousands on this route in the current conditions, if the improvement is not made. Not shown for Proposed Route.

4. Current Year Average Daily THROUGH Traffic with improvement (Thous.).

   This item gives the current year average daily through traffic in thousands on this route for the improved conditions. Not shown for existing route if not a bypass category project.

5. Twenty-Year Future Average Daily THROUGH Traffic with improvement (Thous.).

   This item gives the twenty-year forecasted average daily through traffic in thousands on this route for the improved conditions. Not shown for existing route if not a bypass category project.

6. Number of Route Segments.

   This item gives the number of segments the route is to be divided up into. For a grade separation project, this would normally be 1. For a bypass project, each route can be divided up into a maximum of 10 segments, depending on the level of detail required for the analysis and the conditions of the routes. Normally segments are defined by breaks at signalized intersections or changes in the number of through lanes. The reason for those breaks is that for each segment, the intersection or interchange delay, along with the motorist costs of traveling the segment, are calculated. It is therefore of benefit to break the routes into segments if possible.

7. Year of Forecasted ADT.

   This item gives the year for the forecasted ADT used in the analysis. The default is twenty years past the current year.

SEGMENT DATA EDIT MENU

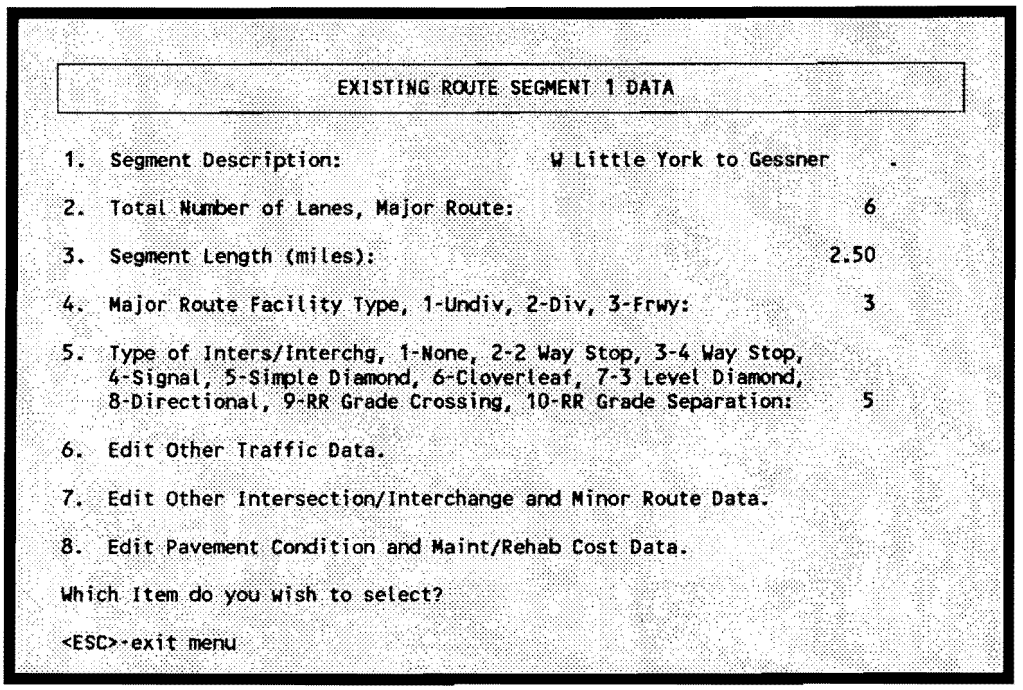


Figure 8. Layout of Route Segment Data Menu

The choices are explained below.

1. Segment Description.

   This item can be used to put a segment description in the input and output. It can be up to 30 characters long.

2. Total Number of Lanes, Major Route.

   This item gives the total number of through lanes on the major route.

3. Segment Length (miles).

   This item gives the length of the segment in miles. The allocation procedure for allocating traffic to a proposed bypass is very sensitive to this item.

4. Major Route Facility Type, 1-Undivided, 2-Divided, 3-Freeway.

   This item gives the facility type for the major route. This is used in calculating the average travel speed for a given traffic volume.

5. Type of Intersection/Interchange (1-None, 2-Two Way Stop, 3-Four Way Stop, 4-Signalized Intersection, 5-Simple Diamond, 6-Cloverleaf, 7-Three Level Diamond, 8-Directional, 9-Railroad At-Grade Crossing, 10-Railroad Grade Separation).

   This item designates the type of intersection or interchange in the segment. This item is used to set the default values on the percent of traffic going through the intersection.

6. Edit Other Traffic Data.

   This option allows for editing of additional route segment data, including additional local traffic, percent trucks, free flow speed, and capacity. It also allows access to the HOV and railroad crossing menus. (See Other Traffic Data Menu, below.)

7. Edit Other Intersection/Interchange and Minor Route Data.

   This option allows for editing of additional intersection or interchange data, including the percent of vehicles with a stop or signal, and the number of intersections or interchanges. It also gives access to the minor route data menu. (See Other Intersection/Interchange Data Menu, below.)

8. Edit Pavement Condition and Maint/Rehab Cost Data.

   This option allows for editing of yearly pavement condition data and yearly maintenance/rehabilitation costs on the route segment. (See Pavement Condition and Maint/Rehab Cost Menu, below.)

OTHER TRAFFIC DATA MENU

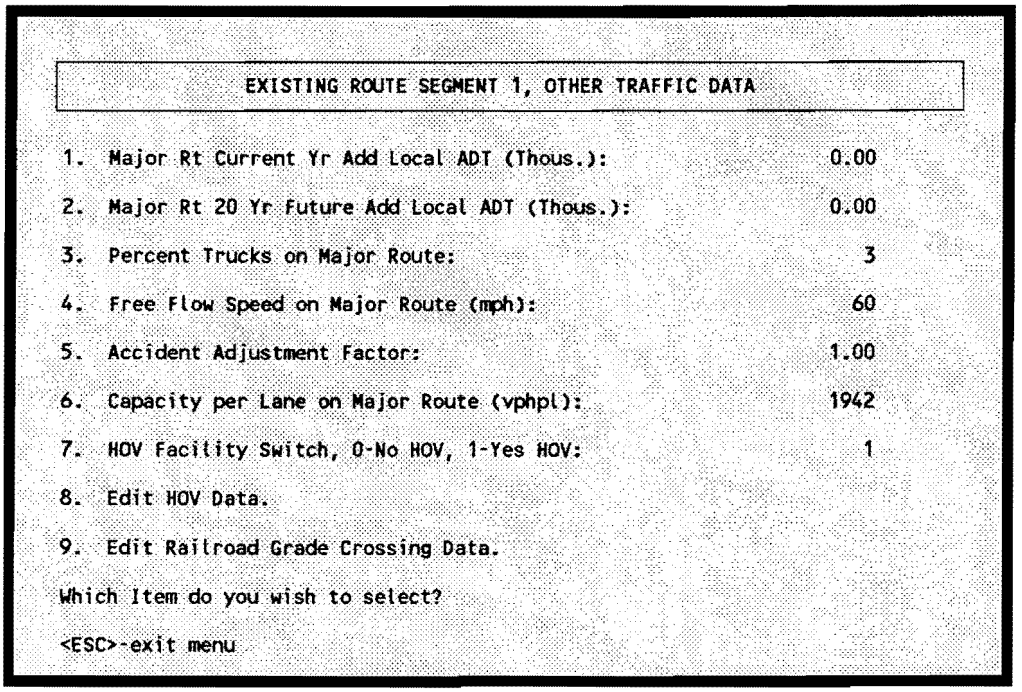


Figure 9. Layout of Other Traffic Data Menu

The choices are explained below.

1. Major Route Current Year Additional Local ADT (Thous.).

   This item gives the current year additional daily traffic on the segment not accounted for in the through traffic for the route. This local traffic option is normally used in the bypass analysis to designate the traffic that cannot be allocated to the new location bypass. It can also be used for varying traffic volumes along a route, existing, alternate, or proposed. For example the lowest volume for any individual segment could be used as the through traffic, with the local traffic reflecting the additional traffic on a given segment above that lowest volume. It makes no difference in the analysis. For each segment the local traffic is summed with the through route traffic to calculate the user costs for that segment.

2. Major Route 20 Year Future Additional Local ADT (Thous.).

   This item gives the 20 year forecasted additional daily traffic on the segment not accounted for in the through traffic for the route. It can be used in the same fashion as the Current Year Local ADT.

3. Percent Trucks on Major Route.

   This item gives the percent trucks, not counting pickups, on the major route for this segment. The default is the percent trucks in the Problem Data Edit Menu.

4. Free Flow Speed on Major Route (mph).

   This item gives the free flow speed on the major route. The free flow speed is the midblock LOS A speed along the segment. The defaults are 60 for a freeway, 55 for a rural nonfreeway, 35 for an urban undivided, and 40 for an urban divided.

5. Accident Adjustment Factor.

   This item gives a factor to adjust the accident rate for unusually high or low accident experience or severity along the route segment. This adjustment factor is similar to the safety factor in HEEM-II. An adjustment factor greater than 1 will increase the calculated number of accidents for the segment, a number less than one will lower the number. The adjustment is multiplicative, so that an adjustment factor of 2.00 would double the number of accidents. The default is 1.00

6. Capacity per Lane on Major Route (vphpl).

   This item gives the capacity per hour per lane on the major route. This is used in calculating the average travel speed for a given traffic volume. It is not used in the intersection delay equations. The defaults are 2000 for freeways, 1900 for rural multilane, 1100 for rural two-lane, 1600 for urban undivided and no intersection, 1800 for urban divided and no intersection, 750 for urban divided with signalized intersection, 650 for urban undivided with signalized intersections, 600 for a 2-way stop, and 200 for a 4-way stop. These are taken from a TTI study on delay [5] and from the HCM [2].

The capacity is then adjusted by the percent trucks assuming a passenger car equivalent of 2, by multiplying the above numbers by 1/(1+(percent trucks/100)).

7. HOV Facility Switch, 0-No HOV, 1-Yes HOV.

   This item keys whether or not the major facility includes an HOV facility.

8. Edit HOV Data.

   This option allows for editing of the HOV data, when the HOV Facility Switch equals 1. (See HOV Data Menu, below.)

9. Edit Railroad Grade Crossing Data.

   This option allows for editing of the railroad grade crossing data, when the type of problem is a railroad grade separation. (See Railroad Grade Crossing Data Menu, below.)

OTHER INTERSECTION/INTERCHANGE DATA MENU

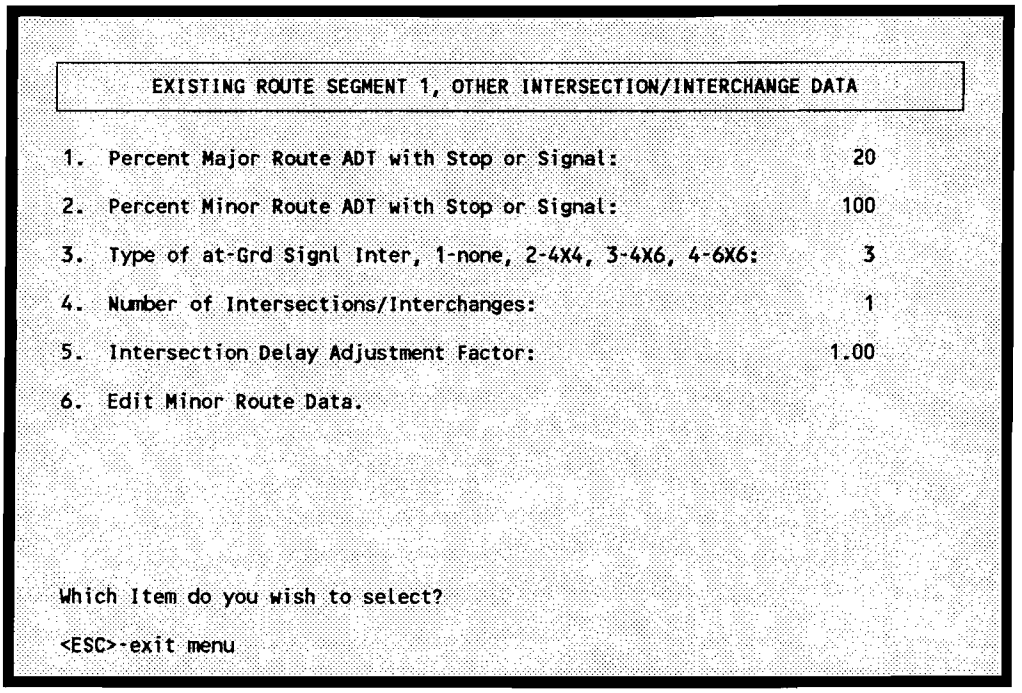


Figure 10. Layout of Other Intersection/Interchange Data Menu

The choices are explained below:

1. Percent Major Route Daily Traffic with Stop or Signal.

   This item gives the percent of the major route daily traffic going through an at-grade stop or signal. This value is important in evaluating interchanges, because much of the benefit results from pulling part or all of the traffic out of an at-grade intersection. The defaults are 100 percent for a four-way stop, signalized intersection, minor route on a simple diamond, or a railroad grade crossing; 20 percent for the major route on a simple diamond; 10 percent for a three-level diamond; and 0 for the others.

2. Percent Minor Route Daily Traffic with Stop or Signal.

   This item gives the percent of the minor route daily traffic going through an at-grade stop or signal.

3. Type of At-Grade Signalized Intersection, 1-none, 2-4X4 configuration, 3-4X6 configuration, 4-6X6 configuration.

   This item gives the at-grade signalized configuration (number of through lanes for each route). The category is used to determine which intersection delay equation to use. The total number of through lanes is used as the default, but this should be checked because interchanges may have a different number of lanes at the signals than they have on the main lanes.

4. Number of Intersections/Interchanges.

   This item gives the number of intersections or interchanges that the intersection data will be applied to. Normally a segment would contain at the most one intersection or interchange. However there are situations where it is desirable to combine several intersections into a single typical intersection. The calculated intersection delay is multiplied by this number to give the total intersection delay for the segment. The default is 1.

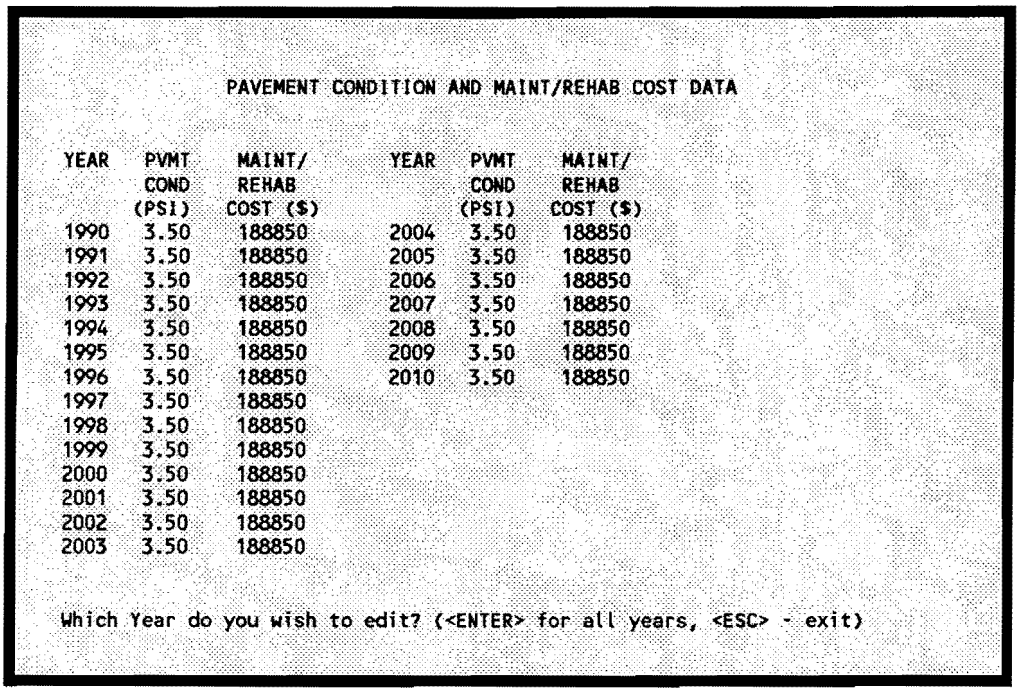
5. Intersection Delay Adjustment Factor.

   This item gives a factor to adjust the delay calculated at the intersection. The program uses equations estimated for optimal signal timing, phasing, etc. For less than ideal conditions, this factor can be used to adjust the estimated intersection delay. The adjustment factor is multiplicative, so that 1.50 would increase the calculated intersection delay by 50 percent. The default is 1.00.

6. Edit Minor Route Data.

   This option allows for editing of specific data on the minor route or cross street. These data include the ADT, number of lanes, facility type, percent trucks, free flow speed, and capacity. (See Minor Route Data Menu, below.)

PAVEMENT CONDITION AND MAINT/REHAB COST MENU



PAVEMENT CONDITION AND MAINT/REHAB COST DATA

YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)	YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)
1990	3.50	188850	2004	3.50	188850
1991	3.50	188850	2005	3.50	188850
1992	3.50	188850	2006	3.50	188850
1993	3.50	188850	2007	3.50	188850
1994	3.50	188850	2008	3.50	188850
1995	3.50	188850	2009	3.50	188850
1996	3.50	188850	2010	3.50	188850
1997	3.50	188850			
1998	3.50	188850			
1999	3.50	188850			
2000	3.50	188850			
2001	3.50	188850			
2002	3.50	188850			
2003	3.50	188850			

Which Year do you wish to edit? (<ENTER> for all years, <ESC> - exit)

Figure 11. Layout of Pavement Condition and Maint/Rehab Cost Menu

For each year during the analysis period, two items can be edited, the pavement condition, and the maintenance/rehabilitation cost. If the same value is desired for all years in the analysis period, then simply hit the <ENTER> key and the input values will be used for all years. For changing values during the analysis period, the values for each individual year would have to be changed.

The choices are explained below:

Pavement Condition.

The pavement condition is represented by the Present Serviceability Index (PSI), a number which can range from 0.1 to 5.0. The program does not internally deteriorate the pavement. The default is a constant throughout the analysis period. Changes in pavement condition over time would have to be provided by the user. The defaults are 3.1 for rural undivided, 3.5 for

rural divided, 3.7 for rural freeway, 2.9 for urban undivided, 3.2 for urban divided, and 3.5 for urban freeway.

Maintenance/Rehabilitation Cost.

The maintenance/rehabilitation cost is a combined annual cost of both routine maintenance and any additional pavement rehabilitation costs. The default is a constant annual value over the analysis period. Any assumed changes in the sum of the routine maintenance and rehabilitation costs would have to be supplied by the user. The default values per lane mile are $2,430 for rural undivided, $4,310 for rural divided, $5,790 for rural freeway, $10,010 for urban undivided, $11,120 for urban divided, and $12,590 for urban freeway.

MINOR ROUTE DATA MENU

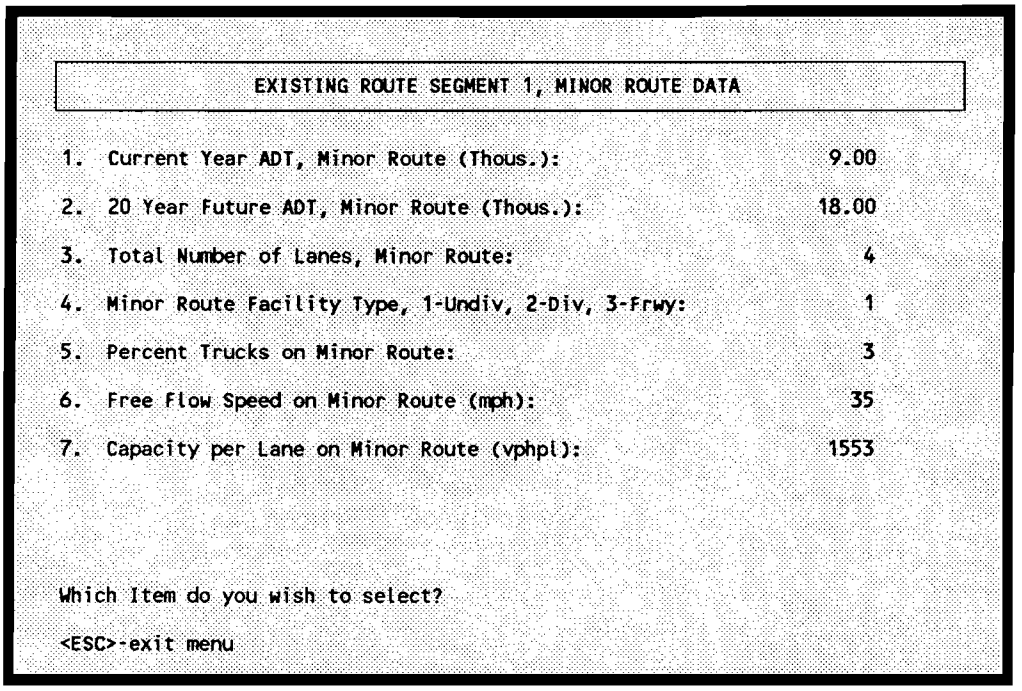


Figure 12. Layout of Minor Route Data Menu

The choices are explained below:

1. Current Year Daily Traffic, Minor Route (Thous.).

   This item gives the current year average daily traffic, in thousands, on the minor route (cross street).

2. 20 Year Future Daily Traffic, Minor Route (Thous.).

   This item gives the 20 year forecasted average daily traffic, in thousands, on the minor route (cross street).

3. Total Number of Lanes, Minor Route.

   This item gives the number of total number of lanes on the minor route (cross street).

4. Minor Route Facility Type, 1-Undivided, 2-Divided, 3-Freeway.

   This item gives the facility type for the minor route (cross street).

5. Percent Trucks on Minor Route.

   This item gives the percent trucks, not including pickups, for the minor route (cross street). The default is the percent trucks in the Problem Data Edit Menu.

6. Free Flow Speed on Minor Route (mph).

   This item gives the free flow speed on the minor route. The free flow speed is the midblock LOS A speed along the segment.

7. Capacity per Lane on Minor Route (vphpl).

   This item gives the capacity per hour per lane on the minor route (cross street). The default values are calculated the same as the capacity on the major route.

HOV DATA MENU

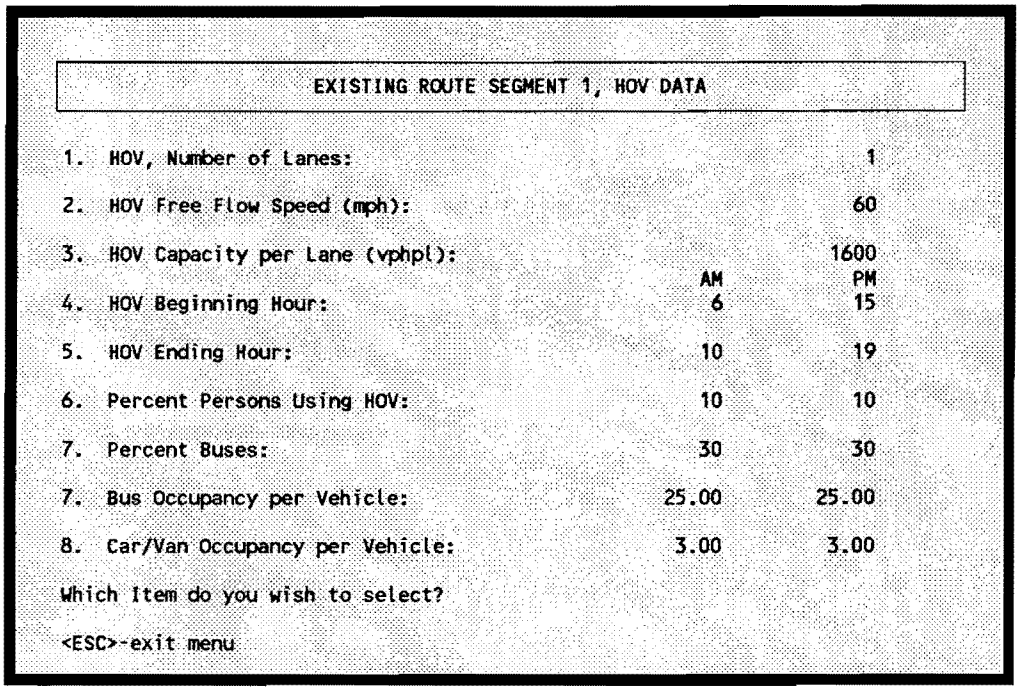


Figure 13. Layout of HOV Data Menu

The choices are explained below:

1. HOV, Number of Lanes.

   This item gives the number of lanes for the HOV.

2. HOV Free Flow Speed (mph).

   This item gives the free flow speed along the HOV. The default is the major route speed.

3. HOV Capacity per Lane (vphpl).

   This item gives the hourly capacity per lane for the HOV. The default is the major route capacity, adjusted for any difference in the percent trucks/buses.

4. HOV Beginning Hour.

   This item gives the beginning hour for the HOV operation. Two peak period operations can be specified, the AM and the PM. The hours use 24 hour military time. The beginning hour would normally be from 0 to 11 in the AM period, and 12-23 in the PM period.

5. HOV Ending Hour.

   This item gives the ending hour for the HOV operation. Two peak period operations can be specified, the AM and the PM. The hours use 24 hour military time. The ending hour would normally be from 1 to 12 in the AM period, and 13-24 in the PM period.

6. Percent Persons Using HOV.

   This item gives the percent of persons traveling in the through lanes of the major route that will divert to the HOV. The total number of persons is held constant, but the total number of vehicles may decline due to the higher occupancy rates on the HOV. When the hourly demand to capacity ratio exceeds about 0.75, the travel speed drops below 50 mph. Significant deterioration of the travel speeds occurs at higher levels, defeating the purpose of the HOV. For that reason if the hourly demand to capacity ratio on the HOV exceeds 0.75, the percent persons is reduced for that hour so as not to exceed 0.75.

7. Percent Buses.

   This item gives the proportion of buses using the HOV as a percent of the total number of vehicles using the HOV.

8. Bus Occupancy per Vehicle.

   This item gives the bus occupancy per vehicle using the HOV.

9. Car/Van Occupancy per Vehicle.

   This item gives the average car and/or the van occupancy using the HOV.

RAILROAD GRADE CROSSING DATA MENU

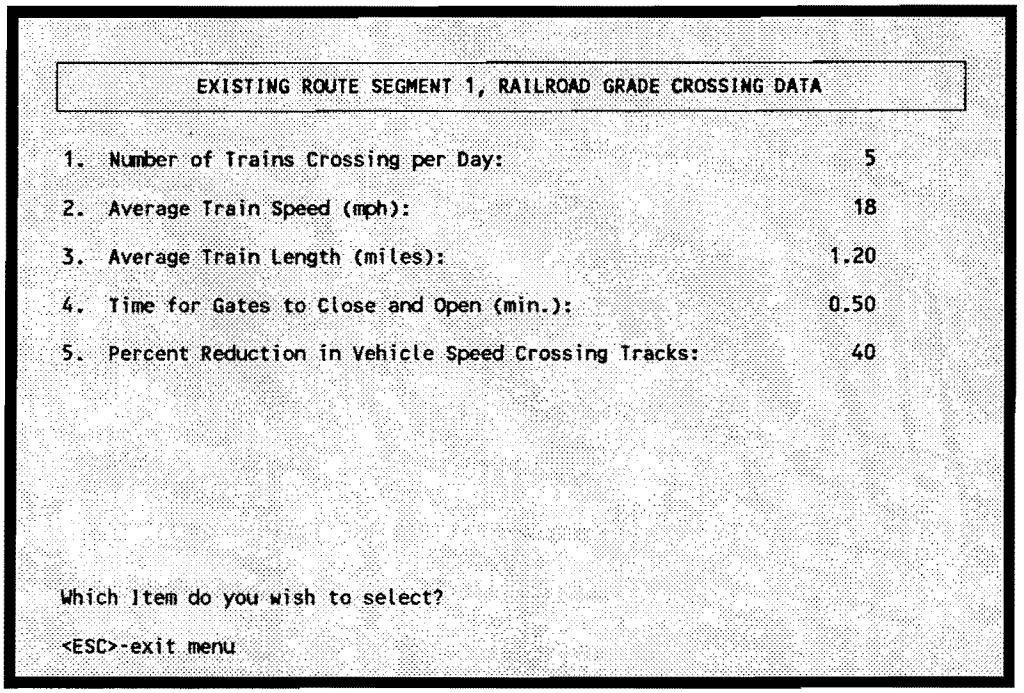


Figure 14. Layout of Railroad Grade Crossing Data Menu

The choices are explained below:

1. Number of Trains Crossing per Day.

   This item gives the average number of trains passing the grade crossing each day.

2. Average Train Speed (mph).

   This item gives the average train speed, in mph, while passing the crossing.

3. Average Train Length (miles).

   This item gives the average train length, in miles, of the trains passing the crossing.

4. Time for Gates to Close and Open (min.).

   This item gives the time, in minutes, for the gates to close and open while the crossing is empty. It is the time the vehicles are prevented from crossing the tracks before and after the train passes the crossing.

5. Percent Reduction in Vehicle Speed Crossing Tracks.

   This item gives the percent reduction in speed to cross the tracks. This is during the time when the crossing is open and traffic can cross the tracks without interruption. Depending on the roughness and humped nature of the crossing, vehicle speeds can be significantly reduced. The recommended reductions, taken from a national study on railroad crossings [6], gives 30 percent reduction for a smooth crossing surface, 40 percent reduction for a typical crossing surface, a 50 percent reduction for a humped and rough crossing surface, and a 60 percent reduction for a very humped and rough crossing surface.

USING THE MAINFRAME VERSION

The mainframe version of the program uses the same calculations as the PC version, and uses the same input data format. It is possible to use the PC to create an input data file and run the mainframe program on that data set. The mainframe program uses batch input.

There are two significant differences between the PC version and the mainframe version. First, it is possible to analyze several problems at the same time on the mainframe version. Since batch input is used, several problem data sets can be combined and run at the same time. Second, since many problems can be run together, the user has the option of requesting a single summary line of the input and output. There is also the option of printing out the output in a format similar to the PC version.

The input format for the data is given below.

HEEM-III INPUT DATA FILE FORMAT

For each project the following sequence is required in the input file:

For all projects:

Problem Card

Traffic Volume Distribution Card

If project is RR Grade Separation:

Train Traffic Distribution Card 1

Train Traffic Distribution Card 2

For all projects:

Existing Route Card

For each existing route segment:

- Existing Route Segment Card 1
- Existing Route Segment Card 2
- Existing Route Segment Card 3
- Existing Route Segment Card 4
- If optional pavement data is yes,
  - Pavement Condition Card 1
  - Pavement Condition Card 2
  - Pavement Condition Card 3
  - Maintenance/Rehabilitation Cost Card 1
  - Maintenance/Rehabilitation Cost Card 2
  - Maintenance/Rehabilitation Cost Card 3
  - Maintenance/Rehabilitation Cost Card 4
  - Maintenance/Rehabilitation Cost Card 5
  - Maintenance/Rehabilitation Cost Card 6

If project has an alternate route:

- Alternate Route Card

If project has an alternate route, for each alternate route segment:

- Alternate Route Segment Card 1
- Alternate Route Segment Card 2
- Alternate Route Segment Card 3
- Alternate Route Segment Card 4
- If optional pavement data is yes,
  - Pavement Condition Card 1
  - Pavement Condition Card 2
  - Pavement Condition Card 3
  - Maintenance/Rehabilitation Cost Card 1
  - Maintenance/Rehabilitation Cost Card 2

Maintenance/Rehabilitation Cost Card 3

Maintenance/Rehabilitation Cost Card 4

Maintenance/Rehabilitation Cost Card 5

Maintenance/Rehabilitation Cost Card 6

For all projects:

Proposed Route Card

For each proposed route segment:

Proposed Route Segment Card 1

Proposed Route Segment Card 2

Proposed Route Segment Card 3

Proposed Route Segment Card 4

If optional pavement data is yes,

Pavement Condition Card 1

Pavement Condition Card 2

Pavement Condition Card 3

Maintenance/Rehabilitation Cost Card 1

Maintenance/Rehabilitation Cost Card 2

Maintenance/Rehabilitation Cost Card 3

Maintenance/Rehabilitation Cost Card 4

Maintenance/Rehabilitation Cost Card 5

Maintenance/Rehabilitation Cost Card 6

PROBLEM CARD

Column	Format		Description
1-2	I2	*	Problem Number
3-32	A30	*	Problem Description
33	I1		Output Switch, 0-complete input and output, 1-summary 1 line input and output; default = 0
34	I1		Allocate Switch, 0-program allocation of through traffic to new location route, 1-no allocation, allocated traffic input by user; default = 0
35-38	I4	*	Current Year
39-40	I2		Discount Rate (%), default = 8
41-42	I2		Analysis Period, default = 20
43	I1		Type of Traffic Growth, 1-constant, 2-straight line, default = 1
44-48	F5.0		Car Value of Time/Person ($/hr), default = 9.52
49-53	F5.0		Truck Value of Time/Person ($/hr), default = 22.63
54-57	F4.0		Car Occupancy Rate, default = 1.3
58-61	F4.0		Truck Occupancy Rate, default = 1.0
62-63	I2		Percent Trucks, default = 3 for urban, 11 for rural
64-69	F6.0	*	Total Construction Cost (millions $)
70	I1	*	Type of Construction, 1-Bypass (New Location), 2-Added Capacity, 3-Interchange, 4-RR Grade Separation
71	I1		Alternate Route Switch, 1-no, 2-yes, default = 1
72-75	F4.0		Operating Cost and Accident Cost Update Factor, default = 1.0
76	I1	*	Area Type, 1-Rural, 2-Urban
77-80	I4		Year when Improvement Completed, default = Current Year + 1

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

TRAFFIC VOLUME DISTRIBUTION CARD

Column	Format		Description	Defaults	
				Rural	Urban
1-2	I2	*	Problem Number		
3-5	F3.0		% ADT Hour 1	0.9	0.9
6-8	F3.0		% ADT Hour 2	0.5	0.5
9-11	F3.0		% ADT Hour 3	0.5	0.4
12-14	F3.0		% ADT Hour 4	0.1	0.3
15-17	F3.0		% ADT Hour 5	0.2	0.4
18-20	F3.0		% ADT Hour 6	0.5	1.8
21-24	F4.0		% ADT Hour 7	1.9	6.3
25-28	F4.0		% ADT Hour 8	6.8	7.7
29-32	F4.0		% ADT Hour 9	7.0	6.0
33-35	F3.0		% ADT Hour 10	5.4	5.1
36-38	F3.0		% ADT Hour 11	5.4	4.9
39-41	F3.0		% ADT Hour 12	5.9	5.1
42-44	F3.0		% ADT Hour 13	6.2	5.1
45-47	F3.0		% ADT Hour 14	6.1	5.3
48-50	F3.0		% ADT Hour 15	6.2	5.7
51-54	F4.0		% ADT Hour 16	6.7	7.1
55-58	F4.0		% ADT Hour 17	7.5	7.9
59-62	F4.0		% ADT Hour 18	8.8	7.6
63-65	F3.0		% ADT Hour 19	6.5	5.7
66-68	F3.0		% ADT Hour 20	4.9	4.4
69-71	F3.0		% ADT Hour 21	3.6	3.2

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

72-74	F3.0	% ADT Hour 22	4.0	3.3
75-77	F3.0	% ADT Hour 23	2.9	3.4
78-80	F3.0	% ADT Hour 24	1.5	1.9

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

TRAIN TRAFFIC DISTRIBUTION CARD 1

Column	Format		Description	Default
1-2	I2	*	Problem Number	
3-6	F4.0		% Trains Hour 1	4.1
7-10	F4.0		% Trains Hour 2	4.1
11-14	F4.0		% Trains Hour 3	4.1
15-18	F4.0		% Trains Hour 4	4.1
19-22	F4.0		% Trains Hour 5	4.2
23-26	F4.0		% Trains Hour 6	4.2
27-30	F4.0		% Trains Hour 7	4.2
31-34	F4.0		% Trains Hour 8	4.2
35-38	F4.0		% Trains Hour 9	4.2
39-42	F4.0		% Trains Hour 10	4.2
43-46	F4.0		% Trains Hour 11	4.2
47-50	F4.0		% Trains Hour 12	4.2

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

TRAIN TRAFFIC DISTRIBUTION CARD 2

Column	Format		Description	Default
1-2	I2	*	Problem Number	
3-6	F4.0		% Trains Hour 13	4.2
7-10	F4.0		% Trains Hour 14	4.2
11-14	F4.0		% Trains Hour 15	4.2
15-18	F4.0		% Trains Hour 16	4.2
19-22	F4.0		% Trains Hour 17	4.2
23-26	F4.0		% Trains Hour 18	4.2
27-30	F4.0		% Trains Hour 19	4.2
31-34	F4.0		% Trains Hour 20	4.2
35-38	F4.0		% Trains Hour 21	4.1
39-42	F4.0		% Trains Hour 22	4.1
43-46	F4.0		% Trains Hour 23	4.1
47-50	F4.0		% Trains Hour 24	4.1

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

ROUTE CARD

Column	Format		Description
1-2	I2	*	Problem Number
3	I1	*	Route Number, 1-Existing, 2-Alternate, 3-Proposed
4-33	A30		Route Description
34-40	F7.0	*	Current Average Daily Through Traffic (Thous.), without improvement (0 for proposed route)
41-47	F7.0	*	20-Year Future Daily Through Traffic (Thous.), without improvement (0 for proposed route)
48-54	F7.0	*	Current Average Daily Through Traffic (Thous.), with improvement (0 for existing route, for non-bypass problems)
55-61	F7.0	*	20-Year Future Daily Through Traffic (Thous.), with improvement (0 for existing route, for non-bypass problems)
62-63	I2		Number of Segments for Route, default = 1

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

ROUTE SEGMENT CARD 1

Column	Format		Description
1-2	I2	*	Problem Number
3	I1	*	Route Number, 1-Existing, 2-Alternate, 3-Proposed
4-5	I2	*	Segment Number, segments must be numbered consecutively from 1 to total number of segments
6	I1	*	Segment Card Number, = 1
7-36	A30		Segment Description
37-43	F7.0		Current Additional Local Segment Traffic on Major Route (Thous.) default=0
44-50	F7.0		20-Year Additional Local Segment Traffic on Major Route (Thous.) default=0
51-52	I2	*	Total Number of Lanes, Major Route
53-55	I3		Free Flow Speed on Major Route (mph) default 60-freeway, 55-rural nonfreeway, 35-urban undivided, 40-urban divided
56-57	I2		Percent Trucks on Major Route, default problem percent trucks
58-64	F7.0	**	Current Daily Traffic Volume on Minor Route (Thous.)
65-71	F7.0	**	20-Year Daily Traffic Volume on Minor Route (Thous.)
72	I1		HOV Switch, 0-No HOV, 1-Yes HOV Facility on Major Route, default=0
75-79	F5.0		Accident Adjustment Factor, default=1.00

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

ROUTE SEGMENT CARD 2

Column	Format		Description
1-2	I2	*	Problem Number
3	I1	*	Route Number, 1-Existing, 2-Alternate, 3-Proposed
4-5	I2	*	Segment Number, segments must be numbered consecutively from 1 to total number of segments
6	I1	*	Segment Card Number, = 2
7-8	I2	**	Total Number of Lanes, Minor Route
9-10	I2		Percent Trucks on Minor Route, default problem percent trucks
11-12	I2	*	Type of Intersection/Interchange, 1-None, 2-Two Way Stop, 3-Four Way Stop, 4-Signalized Intersection, 5-Simple Diamond, 6-Cloverleaf,7-Three Level Diamond, 8-Directional, 9-Railroad At-Grade Crossing, 10-Railroad Grade Separation
13-15	I3		Percent Traffic on Major Route with Interrupted Flow; default 100-four-way stop, signalized intersection, or railroad grade crossing; 20-simple diamond, 0-all others
16-18	I3		Percent Traffic on Minor Route with Interrupted Flow; default 100-two-way stop, four-way stop, signalized intersection, and a simple diamond; 10-three-level diamond; 0-all others
19-23	F5.0	*	Segment Length (miles)
24-26	I3		Free Flow Speed on Minor Route (mph), default 60-freeway, 55-rural nonfreeway, 40-urban divided, 35-urban undivided

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

27-28	I2	Number of Intersections, default 1-Two Way Stop, Four Way Stop, Signalized Intersection, Simple Diamond, Cloverleaf, Three Level Diamond, Directional; 0-all others
29-32	F4.0	Intersection Delay Adjustment Factor, default = 1.00

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

ROUTE SEGMENT CARD 3

Column	Format		Description
1-2	I2	*	Problem Number
3	I1	*	Route Number, 1-Existing, 2-Alternate, 3-Proposed
4-5	I2	*	Segment Number, segments must be numbered consecutively from 1 to total number of segments
6	I1	*	Segment Card Number, = 3
7-10	I4		Capacity per lane per hour, major route, default = CAP*(1/(1+Percent Trucks/100)), where CAP = 2000-Freeway, 1100-Rural Two Lane, 1900-Rural Multilane, 1600-Urban Undivided, 1800-Urban Divided, 600-2 Way Stop, 200-4 Way Stop, 650-Undivided Intersection, 750-Divided Intersection
11-14	I4		Capacity per lane per hour, minor route, default = CAP*(1/(1+Percent Trucks/100)), where CAP = 2000-Freeway, 1100-Rural Two Lane, 1900-Rural Multilane, 1600-Urban Undivided, 1800-Urban Divided, 600-2 Way Stop, 200-4 Way Stop, 650-Undivided Intersection, 750-Divided Intersection
15	I1	*	Major Route Facility Type, 1-Undivided, 2-Divided, 3-Freeway
16	I1	**	Minor Route Facility Type, 1-Undivided, 2-Divided, 3-Freeway
17-18	I2		Number of Trains per Day
19-21	I3		Percent Reduction in Speed Crossing Tracks, Recommended values,30-Smooth Crossing Surface, 40-Typical Crossing Surface, 50-Humped and Rough Crossing Surface, 60-Very Humped and Rough Crossing Surface

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

22-24	F3.0	Time to Lower and Raise Gates (min.)
25-27	I3	Train Speed (mph)
28-32	F5.0	Train Length (miles)
33	I1	Type of At-Grade Signalized Intersection, 1-none, 2-4X4 Lanes, 3-4X6 Lanes, 4-6X6 Lanes, default calculated by total number of intersection lanes
34	I1	HOV Number of Lanes
35-37	I3	HOV Free Flow Speed (mph), default = Major Route Speed
38-41	I4	HOV Capacity per lane per hour, default = Major Route Capacity * (1+Percent Trucks on Major Route/100)/(1+Average Percent Buses/100)
42-43	I2	*** HOV AM, Beginning Hour (0-11)
44-45	I2	*** HOV AM, Ending Hour (1-12)
46-47	I2	*** HOV AM, Percent Persons Using HOV
48-50	I3	*** HOV AM, Percent Buses
51-55	F5.0	*** HOV AM, Bus Occupancy Rate per Vehicle
56-60	F5.0	*** HOV AM, Car/Van Occupancy Rate per Vehicle
61-62	I2	*** HOV PM, Beginning Hour (12-23)
63-64	I2	*** HOV PM, Ending Hour (13-24)
65-66	I2	*** HOV PM, Percent Persons Using HOV
67-69	I3	*** HOV PM, Percent Buses
70-74	F5.0	*** HOV PM, Bus Occupancy Rate per Vehicle
75-79	F5.0	*** HOV PM, Car/Van Occupancy Rate per Vehicle
80	I1	Pavement Flag, 0-no optional data, 1-optional data on following cards, default=0

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

PAVEMENT CONDITION CARD 1

Column	Format	Description
1-4	F4.0	Pavement Condition (PSI) for current year, defaults are 3.1 for rural undivided, 3.5 for rural divided, 3.7 for rural freeway, 2.9 for urban undivided, 3.2 for urban divided, and 3.5 for urban freeway.
5-8	F4.0	Pavement Condition (PSI) for current year + 1, defaults same as above.
9-12	F4.0	Pavement Condition (PSI) for current year + 2, defaults same as above.
13-16	F4.0	Pavement Condition (PSI) for current year + 3, defaults same as above.
17-20	F4.0	Pavement Condition (PSI) for current year + 4, defaults same as above.
21-24	F4.0	Pavement Condition (PSI) for current year + 5, defaults same as above.
25-28	F4.0	Pavement Condition (PSI) for current year + 6, defaults same as above.
29-32	F4.0	Pavement Condition (PSI) for current year + 7, defaults same as above.
33-36	F4.0	Pavement Condition (PSI) for current year + 8, defaults same as above.
37-40	F4.0	Pavement Condition (PSI) for current year + 9, defaults same as above.
41-44	F4.0	Pavement Condition (PSI) for current year + 10, defaults same as above.

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

45-48	F4.0	Pavement Condition (PSI) for current year + 11, defaults same as above.
49-52	F4.0	Pavement Condition (PSI) for current year + 12, defaults same as above.
53-56	F4.0	Pavement Condition (PSI) for current year + 13, defaults same as above.
57-60	F4.0	Pavement Condition (PSI) for current year + 14, defaults same as above.

PAVEMENT CONDITION CARD 2

Column	Format	Description
1-4	F4.0	Pavement Condition (PSI) for current year + 15, defaults same as above.
5-8	F4.0	Pavement Condition (PSI) for current year + 16, defaults same as above.
9-12	F4.0	Pavement Condition (PSI) for current year + 17, defaults same as above.
13-16	F4.0	Pavement Condition (PSI) for current year + 18, defaults same as above.
17-20	F4.0	Pavement Condition (PSI) for current year + 19, defaults same as above.
21-24	F4.0	Pavement Condition (PSI) for current year + 20, defaults same as above.
25-28	F4.0	Pavement Condition (PSI) for current year + 21, defaults same as above.

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

29-32	F4.0	Pavement Condition (PSI) for current year + 22, defaults same as above.
33-36	F4.0	Pavement Condition (PSI) for current year + 23, defaults same as above.
37-40	F4.0	Pavement Condition (PSI) for current year + 24, defaults same as above.
41-44	F4.0	Pavement Condition (PSI) for current year + 25, defaults same as above.
45-48	F4.0	Pavement Condition (PSI) for current year + 26, defaults same as above.
49-52	F4.0	Pavement Condition (PSI) for current year + 27, defaults same as above.
53-56	F4.0	Pavement Condition (PSI) for current year + 28, defaults same as above.
57-60	F4.0	Pavement Condition (PSI) for current year + 29, defaults same as above.

PAVEMENT CONDITION CARD 3

Column	Format	Description
1-4	F4.0	Pavement Condition (PSI) for current year + 30, defaults same as above.
5-8	F4.0	Pavement Condition (PSI) for current year + 31, defaults same as above.
9-12	F4.0	Pavement Condition (PSI) for current year + 32, defaults same as above.

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

13-16	F4.0	Pavement Condition (PSI) for current year + 33, defaults same as above.
17-20	F4.0	Pavement Condition (PSI) for current year + 34, defaults same as above.
21-24	F4.0	Pavement Condition (PSI) for current year + 35, defaults same as above.
25-28	F4.0	Pavement Condition (PSI) for current year + 36, defaults same as above.
29-32	F4.0	Pavement Condition (PSI) for current year + 37, defaults same as above.
33-36	F4.0	Pavement Condition (PSI) for current year + 38, defaults same as above.
37-40	F4.0	Pavement Condition (PSI) for current year + 39, defaults same as above.
41-44	F4.0	Pavement Condition (PSI) for current year + 40, defaults same as above.
45-48	F4.0	Pavement Condition (PSI) for current year + 26, defaults same as above.

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

MAINTENANCE/REHABILITATION COST CARD 1

Column	Format	Description
1-9	I9	Maintenance/Rehabilitation Cost for current year, defaults are 2430 for rural undivided, 4310 for rural divided, 5790 for rural freeway, 10010 for urban undivided, 11120 for urban divided, and 12590 for urban freeway.
10-18	I9	Maintenance/Rehabilitation Cost for current year + 1, defaults same as above.
19-27	I9	Maintenance/Rehabilitation Cost for current year + 2, defaults same as above.
28-36	I9	Maintenance/Rehabilitation Cost for current year + 3, defaults same as above.
37-45	I9	Maintenance/Rehabilitation Cost for current year + 4, defaults same as above.
46-54	I9	Maintenance/Rehabilitation Cost for current year + 5, defaults same as above.
55-63	I9	Maintenance/Rehabilitation Cost for current year + 6, defaults same as above.
64-72	I9	Maintenance/Rehabilitation Cost for current year + 7, defaults same as above.

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

MAINTENANCE/REHABILITATION COST CARD 2

Column	Format	Description
1-9	I9	Maintenance/Rehabilitation Cost for current year + 8, defaults same as above.
10-18	I9	Maintenance/Rehabilitation Cost for current year + 9, defaults same as above.
19-27	I9	Maintenance/Rehabilitation Cost for current year + 10, defaults same as above.
28-36	I9	Maintenance/Rehabilitation Cost for current year + 11, defaults same as above.
37-45	I9	Maintenance/Rehabilitation Cost for current year + 12, defaults same as above.
46-54	I9	Maintenance/Rehabilitation Cost for current year + 13, defaults same as above.
55-63	I9	Maintenance/Rehabilitation Cost for current year + 14, defaults same as above.
64-72	I9	Maintenance/Rehabilitation Cost for current year + 15, defaults same as above.

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

MAINTENANCE/REHABILITATION COST CARD 3

Column	Format	Description
1-9	I9	Maintenance/Rehabilitation Cost for current year + 16, defaults same as above.
10-18	I9	Maintenance/Rehabilitation Cost for current year + 17, defaults same as above.
19-27	I9	Maintenance/Rehabilitation Cost for current year + 18, defaults same as above.
28-36	I9	Maintenance/Rehabilitation Cost for current year + 19, defaults same as above.
37-45	I9	Maintenance/Rehabilitation Cost for current year + 20, defaults same as above.
46-54	I9	Maintenance/Rehabilitation Cost for current year + 21, defaults same as above.
55-63	I9	Maintenance/Rehabilitation Cost for current year + 22, defaults same as above.
64-72	I9	Maintenance/Rehabilitation Cost for current year + 23, defaults same as above.

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

MAINTENANCE/REHABILITATION COST CARD 4

Column	Format	Description
1-9	I9	Maintenance/Rehabilitation Cost for current year + 24, defaults same as above.
10-18	I9	Maintenance/Rehabilitation Cost for current year + 25, defaults same as above.
19-27	I9	Maintenance/Rehabilitation Cost for current year + 26, defaults same as above.
28-36	I9	Maintenance/Rehabilitation Cost for current year + 27, defaults same as above.
37-45	I9	Maintenance/Rehabilitation Cost for current year + 28, defaults same as above.
46-54	I9	Maintenance/Rehabilitation Cost for current year + 29, defaults same as above.
55-63	I9	Maintenance/Rehabilitation Cost for current year + 30, defaults same as above.
64-72	I9	Maintenance/Rehabilitation Cost for current year + 31, defaults same as above.

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

MAINTENANCE/REHABILITATION COST CARD 5

Column	Format	Description
1-9	I9	Maintenance/Rehabilitation Cost for current year + 32, defaults same as above.
10-18	I9	Maintenance/Rehabilitation Cost for current year + 33, defaults same as above.
19-27	I9	Maintenance/Rehabilitation Cost for current year + 34, defaults same as above.
28-36	I9	Maintenance/Rehabilitation Cost for current year + 35, defaults same as above.
37-45	I9	Maintenance/Rehabilitation Cost for current year + 36, defaults same as above.
46-54	I9	Maintenance/Rehabilitation Cost for current year + 37, defaults same as above.
55-63	I9	Maintenance/Rehabilitation Cost for current year + 38, defaults same as above.
64-72	I9	Maintenance/Rehabilitation Cost for current year + 39, defaults same as above.

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

MAINTENANCE/REHABILITATION COST CARD 6

Column	Format	Description
1-9	I9	Maintenance/Rehabilitation Cost for current year + 40, defaults same as above.

* Required Data Item for All Projects
** Required Data Item for Interchange Projects
*** Required Data Item for HOV Facilities

CONCLUSIONS AND RECOMMENDATIONS

The HEEM-III computer program has been developed to assist TxDOT in evaluating proposed added-capacity, interchange, railroad grade separation, and bypass projects. The program does not require a large amount of detailed information to run, though additional information can be used to revise the assumed parameters and relationships in the program. The program is designed to be used at the planning level, not at the design or operational level. The program provides a quick and easy method of evaluating the relative importance of proposed projects using a consistent standard, the benefit-cost ratio. This could then be incorporated into a more comprehensive procedure for ranking and selecting proposed projects for future funding.

HEEM-III has been designed to be easy to use, yet comprehensive enough to handle a wide variety of project characteristics. The program provides a useful tool for evaluating HOV facilities, and improvements to facilities with existing HOV lanes. For bypasses, the traffic can be divided up into through traffic, which can be allocated to the proposed bypass, and local traffic, which is not sensitive to the bypass. The program also provides the capability of adjusting accident rates, calculated intersection delay, and yearly pavement condition and maintenance/rehabilitation costs. These features give a great deal of flexibility in evaluating a project with some "unusual" characteristics. The program also offers the significant advantage of handling induced traffic in a consistent and comprehensive fashion. It is not necessary to "trick" the program or make unrealistic assumptions.

It is recommended that there should be some training of TxDOT personnel that will be using the program. While the program is designed to be easy to use, a person unfamiliar with some of the concepts and terminology of benefit-cost analysis or interchange design may encounter some problems in using HEEM-III, initially.

REFERENCES

1. J. L. Memmott and J. L. Buffington. Revised Highway Economic Evaluation Model. Research Report 225-28F, Texas Transportation Institute, The Texas A&M University System, College Station, Texas, October 1982.
2. Transportation Research Board. Highway Capacity Manual. Special Report 209, Washington D.C., 1985.
3. J. L. Memmott, B. C. Rymer, and T. Urbanik. Texas Ranking of Interchange Projects - TRIP, PC Interchange and RR Grade Separation Benefit-Cost Program. Research Report 1105-1F, Texas Transportation Institute, The Texas A&M University System, College Station, Texas, November 1988.
4. W. F. McFarland and M. K. Chui. The Value of Travel Time: New Estimates Developed Using a Speed-Choice Model. Research Report 396-2F, Texas Transportation Institute, The Texas A&M University System, College Station, Texas, May 1986.
5. J. L. Memmott and J. L. Buffington. A Model to Calculate Delay Savings for Highway Improvement Projects. Research Report 327-1, Texas Transportation Institute, The Texas A&M University System, College Station, Texas, October 1983.
6. A. E. Moon, et al. Guidebook for Planning to Alleviate Urban Railroad Problems, Vol. 3. Report RP-31, Federal Railroad Administration, Federal Highway Administration, Washington, D.C., August 1974.
7. J. P. Zaniewski, et al. Vehicle Operating Costs, Fuel Consumption, and Pavement Type and Condition Factors. Report No. FHWA/PL/82/001, Federal Highway Administration, Washington, D.C., March 1982.
8. Federal Highway Administration. Highway Performance Monitoring System Analytical Process, Vol. 2. Office of Highway Planning, Washington, D.C., January 1986.
9. J. B. Rollins and W. F. McFarland. Costs of Motor Vehicle Accidents in Texas. Research Report 396-1, Texas Transportation Institute, The Texas A&M University System, College Station, Texas, May 1985.

10. J. L. Buffington, L. M. Crane, and R. Salleh. Estimated Economic Impact of the Proposed Improvement of State Highway 199 in Tarrant County, Texas. Research Report 1904, Texas Transportation Institute, The Texas A&M University System, College Station, Texas, March 1991.

APPENDIX A - CALCULATION OF MOTORIST COSTS AND SAVINGS

CALCULATION INTERSECTION AND INTERCHANGE DELAY

The calculation of intersection and interchange delay is based upon equations developed by TTI for the TRIP computer program [3]. These equations relate total intersection at-grade volume to total delay. While several assumptions and approximations were necessary to generate those relationships, they are adequate for use in the HEEM-III, in a planning environment. Given the significant changes in the current traffic volumes over time and the difficulty of predicting the operational effects of a proposed improvement, it would not be possible to use something like the intersection delay calculations in the HCM. The delay equations give a consistent method of evaluating a wide range of intersection and interchange configurations. In addition, cursory testing by the author of the equations found that the equations gave delay totals roughly similar to those derived from the HCM procedure.

For a 4x4 high type intersection (4 through lanes by 4 through lanes), the at-grade delay equation is:

Delay = 1.1778*exp(.00072452*vph)

where

Delay = vehicle hours of delay,

vph = at-grade vehicles/hour.

For a 4x6 high type intersection, the at-grade delay equation is:

Delay = 1.1855*exp(.00065674*vph)

For a 6x6 high type intersection, the at-grade delay equation is:

Delay = 1.2662*exp(.00056726*vph)

For a four-way stop controlled intersection:

Delay = 0.3993*exp(.00511955*vph)

The delay equation for the two-way stop is:

Delay = 0.2629*exp(.00209176*vph)

CALCULATION OF MOTORIST COSTS

Calculations are made on an hourly basis for each direction on both the major and minor routes for each route segment. The process is repeated over a 24-hour period for both the "without improvement" and "with improvement" alternatives. The costs are summed, and the difference between the current and improved conditions becomes the motorist benefits. The analysis is repeated for every year of the analysis period.

The intersection or interchange delay is calculated using the delay equations presented in the previous section in this Appendix. The actual delay used in the calculations modifies the lower and upper parts of the curve so that unreasonable delays are not used. For the upper limit, the equation is cut off at 1.2 times the simulated capacity. For any additional traffic, the same delay per vehicle is used. This follows the reaction of motorists to LOS F conditions where alternate routes are used or the trip is taken during less congested times of the day. The lower end of the curve is adjusted so that for very low traffic volumes, the delay goes to zero as traffic goes to zero. While this may not be precisely true due to limitations in the signal timing mechanism, it gives consistent and reasonable numbers; as the traffic goes up, the delay goes up. Also, since the delay equations are based upon optimal signal timing and phasing, the calculated delay can be modified for less than ideal conditions using the Intersection Delay Adjustment Factor.

There are also operating costs calculated for motorists slowing down and stopping at intersections, and idling costs while waiting for the signal to turn and the queue to dissipate.

Costs are also calculated for vehicles traveling over the segment route. The most important variable is the average running speed. The average running speed is calculated based upon speed-volume relationships estimated from the 1985 Highway Capacity Manual LOS data [2]. The speed equations for VC ratio above capacity and the urban arterial are taken from a TTI study on delay [5]. The equations are given below:

If the volume/capacity (VC) ratio is $\leq$ 1, then

$$\text{Speed} = (\text{FFSPD} - \text{CSPD}) * (1-\text{VC}^2)^{0.5} + \text{CSPD}$$

where

Speed = average running speed over segment, excluding intersections

FFSPD = free flow speed, from input data

MSPD = minimum speed at LOS F, assumed to be 10 in urban, 15 in rural

VC = volume to capacity ratio, capacity taken from input data

CSPD = capacity speed at LOS E, assumed to be 30 in urban, 45 in rural

If the VC ratio is > 1 and $\leq$ 2, then

$$\text{Speed} = \text{CSPD} - \text{CSPD} * [1-(2-\text{VC})^2]^{0.5}$$

If the VC ratio is > 2, then

$$\text{Speed} = \text{MSPD}$$

If the route is an urban arterial, then

$$\text{Speed} = \text{FFSPD} * (1 - 0.01875 * \text{VC})$$

The delay is then simply calculated as the distance divided by the speed.

The operating cost equations, used for the segment and intersection calculations, were estimated from Zaniewski [7], updated to July 1990, and are given below:

Idling Costs, Passenger Car = $1.04/hour

Idling Costs, Truck = $1.08/hour

$$PCYC = 1.3549 + .16592 * Speed + .01141 * Speed^2$$

where PCYC = passenger car cycling cost from Speed to 0 ($/1000 cycles)

$$TCYC = -10.9718 + 3.7359 * Speed + .10429 * Speed^2$$

where TCYC = truck cycling cost from Speed to 0 ($/1000 cycles)

$$\log(PCYC1) = 1.0913 + .0324 * Speed - .0001 * Speed^2$$

where PCYC1 = passenger car cycling cost for a 10-mph speed change ($/1000 cycles)

$$\log(TCYC1) = 3.1828 + .0562 * Speed - .0004 * Speed^2$$

where TCYC1 = truck cycling cost for a 10-mph speed change ($/1000 cycles)

$$\log(PVOC) = 5.7414 - .02750 * Speed + .00033 * Speed^2$$

where PVOC = passenger car running costs per 1000 vehicle miles

$$\log(TVOC) = 6.8948 - .03464 * Speed + .00041 * Speed^2$$

where TVOC = truck running costs per 1000 vehicle miles.

The vehicle operating costs are summed and then adjusted for the pavement condition using the following formula, taken from the Highway Performance Monitoring System Analytical Package [8]. A pavement condition of 4.5 is used as the base for the adjustment.

$$VOC_a = VOC * (0.9818182 + (5.0 - PSI)/(20.0 + (5.0 * (PSI - 3.0))))$$

where VOC = calculated vehicle operating costs

VOC_a = adjusted vehicle operating costs

PSI = Present Serviceability Index

Accident costs are calculated by multiplying the accident rate times the cost per accident. The accident rate is then adjusted by the accident adjustment factor. Accident rates for highway segments are taken from the Highway Performance Monitoring System Analytical Package [8]. Accident rates for intersections, interchanges, and railroad grade crossings were estimated from Texas accident tapes from 1981 to 1986. It was not possible to distinguish among interchange configurations due to the way the data are coded and the small number of accidents at interchanges. Costs per accident were taken from a TTI study on accident costs by Rollins and McFarland [9]. The accident rates and costs are shown in Table 1.

All operating costs and accident costs are updated to July 1990.

Table 1. Accident Rates and Costs in Texas

	PDO Accidents	Injury Accidents	Fatal Accidents
Accident Rates per Intersection per 1000 vehicle lane miles			
Urban			
RR Grade Crossing	0.0257	0.0156	.0005728
At Grade Stop	0.9393	0.5165	.0102303
At Grade Signal	0.4648	0.2145	.0020001
Interchange	0.0879	0.0518	.0014806
Rural			
RR Grade Crossing	0.0063	0.0036	.0004956
At Grade Stop	0.8374	0.5484	.0306748
At Grade Signal	0.8655	0.3598	.0075463
Interchange	0.0694	0.0406	.0046282
Cost per Accident (updated to July 1990)			
Urban			
RR Grade Crossing	2,230	24,890	997,940
Intersection	1,380	14,410	984,310
Interchange	1,310	13,620	950,520
Rural			
RR Grade Crossing	3,140	20,430	956,020
Intersection	1,900	24,490	1,099,450
Interchange	2,030	22,790	1,185,630

	Freeway	Divided	Undivided
Accident Rates per 100 Million Vehicle Miles			
Urban Highway	244	565	616
Rural Highway	93	261	248
Cost per Accident (updated to July 1990)			
Urban Highway	13,360	12,570	9,170
Rural Highway	29,630	37,070	36,670

APPENDIX B - SOURCE CODE FOR HEEM-III, MAINFRAME PROGRAM

```
      CHARACTER*1 KANS,IRFL
      CHARACTER*8 RTYPE
      CHARACTER*9 TYPE
      CHARACTER*30 PDES,RDES,SDES
      COMMON /LABA/ DIS,IPER,IGRW,VTC,VTT,COCP,TOCP,PTRK,COST,ICON,IALT,
     1  UPD,IAR(3),IDES(3),IFFSP(3,10),TVOL(2,3),ISNO(3),XADT(2,3,10),
     2  LN(3,10),IYDAT,ICAP(3,10),IPERC(3,10),IDEV,IDATIN,
     3  IDATCH,I,J,IYR,TD(24),XST(2,3,10),HPER(24),FVOL(2,3),SLNG(3,10),
     4  VOL,CVOL,ISKP,DELAY(2),VOC(2),ACC(2),BEN(4,41),TBEN(4),BCRATIO,
     5  DVOL(2,3,41),LNC(3,10),ISTYP(3,10),IXDAT,IY,
     6  TRLN(3,10),GRTRN(3,10),IVAL,ICAPC(3,10),TRNO(3,10),IPRED(3,10),
     7  GATE(3,10),ITRSPD(3,10),IZDAT1,IZDAT2,IS,IATYP,IPERC1(3,10),
     8  IFFSPC(3,10),IPTRKS(3,10),IPTRKC(3,10),IRTYPE(2,2,2,3,10),
     9  RVOL(2,2,2,3,10),RSPD(2,2,2,3,10),RDIST(2,2,2,3,10),IR(2),RD(2)
      COMMON /LABB/ IFAC(3,10),IFACC(3,10),ISGLN(3,10),IHOVLN(3,10),
     1  IHOVB(2,3,10),IHOVE(2,3,10),IPERHOV(2,3,10),IPBUS(2,3,10),
     2  BUSOCP(2,3,10),VANOCP(2,3,10),IHOV(3,10),NUMINT(3,10),
     3  IYRC,IOUT,IALOC,IHOVSP(3,10),IHOVCAP(3,10),TOTVEH(3,2,3,10,41),
     4  TOTPERS(3,2,3,10,41),AVSPD(3,2,3,10,41)
      COMMON /LABC/ PDES,RDES(3),SDES(3,10),TYPE(3),KANS(4),RTYPE(5),
     1  IRFL(2,2,2,3,10)
      CHARACTER*1 KANSD
      CHARACTER*8 RTYPED
      CHARACTER*9 TYPED
      CHARACTER*20 IMPROV
      CHARACTER*30 DATAIN,DATAOUT
      CHARACTER*80 CARD
      DIMENSION KANSD(4), TYPED(3), HPERD(24), HPERR(24), COI(3,2,3),
     1  RTYPED(5),TP(2),TPR(2,3),IMPROV(2)
      DATA KANSD/'Y','y','N','n'/
      DATA TYPED/'EXISTING','ALTERNATE','PROPOSED'/
      DATA RTYPED/'  NONE  ','DIAGONAL','  LOOP  ','DIRECTNL',
     1  'SEMI-DIR'/
      DATA IMPROV/'WITHOUT Improvement','WITH Improvment'/

      DATA HPERD/0.9,0.5,0.4,0.3,0.4,1.8,6.3,7.7,6.0,5.1,4.9,5.1,5.1,
     1  5.3,5.7,7.1,7.9,7.6,5.7,4.4,3.2,3.3,3.4,1.9/
      DATA HPERR/0.9,0.5,0.5,0.1,0.2,0.5,1.9,6.8,7.0,5.4,5.4,5.9,6.2,
     1  6.1,6.2,6.7,7.5,8.8,6.5,4.9,3.6,4.0,2.9,1.5/
      print*,'Name of Input File? '
      read (*,fmt='(a30)') datain
      OPEN (UNIT=5,FILE=datain,STATUS='OLD')
      print*,'Name of Output File? '
      read (*,fmt='(a30)') dataout
      OPEN (UNIT=6,FILE=dataout,carriage control='fortran')
C
C     DISCLAIMER SCREEN
C
  781 WRITE (6,1365)
      IDAVE=0
C     INITIALIZE VARIABLES
   40 IDAVE=IDAVE+1
      CALL INIT
C     READ IN FIRST CARD, PROBLEM ASSUMPTIONS
         READ (5,170,END=566) CARD
         READ (CARD,172,ERR=45) IPROB
   42    IDAVE=IPROB
         READ (CARD,1180,ERR=45) PDES,IOUT,IALOC,IYR,IDIS,IPER,IGRW,
     1     VTC,VTT,COCP,TOCP,IPTRK,COST,ICON,IALT,UPD,IATYP,IYRC
C     SET DEFAULT VALUES
         IF (IDIS.LE.0) IDIS=8
         DIS=IDIS
         IF (IPER.LE.0) IPER=20
         IF (VTC.LE.0.) VTC=9.52
         IF (VTT.LE.0.) VTT=22.63
         IF (IGRW.LE.0) IGRW=1
         IF (COCP.LE.0.) COCP=1.3
         IF (TOCP.LE.0.) TOCP=1.0
         IF (IATYP.EQ.1.AND.IPTRK.LE.0) IPTRK=11
```

```
        IF (IATYP.EQ.2.AND.IPTRK.LE.0) IPTRK=3
        PTRK=IPTRK
        IF (IALT.LE.0) IALT=1
        IF (UPD.LE.0.) UPD=1.0
        IF (IYRC.LE.0) IYRC=IYR+1
C     ECHO INPUT DATA AND DEFAULTS
        IF (IOUT.EQ.0) THEN
          WRITE (6,1500) IDAVE,PDES,IYR,IDIS,IPER,IGRW,VTC,VTT,COCP
          WRITE (6,1510) TOCP,IPTRK,COST,IYRC,ICON,IALT,UPD,IATYP,
     *       IOUT,IALOC
          GOTO 50
        ENDIF
C     SKIP PROBLEM CARDS WITH ERROR
   45   WRITE (6,160) IDAVE
   47   WRITE (6,171) CARD
        READ (5,170,END=566) CARD
        READ (CARD,172,ERR=47) IPROB
        IF (IDAVE.EQ.IPROB) THEN
          GOTO 47
        ELSE
          CALL INIT
          GOTO 42
        ENDIF
C     READ IN TRAFFIC DISTRIBUTION
   50   IF (IALT.LE.0) IALT=1
        READ (5,170,END=565) CARD
        READ (CARD,172,ERR=45) IPROB
        IF (IPROB.NE.IDAVE) THEN
          WRITE (6,27) IDAVE
          GOTO 42
        ENDIF
        READ (CARD,1185,ERR=45) (HPER(K),K=1,24)
C     SET DEFAULT VALUES
        DO 500 K=1,24
          IF (HPER(K).GT.0.) GOTO 520
  500 CONTINUE
        DO 510 K=1,24
          IF (IATYP.EQ.1) THEN
              HPER(K)=HPERR(K)
          ELSE
              HPER(K)=HPERD(K)
          END IF
  510   CONTINUE
C     ECHO INPUT DATA AND DEFAULTS
  520 IF (IOUT.EQ.0) THEN
        WRITE (6,1530)
        DO 530 K=1,12
           WRITE (6,1550) K-1,K,HPER(K),K+11,K+12,HPER(K+12)
  530   CONTINUE
      ENDIF
C     READ TRAIN DISTRIBUTION
   60   IF (ICON.EQ.4) THEN
          DO 65 IT=1,2
            READ (5,170,END=565) CARD
            READ (CARD,172,ERR=45) IPROB
            IF (IPROB.NE.IDAVE) THEN
              WRITE (6,27) IDAVE
              GOTO 42
            ENDIF
            IT1=12*IT-11
            IT2=12*IT
            READ (CARD,1190,ERR=45) (TD(K),K=IT1,IT2)
   65     CONTINUE
C     SET DEFAULT VALUES
          DO 600 K=1,24
            IF (TD(K).GT.0.) GOTO 620
  600     CONTINUE
          DO 610 K=1,24
            IF (K.LE.4.OR.K.GE.21) THEN
```

```
                TD(K)=4.1
             ELSE
                TD(K)=4.2
             END IF
  610      CONTINUE
C     ECHO INPUT DATA AND DEFAULTS
  620      IF (IOUT.EQ.0) THEN
              WRITE (6,1540)
              DO 630 K=1,12
                 WRITE (6,1550) K-1,K,TD(K),K+11,K+12,TD(K+12)
  630         CONTINUE
           ENDIF
         ENDIF
C     ZERO OUT ALL ADT ARRAYS
         DO 80 IS=1,2
            DO 75 I=1,3
               TVOL(IS,I)=0.
               FVOL(IS,I)=0.
               DO 70 J=1,10
                  XADT(IS,I,J)=0.
                  XST(IS,I,J)=0.
   70          CONTINUE
   75       CONTINUE
   80    CONTINUE
         DO 555 I=1,3
            IF (I.EQ.2.AND.IALT.EQ.1) GO TO 555
C     READ IN ROUTE CARD
            READ (5,170,END=565) CARD
            READ (CARD,173,ERR=45) IPROB,IRTE
            IF (IPROB.NE.IDAVE) THEN
               WRITE (6,27) IDAVE
               GOTO 42
            ENDIF
            IF (IRTE.NE.I) GOTO 45
            READ (CARD,1195,ERR=45) RDES(I),TVOL(1,I),FVOL(1,I),
     1        TVOL(2,I),FVOL(2,I),ISNO(I)
C     SET DEFAULT VALUES
            ISNO(I)=MAX(ISNO(I),1)
            IF (I.EQ.3) THEN
                TVOL(1,3)=0.
                FVOL(1,3)=0.
            END IF
            IF ((I.EQ.1).AND.(ICON.NE.1)) THEN
                TVOL(2,1)=0.
                FVOL(2,1)=0.
            END IF
            JA=ISNO(I)
            DO 550 J=1,JA
C     READ FIRST ROUTE SEGMENT CARD
               READ (5,170,END=565) CARD
               READ (CARD,175,ERR=45) IPROB,IRTE,ISEG,ISEGNO
               IF (IPROB.NE.IDAVE) THEN
                 WRITE (6,27) IDAVE
                 GOTO 42
               ENDIF
               IF (IRTE.NE.I.OR.ISEG.NE.J) GOTO 45
               IF (ISEGNO.NE.1) GOTO 45
               READ (CARD,1200,ERR=45) SDES(I,J),XADT(1,I,J),
     1           XADT(2,I,J),LN(I,J),IFFSP(I,J),IPTRKS(I,J),
     2           XST(1,I,J),XST(2,I,J),IHOV(I,J)
C     READ SECOND ROUTE SEGMENT CARD
               READ (5,170,END=565) CARD
               READ (CARD,175,ERR=45) IPROB,IRTE,ISEG,ISEGNO
               IF (IPROB.NE.IDAVE) THEN
                 WRITE (6,27) IDAVE
                 GOTO 42
               ENDIF
               IF (IRTE.NE.I.OR.ISEG.NE.J) GOTO 45
               IF (ISEGNO.NE.2) GOTO 45
```

```
              READ (CARD,1202,ERR=45) LNC(I,J),
     1          IPTRKC(I,J),ISTYP(I,J),IPERC(I,J),IPERC1(I,J),
     2          SLNG(I,J),IFFSPC(I,J),NUMINT(I,J)
C     READ IN THIRD ROUTE SEGMENT CARD
              READ (5,170,END=565) CARD
              READ (CARD,175,ERR=45) IPROB,IRTE,ISEG,ISEGNO
              IF (IPROB.NE.IDAVE) THEN
                WRITE (6,27) IDAVE
                GOTO 42
              ENDIF
              IF (IRTE.NE.I.OR.ISEG.NE.J) GOTO 45
              IF (ISEGNO.NE.3) GOTO 45
              READ (CARD,1205,ERR=45) ICAP(I,J),ICAPC(I,J),
     1          IFAC(I,J),IFACC(I,J),TRNO(I,J),IPRED(I,J),GATE(I,J),
     2          ITRSPD(I,J),TRLN(I,J),ISGLN(I,J),IHOVLN(I,J),
     3          IHOVSP(I,J),IHOVCAP(I,J),
     3          (IHOVB(KH,I,J),IHOVE(KH,I,J),IPERHOV(KH,I,J),
     4          IPBUS(KH,I,J),BUSOCP(KH,I,J),VANOCP(KH,I,J),KH=1,2)
              IFACC(I,J)=MAX(1,IFACC(I,J))
              ITRSPD(I,J)=MAX(ITRSPD(I,J),5)
              TRSPD=ITRSPD(I,J)
              GRTRN(I,J)=1.-(TRNO(I,J)/24.)*(TRLN(I,J)/TRSPD
     1          +GATE(I,J)/60.)
              GRTRN(I,J)=MAX(0.01,MIN(GRTRN(I,J),0.99))
  550       CONTINUE
  555     CONTINUE
C     SET DEFAULT VALUES
        DO 30 I=1,3
           DO 25 J=1,10
              IR(1)=1
              IR(2)=1
              IF (ISTYP(I,J).GE.5.AND.ISTYP(I,J).LE.8) THEN
              IR(2)=2
              IF (ISTYP(I,J).EQ.5) IR(1)=2
              IF (ISTYP(I,J).EQ.6) IR(2)=3
              IF (ISTYP(I,J).EQ.8) IR(2)=5
              ENDIF
              RD(1)=0.
              RD(2)=0.
              IF (IR(1).EQ.2) RD(1)=.02
              IF (IR(2).EQ.2) RD(2)=-.05
              IF (IR(2).EQ.3) RD(2)=-.25
              IF (IR(1).EQ.4) RD(1)=.15
              IF (ISGLN(I,J).EQ.0) THEN
               IF (ISTYP(I,J).LE.3.OR.ISTYP(I,J).GE.9) THEN
                 ISGLN(I,J)=1
               ELSE
                 IF (ISTYP(I,J).GE.5.AND.ISTYP(I,J).LE.8) THEN
                      ISGLN(I,J)=2
                 ELSE
                      JTOTLN=LNC(I,J)+LN(I,J)
                      IF (JTOTLN.LE.8) THEN
                                ISGLN(I,J)= 2
                      ELSE
                         IF (JTOTLN.LE.10) THEN
                                   ISGLN(I,J)= 3
                         ELSE
                                   ISGLN(I,J)=4
                         END IF
                      END IF
                 END IF
               ENDIF
              END IF
              IF (IFFSP(I,J).LE.0) THEN
              IF (IFAC(I,J).EQ.3) THEN
                   IFFSP(I,J)=60
              ELSE
                   IF (IATYP.EQ.1) THEN
                      IFFSP(I,J)=55
```

```
                ELSE
                    IF (IFAC(I,J).EQ.1) THEN
                       IFFSP(I,J)=35
                    ELSE
                       IFFSP(I,J)=40
                    END IF
                END IF
             END IF
            END IF
            IF (IHOVSP(I,J).LE.0.AND.IHOV(I,J).EQ.1)
     1        IHOVSP(I,J)=IFFSP(I,J)
            IF (IFFSPC(I,J).LE.0) THEN
            IF (IFACC(I,J).EQ.3) THEN
                  IFFSPC(I,J)=60
            ELSE
                 IF (IATYP.EQ.1) THEN
                    IFFSPC(I,J)=55
                 ELSE
                    IF (IFACC(I,J).EQ.1) THEN
                        IFFSPC(I,J)=35
                    ELSE
                        IFFSPC(I,J)=40
                    END IF
                END IF
             END IF
            END IF
          DO 20 IN=1,2
            DO 15 ID=1,2
              DO 10 IS=1,2
                IF (IRTYPE(IS,ID,IN,I,J).NE.0) GOTO 10
                IRTYPE(IS,ID,IN,I,J)=IR(IN)
                IF (IRFL(IS,ID,IN,I,J).EQ.' ') THEN
                     IF (ISTYP(I,J).GE.2.AND.ISTYP(I,J).LE.5) THEN
                          IRFL(IS,ID,IN,I,J)=KANS(1)
                     ELSE
                          IRFL(IS,ID,IN,I,J)=KANS(3)
                     END IF
                END IF
                IF (RVOL(IS,ID,IN,I,J).EQ.0.) RVOL(IS,ID,IN,I,J)=5.
                IF (RDIST(IS,ID,IN,I,J).EQ.0.)
     1             RDIST(IS,ID,IN,I,J)=RD(IN)
   10         CONTINUE
              IF (RSPD(1,ID,IN,I,J).EQ.0) THEN
                RSP=0.
                FFSP=IFFSP(I,J)
                IF (IRTYPE(1,ID,IN,I,J).EQ.2) RSP=.65*FFSP
                IF (IRTYPE(1,ID,IN,I,J).EQ.3) RSP=.50*FFSP
                IF (IRTYPE(1,ID,IN,I,J).EQ.4) RSP=.80*FFSP
                IF (IRTYPE(1,ID,IN,I,J).EQ.5) RSP=.75*FFSP
                RSPD(1,ID,IN,I,J)=RSP
              END IF
              IF (RSPD(2,ID,IN,I,J).EQ.0.) THEN
                RSP=0.
                FFSP=IFFSPC(I,J)
                IF (IRTYPE(2,ID,IN,I,J).EQ.2) RSP=.65*FFSP
                IF (IRTYPE(2,ID,IN,I,J).EQ.3) RSP=.50*FFSP
                IF (IRTYPE(2,ID,IN,I,J).EQ.4) RSP=.80*FFSP
                IF (IRTYPE(2,ID,IN,I,J).EQ.5) RSP=.75*FFSP
                RSPD(2,ID,IN,I,J)=RSP
              END IF
   15       CONTINUE
   20     CONTINUE
   25   CONTINUE
   30 CONTINUE
      DO 31 I=1,3
        DO 26 J=1,ISNO(I)
          IF (IPTRKS(I,J).LE.0) IPTRKS(I,J)=IPTRK
          IF (IPTRKC(I,J).LE.0) IPTRKC(I,J)=IPTRK
          IF (ICAP(I,J).EQ.0) THEN
```

```
            ICAP(I,J)=2000
            ITLN=LN(I,J)
           IMLT=1
           IF (ITLN.GT.2) IMLT=2
           IF (IMLT.EQ.1.AND.IATYP.EQ.1.AND.IFAC(I,J).NE.3) ICAP(I,
     1       J)=1100
           IF (IMLT.EQ.2.AND.IATYP.EQ.1.AND.IFAC(I,J).NE.3) ICAP(I,
     1       J)=1900
           IF (IFAC(I,J).EQ.1.AND.IATYP.EQ.2) ICAP(I,J)=1600
           IF (IFAC(I,J).EQ.2.AND.IATYP.EQ.2) ICAP(I,J)=1800
           IF (ISTYP(I,J).EQ.2) ICAP(I,J)=600
           IF (ISTYP(I,J).EQ.3) ICAP(I,J)=200
           IF (IFAC(I,J).EQ.1.AND.ISTYP(I,J).EQ.4) ICAP(I,J)=650
           IF (IFAC(I,J).EQ.2.AND.ISTYP(I,J).EQ.4) ICAP(I,J)=750
           PTRKS=IPTRKS(I,J)
           ICAP(I,J)=ICAP(I,J)/(1.+PTRKS/100.)
           END IF
           IF (IHOVCAP(I,J).EQ.0.AND.IHOV(I,J).EQ.1) THEN
              AVPBUS=(IPBUS(1,I,J)*(IHOVE(1,I,J)-IHOVB(1,I,J))+
     1             IPBUS(2,I,J)*(IHOVE(2,I,J)-IHOVB(2,I,J)))/
     2             (IHOVE(1,I,J)-IHOVB(1,I,J)+IHOVE(2,I,J)-
     3             IHOVB(2,I,J))
              IHOVCAP(I,J)=ICAP(I,J)*(1.+PTRKS/100.)/
     1               (1.+AVPBUS/100.)
           ENDIF
           IF (ICAPC(I,J).EQ.0) THEN
              ICAPC(I,J)=2000
              ITLN=LNC(I,J)
              IF (ITLN.GT.2) THEN
                    IMLT=2
              ELSE
                    IMLT=1
              END IF
              IF (IMLT.EQ.1.AND.IATYP.EQ.1.AND.IFACC(I,
     1          J).NE.3) ICAPC(I,J)=1100
              IF (IMLT.EQ.2.AND.IATYP.EQ.1.AND.IFACC(I,
     1          J).NE.3) ICAPC(I,J)=1900
              IF (IFACC(I,J).EQ.1.AND.IATYP.EQ.2) ICAPC(I,J)=1600
              IF (IFACC(I,J).EQ.2.AND.IATYP.EQ.2) ICAPC(I,J)=1800
              IF (ISTYP(I,J).EQ.2) ICAPC(I,J)=600
              IF (ISTYP(I,J).EQ.3) ICAPC(I,J)=200
              IF (IFACC(I,J).EQ.1.AND.ISTYP(I,J).EQ.4) ICAPC(I,
     1          J)=650
              IF (IFACC(I,J).EQ.2.AND.ISTYP(I,J).EQ.4) ICAPC(I,
     1          J)=750
              IF (IFACC(I,J).EQ.1.AND.ISTYP(I,J).EQ.5) ICAPC(I,
     1          J)=650
              IF (IFACC(I,J).EQ.2.AND.ISTYP(I,J).EQ.5) ICAPC(I,
     1          J)=750
              PTRKC=IPTRKC(I,J)
              ICAPC(I,J)=ICAPC(I,J)/(1.+PTRKC/100.)
           END IF
           IF (IPERC(I,J).EQ.0) THEN
           IPERC(I,J)=100
           IPERC1(I,J)=100
           IF (ISTYP(I,J).EQ.5) IPERC(I,J)=20
           IF (ISTYP(I,J).EQ.7) IPERC(I,J)=10
           IF (ISTYP(I,J).EQ.1.OR.ISTYP(I,J).EQ.2.OR.ISTYP(I,
     1       J).EQ.6.OR.ISTYP(I,J).EQ.8.OR.ISTYP(I,
     2       J).EQ.10) IPERC(I,J)=0
           IF (ISTYP(I,J).EQ.7) IPERC1(I,J)=10
           IF (ISTYP(I,J).EQ.1.OR.ISTYP(I,J).EQ.6.OR.ISTYP(I,
     1       J).EQ.8) IPERC1(I,J)=0
           END IF
           IF (NUMINT(I,J).LE.0.AND.ISTYP(I,J).GT.1.AND.
     1       ISTYP(I,J).LT.9) NUMINT(I,J)=1
26    CONTINUE
31 CONTINUE
   IDATIN=1
```

```
      IDATCH=0
      IXDAT=0
      IYDAT=0
      IZDAT1=0
      IZDAT2=0
      DO 5 L=1,5
         RTYPE(L)=RTYPED(L)
         IF (L.EQ.5) GO TO 5
         KANS(L)=KANSD(L)
         IF (L.GE.4) GO TO 5
         TYPE(L)=TYPED(L)
    5 CONTINUE
C     ALLOCATE TRAFFIC TO NEW LOCATION
      IF (IALOC.EQ.0) CALL ALLOCATE
C     ECHO ROUTE & SEGMENT DATA
      IF (IOUT.EQ.0) THEN
         DO 110 I=1,3
            IF (I.EQ.2.AND.IALT.EQ.1) GOTO 110
            WRITE (6,1560) IPROB,PDES,TYPED(I),RDES(I),TVOL(1,I),
     1        FVOL(1,I),TVOL(2,I),FVOL(2,I),ISNO(I)
            DO 100 J=1,ISNO(I)
               WRITE (6,1570) IPROB,PDES,TYPED(I),RDES(I),J,SDES(I,J),
     1          XADT(1,I,J),XADT(2,I,J),LN(I,J),SLNG(I,J),
     2          IFFSP(I,J),IPTRKS(I,J),IFAC(I,J),ICAP(I,J),ISTYP(I,J)
               IF (ISTYP(I,J).EQ.1.OR.ISTYP(I,J).GE.9) GOTO 90
C     ECHO INTERSECTION/INTERCHANGE DATA
               WRITE (6,1580) XST(1,I,J),XST(2,I,J),LNC(I,J),
     1          IFFSPC(I,J),IPTRKC(I,J),IFACC(I,J),ICAPC(I,J),
     2          IPERC(I,J),IPERC1(I,J),NUMINT(I,J),
     3          ISGLN(I,J),IHOV(I,J)
   90          IF (IHOV(I,J).EQ.0) GOTO 95
C     ECHO HOV DATA
               WRITE (6,1590) IHOVLN(I,J),IHOVSP(I,J),IHOVCAP(I,J),
     1           (IHOVB(KH,I,J),IHOVE(KH,I,J),IPERHOV(KH,I,J),
     2           IPBUS(KH,I,J),BUSOCP(KH,I,J),VANOCP(KH,I,J),KH=1,2)
   95          IF (ISTYP(I,J).LT.9) GOTO 100
C     ECHO TRAIN DATA
               WRITE (6,1600) TRNO(I,J),ITRSPD(I,J),TRLN(I,J),
     1           GATE(I,J),IPRED(I,J)
  100       CONTINUE
  110    CONTINUE
      ENDIF
      IDATCH=0
C   Analyze Problem.
  710 IYEAR=IPER+1
      ICYR=IYRC-IYR
      DO 715 IS=1,4
         TBEN(IS)=0.
      DO 712 IY=1,IYEAR
         BEN(IS,IY)=0.
  712    CONTINUE
  715 CONTINUE
      DO 745 IY=1,IYEAR
         EXP=(IY-1)/20.
         DO 740 IS=1,2
            TP(IS)=0.
            I1=1
            I2=3
            IF (IS.EQ.1.AND.ICON.GT.2) I2=IALT
            IF (IS.EQ.2.AND.ICON.GT.2) I1=4-IALT
            DO 735 I=I1,I2
               TPR(IS,I)=0.
               IF (I.EQ.2.AND.IALT.EQ.1) GO TO 735
               VOLT1=TVOL(IS,I)
               VOLT2=FVOL(IS,I)
               VOLS=0.
               IF (VOLT1.LE.0.) GO TO 720
               IF (IGRW.EQ.1) THEN
                  VOLS=VOLT1*((VOLT2/VOLT1)**EXP)
```

```
            ELSE
               VOLS=VOLT1+(VOLT2-VOLT1)*EXP
            END IF
720         DVOL(IS,I,IY)=VOLS
            IF (IY.LE.ICYR.AND.IS.EQ.2) GO TO 735
            DO 722 IB=1,3
               COI(IB,IS,I)=0.
722         CONTINUE
            DO 730 J=1,ISNO(I)
               XV1=XADT(1,I,J)
               XV2=XADT(2,I,J)
               XCV1=XST(1,I,J)
               XCV2=XST(2,I,J)
               VOL=VOLS
               CVOL=0.
               IF (IGRW.EQ.1) THEN
                  IF (XV1.LE.0.) GO TO 723
                  VOL=VOLS+XV1*((XV2/XV1)**EXP)
723               IF (XCV1.LE.0.) GO TO 725
                  CVOL=XCV1*((XCV2/XCV1)**EXP)
               ELSE
                  VOL=VOLS+XV1+(XV2-XV1)*EXP
                  CVOL=XCV1+(XCV2-XCV1)*EXP
               END IF
725            IF (ISTYP(I,J).GE.9) CVOL=0.
               CALL ANALYZE
               COI(1,IS,I)=COI(1,IS,I)+((DELAY(1)*VOL)+
     1           (DELAY(2)*CVOL))*365/((1.+DIS/100)**(IY-1))
               COI(2,IS,I)=COI(2,IS,I)+((VOC(1)*VOL)+
     1           (VOC(2)*CVOL))*365/((1.+DIS/100)**(IY-1))
               COI(3,IS,I)=COI(3,IS,I)+((ACC(1)*VOL)+
     1           (ACC(2)*CVOL))*365/((1.+DIS/100)**(IY-1))
               DO 727 L=1,3
                 IF (TOTVEH(L,IS,I,J,IY).GT.0.)
     1             AVSPD(L,IS,I,J,IY)=AVSPD(L,IS,I,J,IY)/
     2              TOTVEH(L,IS,I,J,IY)
                   TOTVEH(L,IS,I,J,IY)=TOTVEH(L,IS,I,J,IY)/1000.
                   TOTPERS(L,IS,I,J,IY)=TOTPERS(L,IS,I,J,IY)/1000.
                   TPR(IS,I)=TPR(IS,I)+TOTPERS(L,IS,I,J,IY)
727            CONTINUE
730         CONTINUE
735      CONTINUE
740   CONTINUE
      IF (IY.LE.ICYR) GOTO 745
      DO 743 I=1,3
       DO 742 IS=1,2
         TP(IS)=TP(IS)+TPR(IS,I)
742    CONTINUE
         DO 741 IB=1,3
            BEN(IB,IY)=BEN(IB,IY)+COI(IB,1,I)-COI(IB,2,I)
            TTP=TP(1)-TP(2)
            IF (I.EQ.3.AND.ABS(TTP).GT.0.001.AND.TPR(1,1).GT.0.) THEN
               CTP=COI(IB,1,1)/TPR(1,1)
               IF (IALT.EQ.2.AND.TPR(1,2).GT.0.)
     1           CTP=(COI(IB,1,1)/TPR(1,1)+COI(IB,1,2)/TPR(1,2))/2.
               IF (TPR(2,3).GT.0.) BEN(IB,IY)=BEN(IB,IY)+
     1           .5*(CTP+(COI(IB,2,3)/TPR(2,3)))*TTP
            ENDIF
741      CONTINUE
743   CONTINUE
      BEN(4,IY)=BEN(1,IY)+BEN(2,IY)+BEN(3,IY)
      TBEN(1)=TBEN(1)+BEN(1,IY)
      TBEN(2)=TBEN(2)+BEN(2,IY)
      TBEN(3)=TBEN(3)+BEN(3,IY)
      TBEN(4)=TBEN(4)+BEN(4,IY)
745 CONTINUE
    DCOST=COST/((1.+DIS/100)**(ICYR-1))
    COST=MAX(DCOST,0.01)
    BCRATIO=TBEN(4)/COST/1000.
```

```
      IF (IOUT.EQ.0) THEN
         WRITE (6,1650) IDAVE,PDES,IMPROV(1),IMPROV(2)
         WRITE (6,1655) IYR,((DVOL(IS,I,1),I=1,3),IS=1,2)
         IYR1=IYR+1
         WRITE (6,1655) IYR1,((DVOL(IS,I,2),I=1,3),IS=1,2)
         IYEAR=IPER+1
         INY=1
         IF (IYEAR.GT.21) INY=2
         DO 750 IY=3,IPER,INY
            ICYER=IYR+IY-1
            WRITE (6,1655) ICYER,((DVOL(IS,I,IY),I=1,3),IS=1,2)
  750    CONTINUE
         ICYER=IYR+IPER
         WRITE (6,1655) ICYER,((DVOL(IS,I,IYEAR),I=1,3),IS=1,2)
         DO 810 IS=1,2
          DO 800 I=1,3
            IF (IALT.EQ.1.AND.I.EQ.2) GOTO 800
            IF (I.EQ.3.AND.IS.EQ.1) GOTO 800
            IF (I.EQ.1.AND.IS.EQ.3.AND.ICON.GT.1) GOTO 800
            DO 780 J=1,ISNO(I)
               WRITE (6,1700) IDAVE,PDES,TYPED(I),RDES(I),J,SDES(I,J),
     1          IMPROV(IS)
               TVEH=TOTVEH(1,IS,I,J,1)+TOTVEH(3,IS,I,J,1)
               TPERS=TOTPERS(1,IS,I,J,1)+TOTPERS(3,IS,I,J,1)
               WRITE (6,1710) IYR,AVSPD(1,IS,I,J,1),TOTVEH(1,IS,I,J,1),
     1          TOTPERS(1,IS,I,J,1),AVSPD(3,IS,I,J,1),
     2          TOTVEH(3,IS,I,J,1),TOTPERS(3,IS,I,J,1),
     3          TVEH,TPERS,TOTVEH(2,IS,I,J,1)
               IYR1=IYR+1
               TVEH=TOTVEH(1,IS,I,J,2)+TOTVEH(3,IS,I,J,2)
               TPERS=TOTPERS(1,IS,I,J,2)+TOTPERS(3,IS,I,J,2)
               WRITE (6,1710) IYR1,AVSPD(1,IS,I,J,2),TOTVEH(1,IS,I,J,2),
     1          TOTPERS(1,IS,I,J,2),AVSPD(3,IS,I,J,2),
     2          TOTVEH(3,IS,I,J,2),TOTPERS(3,IS,I,J,2),
     3          TVEH,TPERS,TOTVEH(2,IS,I,J,2)
               DO 760 IY=3,IPER,INY
                  ICYER=IYR+IY-1
               TVEH=TOTVEH(1,IS,I,J,IY)+TOTVEH(3,IS,I,J,IY)
               TPERS=TOTPERS(1,IS,I,J,IY)+TOTPERS(3,IS,I,J,IY)
               WRITE (6,1710) ICYER,AVSPD(1,IS,I,J,IY),
     1          TOTVEH(1,IS,I,J,IY),TOTPERS(1,IS,I,J,IY),
     2          AVSPD(3,IS,I,J,IY),TOTVEH(3,IS,I,J,IY),
     3          TOTPERS(3,IS,I,J,IY),TVEH,TPERS,TOTVEH(2,IS,I,J,IY)
  760          CONTINUE
               ICYER=IYR+IPER
               TVEH=TOTVEH(1,IS,I,J,IYEAR)+TOTVEH(3,IS,I,J,IYEAR)
               TPERS=TOTPERS(1,IS,I,J,IYEAR)+TOTPERS(3,IS,I,J,IYEAR)
               WRITE (6,1710) ICYER,AVSPD(1,IS,I,J,IYEAR),
     1          TOTVEH(1,IS,I,J,IYEAR),TOTPERS(1,IS,I,J,IYEAR),
     2          AVSPD(3,IS,I,J,IYEAR),TOTVEH(3,IS,I,J,IYEAR),
     3          TOTPERS(3,IS,I,J,IYEAR),TVEH,TPERS,
     4          TOTVEH(2,IS,I,J,IYEAR)
  780       CONTINUE
  800     CONTINUE
  810    CONTINUE
         WRITE (6,1665) IDAVE,PDES
         WRITE (6,1670) IYR,(BEN(IT,1),IT=1,4)
         WRITE (6,1670) IYR1,(BEN(IT,2),IT=1,4)
         DO 825 IY=3,IPER,INY
            ICYER=IYR+IY-1
            WRITE (6,1670) ICYER,(BEN(IT,IY),IT=1,4)
  825    CONTINUE
         ICYER=IYR+IPER
         WRITE (6,1670) ICYER,(BEN(IT,IYEAR),IT=1,4)
         WRITE (6,1675) (TBEN(IT),IT=1,4)
         TBENM=TBEN(4)/1000.
         WRITE (6,1680) TBENM,COST,BCRATIO
      ELSE
         CALL MAINDIS(IDAVE)
```

```
      ENDIF
      GO TO 40
  565 WRITE (6,28) IDAVE
  566 STOP
C
C
  120 FORMAT (A30,I4,F4.1,I2,I1,2(F5.2),2(F4.2),F4.1,F6.2,2(I1),F4.2,I1)
  125 FORMAT (6(F3.1),4(F4.1),5(F3.1),4(F4.1),5(F3.1))
  130 FORMAT (12(F4.1)/12(F4.1))
  135 FORMAT (I1,A30,4(F7.2),I2)
  140 FORMAT (A30,2(F7.2),2(I2),F3.0,F4.1,2(F7.2)/I2,I2,F4.1,I2,2(I3),
     1  F5.2,F3.0)
  145 FORMAT (2(I4),2(I1),I2,I3,F3.1,F3.0,F5.2,I1)
  150 FORMAT (I1,F4.1,F4.1,F5.2,A1)
  160 FORMAT (1X,'Error in Reading Problem ',I2,1X,
     1 ' Following Cards Skipped')
  170 FORMAT (A80)
  171 FORMAT (1X,A80)
  172 FORMAT (I2)
  173 FORMAT (I2,I1)
  175 FORMAT (I2,I1,I2,I1)
 1180 FORMAT (2X,A30,2(I1),I4,I2,I2,I1,2(F5.0),2(F4.0),I2,F6.0,2(I1),
     1  F4.0,I1,I4)
 1185 FORMAT (2X,6(F3.0),3(F4.0),6(F3.0),3(F4.0),6(F3.0))
 1190 FORMAT (2X,12(F4.0))
 1195 FORMAT (3X,A30,4(F7.0),I2)
 1200 FORMAT (6X,A30,2(F7.0),I2,I3,I2,2(F7.0),I1)
 1202 FORMAT (6X,I2,I2,I2,I3,I3,F5.0,I3,I2)
 1205 FORMAT (6X,2(I4),2(I1),I2,I3,F3.0,I3,F5.0,I1,I1,I3,I4,2(3(I2),
     1  I3,2(F5.0)))
 1210 FORMAT (I1,F4.0,F4.0,F5.0,A1)
   27 FORMAT (1X,'Premature end of problem data.  Problem ',I4,
     1  ' not analyzed.'/)
   28 FORMAT (1X,'Premature end of data.  Problem(s) ',I4,
     1       ' and beyond not analyzed.'/)
   29 FORMAT (1X,'Thank You.  All problems analyzed.'/)
 1365 FORMAT (28X,        '***** H E E M III *****'                /
     * 19X,      'REVISED HIGHWAY ECONOMIC EVALUALTION MODEL'      /
     * 34X,                    'VERSION 1.0'                       ///
     * 13X,'Texas Department of Highways and Public Transportation'///
     * 17X,    'Revised by the Texas Transportation Institute,'    /
     * 26X,            'Texas A&M University System'               /
     * 20X,       'Dr. Jeffery L. Memmott, (409) 845-9939.'       /)
 1500 FORMAT ('1',1X,'Problem Number ',I2,8X,A30//
     * 3X,'PROBLEM ASSUMPTIONS'//
     * 5X,'1.  Current Year:',49X,I4/
     * 5X,'2.  Discount Rate (%):',46X,I2/
     * 5X,'3.  Analysis Period (Years):',40X,I2/
     * 5X,'4.  Type of Traffic Growth Rate (1-Const Grwth, ',
     * '2-Strght Ln):',8X,I1/
     * 5X,'5.  Car Value of Time per Person ($/hr):',25X,F5.2/
     * 5X,'6.  Truck Value of Time per Person ($/hr):',23X,F5.2/
     * 5X,'7.  Car Occupancy Rate:',43X,F4.2)
 1510 FORMAT (5X,'8.  Truck Occupancy Rate:',41X,F4.2/
     * 5X,'9.  Percent Trucks:',49X,I2/
     * 5X,'10. Total Construction Cost (Millions of $):',20X,F6.2/
     * 5X,'11. Year when Improvement Completed:',30X,I4/
     * 5X,'12. Const. Cat. (1-Bypass, 2-Add Cap, 3-Intchng, ',
     * '4-RR Gr Sep):',7X,I1/
     * 5X,'13. Alternate Parallel Route in Analysis ',
     * '(1-No, 2-Yes):',14X,I1/
     * 5X,'14. Operating Cost and Accident Cost Update Factor:',
     * 15X,F4.2/
     * 5X,'15. Area Type (1-Rural, 2-Urban):',36X,I1/
     * 5X,'16. Output Switch (0-Complete Input/Output, '
     * '1-Summary Output):',7X,I1/
     * 5X,'17. Allocation Switch (0-Program Alloc, 1-No Alloc):',17X,I1)
 1530 FORMAT (//1X,'HOURLY TRAFFIC DISTRIBUTION'//
     * 5X,'Hour',7X,'% of ADT',20X,'Hour',7X,'% of ADT'/
```

```
    * 15X,'During Hour',28x,'During Hour'/)
1540 FORMAT (//1X,'HOURLY TRAIN TRAFFIC DISTRIBUTION'//
    * 5X,'Hour',3X,'% of Daily Trains',15X,'Hour',3X,
    * '% of Daily Trains'/
    * 15X,'During Hour',28x,'During Hour'/)
1550 FORMAT (4X,I2,'-',I2,9X,F4.1,21X,I2,'-',I2,9X,F4.1)
1560 FORMAT ('1',1X,'Problem Number ',I2,8X,A30/
    1 2X,A9,' Route',10X,A30//
    2 5X,'1.  Current Year Through ADT without Improvement (Thous.):',
    3 5X,F7.2/
    4 5X,'2.  20 Year Future Through ADT without Improvement '
    5 '(Thous.):',3X,F7.2/
    6 5X,'3.  Current Year Through ADT with Improvement (Thous.):',
    7 8X,F7.2/
    8 5X,'4.  20 Year Future Through ADT with Improvement (Thous.):',
    9 6X,F7.2/
    $ 5X,'5.  Number of Route Segments:',39X,I2)
1570 FORMAT ('1',1X,'Problem Number ',I2,8X,A30/
    1 2X,A9,' Route',10X,A30/2X,'Segment ',I2,15X,A30//
    3 5X,'1.  Major Rt Current Yr Add Local ADT (Thous.):',16X,F7.2/
    4 5X,'2.  Major Rt 20 Yr Future Add Local ADT (Thous.):',14X,F7.2/
    5 5X,'3.  Total Number of Lanes, Major Route:',29X,I2/
    6 5X,'4.  Segment Length (miles):',38X,F5.2/
    7 5X,'5.  Free Flow Speed on Major Route (mph):',26X,I3/
    8 5X,'6.  Percent Trucks on Major Route:',34X,I2/
    9 5X,'7.  Major Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:',15X,
    $ I1/5X,'8.  Capacity per Lane on Major Route (vphpl):',21X,I4/
    2 5X,'9.  Type of Inters/Interchg, 1-None, 2-2 Way Stop, 3-4 Way ',
    3 'Stop,'/9X,'4-Signal, 5-Simple Diamond, 6-Cloverleaf, 7-3 Level',
    4 ' Diamond,'/9X,'8-Directional, 9-RR Grade Crossing, 10-RR Grade',
    5 ' Separation:',5X,I2)
1580 FORMAT (5X,'10. Current ADT, Minor Route (Thous.):',25X,F7.2/
    1 5X,'11. 20 Year Future ADT, Minor Route (Thous.):',18X,F7.2/
    2 5X,'12. Total Number of Lanes, Minor Route:',29X,I2/
    3 5X,'13. Free Flow Speed on Minor Route (mph):',26X,I3/
    4 5X,'14. Percent Trucks on Minor Route:',34X,I2/
    5 5X,'15. Minor Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:',15X,
    6 I1/5X,'16. Capacity per Lane on Minor Route (vphpl):',21X,I4/
    7 5X,'17. Percent Major Route ADT with Stop or Signal:',19X,I3/
    8 5X,'18. Percent Minor Route ADT with Stop or Signal:',19X,I3/
    9 5X,'19. Number of Intersections:',40X,I2/
    1 5X,'20. Type of At-Grd Signl Inter, 1-none, 2-4X4, 3-4X6,',
    2 '4-6X6:',10X,I1/
    3 5X,'21. HOV Facility Switch, 0-No HOV, 1-Yes HOV:',24X,I1)
1590 FORMAT (5X,'22. HOV, Number of Lanes:',44X,I1/
    * 5X,'23. HOV Free Flow Speed (mph):',37X,I3/
    * 5X,'24. HOV Capacity per Lane (vplph):',32X,I4/
    1 5X,'23. HOV AM, Beginning Hour:',41X,I2/
    2 5X,'24. HOV AM, Ending Hour:',44X,I2/
    3 5X,'25. HOV AM, Percent Persons Using HOV:',30X,I2/
    4 5X,'26. HOV AM, Percent Buses:',41X,I3/
    5 5X,'27. HOV AM, Bus Occupancy Rate per Vehicle:',22X,F5.2/
    6 5X,'28. HOV AM, Car/Van Occupancy Rate per Vehicle:',18X,F5.2/
    1 5X,'30. HOV PM, Beginning Hour:',41X,I2/
    2 5X,'31. HOV PM, Ending Hour:',44X,I2/
    3 5X,'32. HOV PM, Percent Persons Using HOV:',30X,I2/
    4 5X,'33. HOV PM, Percent Buses:',41X,I3/
    5 5X,'34. HOV PM, Bus Occupancy Rate per Vehicle:',22X,F5.2/
    6 5X,'35. HOV PM, Car/Van Occupancy Rate per Vehicle:',18X,F5.2)
1600 FORMAT (5X,'36. Number of Trains Crossing per Day:',30X,I2/
    1 5X,'37. Average Train Speed (mph):',37X,I3/
    2 5X,'38. Average Train Length (miles):',32X,F5.2/
    3 5X,'39. Time for Gates to Close and Open (min.):',22X,F4.2/
    4 5X,'40. Percent Reduction in Vehicle Speed Crossing Tracks:',
    5 12X,I3)
1650 FORMAT ('1',1X,'Problem Number ',I2,8X,A30//
    1  25X,'Daily Through Traffic (Thous.)'//15X,A20,
    1  14X,A20/3X,
    2  'Year',2(4X,'Existing',2X,'Alternate',2X,'Proposed')/)
```

```
1655 FORMAT (3X,I4,4X,2(F7.2,3X,F7.2,4X,F7.2,5X))
1660 FORMAT (1X/)
1665 FORMAT ('1',1X,'Problem Number ',I2,8X,A30//
    1   21X,'Summary of Discounted Benefits (Thous. $)'//3X,
    1  'Year',4X,'Delay Savings',3X,'Red Veh Op Cost',3X,
    2  'Red Acc Cost',4X,'Total Benefits'/)
1670 FORMAT (3X,I4,5X,F9.2,9X,F9.2,7X,F9.2,8X,F9.2)
1675 FORMAT (3X,'Total',4X,F9.2,9X,F9.2,7X,F9.2,8X,F9.2/)
1680 FORMAT (1X,'Total Discounted User Benefits (Millions $) :',
    1  F7.2/1X,'Discounted Construction Cost (Millions $) :  ',F7.2/1X,
    2  'Benefit-Cost Ratio :                              ',F7.2)
1700 FORMAT ('1',1X,'Problem Number ',I2,8X,A30/
    1  2X,A9,' Route',10X,A30/2X,'Segment ',I2,15X,A30//30X,A20//
    2  14X,'Major Route',12X,'HOV Facility',8X,'Combined Total',4X,
    3  'Minor'/75X,'Route'/2X,'Year',3X,2('Aver.',4X,'Num.',4X,
    4  'Num.',3X),2X,'Num.',4X,'Num.',5X,'Num.'/
    5  9X,2('Speed',4X,'Veh.',3X,
    6  'Pers.',3X),2X,'Veh.',3X,'Pers.',5X,'Veh.'/9X,2('(mph)',3X,
    7  '(000)',3X,'(000)',3X),1X,'(000)',3X,'(000)',4X,'(000)'/)
1710 FORMAT (2X,I4,2X,2(F6.2,1X,2(F7.2,1X),1X),F7.2,1X,F7.2,2X,F7.2)
     END
     SUBROUTINE INIT
     CHARACTER*1 KANS,IRFL
     CHARACTER*8 RTYPE
     CHARACTER*9 TYPE
     CHARACTER*30 IDUM2
     COMMON /LABA/ IDUM(2143)
     COMMON /LABB/ IDUM1(22743)
     COMMON /LABC/ IDUM2(34),TYPE(3),KANS(4),RTYPE(5),
    1  IRFL(2,2,2,3,10)
     CHARACTER*30 KDUM
     DATA KDUM/'                                '/
     DO 5 IK=1,2143
        IDUM(IK)=0
   5 CONTINUE
     DO 10 IJ=1,22743
        IDUM1(IJ)=0
  10 CONTINUE
     DO 15 I=1,34
        IDUM2(I)=KDUM
  15 CONTINUE
     RETURN
     END
     SUBROUTINE ALLOCATE
     CHARACTER*1 KANS,IRFL
     CHARACTER*8 RTYPE
     CHARACTER*9 TYPE
     CHARACTER*30 PDES,RDES,SDES
     COMMON /LABA/ DIS,IPER,IGRW,VTC,VTT,COCP,TOCP,PTRK,COST,ICON,IALT,
    1  UPD,IAR(3),IDES(3),IFFSP(3,10),TVOL(2,3),ISNO(3),XADT(2,3,10),
    2  LN(3,10),IYDAT,ICAP(3,10),IPERC(3,10),IDEV,IDATIN,
    3  IDATCH,I,J,IYR,TD(24),XST(2,3,10),HPER(24),FVOL(2,3),SLNG(3,10),
    4  VOL,CVOL,ISKP,DELAY(2),VOC(2),ACC(2),BEN(4,41),TBEN(4),BCRATIO,
    5  DVOL(2,3,41),LNC(3,10),ISTYP(3,10),IXDAT,IY,
    6  TRLN(3,10),GRTRN(3,10),IVAL,ICAPC(3,10),TRNO(3,10),IPRED(3,10),
    7  GATE(3,10),ITRSPD(3,10),IZDAT1,IZDAT2,IS,IATYP,IPERC1(3,10),
    8  IFFSPC(3,10),IPTRKS(3,10),IPTRKC(3,10),IRTYPE(2,2,2,3,10),
    9  RVOL(2,2,2,3,10),RSPD(2,2,2,3,10),RDIST(2,2,2,3,10),IR(2),RD(2)
     COMMON /LABB/ IFAC(3,10),IFACC(3,10),ISGLN(3,10),IHOVLN(3,10),
    1  IHOVB(2,3,10),IHOVE(2,3,10),IPERHOV(2,3,10),IPBUS(2,3,10),
    2  BUSOCP(2,3,10),VANOCP(2,3,10),IHOV(3,10),NUMINT(3,10),
    3  IYRC,IOUT,IALOC,IHOVSP(3,10),IHOVCAP(3,10),TOTVEH(3,2,3,10,41),
    4  TOTPERS(3,2,3,10,41),AVSPD(3,2,3,10,41)
     COMMON /LABC/ PDES,RDES(3),SDES(3,10),TYPE(3),KANS(4),RTYPE(5),
    1  IRFL(2,2,2,3,10)
     DIMENSION C(3,3), V(3,3), A(3), B(3), VI(3)
     DO 10 I=1,3
        TVOL(2,I)=0.
        DO 5 IZ=1,3
```

```
        V(I,IZ)=0.
 5    CONTINUE
10 CONTINUE
   VOLMT=TVOL(1,1)+TVOL(1,2)
   DO 30 IZ=1,IALT
      IZ1=IZ
      DO 25 I=IZ1,3
         IF (IZ.EQ.1.AND.I.EQ.2) GO TO 25
         IF (IZ.EQ.2.AND.I.EQ.3) GO TO 25
         DO 20 IB=1,3
            SN=IB
            VOLS=VOLMT/SN
            C(I,IB)=0.
            IF (IB.EQ.3) VOLS=.001
            DO 15 J=1,ISNO(I)
               VOL=VOLS+XADT(1,I,J)
               CVOL=XST(1,I,J)
               CALL ANALYZE
               C(I,IB)=C(I,IB)+DELAY(1)+VOC(1)+ACC(1)
15          CONTINUE
            V(I,IB)=VOLS
20       CONTINUE
         IF (C(I,1).LE.C(I,3)) THEN
            B(I)=0.
            A(I)=0.
            GO TO 25
         ELSE
            COF1=ALOG(C(I,1)-C(I,3))
         END IF
         IF (C(I,2).LE.C(I,3)) THEN
            B(I)=0.
            A(I)=0.
            GO TO 25
         ELSE
            COF2=ALOG(C(I,2)-C(I,3))
         END IF
         IF (V(I,1).LE.0..OR.V(I,2).LE.0.) THEN
            B(I)=0.
            A(I)=0.
            GO TO 25
         ELSE
            COF3=ALOG(V(I,1))-ALOG(V(I,2))
         END IF
         B(I)=(COF1-COF2)/COF3
         A(I)=(C(I,1)-C(I,3))/(V(I,1)**B(I))
25    CONTINUE
30 CONTINUE
   VI(1)=TVOL(1,1)/2.
   VI(2)=TVOL(1,2)/2.
   VE=VI(1)
   VA=VI(2)
   VT=VOLMT
   VI(3)=VT-VI(1)-VI(2)
   VP=VI(3)
35 DO 45 IZ=1,3
      IF (IALT.EQ.1.AND.IZ.GE.2) GO TO 45
      I1=1
      I2=3
      I3=2
      IF (IZ.EQ.2) THEN
         I1=2
         I3=1
      END IF
      IF (IZ.EQ.3) THEN
         I2=2
         I3=3
      END IF
40    F=C(I1,3)+A(I1)*(VI(I1)**B(I1))-C(I2,3)-A(I2)*(VI(I2)**B(I2))
      IF (VI(I1).EQ.0..AND.B(I1).LE.1.) THEN
```

```
         B1EX=1.
      ELSE
         B1EX=VI(I1)**(B(I1)-1)
      END IF
      IF (VI(I2).EQ.0..AND.B(I2).LE.1.) THEN
         B2EX=1.
      ELSE
         B2EX=VI(I2)**(B(I2)-1)
      END IF
      F1=A(I1)*B(I1)*B1EX+A(I2)*B(I2)*B2EX
      IF (F1.EQ.0.) THEN
         FT=0.
      ELSE
         FT=F/F1
      END IF
      IF (FT.GT.VI(I1)) THEN
         VI(I2)=VI(I2)+VI(I1)
         VI(I1)=0.
         FT=0.
      END IF
      IF (VI(I2)+FT.LT.0.) THEN
         VI(I1)=VI(I2)+VI(I1)
         VI(I2)=0.
         FT=0.
      END IF
      FTA=ABS(FT)
      IF (FTA.GE.0.001) THEN
         VI(I1)=VI(I1)-FT
         VI(I2)=VI(I2)+FT
         GO TO 40
      END IF
45 CONTINUE
   TVOL(2,I1)=VI(I1)
   TVOL(2,I3)=VI(I3)
   TVOL(2,I2)=VI(I2)
   VCH1=ABS(VE-TVOL(2,1))
   VCH2=ABS(VA-TVOL(2,2))
   VCH3=ABS(VP-TVOL(2,3))
   IF (VCH1.LT.0.001.AND.VCH2.LT.0.001.AND.VCH3.LT.0.001) GO TO 50
   VE=TVOL(2,1)
   VA=TVOL(2,2)
   VP=TVOL(2,3)
   GO TO 35
50 FVOLMT=FVOL(1,1)+FVOL(1,2)
   DO 55 I=1,3
      FVOL(2,I)=TVOL(2,I)*(FVOLMT/VOLMT)
55 CONTINUE
   RETURN
   END
   SUBROUTINE ANALYZE
   CHARACTER*1 KANS,IRFL
   CHARACTER*8 RTYPE
   CHARACTER*9 TYPE
   CHARACTER*30 PDES,RDES,SDES
   COMMON /LABA/ DIS,IPER,IGRW,VTC,VTT,COCP,TOCP,PTRK,COST,ICON,IALT,
  1  UPD,IAR(3),IDES(3),IFFSP(3,10),TVOL(2,3),ISNO(3),XADT(2,3,10),
  2  LN(3,10),IYDAT,ICAP(3,10),IPERC(3,10),IDEV,IDATIN,
  3  IDATCH,I,J,IYR,TD(24),XST(2,3,10),HPER(24),FVOL(2,3),SLNG(3,10),
  4  VOL,CVOL,ISKP,DELAY(2),VOC(2),ACC(2),BEN(4,41),TBEN(4),BCRATIO,
  5  DVOL(2,3,41),LNC(3,10),ISTYP(3,10),IXDAT,IY,
  6  TRLN(3,10),GRTRN(3,10),IVAL,ICAPC(3,10),TRNO(3,10),IPRED(3,10),
  7  GATE(3,10),ITRSPD(3,10),IZDAT1,IZDAT2,IS,IATYP,IPERC1(3,10),
  8  IFFSPC(3,10),IPTRKS(3,10),IPTRKC(3,10),IRTYPE(2,2,2,3,10),
  9  RVOL(2,2,2,3,10),RSPD(2,2,2,3,10),RDIST(2,2,2,3,10),IR(2),RD(2)
   COMMON /LABB/ IFAC(3,10),IFACC(3,10),ISGLN(3,10),IHOVLN(3,10),
  1  IHOVB(2,3,10),IHOVE(2,3,10),IPERHOV(2,3,10),IPBUS(2,3,10),
  2  BUSOCP(2,3,10),VANOCP(2,3,10),IHOV(3,10),NUMINT(3,10),
  3  IYRC,IOUT,IALOC,IHOVSP(3,10),IHOVCAP(3,10),TOTVEH(3,2,3,10,41),
  4  TOTPERS(3,2,3,10,41),AVSPD(3,2,3,10,41)
```

```
 COMMON /LABC/ PDES,RDES(3),SDES(3,10),TYPE(3),KANS(4),RTYPE(5),
1  IRFL(2,2,2,3,10)
 DOUBLE PRECISION BDEL(5)
 DIMENSION ACRF(2,3,5), ACT(2,3,5), ADEL(5),DEL(3),OC(3),AC(3),
1  TACR(2,3),TACC(2,3)
 DATA ACRF/0.,0.,0.,0.,0.,0.,0.0306748,0.0102303,0.5484,0.5165,
1  0.8374,0.9393,0.0075463,0.0020001,0.3598,0.2145,0.8655,0.4648,
2  0.0046282,0.0014806,0.0406,0.0518,0.0694,0.0879,0.0002478,
3  0.0000955,0.0018,0.0026,0.0032,0.0043/
 DATA ACT/0.,0.,0.,0.,0.,0.,990492.,886770.,22066.,12980.,1711.,
1  1239.,990492.,886770.,22066.,12980.,1711.,1239.,1068136.,
2  856326.,20532.,12272.,1829.,1180.,861282.,899042.,18408.,22420.,
3  2832.,2006./
 DATA ADEL/0.3993,0.2629,1.1778,1.1855,1.2662/
 DATA BDEL/0.00511955,0.00209176,0.00072452,0.00065674,0.00056726/
 DATA TACR/248.,616.,261.,565.,93.,244./
 DATA TACC/33040.,8260.,33394.,11328.,36698.,12036./
 ISTY=ISTYP(I,J)
 TNUMIN=NUMINT(I,J)
 ITR=0
 IF (ISTY.GE.9) ITR=1
 IF (ITR.EQ.1) THEN
    CY=3600.
    PRD=IPRED(I,J)/100.
 END IF
 ACF=0.
 ISAC=1
 ISAD=1
 IF (ISTY.EQ.2.OR.ISTY.EQ.3) THEN
    ISAC=2
    ISAD=2
 END IF
 IF (ISTY.EQ.4) THEN
    ISAC=3
    ISAD=3
 END IF
 IF (ISTY.GE.5.AND.ISTY.LE.8) THEN
    ISAC=4
    ISAD=3
 END IF
 IF (ISTY.EQ.9) THEN
    ISAC=5
    ISAD=5
 END IF
 TVOI=VOL*IPERC(I,J)/100.+CVOL*IPERC1(I,J)/100.
 IF (ISTY.EQ.2) TVOI=CVOL*IPERC1(I,J)/100.*10.
 XCOCP=COCP
 XTOCP=TOCP
 INX=2
 IF (IHOV(I,J).EQ.1) INX=3
 DO 30 IN=1,INX
    IF (IN.LE.2) THEN
       DELAY(IN)=0.
       VOC(IN)=0.
       ACC(IN)=0.
    ENDIF
    DEL(IN)=0.
    OC(IN)=0.
    AC(IN)=0.
    ISPD=IFFSP(I,J)
    IF (IN.EQ.3) ISPD=IHOVSP(I,J)
    SPD=MAX(5,ISPD)
    PTK=IPTRKS(I,J)
    IF (IN.EQ.2) PTK=IPTRKC(I,J)
    PT=PTK/100.
    ROCP=COCP*(1.-PT)+TOCP*PT
    PRC=IPERC(I,J)
    IF (IN.EQ.2) PRC=IPERC1(I,J)
    DO 5 IAT=1,3
```

```
      ACF=ACF+ACRF(IATYP,IAT,ISAC)*ACT(IATYP,IAT,ISAC)*(1.-PRC/
     1      100.)+ACRF(IATYP,IAT,ISAD)*ACT(IATYP,IAT,ISAD)*(PRC/100.)
    5 CONTINUE
      VO=VOL
      IF (IN.EQ.2) VO=CVOL
      IF (VO.LE.0.) GO TO 30
      LAN=LN(I,J)
      IF (IN.EQ.2) LAN=LNC(I,J)
      IF (IN.EQ.3) LAN=IHOVLN(I,J)
      IF (LAN.LE.0) GO TO 30
      VOI=VO*IPERC(I,J)/100.
      IF (IN.EQ.2) VOI=VO*IPERC1(I,J)/100.
      DO 25 K=1,24
         TVOHI=TVOI*HPER(K)/100.*1000.
         VOH=VO*HPER(K)/100.*1000.
         VOHI=VOI*HPER(K)/100.*1000.
         XCOCP=COCP
         XTOCP=TOCP
         PT=PTK/100.
         RLN=LAN
         CAP=ICAP(I,J)*RLN
         IF (IN.EQ.2) CAP=ICAPC(I,J)*RLN
         IF (IN.EQ.3) CAP=IHOVCAP(I,J)*RLN
         IF (INX.EQ.3.AND.IN.NE.2) THEN
            IHV=0
            ADJV=1.
            IF (K-1.GE.IHOVB(1,I,J).AND.K.LE.IHOVE(1,I,J)) IHV=1
            IF (K-1.GE.IHOVB(2,I,J).AND.K.LE.IHOVE(2,I,J)) IHV=2
            IF (IHV.EQ.0.AND.IN.EQ.3) GOTO 25
            IF (IHV.NE.0) THEN
               PERHOV=IPERHOV(IHV,I,J)
               PBUS=IPBUS(IHV,I,J)
               HOCP=BUSOCP(IHV,I,J)*
     2              PBUS/100.+VANOCP(IHV,I,J)*
     3              (1.-PBUS/100.)
               PERHOVM=(HOCP/ROCP)*(.75*CAP/VOH)*100
               IF (PERHOVM.LT.PERHOV) PERHOV=PERHOVM
               IF (IN.EQ.1) THEN
                  ADJV=1.-PERHOV/100.
               ELSE
                  ADJV=ROCP*(PERHOV/100.)/HOCP
                  PT=PBUS/100.
                  XCOCP=VANOCP(IHV,I,J)+(BUSOCP(IHV,I,J)-1.)*
     1                 PT/(1.-PT)
                  XTOCP=1.
               ENDIF
            ENDIF
            TVOHI=TVOHI*ADJV
            VOH=VOH*ADJV
            VOHI=VOHI*ADJV
         ENDIF
         TOTVEH(IN,IS,I,J,IY)=TOTVEH(IN,IS,I,J,IY)+VOH
         XOCP=XCOCP*(1.-PT)+XTOCP*PT
         TOTPERS(IN,IS,I,J,IY)=TOTPERS(IN,IS,I,J,IY)+
     1       VOH*XOCP
         VT=VTC*XCOCP*(1.-PT)+VTT*XTOCP*PT
         AVICS=0.94*(1.-PT)+.97*PT
         GR=1
         IF (ITR.EQ.1) THEN
            RED=1.-GRTRN(I,J)
            GR=1.-RED*(TD(K)/100.)*24.
         END IF
            IF (ITR.EQ.1) CAP=CAP*GR/GRTRN(I,J)
            CAP=MAX(CAP,100.)
            PTR=1.
            IF (ITR.EQ.1) PTR=TRNO(I,J)*TD(K)/2./100.*24.
            AVOL=VOHI
            VCI=AVOL/CAP
            IF (ITR.EQ.1) THEN
```

```
            VCI=MIN(1.,VCI)
          ELSE
          VCI=MIN(VCI,1.2)
          END IF
          VC=VOH/CAP
          IF (ITR.EQ.1) THEN
               VC=MIN(1.,VC)
          ELSE
          VC=MIN(VC,2.)
          END IF
          BCOF=SPD/4.
          ACOF=SPD/2.
          IF (VC.LE.1.) THEN
               SPR=(SPD-ACOF)*SQRT(1.-VC*VC)+ACOF
          ELSE
               SPR=ACOF-ACOF*SQRT(1.-(2.-VC)*(2.-VC))
          END IF
          SPR=MAX(SPR,BCOF)
          AVSPD(IN,IS,I,J,IY)=AVSPD(IN,IS,I,J,IY)+SPR*VOH
          IF (IN.NE.2) THEN
            RNDEL=SLNG(I,J)*3600/SPR
          ELSE
          RNDEL=0.
          END IF
          IF (GR.GE.1..OR.ITR.EQ.0) THEN
             T1=0.
             T2=0.
          ELSE
          GRVCI=GR*VCI
          GRVCI=MIN(0.9,MAX(GRVCI,0.001))
          T1=0.38*CY*((1.-GR)**2)/(1.-GRVCI)
          T21=173.*(VCI**2)
          T22=(VCI-1.)+SQRT((VCI-1.)*(VCI-1.)+16.*VCI/CAP)
          T2=T21*T22
          END IF
10        TT=T1+T2
          TT=MIN(TT,150.)
          IF (ITR.EQ.1) THEN
             VCID=1.-VCI
             IF (VCID.LE.0.) VCID=.001
             PSTP=(1.-GR)/VCID
          ELSE
             PSTP=VCI
          END IF
             PSTP=MIN(PSTP,1.)
          T3=0.
          TCYTK=0.
          TCYCR=0.
          IF (ISTY.EQ.9.AND.PRD.GT.0.) THEN
             SPR1=SPR*(1.-PRD)
             SPR1=MAX(SPR1,0.)
             T3CR=0.86645+.030623*SPR-.045649*SPR1
             T3TK=0.40922+.05493*SPR-.055846*SPR1
             SPRC1=MAX(SPR1,5.)
             SPRC=MAX(SPR,10.)
             T3=(1.-PT)*T3CR*T3CR+PT*T3TK*T3TK+.01*(1./SPRC1-1./
     1         SPRC)*1000.
             TCYTK=EXP(3.0784+.0562*SPR-.0004*SPR*SPR)*(SPR-SPR1)/
     1         10.
             TCYCR=EXP(0.9869+.0324*SPR-.0001*SPR*SPR)*(SPR-SPR1)/
     1         10.
          END IF
          T4=0.
          ROC=0
        IF (IN.LE.2) THEN
         DO 20 ID=1,2
            DO 15 IR1=1,2
               RVOLT=VOH*2.*RVOL(IN,ID,IR1,I,J)/100.
               RDISTT=RDIST(IN,ID,IR1,I,J)
```

```
            RSPDT=RSPD(IN,ID,IR1,I,J)
            IF (RSPDT.EQ.0.) GO TO 15
            T4=T4-RVOLT*RDISTT/RSPDT
            ROCCR=EXP(5.6370-0.0275*RSPDT+0.00033*RSPDT*RSPDT)
            ROCTK=EXP(6.7904-0.03464*RSPDT+.00041*RSPDT*RSPDT)
            ROC=ROC-(ROCCR*(1.-PT)+ROCTK*PT)/1000.*RVOLT*RDISTT
15          CONTINUE
20       CONTINUE
        ENDIF
            DELH=((TT*1.3)*VOHI+RNDEL*VOH)/3600+T3*VOHI/
     1        1000.*(1.-PSTP)+T4
            DEL(IN)=DEL(IN)+DELH*VT
            CSTID=(TT)*AVICS*VOHI/3600.
            CYTK=-9.8845+3.3657*SPR+0.09396*SPR*SPR
            CYCR=1.2206+0.14948*SPR+0.01028*SPR*SPR
            CSTCY=((CYTK*PT+CYCR*(1.-PT))*PSTP+(TCYTK*PT+
     1        TCYCR*(1.-PT))*(1.-PSTP))*VOHI/1000.
            IF (IN.NE.2) THEN
               OCCR=EXP(5.6370-0.0275*SPR+0.00033*SPR*SPR)
               OCTK=EXP(6.7904-0.03464*SPR+.00041*SPR*SPR)
               CSTOP=(OCCR*(1.-PT)+OCTK*PT)/1000.*VOH*SLNG(I,J)
               SPRH=SPR+5.
               RCYTK=EXP(3.0784+.0562*SPRH-.0004*SPRH*SPRH)

               RCYCR=EXP(0.9869+.0324*SPRH-.0001*SPRH*SPRH)

               TCY=(RCYCR*(1.-PT)+RCYTK*PT)*(VOH/1000.)*SLNG(I,J)*
     1           (3.*VC)
               OC(IN)=OC(IN)+(CSTID+CSTCY+CSTOP+TCY+ROC)*UPD
               TAC=((TACR(IATYP,IFAC(I,J))*TACC(IATYP,IFAC(I,J)))/
     1            1.0E+8)*(VOH/1000.)*SLNG(I,J)
            END IF
            AC(IN)=AC(IN)+(ACF*PTR*VOH/1000./RLN/365.+TAC)*UPD
         IF (ITR.EQ.0) THEN
            ITY=0
            IF (ISTYP(I,J).EQ.3) ITY=1
            IF (ISTYP(I,J).EQ.2) ITY=2
            IF (ISTYP(I,J).GE.4.AND.ISTYP(I,J).LE.8) THEN
               IF (ISGLN(I,J).EQ.2) ITY=3
               IF (ISGLN(I,J).EQ.3) ITY=4
               IF (ISGLN(I,J).EQ.4) ITY=5
            END IF
            IF (ITY.GT.0.AND.TVOHI.GT.0.) THEN
               TVOHI1=TVOHI
               IF (ITY.EQ.1) TVOHI1=MIN(960.,TVOHI)
               IF (ITY.EQ.2) TVOHI1=MIN(1200.,TVOHI)
               IF (ITY.EQ.3) TVOHI1=MIN(7200.,TVOHI)
               IF (ITY.EQ.4) TVOHI1=MIN(TVOHI,8280.)
               IF (ITY.EQ.5) TVOHI1=MIN(9360.,TVOHI)
               DELT=1.3*ADEL(ITY)*EXP(BDEL(ITY)*TVOHI1)*(TVOHI/
     1           TVOHI1)
               VMIN=1./BDEL(ITY)
               IF (VMIN.GT.TVOHI) DELT=1.3*ADEL(ITY)*EXP(BDEL(ITY)*
     1           VMIN)*(TVOHI/VMIN)*(TVOHI/VMIN)
               IF (IN.EQ.3) DELT=0.
               DEL(IN)=DEL(IN)+DELT*(VOHI/TVOHI)*TNUMIN*VT
               CSTIDT=DELT*(VOHI/TVOHI)*AVICS
               OC(IN)=OC(IN)+CSTIDT*UPD
            END IF
         END IF
25    CONTINUE
30 CONTINUE
   IF (VOL.GT.0.) THEN
      DELAY(1)=(DEL(1)+DEL(3))/(VOL*1000.)
      VOC(1)=1.11*(OC(1)+OC(3))/(VOL*1000.)
      ACC(1)=1.11*(AC(1)+AC(3))/(VOL*1000.)
   ENDIF
   IF (CVOL.GT.0.) THEN
      DELAY(2)=DEL(2)/(CVOL*1000.)
```

```
      VOC(2)=1.11*OC(2)/(CVOL*1000.)
      ACC(2)=1.11*AC(2)/(CVOL*1000.)
    ENDIF
    RETURN
    END
    SUBROUTINE MAINDIS (ICOUNT)
    CHARACTER*1 KANS,IRFL
    CHARACTER*8 RTYPE
    CHARACTER*9 TYPE
    CHARACTER*30 PDES,RDES,SDES
    COMMON /LABA/ DIS,IPER,IGRW,VTC,VTT,COCP,TOCP,PTRK,COST,ICON,IALT,
   1  UPD,IAR(3),IDES(3),IFFSP(3,10),TVOL(2,3),ISNO(3),XADT(2,3,10),
   2  LN(3,10),IYDAT,ICAP(3,10),IPERC(3,10),IDEV,IDATIN,
   3  IDATCH,I,J,IYR,TD(24),XST(2,3,10),HPER(24),FVOL(2,3),SLNG(3,10),
   4  VOL,CVOL,ISKP,DELAY(2),VOC(2),ACC(2),BEN(4,41),TBEN(4),BCRATIO,
   5  DVOL(2,3,41),LNC(3,10),ISTYP(3,10),IXDAT,IY,
   6  TRLN(3,10),GRTRN(3,10),IVAL,ICAPC(3,10),TRNO(3,10),IPRED(3,10),
   7  GATE(3,10),ITRSPD(3,10),IZDAT1,IZDAT2,IS,IATYP,IPERC1(3,10),
   8  IFFSPC(3,10),IPTRKS(3,10),IPTRKC(3,10),IRTYPE(2,2,2,3,10),
   9  RVOL(2,2,2,3,10),RSPD(2,2,2,3,10),RDIST(2,2,2,3,10),IR(2),RD(2)
    COMMON /LABB/ IFAC(3,10),IFACC(3,10),ISGLN(3,10),IHOVLN(3,10),
   1  IHOVB(2,3,10),IHOVE(2,3,10),IPERHOV(2,3,10),IPBUS(2,3,10),
   2  BUSOCP(2,3,10),VANOCP(2,3,10),IHOV(3,10),NUMINT(3,10),
   3  IYRC,IOUT,IALOC,IHOVSP(3,10),IHOVCAP(3,10),TOTVEH(3,2,3,10,41),
   4  TOTPERS(3,2,3,10,41),AVSPD(3,2,3,10,41)
    COMMON /LABC/ PDES,RDES(3),SDES(3,10),TYPE(3),KANS(4),RTYPE(5),
   1  IRFL(2,2,2,3,10)
    CHARACTER*1 RURURB
    CHARACTER*2 TYPEC
    CHARACTER*3 PTYPE
    DIMENSION RURURB(2), PTYPE(4),TYPEC(6)
    DATA TYPEC/'*U','*D','*F','CR','DR','FR'/
    DATA PTYPE/'New','Add','Int','RGS'/
    DATA RURURB/'R','U'/
    IF (IATYP.EQ.1) THEN
        ITYPEE=IFAC(1,1)+3
        ITYPEP=IFAC(3,1)+3
    ELSE
        ITYPEE=IFAC(1,1)
        ITYPEP=IFAC(3,1)
    END IF
    TBENM=TBEN(4)/1000.
    ITLN=LN(1,1)
    ITLNP=LN(3,1)
    IF (MOD(ICOUNT,50).EQ.1) WRITE (6,100)
    WRITE (6,55) ICOUNT,PDES,RURURB(IATYP),ITLN,TYPEC(ITYPEE)
   1   ,SLNG(1,1),ITLNP,TYPEC(ITYPEP),SLNG(3,1),PTYPE(ICON),PTRK
   2   ,TVOL(1,1),FVOL(1,1),COST,TBENM,BCRATIO
    RETURN
100 FORMAT ('1',1X,'Index',T18,'Description',T39,'U Existing Rt',
   1  T54,'Proposed Rt  Proj  Trck',T79,'Current',T91,'Proj',
   2  T97,'Const,ROW',T111,'User',T119,'Benifit',/T3,'No',T39
   3  ,'/ No Ty Lngth',T54,'No Ty Lngth',T67,'Type',T74,'%',
   4  T81,'ADT',T91,'ADT',T100,'Cost',T109,'Benefits',T121,'Cost'
   5  ,/T39,'R Ln',T54,'Ln',T79,'(Thous)',T89,'(Thous)',T97,
   6  '(Million)',T108,'(Million)',T120,'Ratio',//)
 55 FORMAT (1X,I4,2X,A30,T39,A1,1X,I2,1X,A2,1X,F5.1,2X,I2,1X,A2,1X,
   1  F5.1,T67,A3,T73,F4.1,T80,F6.2,T90,F6.2,T98,F7.2,T108,F9.2,
   2  T119,F7.2/)
    END
```

APPENDIX C - EXAMPLE INPUT AND OUTPUT FOR HEEM-III

As an example of the use of HEEM-III, a portion of the results of a TTI study of a proposed improvement to State Highway 199 in Tarrant County, Texas will be summarized here. The study, number 1904, was directed by Jesse L. Buffington, TTI. The study coordinator was Burton Clifton, District 2, TxDOT. Several parts of the final report, TX-90/1904 [9], will be excerpted for this example. Detailed data to run HEEM-III is given on the Central route alternative, and an example of the printed input and output is given at the end. The total benefits on the detailed output do not exactly match the summary tables from the report because a newer version of HEEM-III was used to generate the output.

SUMMARY OF ALTERNATIVES

TxDOT's District 2 personnel are in the process of evaluating the proposed improvement of State Highway 199 which is located in northwestern Tarrant County. This highway passes through four small "satellite" cities (Lakeside, Lake Worth, Sansom Park and River Oaks) as it leads into Fort Worth and terminates at Interstate Highway 30 near downtown Fort Worth. Presently, the highway is a four-lane facility with undivided and divided at-grade sections with no restrictions on access. The proposed facility is a full limited access freeway with or without service roads.

Three alternate routes are being studied, and all three will affect the four satellite cities, Fort Worth and the rural part of Tarrant County. The route alternatives are as follows: (1) the central route - follows the existing route which contains considerable strip commercial development sprinkled with random vacant land and would require the acquisition of additional land, located primarily on only one side of the existing right of way; (2) the north route would bypass Lake Worth and Sansom Park almost completely and pass mostly through a large portion of vacant land area as well as several residential neighborhoods; and (3) the south route would pass through parts of Sansom Park and Lake Worth and through vacant land and several residential neighborhoods. Most of the northern route and nearly half of the southern route would pass through the city of Fort Worth. A map of the proposed routes is given in Figure C1.

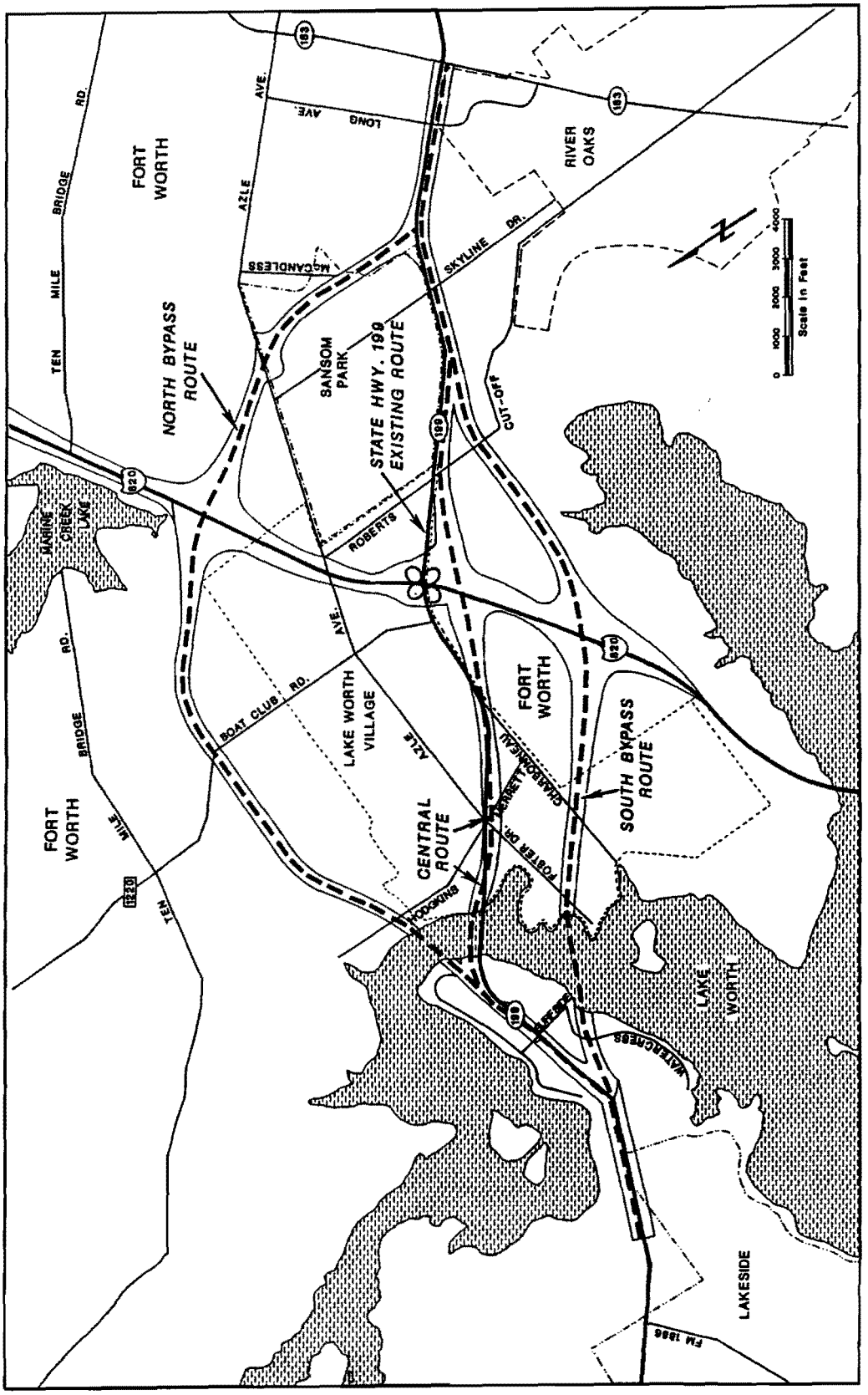


Figure C1. Map of Alternative Proposed Routes

IMPACT ON HIGHWAY USERS

Users of any segment of a highway system experience what is called highway user costs. These costs are traditionally classified into three types: (1) time or delay costs, (2) vehicle operating costs and (3) accident costs. One of the ways to justify improving a segment of an existing highway or bypassing the existing segment with a new segment is to be able to show that the money required to pay for and maintain the improvement will produce an even greater dollar amount of user cost savings. Therefore, the State Highway 199 proposed improvement project is being evaluated for the same reason in this study. The methodology, data requirements and the estimated impact on highway users of this segment of the highway are presented below.

Methodology and Data Requirements

The third version of Highway Economic Evaluation Model (HEEM-III) is used to estimate the use cost savings that might result from implementing either of the proposed routes, namely, the central route, the north route or the south route. HEEM-III, which is the TxDOT's official user cost estimating model, is designed to effectively estimate the user costs of either widening the existing facility or bypassing the existing facility. This model is also equipped to handle induced traffic that is apparently occurring in this segment of SH 199.

Design and Traffic Data

The basic design and traffic volumes for the existing and proposed routes needed as model input data are presented in Table C1. Also, the total length of the existing and proposed routes is presented in Table C1. The other detailed local and through traffic projections needed as model inputs were obtained from TTI's Arlington office. No detailed explanation is given in this report on the methods used to generate these traffic projections. However, they are based on 1988 peak hour machine and manual counts along the existing highway. An annual growth rate of 3% is used to make the 2012 projections for the existing and proposed routes in the improved state. The existing route volumes are split between local and through traffic as follows: local 32% and through 68%. The projections for the existing route remaining in the unimproved state are based on a historical series of SH 199 and intersectional counts dating back to 1963 and

applying a 2.4% annual growth rate. The intersections analyzed by the model for each route are as follows:

Central Route

Surfside Drive, Foster Drive/Hodgkins Road, Merrett/Azle Avenue, Roberts Cut-off Road, Skyline Drive, Long Avenue and SH 183.

North Route

Existing SH 199 near Love Circle,Hodgkins Road, Boat Club Road, IH 820, Azle Avenue, McCandless Avenue, Existing SH 199 near Long Avenue and SH 183.

South Route

Existing SH 199 near Midland Drive, Surfside/Watercress, Charbonneau Road at Shawnee Trail, IH 820, Roberts Cut-off, SH 199 between Cheyenne Street and Skyline Drive, Long Avenue and SH 183.

Problem Assumptions

The problem assumptions are listed in Table C2, and the assumptions for each of the proposed routes are listed in Table C4. Also, the HEEM-III unit costs are updated to 1990. The stream of user costs are discounted back to 1992, considered in the analysis as the current year. Table C3 gives a more detailed breakdown of the total construction costs, divided into construction, right of way and relocation costs. No additional alternate route besides the existing SH 199 is assumed in the model. Detailed segment assumptions along the Central Route, for the existing conditions, are given in Table C5. The proposed conditions are given in Table C6.

Highway User Cost Impact

The estimated highway user cost savings by route alternative are presented in Table C7. These savings are broken down into delay savings, operating cost savings and accident cost savings. Also given, are the savings of each type for Year 1, Year 20 and the 20 year total. The south route would produce the most delay cost, operating cost savings and accident cost savings over the 20 year life of the improvement. The central route would produce the least delay savings and accident cost savings.

To generate a benefit to cost ratio, the stream of benefits and costs over the 20 year period assumed to be the life of the improvement is discounted back to 1992, the

first year that the improvement is assumed to be operational. The construction costs do not have maintenance costs included, so there are no construction costs that will be incurred during the life of improvement. Hence, these costs are not discounted. Table C8 shows the level of discounted user benefits for each route alternative. As can be seen, the proposed south route would produce the most user benefits and the proposed north route the least. On the other hand, the proposed central route would cost the least to construct and the south route would cost the most to construct. As a result, the benefit-to-cost ratio for the central route is the highest of three route alternatives, but it is only slightly higher than the one for the south route. The north route produces the lowest ratio. Since all three the ratios are above I.0, they all are economically feasible.

An incremental benefit-cost analysis can be used to compare routes. The north route costs $30.82 million more than the central route but has $37.37 million less benefits, giving a negative incremental benefit-cost ratio of -1.21. Similarly, the north route costs $1 million more than the south route but has $123.32 million less benefits, giving a benefit cost ratio of -123.32 for the north-south comparison. From a benefit-cost analysis viewpoint, the north route is clearly inferior to both the central route and the south route since it costs more but gives less benefits (savings in user costs).

The south route costs $29.97 million more than the central route and has $85.48 more benefits for an incremental benefit-cost ratio of 2.85. This indicates, from a user cost savings viewpoint, that the extra investment required for the south route would be justified from a user cost viewpoint if sufficient funds were available for this increment of investment.

Table C1. Characteristics of State Highway 199 Proposed Alternate Routes

CHARACTERISTIC	QUANTITY/DESCRIPTION BY ROUTE			
	EXISTING	CENTRAL	NORTH	SOUTH
Main lanes	4	8	8	8
Divided/undivided	div & und	divided	divided	divided
Frontage roads (lanes)	part-2	2	2	2
Access (direct/limited)	mixed	limited	limited	limited
Length in miles	6.31	6.21	7.11	6.00
Greatest distance from existing route	N/A	0.20	1.30	0.80
Distance to Fort Worth CBD	7.14	7.13	7.85	6.53
Current ADT (1992)	34,035	N/A	N/A	N/A
Projected ADT (2012)	54,692	70,028	70,594	71,278
Dominant abutting land use	Comm	comm	vacant	vacant
Business displacements	N/A	145	55	89
Residential displacements	N/A	143	98	282

Table C2. Problem Assumptions.

	CENTRAL	NORTH	SOUTH
Current Year	1992	1992	1992
Discount Rate (%)	8	8	8
Analysis Period	20	20	20
Type of Traffic Growth Rate	Constant	Constant	Constant
Car Value of Time per Person ($/hr)	8.58	8.58	8.58
Truck Value of Time per Person ($/hr)	20.39	20.39	20.39
Car Occupancy Rate	1.30	1.30	1.30
Truck Occupancy Rate	1.00	1.00	1.00
Percent Truck	10	10	10
Total Construction Cost	145,890,072	176,819,672	175,855,997
Year When Improvement Completed	1993	1993	1993
Operating Cost and Accident Cost Update Factor	1.00	1.00	1.00

Table C3. Estimated Construction, Right of Way and Relocation Costs of Each Route Alternative in 1992.[1]

TYPE OF COST	CENTRAL ROUTE	NORTH ROUTE	SOUTH ROUTE
Construction	115,200,000	148,900,000	136,900,000
Right of Way	27,878,476	26,095,676	34,988,000
Relocation	2,811,596	1,823,996	4,097,996
Total	145,890,072	176,819,672	175,855,997

[1]Estimates made by SDHPT District 2 personnel in 1991 and updated to 1992 based on a 6 % inflation rate. These costs represent the segment of existing or improved route between 0.45 mile east of FM 1886 and 0.06 mile east of SH 183.

Table C4. Route Assumptions, Central Route

	Existing	Proposed
Current Year Through ADT (Thous.)	26.56	35.05
20-year Forecasted Through ADT (Thous.)	42.69	63.30
Number of Route Segments	8	8

Table C5. Segment Assumptions, Central Route, Existing Conditions

	Route Segments							
	1	2	3	4	5	6	7	8
Description	surfside	hodgkins	azle	IH820	robert's	skyline	long ave	SH183
Number of Lanes	4	4	4	4	4	4	4	4
Length (miles)	1.01	1.23	0.20	1.40	0.27	0.98	0.80	0.36
Facility Type	Div	Div	Div	Div	Div	Div	Div	Div
Type of Inters/Interchg	Stop	Signal	Signal	Cloverlf	Signal	Signal	Signal	Signal
Major Rt. Current Add Local ADT (Thous.)	10.33	12.40	10.45	5.31	6.26	8.23	6.60	0.00
Major Rt. Forecast Add Local ADT (Thous.)	16.60	19.92	16.79	8.54	10.05	13.22	13.22	0.00
Minor Rt. Current ADT (Thous.)	0.76	1.89	2.00	43.39	4.84	2.70	5.76	9.50
Minor Rt. Forecast ADT (Thous.)	1.22	3.04	3.22	82.31	7.78	4.34	9.26	15.27
Minor Rt. No. of Lanes	2	2	2	6	2	2	4	4
Minor Rt. Facility Type	Undiv	Undiv	Undiv	Frwy	Undiv	Undiv	Div	Div

Table C6. Segment Assumptions, Central Route, Proposed Conditions

	Route Segments							
	1	2	3	4	5	6	7	8
Description	surfside	hodgkins	azle	IH820	robert's	skyline	long ave	SH183
Number of Lanes	8	8	8	8	8	8	8	6
Length (miles)	1.01	1.23	0.20	1.40	0.27	0.98	0.80	0.36
Facility Type	Frwy	Frwy	Frwy	Frwy	Frwy	Frwy	Frwy	Frwy
Type of Inters/Interchg	Dmnd	Dmnd	Dmnd	Dircnt	Dmnd	Dmnd	Dmnd	3 Dmnd
Major Rt. Current Add Local ADT (Thous.)	4.87	1.77	0.00	0.44	3.77	7.59	6.81	6.45
Major Rt. Forecast Add Local ADT (Thous.)	8.80	3.20	0.00	0.80	6.80	13.70	12.30	11.65
Minor Rt. Current ADT (Thous.)	0.76	1.89	2.00	43.39	4.84	2.70	5.76	9.50
Minor Rt. Forecast ADT (Thous.)	1.22	3.04	3.22	82.31	7.78	4.34	9.26	15.27
Minor Rt. No. of Lanes	2	2	2	6	2	2	4	4
Minor Rt. Facility Type	Undiv	Undiv	Undiv	Frwy	Undiv	Undiv	Div	Div

Table C7. Estimated Highway User Cost Savings by Route Alternative.[2]

TYPE OF SAVINGS BY YEAR	CENTRAL ROUTE	NORTH ROUTE	SOUTH ROUTE
	(Thousand $)		
Delay Savings			
Year 1	23,004.78	21,155.94	23,056.57
Year 20	25,395.13	25,654.61	32,993.40
20 Year Total	512,658.70	501,914.40	580,910.60
Operating Cost Savings			
Year 1	4,109.93	2,047.46	4,906.36
Year 20	2,455.74	1,630.62	3,375.25
20 Year Total	65,054.77	37,977.03	81,178.98
Accident Cost Savings			
Year 1	360.85	393.86	404.72
Year 20	144.37	159.17	212.15
20 Year Total	4,742.72	5,198.41	5,850.16
Total Cost Savings			
Year 1	27,475.56	23,597.27	28,367.65
Year 20	27,995.24	27,444.40	36,580.79
20 Year Total	582,456.30	545,089.90	667,940.10

[2]Based on data furnished by TTI's Arlington personnel and analyzed in the HEEM-III Highway Economic Evaluation Model by comparing user costs of the existing route with each route alternate from 0.45 miles east of FM 1886 and 0.06 miles east of SH 183.

Table C8. Benefit-Cost Ratio.

	CENTRAL ROUTE	NORTH ROUTE	SOUTH ROUTE
Total Discounted User Benefits (Mill $)	582.46	545.09	667.94
Discounted Construction Cost (Mill $)	145.89	176.81	175.86
Benefit-Cost Ratio	3.99	3.08	3.80

09/15/92 16:31

***** H E E M III *****
REVISED HIGHWAY ECONOMIC EVALUATION MODEL
VERSION 1.0

Texas Department of Transportation (TxDOT)

Revised by the Texas Transportation Institute,
Texas A&M University System
Dr. Jeffery L. Memmott, (409) 845-9939.

Problem Number 1 Central Route Alternative .

PROBLEM ASSUMPTIONS

1.	Problem Description:	Central Route Alternative .
2.	Current Year:	1992
3.	Problem Number:	1
4.	Area Type (1-Rural, 2-Urban):	2
5.	Const. Cat. (1-Bypass, 2-Add Cap, 3-Intchng, 4-RR Gr Sep):	2
6.	Percent Trucks:	10
7.	Alternate Parallel Route in Analysis (1-No, 2-Yes):	1
8.	Total Construction Cost (Millions of $):	145.89

ADDITIONAL PROBLEM ASSUMPTIONS

1.	Discount Rate (%):	8
2.	Analysis Period (Years):	20
3.	Type of Traffic Growth Rate (1-Const Grwth, 2-Strght Ln):	1
4.	Year when Improvement Completed:	1993
5.	Car Value of Time per Person ($/hr):	8.58
6.	Truck Value of Time per Person ($/hr):	20.39
7.	Car Occupancy Rate:	1.30
8.	Truck Occupancy Rate:	1.00
9.	Operating Cost and Accident Cost Update Factor:	1.00

HOURLY TRAFFIC DISTRIBUTION

Hour	% of ADT During Hour	Hour	% of ADT During Hour
0- 1	0.9	12-13	5.1
1- 2	0.5	13-14	5.3
2- 3	0.4	14-15	5.7
3- 4	0.3	15-16	7.1
4- 5	0.4	16-17	7.9
5- 6	1.8	17-18	7.6
6- 7	6.3	18-19	5.7
7- 8	7.7	19-20	4.4
8- 9	6.0	20-21	3.2
9-10	5.1	21-22	3.3
10-11	4.9	22-23	3.4
11-12	5.1	23-24	1.9

Problem Number 1 Central Route Alternative .
EXISTING Route exist current cond .

ROUTE DATA

1.	Route Description: exist current cond	.
2.	Current Year Through ADT without Improvement (Thous.):	26.56
3.	Forecasted Through ADT without Improvement (Thous.):	42.69
6.	Number of Route Segments:	8
7.	Year of Forecasted ADT:	2012

Problem Number 1 Central Route Alternative .
EXISTING Route exist current cond .
Segment 1 ex_surfside .

ROUTE SEGMENT DATA

1.	Segment Description: ex_surfside	.
2.	Total Number of Lanes, Major Route:	4
3.	Segment Length (miles):	1.01
4.	Major Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	2
5.	Type of Inters/Interchg, 1-None, 2-2 Way Stop, 3-4 Way Stop, 4-Signal, 5-Simple Diamond, 6-Cloverleaf, 7-3 Level Diamond, 8-Directional, 9-RR Grade Crossing, 10-RR Grade Separation:	2

OTHER TRAFFIC DATA

1.	Major Rt Current Yr Add Local ADT (Thous.):	10.33
2.	Major Rt Forecasted Add Local ADT (Thous.):	16.60
3.	Percent Trucks on Major Route:	10
4.	Free Flow Speed on Major Route (mph):	40
5.	Accident Adjustment Factor:	1.00
6.	Capacity per Lane on Major Route (vphpl):	545
7.	HOV Facility Switch, 0-No HOV, 1-Yes HOV:	0

OTHER INTERSECTION/INTERCHANGE DATA

1.	Percent Major Route ADT with Stop or Signal:	0
2.	Percent Minor Route ADT with Stop or Signal:	100
3.	Type of At-Grd Signl Inter, 1-none, 2-4X4, 3-4X6,4-6X6:	1
4.	Number of Intersections:	1
5.	Intersection Delay Adjustment Factor:	1.00

MINOR ROUTE DATA

1.	Current ADT, Minor Route (Thous.):	0.76
2.	Forecasted ADT, Minor Route (Thous.):	1.22
3.	Total Number of Lanes, Minor Route:	2
4.	Minor Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	1
5.	Percent Trucks on Minor Route:	10
6.	Free Flow Speed on Minor Route (mph):	35
7.	Capacity per Lane on Minor Route (vphpl):	545

PAVEMENT CONDITION MAINT/REHAB COST DATA

YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)	YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)
1992	3.20	44925	2006	3.20	44925
1993	3.20	44925	2007	3.20	44925
1994	3.20	44925	2008	3.20	44925
1995	3.20	44925	2009	3.20	44925
1996	3.20	44925	2010	3.20	44925
1997	3.20	44925	2011	3.20	44925
1998	3.20	44925	2012	3.20	44925
1999	3.20	44925			
2000	3.20	44925			
2001	3.20	44925			
2002	3.20	44925			
2003	3.20	44925			
2004	3.20	44925			
2005	3.20	44925			

Problem Number 1 Central Route Alternative .
EXISTING Route exist current cond .
Segment 2 ex_hodgkins .

ROUTE SEGMENT DATA

1.	Segment Description: ex_hodgkins	.
2.	Total Number of Lanes, Major Route:	4
3.	Segment Length (miles):	1.23
4.	Major Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	2
5.	Type of Inters/Interchg, 1-None, 2-2 Way Stop, 3-4 Way Stop, 4-Signal, 5-Simple Diamond, 6-Cloverleaf, 7-3 Level Diamond, 8-Directional, 9-RR Grade Crossing, 10-RR Grade Separation:	4

OTHER TRAFFIC DATA

1.	Major Rt Current Yr Add Local ADT (Thous.):	12.40
2.	Major Rt Forecasted Add Local ADT (Thous.):	19.92
3.	Percent Trucks on Major Route:	10
4.	Free Flow Speed on Major Route (mph):	40
5.	Accident Adjustment Factor:	1.00
6.	Capacity per Lane on Major Route (vphpl):	681
7.	HOV Facility Switch, 0-No HOV, 1-Yes HOV:	0

OTHER INTERSECTION/INTERCHANGE DATA

1.	Percent Major Route ADT with Stop or Signal:	100
2.	Percent Minor Route ADT with Stop or Signal:	100
3.	Type of At-Grd Signl Inter, 1-none, 2-4X4, 3-4X6,4-6X6:	2
4.	Number of Intersections:	1
5.	Intersection Delay Adjustment Factor:	1.00

MINOR ROUTE DATA

1.	Current ADT, Minor Route (Thous.):	1.89
2.	Forecasted ADT, Minor Route (Thous.):	3.04
3.	Total Number of Lanes, Minor Route:	2
4.	Minor Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	1
5.	Percent Trucks on Minor Route:	10
6.	Free Flow Speed on Minor Route (mph):	35
7.	Capacity per Lane on Minor Route (vphpl):	590

PAVEMENT CONDITION MAINT/REHAB COST DATA

YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)	YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)
1992	3.20	54710	2006	3.20	54710
1993	3.20	54710	2007	3.20	54710
1994	3.20	54710	2008	3.20	54710
1995	3.20	54710	2009	3.20	54710
1996	3.20	54710	2010	3.20	54710
1997	3.20	54710	2011	3.20	54710
1998	3.20	54710	2012	3.20	54710
1999	3.20	54710			
2000	3.20	54710			
2001	3.20	54710			
2002	3.20	54710			
2003	3.20	54710			
2004	3.20	54710			
2005	3.20	54710			

Problem Number 1 Central Route Alternative .
EXISTING Route exist current cond .
Segment 3 ex_azle .

ROUTE SEGMENT DATA

1.	Segment Description: ex_azle	.
2.	Total Number of Lanes, Major Route:	4
3.	Segment Length (miles):	0.20
4.	Major Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	2
5.	Type of Inters/Interchg, 1-None, 2-2 Way Stop, 3-4 Way Stop, 4-Signal, 5-Simple Diamond, 6-Cloverleaf, 7-3 Level Diamond, 8-Directional, 9-RR Grade Crossing, 10-RR Grade Separation:	4

OTHER TRAFFIC DATA

1.	Major Rt Current Yr Add Local ADT (Thous.):	10.45
2.	Major Rt Forecasted Add Local ADT (Thous.):	16.79
3.	Percent Trucks on Major Route:	10
4.	Free Flow Speed on Major Route (mph):	40
5.	Accident Adjustment Factor:	1.00
6.	Capacity per Lane on Major Route (vphpl):	681
7.	HOV Facility Switch, 0-No HOV, 1-Yes HOV:	0

OTHER INTERSECTION/INTERCHANGE DATA

1.	Percent Major Route ADT with Stop or Signal:	100
2.	Percent Minor Route ADT with Stop or Signal:	100
3.	Type of At-Grd Signl Inter, 1-none, 2-4X4, 3-4X6,4-6X6:	2
4.	Number of Intersections:	1
5.	Intersection Delay Adjustment Factor:	1.00

MINOR ROUTE DATA

1.	Current ADT, Minor Route (Thous.):	2.00
2.	Forecasted ADT, Minor Route (Thous.):	3.22
3.	Total Number of Lanes, Minor Route:	2
4.	Minor Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	1
5.	Percent Trucks on Minor Route:	10
6.	Free Flow Speed on Minor Route (mph):	35
7.	Capacity per Lane on Minor Route (vphpl):	590

PAVEMENT CONDITION MAINT/REHAB COST DATA

YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)	YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)
1992	3.20	8896	2006	3.20	8896
1993	3.20	8896	2007	3.20	8896
1994	3.20	8896	2008	3.20	8896
1995	3.20	8896	2009	3.20	8896
1996	3.20	8896	2010	3.20	8896
1997	3.20	8896	2011	3.20	8896
1998	3.20	8896	2012	3.20	8896
1999	3.20	8896			
2000	3.20	8896			
2001	3.20	8896			
2002	3.20	8896			
2003	3.20	8896			
2004	3.20	8896			
2005	3.20	8896			

Problem Number 1 Central Route Alternative .
EXISTING Route exist current cond .
Segment 4 ex_IH820 .

ROUTE SEGMENT DATA

1.	Segment Description:	ex_IH820 .
2.	Total Number of Lanes, Major Route:	4
3.	Segment Length (miles):	1.40
4.	Major Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	2
5.	Type of Inters/Interchg, 1-None, 2-2 Way Stop, 3-4 Way Stop, 4-Signal, 5-Simple Diamond, 6-Cloverleaf, 7-3 Level Diamond, 8-Directional, 9-RR Grade Crossing, 10-RR Grade Separation:	6

OTHER TRAFFIC DATA

1.	Major Rt Current Yr Add Local ADT (Thous.):	5.31
2.	Major Rt Forecasted Add Local ADT (Thous.):	8.54
3.	Percent Trucks on Major Route:	10
4.	Free Flow Speed on Major Route (mph):	40
5.	Accident Adjustment Factor:	1.00
6.	Capacity per Lane on Major Route (vphpl):	1636
7.	HOV Facility Switch, 0-No HOV, 1-Yes HOV:	0

OTHER INTERSECTION/INTERCHANGE DATA

1.	Percent Major Route ADT with Stop or Signal:	0
2.	Percent Minor Route ADT with Stop or Signal:	0
3.	Type of At-Grd Signl Inter, 1-none, 2-4X4, 3-4X6,4-6X6:	1
4.	Number of Intersections:	1
5.	Intersection Delay Adjustment Factor:	1.00

MINOR ROUTE DATA

1.	Current ADT, Minor Route (Thous.):	43.39
2.	Forecasted ADT, Minor Route (Thous.):	82.31
3.	Total Number of Lanes, Minor Route:	6
4.	Minor Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	3
5.	Percent Trucks on Minor Route:	10
6.	Free Flow Speed on Minor Route (mph):	60
7.	Capacity per Lane on Minor Route (vphpl):	1818

PAVEMENT CONDITION MAINT/REHAB COST DATA

YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)	YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)
1992	3.20	62272	2006	3.20	62272
1993	3.20	62272	2007	3.20	62272
1994	3.20	62272	2008	3.20	62272
1995	3.20	62272	2009	3.20	62272
1996	3.20	62272	2010	3.20	62272
1997	3.20	62272	2011	3.20	62272
1998	3.20	62272	2012	3.20	62272
1999	3.20	62272			
2000	3.20	62272			
2001	3.20	62272			
2002	3.20	62272			
2003	3.20	62272			
2004	3.20	62272			
2005	3.20	62272			

Problem Number 1 Central Route Alternative .
EXISTING Route exist current cond .
Segment 5 ex_robert's .

ROUTE SEGMENT DATA

1.	Segment Description: ex_robert's	.
2.	Total Number of Lanes, Major Route:	4
3.	Segment Length (miles):	0.27
4.	Major Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	2
5.	Type of Inters/Interchg, 1-None, 2-2 Way Stop, 3-4 Way Stop, 4-Signal, 5-Simple Diamond, 6-Cloverleaf, 7-3 Level Diamond, 8-Directional, 9-RR Grade Crossing, 10-RR Grade Separation:	4

OTHER TRAFFIC DATA

1.	Major Rt Current Yr Add Local ADT (Thous.):	6.26
2.	Major Rt Forecasted Add Local ADT (Thous.):	10.05
3.	Percent Trucks on Major Route:	10
4.	Free Flow Speed on Major Route (mph):	40
5.	Accident Adjustment Factor:	1.00
6.	Capacity per Lane on Major Route (vphpl):	681
7.	HOV Facility Switch, 0-No HOV, 1-Yes HOV:	0

OTHER INTERSECTION/INTERCHANGE DATA

1.	Percent Major Route ADT with Stop or Signal:	100
2.	Percent Minor Route ADT with Stop or Signal:	100
3.	Type of At-Grd Signl Inter, 1-none, 2-4X4, 3-4X6,4-6X6:	2
4.	Number of Intersections:	1
5.	Intersection Delay Adjustment Factor:	1.00

MINOR ROUTE DATA

1.	Current ADT, Minor Route (Thous.):	4.84
2.	Forecasted ADT, Minor Route (Thous.):	7.78
3.	Total Number of Lanes, Minor Route:	2
4.	Minor Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	1
5.	Percent Trucks on Minor Route:	10
6.	Free Flow Speed on Minor Route (mph):	35
7.	Capacity per Lane on Minor Route (vphpl):	590

PAVEMENT CONDITION MAINT/REHAB COST DATA

YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)	YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)
1992	3.20	12010	2006	3.20	12010
1993	3.20	12010	2007	3.20	12010
1994	3.20	12010	2008	3.20	12010
1995	3.20	12010	2009	3.20	12010
1996	3.20	12010	2010	3.20	12010
1997	3.20	12010	2011	3.20	12010
1998	3.20	12010	2012	3.20	12010
1999	3.20	12010			
2000	3.20	12010			
2001	3.20	12010			
2002	3.20	12010			
2003	3.20	12010			
2004	3.20	12010			
2005	3.20	12010			

Problem Number 1 Central Route Alternative .
EXISTING Route exist current cond .
Segment 6 ex_skyline .

ROUTE SEGMENT DATA

1.	Segment Description: ex_skyline	.
2.	Total Number of Lanes, Major Route:	4
3.	Segment Length (miles):	0.98
4.	Major Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	2
5.	Type of Inters/Interchg, 1-None, 2-2 Way Stop, 3-4 Way Stop, 4-Signal, 5-Simple Diamond, 6-Cloverleaf, 7-3 Level Diamond, 8-Directional, 9-RR Grade Crossing, 10-RR Grade Separation:	4

OTHER TRAFFIC DATA

1.	Major Rt Current Yr Add Local ADT (Thous.):	8.23
2.	Major Rt Forecasted Add Local ADT (Thous.):	13.22
3.	Percent Trucks on Major Route:	10
4.	Free Flow Speed on Major Route (mph):	40
5.	Accident Adjustment Factor:	1.00
6.	Capacity per Lane on Major Route (vphpl):	681
7.	HOV Facility Switch, 0-No HOV, 1-Yes HOV:	0

OTHER INTERSECTION/INTERCHANGE DATA

1.	Percent Major Route ADT with Stop or Signal:	100
2.	Percent Minor Route ADT with Stop or Signal:	100
3.	Type of At-Grd Signl Inter, 1-none, 2-4X4, 3-4X6,4-6X6:	2
4.	Number of Intersections:	1
5.	Intersection Delay Adjustment Factor:	1.00

MINOR ROUTE DATA

1.	Current ADT, Minor Route (Thous.):	2.70
2.	Forecasted ADT, Minor Route (Thous.):	4.34
3.	Total Number of Lanes, Minor Route:	2
4.	Minor Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	1
5.	Percent Trucks on Minor Route:	10
6.	Free Flow Speed on Minor Route (mph):	35
7.	Capacity per Lane on Minor Route (vphpl):	590

PAVEMENT CONDITION MAINT/REHAB COST DATA

YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)	YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)
1992	3.20	43590	2006	3.20	43590
1993	3.20	43590	2007	3.20	43590
1994	3.20	43590	2008	3.20	43590
1995	3.20	43590	2009	3.20	43590
1996	3.20	43590	2010	3.20	43590
1997	3.20	43590	2011	3.20	43590
1998	3.20	43590	2012	3.20	43590
1999	3.20	43590			
2000	3.20	43590			
2001	3.20	43590			
2002	3.20	43590			
2003	3.20	43590			
2004	3.20	43590			
2005	3.20	43590			

Problem Number 1 Central Route Alternative .
EXISTING Route exist current cond .
Segment 7 ex_long ave .

ROUTE SEGMENT DATA

1.	Segment Description: ex_long ave	.
2.	Total Number of Lanes, Major Route:	4
3.	Segment Length (miles):	0.80
4.	Major Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	2
5.	Type of Inters/Interchg, 1-None, 2-2 Way Stop, 3-4 Way Stop, 4-Signal, 5-Simple Diamond, 6-Cloverleaf, 7-3 Level Diamond, 8-Directional, 9-RR Grade Crossing, 10-RR Grade Separation:	4

OTHER TRAFFIC DATA

1.	Major Rt Current Yr Add Local ADT (Thous.):	6.60
2.	Major Rt Forecasted Add Local ADT (Thous.):	13.22
3.	Percent Trucks on Major Route:	10
4.	Free Flow Speed on Major Route (mph):	40
5.	Accident Adjustment Factor:	1.00
6.	Capacity per Lane on Major Route (vphpl):	681
7.	HOV Facility Switch, 0-No HOV, 1-Yes HOV:	0

OTHER INTERSECTION/INTERCHANGE DATA

1.	Percent Major Route ADT with Stop or Signal:	100
2.	Percent Minor Route ADT with Stop or Signal:	100
3.	Type of At-Grd Signl Inter, 1-none, 2-4X4, 3-4X6,4-6X6:	2
4.	Number of Intersections:	1
5.	Intersection Delay Adjustment Factor:	1.00

MINOR ROUTE DATA

1.	Current ADT, Minor Route (Thous.):	5.76
2.	Forecasted ADT, Minor Route (Thous.):	9.26
3.	Total Number of Lanes, Minor Route:	4
4.	Minor Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	2
5.	Percent Trucks on Minor Route:	10
6.	Free Flow Speed on Minor Route (mph):	40
7.	Capacity per Lane on Minor Route (vphpl):	681

PAVEMENT CONDITION MAINT/REHAB COST DATA

YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)	YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)
1992	3.20	35584	2006	3.20	35584
1993	3.20	35584	2007	3.20	35584
1994	3.20	35584	2008	3.20	35584
1995	3.20	35584	2009	3.20	35584
1996	3.20	35584	2010	3.20	35584
1997	3.20	35584	2011	3.20	35584
1998	3.20	35584	2012	3.20	35584
1999	3.20	35584			
2000	3.20	35584			
2001	3.20	35584			
2002	3.20	35584			
2003	3.20	35584			
2004	3.20	35584			
2005	3.20	35584			

Problem Number 1 Central Route Alternative .
EXISTING Route exist current cond .
Segment 8 ex_SH183 .

ROUTE SEGMENT DATA

1.	Segment Description: ex_SH183	.
2.	Total Number of Lanes, Major Route:	4
3.	Segment Length (miles):	0.36
4.	Major Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	2
5.	Type of Inters/Interchg, 1-None, 2-2 Way Stop, 3-4 Way Stop, 4-Signal, 5-Simple Diamond, 6-Cloverleaf, 7-3 Level Diamond, 8-Directional, 9-RR Grade Crossing, 10-RR Grade Separation:	4

OTHER TRAFFIC DATA

1.	Major Rt Current Yr Add Local ADT (Thous.):	0.00
2.	Major Rt Forecasted Add Local ADT (Thous.):	0.00
3.	Percent Trucks on Major Route:	10
4.	Free Flow Speed on Major Route (mph):	40
5.	Accident Adjustment Factor:	1.00
6.	Capacity per Lane on Major Route (vphpl):	681
7.	HOV Facility Switch, 0-No HOV, 1-Yes HOV:	0

OTHER INTERSECTION/INTERCHANGE DATA

1.	Percent Major Route ADT with Stop or Signal:	100
2.	Percent Minor Route ADT with Stop or Signal:	100
3.	Type of At-Grd Signl Inter, 1-none, 2-4X4, 3-4X6,4-6X6:	2
4.	Number of Intersections:	1
5.	Intersection Delay Adjustment Factor:	1.00

MINOR ROUTE DATA

1.	Current ADT, Minor Route (Thous.):	9.50
2.	Forecasted ADT, Minor Route (Thous.):	15.27
3.	Total Number of Lanes, Minor Route:	4
4.	Minor Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	2
5.	Percent Trucks on Minor Route:	10
6.	Free Flow Speed on Minor Route (mph):	40
7.	Capacity per Lane on Minor Route (vphpl):	681

PAVEMENT CONDITION MAINT/REHAB COST DATA

YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)	YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)
1992	3.20	16013	2006	3.20	16013
1993	3.20	16013	2007	3.20	16013
1994	3.20	16013	2008	3.20	16013
1995	3.20	16013	2009	3.20	16013
1996	3.20	16013	2010	3.20	16013
1997	3.20	16013	2011	3.20	16013
1998	3.20	16013	2012	3.20	16013
1999	3.20	16013			
2000	3.20	16013			
2001	3.20	16013			
2002	3.20	16013			
2003	3.20	16013			
2004	3.20	16013			
2005	3.20	16013			

Problem Number 1 Central Route Alternative .
PROPOSED Route proposed central route .

ROUTE DATA

1. Route Description: proposed central route .
4. Current Year Through ADT with Improvement (Thous.): 35.05
5. Forecasted Through ADT with Improvement (Thous.): 63.30
6. Number of Route Segments: 8
7. Year of Forecasted ADT: 2012

Problem Number 1 Central Route Alternative .
PROPOSED Route proposed central route .
Segment 1 prop_surfside .

ROUTE SEGMENT DATA

1.	Segment Description:	prop_surfside .
2.	Total Number of Lanes, Major Route:	8
3.	Segment Length (miles):	1.01
4.	Major Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	3
5.	Type of Inters/Interchg, 1-None, 2-2 Way Stop, 3-4 Way Stop, 4-Signal, 5-Simple Diamond, 6-Cloverleaf, 7-3 Level Diamond, 8-Directional, 9-RR Grade Crossing, 10-RR Grade Separation:	5

OTHER TRAFFIC DATA

1.	Major Rt Current Yr Add Local ADT (Thous.):	4.87
2.	Major Rt Forecasted Add Local ADT (Thous.):	8.80
3.	Percent Trucks on Major Route:	10
4.	Free Flow Speed on Major Route (mph):	60
5.	Accident Adjustment Factor:	1.00
6.	Capacity per Lane on Major Route (vphpl):	1818
7.	HOV Facility Switch, 0-No HOV, 1-Yes HOV:	0

OTHER INTERSECTION/INTERCHANGE DATA

1.	Percent Major Route ADT with Stop or Signal:	7
2.	Percent Minor Route ADT with Stop or Signal:	100
3.	Type of At-Grd Signl Inter, 1-none, 2-4X4, 3-4X6,4-6X6:	2
4.	Number of Intersections:	1
5.	Intersection Delay Adjustment Factor:	1.00

MINOR ROUTE DATA

1.	Current ADT, Minor Route (Thous.):	0.76
2.	Forecasted ADT, Minor Route (Thous.):	1.22
3.	Total Number of Lanes, Minor Route:	2
4.	Minor Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	1
5.	Percent Trucks on Minor Route:	10
6.	Free Flow Speed on Minor Route (mph):	35
7.	Capacity per Lane on Minor Route (vphpl):	545

PAVEMENT CONDITION MAINT/REHAB COST DATA

YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)	YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)
			2006	3.50	101727
1993	3.50	101727	2007	3.50	101727
1994	3.50	101727	2008	3.50	101727
1995	3.50	101727	2009	3.50	101727
1996	3.50	101727	2010	3.50	101727
1997	3.50	101727	2011	3.50	101727
1998	3.50	101727	2012	3.50	101727
1999	3.50	101727			
2000	3.50	101727			
2001	3.50	101727			
2002	3.50	101727			
2003	3.50	101727			
2004	3.50	101727			
2005	3.50	101727			

Problem Number 1 Central Route Alternative .
PROPOSED Route proposed central route .
Segment 2 prop_hodgkins .

ROUTE SEGMENT DATA

1.	Segment Description:	prop_hodgkins .
2.	Total Number of Lanes, Major Route:	8
3.	Segment Length (miles):	1.23
4.	Major Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	3
5.	Type of Inters/Interchg, 1-None, 2-2 Way Stop, 3-4 Way Stop, 4-Signal, 5-Simple Diamond, 6-Cloverleaf, 7-3 Level Diamond, 8-Directional, 9-RR Grade Crossing, 10-RR Grade Separation:	5

OTHER TRAFFIC DATA

1.	Major Rt Current Yr Add Local ADT (Thous.):	1.77
2.	Major Rt Forecasted Add Local ADT (Thous.):	3.20
3.	Percent Trucks on Major Route:	10
4.	Free Flow Speed on Major Route (mph):	60
5.	Accident Adjustment Factor:	1.00
6.	Capacity per Lane on Major Route (vphpl):	1818
7.	HOV Facility Switch, 0-No HOV, 1-Yes HOV:	0

OTHER INTERSECTION/INTERCHANGE DATA

1.	Percent Major Route ADT with Stop or Signal:	7
2.	Percent Minor Route ADT with Stop or Signal:	100
3.	Type of At-Grd Signl Inter, 1-none, 2-4X4, 3-4X6,4-6X6:	2
4.	Number of Intersections:	1
5.	Intersection Delay Adjustment Factor:	1.00

MINOR ROUTE DATA

1.	Current ADT, Minor Route (Thous.):	1.89
2.	Forecasted ADT, Minor Route (Thous.):	3.04
3.	Total Number of Lanes, Minor Route:	2
4.	Minor Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	1
5.	Percent Trucks on Minor Route:	10
6.	Free Flow Speed on Minor Route (mph):	35
7.	Capacity per Lane on Minor Route (vphpl):	590

PAVEMENT CONDITION MAINT/REHAB COST DATA

YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)	YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)
			2006	3.50	123886
1993	3.50	123886	2007	3.50	123886
1994	3.50	123886	2008	3.50	123886
1995	3.50	123886	2009	3.50	123886
1996	3.50	123886	2010	3.50	123886
1997	3.50	123886	2011	3.50	123886
1998	3.50	123886	2012	3.50	123886
1999	3.50	123886			
2000	3.50	123886			
2001	3.50	123886			
2002	3.50	123886			
2003	3.50	123886			
2004	3.50	123886			
2005	3.50	123886			

Problem Number 1 Central Route Alternative .
PROPOSED Route proposed central route .
Segment 3 prop_azle .

ROUTE SEGMENT DATA

1.	Segment Description: prop_azle	.
2.	Total Number of Lanes, Major Route:	8
3.	Segment Length (miles):	0.20
4.	Major Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	3
5.	Type of Inters/Interchg, 1-None, 2-2 Way Stop, 3-4 Way Stop, 4-Signal, 5-Simple Diamond, 6-Cloverleaf, 7-3 Level Diamond, 8-Directional, 9-RR Grade Crossing, 10-RR Grade Separation:	5

OTHER TRAFFIC DATA

1.	Major Rt Current Yr Add Local ADT (Thous.):	0.00
2.	Major Rt Forecasted Add Local ADT (Thous.):	0.00
3.	Percent Trucks on Major Route:	10
4.	Free Flow Speed on Major Route (mph):	60
5.	Accident Adjustment Factor:	1.00
6.	Capacity per Lane on Major Route (vphpl):	1818
7.	HOV Facility Switch, 0-No HOV, 1-Yes HOV:	0

OTHER INTERSECTION/INTERCHANGE DATA

1.	Percent Major Route ADT with Stop or Signal:	5
2.	Percent Minor Route ADT with Stop or Signal:	100
3.	Type of At-Grd Signl Inter, 1-none, 2-4X4, 3-4X6,4-6X6:	2
4.	Number of Intersections:	1
5.	Intersection Delay Adjustment Factor:	1.00

MINOR ROUTE DATA

1.	Current ADT, Minor Route (Thous.):	2.00
2.	Forecasted ADT, Minor Route (Thous.):	3.22
3.	Total Number of Lanes, Minor Route:	2
4.	Minor Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	1
5.	Percent Trucks on Minor Route:	10
6.	Free Flow Speed on Minor Route (mph):	35
7.	Capacity per Lane on Minor Route (vphpl):	590

PAVEMENT CONDITION MAINT/REHAB COST DATA

YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)	YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)
			2006	3.50	20144
1993	3.50	20144	2007	3.50	20144
1994	3.50	20144	2008	3.50	20144
1995	3.50	20144	2009	3.50	20144
1996	3.50	20144	2010	3.50	20144
1997	3.50	20144	2011	3.50	20144
1998	3.50	20144	2012	3.50	20144
1999	3.50	20144			
2000	3.50	20144			
2001	3.50	20144			
2002	3.50	20144			
2003	3.50	20144			
2004	3.50	20144			
2005	3.50	20144			

Problem Number 1 Central Route Alternative .
PROPOSED Route proposed central route .
Segment 4 prop_IH820 .

ROUTE SEGMENT DATA

1.	Segment Description:	prop_IH820 .
2.	Total Number of Lanes, Major Route:	8
3.	Segment Length (miles):	1.36
4.	Major Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	3
5.	Type of Inters/Interchg, 1-None, 2-2 Way Stop, 3-4 Way Stop, 4-Signal, 5-Simple Diamond, 6-Cloverleaf, 7-3 Level Diamond, 8-Directional, 9-RR Grade Crossing, 10-RR Grade Separation:	8

OTHER TRAFFIC DATA

1.	Major Rt Current Yr Add Local ADT (Thous.):	0.44
2.	Major Rt Forecasted Add Local ADT (Thous.):	0.80
3.	Percent Trucks on Major Route:	10
4.	Free Flow Speed on Major Route (mph):	60
5.	Accident Adjustment Factor:	1.00
6.	Capacity per Lane on Major Route (vphpl):	1818
7.	HOV Facility Switch, 0-No HOV, 1-Yes HOV:	0

OTHER INTERSECTION/INTERCHANGE DATA

1.	Percent Major Route ADT with Stop or Signal:	0
2.	Percent Minor Route ADT with Stop or Signal:	0
3.	Type of At-Grd Signl Inter, 1-none, 2-4X4, 3-4X6,4-6X6:	1
4.	Number of Intersections:	1
5.	Intersection Delay Adjustment Factor:	1.00

MINOR ROUTE DATA

1.	Current ADT, Minor Route (Thous.):	43.39
2.	Forecasted ADT, Minor Route (Thous.):	82.31
3.	Total Number of Lanes, Minor Route:	6
4.	Minor Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	3
5.	Percent Trucks on Minor Route:	10
6.	Free Flow Speed on Minor Route (mph):	60
7.	Capacity per Lane on Minor Route (vphpl):	1818

PAVEMENT CONDITION MAINT/REHAB COST DATA

YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)	YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)
			2006	3.50	136979
1993	3.50	136979	2007	3.50	136979
1994	3.50	136979	2008	3.50	136979
1995	3.50	136979	2009	3.50	136979
1996	3.50	136979	2010	3.50	136979
1997	3.50	136979	2011	3.50	136979
1998	3.50	136979	2012	3.50	136979
1999	3.50	136979			
2000	3.50	136979			
2001	3.50	136979			
2002	3.50	136979			
2003	3.50	136979			
2004	3.50	136979			
2005	3.50	136979			

Problem Number 1 Central Route Alternative .
PROPOSED Route proposed central route .
Segment 5 prop_IH 820 .

ROUTE SEGMENT DATA

1.	Segment Description: prop_IH 820	.
2.	Total Number of Lanes, Major Route:	8
3.	Segment Length (miles):	0.27
4.	Major Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	3
5.	Type of Inters/Interchg, 1-None, 2-2 Way Stop, 3-4 Way Stop, 4-Signal, 5-Simple Diamond, 6-Cloverleaf, 7-3 Level Diamond, 8-Directional, 9-RR Grade Crossing, 10-RR Grade Separation:	5

OTHER TRAFFIC DATA

1.	Major Rt Current Yr Add Local ADT (Thous.):	3.77
2.	Major Rt Forecasted Add Local ADT (Thous.):	6.80
3.	Percent Trucks on Major Route:	10
4.	Free Flow Speed on Major Route (mph):	60
5.	Accident Adjustment Factor:	1.00
6.	Capacity per Lane on Major Route (vphpl):	1818
7.	HOV Facility Switch, 0-No HOV, 1-Yes HOV:	0

OTHER INTERSECTION/INTERCHANGE DATA

1.	Percent Major Route ADT with Stop or Signal:	26
2.	Percent Minor Route ADT with Stop or Signal:	100
3.	Type of At-Grd Signl Inter, 1-none, 2-4X4, 3-4X6,4-6X6:	2
4.	Number of Intersections:	1
5.	Intersection Delay Adjustment Factor:	1.00

MINOR ROUTE DATA

1.	Current ADT, Minor Route (Thous.):	4.84
2.	Forecasted ADT, Minor Route (Thous.):	7.78
3.	Total Number of Lanes, Minor Route:	2
4.	Minor Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	1
5.	Percent Trucks on Minor Route:	10
6.	Free Flow Speed on Minor Route (mph):	35
7.	Capacity per Lane on Minor Route (vphpl):	590

PAVEMENT CONDITION MAINT/REHAB COST DATA

YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)	YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)
			2006	3.50	27194
1993	3.50	27194	2007	3.50	27194
1994	3.50	27194	2008	3.50	27194
1995	3.50	27194	2009	3.50	27194
1996	3.50	27194	2010	3.50	27194
1997	3.50	27194	2011	3.50	27194
1998	3.50	27194	2012	3.50	27194
1999	3.50	27194			
2000	3.50	27194			
2001	3.50	27194			
2002	3.50	27194			
2003	3.50	27194			
2004	3.50	27194			
2005	3.50	27194			

Problem Number 1 Central Route Alternative .
PROPOSED Route proposed central route .
Segment 6 prop_robert's .

ROUTE SEGMENT DATA

1.	Segment Description:	prop_robert's .
2.	Total Number of Lanes, Major Route:	8
3.	Segment Length (miles):	0.98
4.	Major Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	3
5.	Type of Inters/Interchg, 1-None, 2-2 Way Stop, 3-4 Way Stop, 4-Signal, 5-Simple Diamond, 6-Cloverleaf, 7-3 Level Diamond, 8-Directional, 9-RR Grade Crossing, 10-RR Grade Separation:	5

OTHER TRAFFIC DATA

1.	Major Rt Current Yr Add Local ADT (Thous.):	7.59
2.	Major Rt Forecasted Add Local ADT (Thous.):	13.70
3.	Percent Trucks on Major Route:	10
4.	Free Flow Speed on Major Route (mph):	60
5.	Accident Adjustment Factor:	1.00
6.	Capacity per Lane on Major Route (vphpl):	1818
7.	HOV Facility Switch, 0-No HOV, 1-Yes HOV:	0

OTHER INTERSECTION/INTERCHANGE DATA

1.	Percent Major Route ADT with Stop or Signal:	9
2.	Percent Minor Route ADT with Stop or Signal:	100
3.	Type of At-Grd Signl Inter, 1-none, 2-4X4, 3-4X6,4-6X6:	2
4.	Number of Intersections:	1
5.	Intersection Delay Adjustment Factor:	1.00

MINOR ROUTE DATA

1.	Current ADT, Minor Route (Thous.):	2.70
2.	Forecasted ADT, Minor Route (Thous.):	4.34
3.	Total Number of Lanes, Minor Route:	2
4.	Minor Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	1
5.	Percent Trucks on Minor Route:	10
6.	Free Flow Speed on Minor Route (mph):	35
7.	Capacity per Lane on Minor Route (vphpl):	590

PAVEMENT CONDITION MAINT/REHAB COST DATA

YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)	YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)
			2006	3.50	98706
1993	3.50	98706	2007	3.50	98706
1994	3.50	98706	2008	3.50	98706
1995	3.50	98706	2009	3.50	98706
1996	3.50	98706	2010	3.50	98706
1997	3.50	98706	2011	3.50	98706
1998	3.50	98706	2012	3.50	98706
1999	3.50	98706			
2000	3.50	98706			
2001	3.50	98706			
2002	3.50	98706			
2003	3.50	98706			
2004	3.50	98706			
2005	3.50	98706			

Problem Number 1 Central Route Alternative .
PROPOSED Route proposed central route .
Segment 7 prop_skyline .

ROUTE SEGMENT DATA

1.	Segment Description:	prop_skyline .
2.	Total Number of Lanes, Major Route:	8
3.	Segment Length (miles):	0.80
4.	Major Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	3
5.	Type of Inters/Interchg, 1-None, 2-2 Way Stop, 3-4 Way Stop, 4-Signal, 5-Simple Diamond, 6-Cloverleaf, 7-3 Level Diamond, 8-Directional, 9-RR Grade Crossing, 10-RR Grade Separation:	5

OTHER TRAFFIC DATA

1.	Major Rt Current Yr Add Local ADT (Thous.):	6.81
2.	Major Rt Forecasted Add Local ADT (Thous.):	12.30
3.	Percent Trucks on Major Route:	10
4.	Free Flow Speed on Major Route (mph):	60
5.	Accident Adjustment Factor:	1.00
6.	Capacity per Lane on Major Route (vphpl):	1818
7.	HOV Facility Switch, 0-No HOV, 1-Yes HOV:	0

OTHER INTERSECTION/INTERCHANGE DATA

1.	Percent Major Route ADT with Stop or Signal:	20
2.	Percent Minor Route ADT with Stop or Signal:	100
3.	Type of At-Grd Signl Inter, 1-none, 2-4X4, 3-4X6,4-6X6:	2
4.	Number of Intersections:	1
5.	Intersection Delay Adjustment Factor:	1.00

MINOR ROUTE DATA

1.	Current ADT, Minor Route (Thous.):	2.70
2.	Forecasted ADT, Minor Route (Thous.):	4.34
3.	Total Number of Lanes, Minor Route:	4
4.	Minor Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	2
5.	Percent Trucks on Minor Route:	10
6.	Free Flow Speed on Minor Route (mph):	40
7.	Capacity per Lane on Minor Route (vphpl):	681

PAVEMENT CONDITION MAINT/REHAB COST DATA

YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)	YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)
			2006	3.50	80576
1993	3.50	80576	2007	3.50	80576
1994	3.50	80576	2008	3.50	80576
1995	3.50	80576	2009	3.50	80576
1996	3.50	80576	2010	3.50	80576
1997	3.50	80576	2011	3.50	80576
1998	3.50	80576	2012	3.50	80576
1999	3.50	80576			
2000	3.50	80576			
2001	3.50	80576			
2002	3.50	80576			
2003	3.50	80576			
2004	3.50	80576			
2005	3.50	80576			

Problem Number 1 Central Route Alternative .
PROPOSED Route proposed central route .
Segment 8 prop_SH183 .

ROUTE SEGMENT DATA

1.	Segment Description:	prop_SH183 .
2.	Total Number of Lanes, Major Route:	6
3.	Segment Length (miles):	0.36
4.	Major Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	3
5.	Type of Inters/Interchg, 1-None, 2-2 Way Stop, 3-4 Way Stop, 4-Signal, 5-Simple Diamond, 6-Cloverleaf, 7-3 Level Diamond, 8-Directional, 9-RR Grade Crossing, 10-RR Grade Separation:	7

OTHER TRAFFIC DATA

1.	Major Rt Current Yr Add Local ADT (Thous.):	6.45
2.	Major Rt Forecasted Add Local ADT (Thous.):	11.65
3.	Percent Trucks on Major Route:	10
4.	Free Flow Speed on Major Route (mph):	60
5.	Accident Adjustment Factor:	1.00
6.	Capacity per Lane on Major Route (vphpl):	1818
7.	HOV Facility Switch, 0-No HOV, 1-Yes HOV:	0

OTHER INTERSECTION/INTERCHANGE DATA

1.	Percent Major Route ADT with Stop or Signal:	21
2.	Percent Minor Route ADT with Stop or Signal:	26
3.	Type of At-Grd Signl Inter, 1-none, 2-4X4, 3-4X6,4-6X6:	2
4.	Number of Intersections:	1
5.	Intersection Delay Adjustment Factor:	1.00

MINOR ROUTE DATA

1.	Current ADT, Minor Route (Thous.):	9.50
2.	Forecasted ADT, Minor Route (Thous.):	15.27
3.	Total Number of Lanes, Minor Route:	4
4.	Minor Route Facility Type, 1-Undiv, 2-Div, 3-Frwy:	2
5.	Percent Trucks on Minor Route:	10
6.	Free Flow Speed on Minor Route (mph):	40
7.	Capacity per Lane on Minor Route (vphpl):	681

PAVEMENT CONDITION MAINT/REHAB COST DATA

YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)	YEAR	PVMT COND (PSI)	MAINT/ REHAB COST ($)
			2006	3.50	27194
1993	3.50	27194	2007	3.50	27194
1994	3.50	27194	2008	3.50	27194
1995	3.50	27194	2009	3.50	27194
1996	3.50	27194	2010	3.50	27194
1997	3.50	27194	2011	3.50	27194
1998	3.50	27194	2012	3.50	27194
1999	3.50	27194			
2000	3.50	27194			
2001	3.50	27194			
2002	3.50	27194			
2003	3.50	27194			
2004	3.50	27194			
2005	3.50	27194			

Problem Number 1 Central Route Alternative .

Daily Through Traffic (Thous.)

Year	WITHOUT Improvement Existing	Alternate	Proposed	WITH Improvment Existing	Alternate	Proposed
1992	26.56	0.00	0.00	0.00	0.00	35.05
1993	27.20	0.00	0.00	0.00	0.00	36.10
1994	27.85	0.00	0.00	0.00	0.00	37.18
1995	28.52	0.00	0.00	0.00	0.00	38.30
1996	29.20	0.00	0.00	0.00	0.00	39.45
1997	29.91	0.00	0.00	0.00	0.00	40.63
1998	30.62	0.00	0.00	0.00	0.00	41.85
1999	31.36	0.00	0.00	0.00	0.00	43.11
2000	32.11	0.00	0.00	0.00	0.00	44.40
2001	32.88	0.00	0.00	0.00	0.00	45.73
2002	33.67	0.00	0.00	0.00	0.00	47.10
2003	34.48	0.00	0.00	0.00	0.00	48.52
2004	35.31	0.00	0.00	0.00	0.00	49.97
2005	36.16	0.00	0.00	0.00	0.00	51.47
2006	37.03	0.00	0.00	0.00	0.00	53.01
2007	37.91	0.00	0.00	0.00	0.00	54.60
2008	38.82	0.00	0.00	0.00	0.00	56.24
2009	39.76	0.00	0.00	0.00	0.00	57.93
2010	40.71	0.00	0.00	0.00	0.00	59.67
2011	41.69	0.00	0.00	0.00	0.00	61.46
2012	42.69	0.00	0.00	0.00	0.00	63.30

Problem Number 1 Central Route Alternative .
EXISTING Route exist current cond .
Segment 1 ex_surfside .

WITHOUT Improvement

Year	Major Route			HOV Facility			Combined Total		Minor Route
	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)
1992	22.90	36.89	46.85	0.00	0.00	0.00	36.89	46.85	0.76
1993	22.22	37.78	47.98	0.00	0.00	0.00	37.78	47.98	0.78
1994	21.10	38.68	49.13	0.00	0.00	0.00	38.68	49.13	0.80
1995	20.43	39.61	50.31	0.00	0.00	0.00	39.61	50.31	0.82
1996	19.80	40.56	51.51	0.00	0.00	0.00	40.56	51.51	0.84
1997	18.95	41.54	52.75	0.00	0.00	0.00	41.54	52.75	0.86
1998	18.16	42.53	54.02	0.00	0.00	0.00	42.53	54.02	0.88
1999	16.94	43.55	55.31	0.00	0.00	0.00	43.55	55.31	0.90
2000	16.24	44.60	56.64	0.00	0.00	0.00	44.60	56.64	0.92
2001	15.73	45.67	58.00	0.00	0.00	0.00	45.67	58.00	0.94
2002	15.33	46.77	59.39	0.00	0.00	0.00	46.77	59.39	0.96
2003	15.00	47.89	60.82	0.00	0.00	0.00	47.89	60.82	0.99
2004	14.73	49.04	62.28	0.00	0.00	0.00	49.04	62.28	1.01
2005	14.36	50.22	63.78	0.00	0.00	0.00	50.22	63.78	1.03
2006	14.21	51.42	65.31	0.00	0.00	0.00	51.42	65.31	1.06
2007	14.09	52.66	66.88	0.00	0.00	0.00	52.66	66.88	1.08
2008	13.98	53.92	68.48	0.00	0.00	0.00	53.92	68.48	1.11
2009	13.87	55.22	70.13	0.00	0.00	0.00	55.22	70.13	1.14
2010	13.77	56.54	71.81	0.00	0.00	0.00	56.54	71.81	1.16
2011	13.69	57.90	73.53	0.00	0.00	0.00	57.90	73.53	1.19
2012	13.61	59.29	75.30	0.00	0.00	0.00	59.29	75.30	1.22

Problem Number 1 Central Route Alternative .
EXISTING Route exist current cond .
Segment 2 ex_hodgkins .

WITHOUT Improvement

Year	Major Route			HOV Facility			Combined Total		Minor Route
	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)
1992	27.28	38.96	49.48	0.00	0.00	0.00	38.96	49.48	1.89
1993	26.67	39.90	50.67	0.00	0.00	0.00	39.90	50.67	1.94
1994	26.17	40.85	51.88	0.00	0.00	0.00	40.85	51.88	1.98
1995	25.70	41.83	53.13	0.00	0.00	0.00	41.83	53.13	2.03
1996	25.16	42.84	54.40	0.00	0.00	0.00	42.84	54.40	2.08
1997	24.37	43.87	55.71	0.00	0.00	0.00	43.87	55.71	2.13
1998	23.79	44.92	57.05	0.00	0.00	0.00	44.92	57.05	2.18
1999	22.96	46.00	58.42	0.00	0.00	0.00	46.00	58.42	2.23
2000	22.29	47.10	59.82	0.00	0.00	0.00	47.10	59.82	2.29
2001	21.18	48.23	61.25	0.00	0.00	0.00	48.23	61.25	2.34
2002	20.48	49.39	62.72	0.00	0.00	0.00	49.39	62.72	2.40
2003	19.86	50.57	64.23	0.00	0.00	0.00	50.57	64.23	2.45
2004	19.01	51.79	65.77	0.00	0.00	0.00	51.79	65.77	2.51
2005	18.25	53.03	67.35	0.00	0.00	0.00	53.03	67.35	2.57
2006	17.00	54.30	68.97	0.00	0.00	0.00	54.30	68.97	2.64
2007	16.32	55.61	70.62	0.00	0.00	0.00	55.61	70.62	2.70
2008	15.77	56.94	72.32	0.00	0.00	0.00	56.94	72.32	2.76
2009	15.36	58.31	74.05	0.00	0.00	0.00	58.31	74.05	2.83
2010	15.03	59.71	75.83	0.00	0.00	0.00	59.71	75.83	2.90
2011	14.75	61.14	77.65	0.00	0.00	0.00	61.14	77.65	2.97
2012	14.38	62.61	79.51	0.00	0.00	0.00	62.61	79.51	3.04

Problem Number 1 Central Route Alternative .
EXISTING Route exist current cond .
Segment 3 ex_azle .

WITHOUT Improvement

Year	Major Route			HOV Facility			Combined Total		Minor Route
	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)
1992	29.08	37.01	47.00	0.00	0.00	0.00	37.01	47.00	2.00
1993	28.37	37.90	48.13	0.00	0.00	0.00	37.90	48.13	2.05
1994	27.40	38.81	49.29	0.00	0.00	0.00	38.81	49.29	2.10
1995	26.77	39.74	50.47	0.00	0.00	0.00	39.74	50.47	2.15
1996	26.24	40.69	51.68	0.00	0.00	0.00	40.69	51.68	2.20
1997	25.78	41.67	52.92	0.00	0.00	0.00	41.67	52.92	2.25
1998	25.26	42.67	54.19	0.00	0.00	0.00	42.67	54.19	2.31
1999	24.47	43.70	55.49	0.00	0.00	0.00	43.70	55.49	2.36
2000	23.89	44.74	56.83	0.00	0.00	0.00	44.74	56.83	2.42
2001	23.07	45.82	58.19	0.00	0.00	0.00	45.82	58.19	2.48
2002	22.41	46.92	59.59	0.00	0.00	0.00	46.92	59.59	2.54
2003	21.32	48.04	61.02	0.00	0.00	0.00	48.04	61.02	2.60
2004	20.58	49.20	62.48	0.00	0.00	0.00	49.20	62.48	2.66
2005	19.96	50.38	63.98	0.00	0.00	0.00	50.38	63.98	2.73
2006	19.14	51.59	65.52	0.00	0.00	0.00	51.59	65.52	2.79
2007	18.40	52.83	67.09	0.00	0.00	0.00	52.83	67.09	2.86
2008	17.11	54.10	68.70	0.00	0.00	0.00	54.10	68.70	2.93
2009	16.49	55.39	70.35	0.00	0.00	0.00	55.39	70.35	3.00
2010	15.84	56.72	72.04	0.00	0.00	0.00	56.72	72.04	3.07
2011	15.42	58.09	73.77	0.00	0.00	0.00	58.09	73.77	3.14
2012	15.08	59.48	75.54	0.00	0.00	0.00	59.48	75.54	3.22

Problem Number 1 Central Route Alternative .
EXISTING Route exist current cond .
Segment 4 ex_IH820 .

WITHOUT Improvement

Year	Major Route Aver. Speed (mph)	Major Route Num. Veh. (000)	Major Route Num. Pers. (000)	HOV Facility Aver. Speed (mph)	HOV Facility Num. Veh. (000)	HOV Facility Num. Pers. (000)	Combined Total Num. Veh. (000)	Combined Total Num. Pers. (000)	Minor Route Num. Veh. (000)
1992	39.16	31.87	40.47	0.00	0.00	0.00	31.87	40.47	43.39
1993	39.12	32.64	41.45	0.00	0.00	0.00	32.64	41.45	44.80
1994	39.07	33.42	42.44	0.00	0.00	0.00	33.42	42.44	46.26
1995	39.02	34.22	43.46	0.00	0.00	0.00	34.22	43.46	47.76
1996	38.98	35.04	44.51	0.00	0.00	0.00	35.04	44.51	49.32
1997	38.92	35.89	45.57	0.00	0.00	0.00	35.89	45.57	50.92
1998	38.87	36.75	46.67	0.00	0.00	0.00	36.75	46.67	52.58
1999	38.81	37.63	47.79	0.00	0.00	0.00	37.63	47.79	54.29
2000	38.75	38.53	48.94	0.00	0.00	0.00	38.53	48.94	56.06
2001	38.69	39.46	50.11	0.00	0.00	0.00	39.46	50.11	57.88
2002	38.62	40.41	51.32	0.00	0.00	0.00	40.41	51.32	59.76
2003	38.55	41.38	52.55	0.00	0.00	0.00	41.38	52.55	61.71
2004	38.48	42.37	53.81	0.00	0.00	0.00	42.37	53.81	63.71
2005	38.40	43.39	55.10	0.00	0.00	0.00	43.39	55.10	65.79
2006	38.32	44.43	56.43	0.00	0.00	0.00	44.43	56.43	67.93
2007	38.23	45.50	57.78	0.00	0.00	0.00	45.50	57.78	70.14
2008	38.14	46.59	59.17	0.00	0.00	0.00	46.59	59.17	72.42
2009	38.04	47.71	60.59	0.00	0.00	0.00	47.71	60.59	74.77
2010	37.94	48.86	62.05	0.00	0.00	0.00	48.86	62.05	77.21
2011	37.83	50.03	63.54	0.00	0.00	0.00	50.03	63.54	79.72
2012	37.71	51.23	65.06	0.00	0.00	0.00	51.23	65.06	82.31

Problem Number 1 Central Route Alternative .
EXISTING Route exist current cond .
Segment 5 ex_robert's .

WITHOUT Improvement

Year	Major Route			HOV Facility			Combined Total		Minor Route
	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)
1992	33.52	32.82	41.68	0.00	0.00	0.00	32.82	41.68	4.84
1993	32.99	33.61	42.68	0.00	0.00	0.00	33.61	42.68	4.96
1994	32.28	34.41	43.71	0.00	0.00	0.00	34.41	43.71	5.08
1995	31.23	35.24	44.76	0.00	0.00	0.00	35.24	44.76	5.20
1996	29.91	36.09	45.83	0.00	0.00	0.00	36.09	45.83	5.32
1997	29.13	36.95	46.93	0.00	0.00	0.00	36.95	46.93	5.45
1998	28.42	37.84	48.06	0.00	0.00	0.00	37.84	48.06	5.58
1999	27.45	38.75	49.21	0.00	0.00	0.00	38.75	49.21	5.71
2000	26.81	39.68	50.39	0.00	0.00	0.00	39.68	50.39	5.85
2001	26.27	40.63	51.60	0.00	0.00	0.00	40.63	51.60	5.99
2002	25.81	41.60	52.84	0.00	0.00	0.00	41.60	52.84	6.14
2003	25.30	42.60	54.11	0.00	0.00	0.00	42.60	54.11	6.28
2004	24.51	43.63	55.40	0.00	0.00	0.00	43.63	55.40	6.43
2005	23.93	44.67	56.73	0.00	0.00	0.00	44.67	56.73	6.59
2006	23.12	45.74	58.10	0.00	0.00	0.00	45.74	58.10	6.75
2007	22.46	46.84	59.49	0.00	0.00	0.00	46.84	59.49	6.91
2008	21.39	47.97	60.92	0.00	0.00	0.00	47.97	60.92	7.08
2009	20.62	49.12	62.38	0.00	0.00	0.00	49.12	62.38	7.25
2010	20.01	50.30	63.88	0.00	0.00	0.00	50.30	63.88	7.42
2011	19.19	51.50	65.41	0.00	0.00	0.00	51.50	65.41	7.60
2012	18.45	52.74	66.98	0.00	0.00	0.00	52.74	66.98	7.78

Problem Number 1 Central Route Alternative .
EXISTING Route exist current cond .
Segment 6 ex_skyline .

WITHOUT Improvement

Year	Major Route			HOV Facility			Combined Total		Minor Route
	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)
1992	31.72	34.79	44.18	0.00	0.00	0.00	34.79	44.18	2.70
1993	30.60	35.63	45.24	0.00	0.00	0.00	35.63	45.24	2.76
1994	29.53	36.48	46.33	0.00	0.00	0.00	36.48	46.33	2.83
1995	28.81	37.36	47.44	0.00	0.00	0.00	37.36	47.44	2.90
1996	28.05	38.25	48.58	0.00	0.00	0.00	38.25	48.58	2.97
1997	27.13	39.17	49.75	0.00	0.00	0.00	39.17	49.75	3.04
1998	26.54	40.11	50.94	0.00	0.00	0.00	40.11	50.94	3.11
1999	26.06	41.07	52.16	0.00	0.00	0.00	41.07	52.16	3.19
2000	25.59	42.06	53.42	0.00	0.00	0.00	42.06	53.42	3.26
2001	25.01	43.07	54.70	0.00	0.00	0.00	43.07	54.70	3.34
2002	24.24	44.10	56.01	0.00	0.00	0.00	44.10	56.01	3.42
2003	23.64	45.16	57.36	0.00	0.00	0.00	45.16	57.36	3.51
2004	22.81	46.25	58.73	0.00	0.00	0.00	46.25	58.73	3.59
2005	22.12	47.36	60.14	0.00	0.00	0.00	47.36	60.14	3.68
2006	21.00	48.49	61.59	0.00	0.00	0.00	48.49	61.59	3.76
2007	20.34	49.66	63.06	0.00	0.00	0.00	49.66	63.06	3.85
2008	19.71	50.85	64.58	0.00	0.00	0.00	50.85	64.58	3.95
2009	18.85	52.07	66.13	0.00	0.00	0.00	52.07	66.13	4.04
2010	17.99	53.32	67.72	0.00	0.00	0.00	53.32	67.72	4.14
2011	16.86	54.60	69.34	0.00	0.00	0.00	54.60	69.34	4.24
2012	16.15	55.91	71.01	0.00	0.00	0.00	55.91	71.01	4.34

Problem Number 1 Central Route Alternative .
EXISTING Route exist current cond .
Segment 7 ex_long ave .

WITHOUT Improvement

Year	Major Route			HOV Facility			Combined Total		Minor Route
	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)
1992	33.30	33.16	42.11	0.00	0.00	0.00	33.16	42.11	5.76
1993	32.66	34.03	43.22	0.00	0.00	0.00	34.03	43.22	5.90
1994	31.58	34.93	44.36	0.00	0.00	0.00	34.93	44.36	6.04
1995	30.24	35.84	45.52	0.00	0.00	0.00	35.84	45.52	6.19
1996	29.27	36.79	46.72	0.00	0.00	0.00	36.79	46.72	6.33
1997	28.49	37.76	47.95	0.00	0.00	0.00	37.76	47.95	6.49
1998	27.45	38.75	49.22	0.00	0.00	0.00	38.75	49.22	6.64
1999	26.75	39.78	50.51	0.00	0.00	0.00	39.78	50.51	6.80
2000	26.18	40.83	51.85	0.00	0.00	0.00	40.83	51.85	6.96
2001	25.67	41.91	53.22	0.00	0.00	0.00	41.91	53.22	7.13
2002	25.05	43.01	54.63	0.00	0.00	0.00	43.01	54.63	7.30
2003	24.22	44.15	56.07	0.00	0.00	0.00	44.15	56.07	7.48
2004	23.52	45.32	57.56	0.00	0.00	0.00	45.32	57.56	7.66
2005	22.65	46.52	59.09	0.00	0.00	0.00	46.52	59.09	7.84
2006	21.74	47.76	60.65	0.00	0.00	0.00	47.76	60.65	8.03
2007	20.67	49.03	62.26	0.00	0.00	0.00	49.03	62.26	8.22
2008	19.99	50.33	63.92	0.00	0.00	0.00	50.33	63.92	8.42
2009	19.09	51.67	65.62	0.00	0.00	0.00	51.67	65.62	8.62
2010	18.24	53.04	67.37	0.00	0.00	0.00	53.04	67.37	8.83
2011	16.92	54.46	69.16	0.00	0.00	0.00	54.46	69.16	9.04
2012	16.15	55.91	71.01	0.00	0.00	0.00	55.91	71.01	9.26

Problem Number 1 Central Route Alternative .
EXISTING Route exist current cond .
Segment 8 ex_SH183 .

WITHOUT Improvement

Year	Major Route Aver. Speed (mph)	Major Route Num. Veh. (000)	Major Route Num. Pers. (000)	HOV Facility Aver. Speed (mph)	HOV Facility Num. Veh. (000)	HOV Facility Num. Pers. (000)	Combined Total Num. Veh. (000)	Combined Total Num. Pers. (000)	Minor Route Num. Veh. (000)
1992	36.25	26.56	33.73	0.00	0.00	0.00	26.56	33.73	9.50
1993	36.04	27.20	34.54	0.00	0.00	0.00	27.20	34.54	9.73
1994	35.80	27.85	35.37	0.00	0.00	0.00	27.85	35.37	9.96
1995	35.55	28.52	36.22	0.00	0.00	0.00	28.52	36.22	10.20
1996	35.28	29.20	37.09	0.00	0.00	0.00	29.20	37.09	10.45
1997	34.99	29.91	37.98	0.00	0.00	0.00	29.91	37.98	10.70
1998	34.67	30.62	38.89	0.00	0.00	0.00	30.62	38.89	10.95
1999	34.32	31.36	39.83	0.00	0.00	0.00	31.36	39.83	11.22
2000	33.92	32.11	40.78	0.00	0.00	0.00	32.11	40.78	11.49
2001	33.48	32.88	41.76	0.00	0.00	0.00	32.88	41.76	11.76
2002	32.95	33.67	42.76	0.00	0.00	0.00	33.67	42.76	12.04
2003	32.14	34.48	43.79	0.00	0.00	0.00	34.48	43.79	12.33
2004	31.14	35.31	44.84	0.00	0.00	0.00	35.31	44.84	12.63
2005	29.83	36.16	45.92	0.00	0.00	0.00	36.16	45.92	12.93
2006	29.07	37.03	47.02	0.00	0.00	0.00	37.03	47.02	13.24
2007	28.36	37.91	48.15	0.00	0.00	0.00	37.91	48.15	13.56
2008	27.39	38.82	49.31	0.00	0.00	0.00	38.82	49.31	13.89
2009	26.76	39.76	50.49	0.00	0.00	0.00	39.76	50.49	14.22
2010	26.23	40.71	51.70	0.00	0.00	0.00	40.71	51.70	14.56
2011	25.77	41.69	52.94	0.00	0.00	0.00	41.69	52.94	14.91
2012	25.25	42.69	54.22	0.00	0.00	0.00	42.69	54.22	15.27

Problem Number 1 Central Route Alternative .
PROPOSED Route proposed central route .
Segment 1 prop_surfside .

WITH Improvment

Year	Major Route			HOV Facility			Combined Total		Minor Route
	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)
1992									
1993	59.58	41.12	52.22	0.00	0.00	0.00	41.12	52.22	0.78
1994	59.56	42.35	53.79	0.00	0.00	0.00	42.35	53.79	0.80
1995	59.53	43.62	55.40	0.00	0.00	0.00	43.62	55.40	0.82
1996	59.50	44.93	57.06	0.00	0.00	0.00	44.93	57.06	0.84
1997	59.47	46.28	58.77	0.00	0.00	0.00	46.28	58.77	0.86
1998	59.44	47.67	60.54	0.00	0.00	0.00	47.67	60.54	0.88
1999	59.40	49.10	62.35	0.00	0.00	0.00	49.10	62.35	0.90
2000	59.37	50.57	64.22	0.00	0.00	0.00	50.57	64.22	0.92
2001	59.33	52.09	66.15	0.00	0.00	0.00	52.09	66.15	0.94
2002	59.28	53.65	68.13	0.00	0.00	0.00	53.65	68.13	0.96
2003	59.24	55.26	70.18	0.00	0.00	0.00	55.26	70.18	0.99
2004	59.19	56.92	72.28	0.00	0.00	0.00	56.92	72.28	1.01
2005	59.14	58.62	74.45	0.00	0.00	0.00	58.62	74.45	1.03
2006	59.09	60.38	76.69	0.00	0.00	0.00	60.38	76.69	1.06
2007	59.03	62.19	78.99	0.00	0.00	0.00	62.19	78.99	1.08
2008	58.97	64.06	81.36	0.00	0.00	0.00	64.06	81.36	1.11
2009	58.91	65.98	83.80	0.00	0.00	0.00	65.98	83.80	1.14
2010	58.84	67.96	86.31	0.00	0.00	0.00	67.96	86.31	1.16
2011	58.77	70.00	88.90	0.00	0.00	0.00	70.00	88.90	1.19
2012	58.69	72.10	91.57	0.00	0.00	0.00	72.10	91.57	1.22

Problem Number 1 Central Route Alternative .
PROPOSED Route proposed central route .
Segment 2 prop_hodgkins .

WITH Improvment

Year	Major Route			HOV Facility			Combined Total		Minor Route
	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)
1992									
1993	59.65	37.92	48.16	0.00	0.00	0.00	37.92	48.16	1.94
1994	59.62	39.06	49.61	0.00	0.00	0.00	39.06	49.61	1.98
1995	59.60	40.23	51.10	0.00	0.00	0.00	40.23	51.10	2.03
1996	59.58	41.44	52.63	0.00	0.00	0.00	41.44	52.63	2.08
1997	59.55	42.68	54.21	0.00	0.00	0.00	42.68	54.21	2.13
1998	59.52	43.96	55.84	0.00	0.00	0.00	43.96	55.84	2.18
1999	59.49	45.28	57.51	0.00	0.00	0.00	45.28	57.51	2.23
2000	59.46	46.64	59.24	0.00	0.00	0.00	46.64	59.24	2.29
2001	59.43	48.04	61.01	0.00	0.00	0.00	48.04	61.01	2.34
2002	59.39	49.48	62.84	0.00	0.00	0.00	49.48	62.84	2.40
2003	59.35	50.97	64.73	0.00	0.00	0.00	50.97	64.73	2.45
2004	59.32	52.50	66.67	0.00	0.00	0.00	52.50	66.67	2.51
2005	59.27	54.07	68.67	0.00	0.00	0.00	54.07	68.67	2.57
2006	59.23	55.69	70.73	0.00	0.00	0.00	55.69	70.73	2.64
2007	59.18	57.36	72.85	0.00	0.00	0.00	57.36	72.85	2.70
2008	59.13	59.08	75.04	0.00	0.00	0.00	59.08	75.04	2.76
2009	59.07	60.86	77.29	0.00	0.00	0.00	60.86	77.29	2.83
2010	59.02	62.68	79.61	0.00	0.00	0.00	62.68	79.61	2.90
2011	58.96	64.56	82.00	0.00	0.00	0.00	64.56	82.00	2.97
2012	58.89	66.50	84.46	0.00	0.00	0.00	66.50	84.46	3.04

Problem Number 1 Central Route Alternative .
PROPOSED Route proposed central route .
Segment 3 prop_azle .

WITH Improvment

Year	Major Route			HOV Facility			Combined Total		Minor Route
	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)
1992									
1993	59.68	36.10	45.85	0.00	0.00	0.00	36.10	45.85	2.05
1994	59.66	37.18	47.22	0.00	0.00	0.00	37.18	47.22	2.10
1995	59.64	38.30	48.64	0.00	0.00	0.00	38.30	48.64	2.15
1996	59.62	39.45	50.10	0.00	0.00	0.00	39.45	50.10	2.20
1997	59.59	40.63	51.60	0.00	0.00	0.00	40.63	51.60	2.25
1998	59.57	41.85	53.15	0.00	0.00	0.00	41.85	53.15	2.31
1999	59.54	43.11	54.74	0.00	0.00	0.00	43.11	54.74	2.36
2000	59.51	44.40	56.39	0.00	0.00	0.00	44.40	56.39	2.42
2001	59.48	45.73	58.08	0.00	0.00	0.00	45.73	58.08	2.48
2002	59.45	47.10	59.82	0.00	0.00	0.00	47.10	59.82	2.54
2003	59.42	48.52	61.61	0.00	0.00	0.00	48.52	61.61	2.60
2004	59.38	49.97	63.46	0.00	0.00	0.00	49.97	63.46	2.66
2005	59.34	51.47	65.37	0.00	0.00	0.00	51.47	65.37	2.73
2006	59.30	53.01	67.33	0.00	0.00	0.00	53.01	67.33	2.79
2007	59.26	54.60	69.35	0.00	0.00	0.00	54.60	69.35	2.86
2008	59.21	56.24	71.43	0.00	0.00	0.00	56.24	71.43	2.93
2009	59.16	57.93	73.57	0.00	0.00	0.00	57.93	73.57	3.00
2010	59.11	59.67	75.78	0.00	0.00	0.00	59.67	75.78	3.07
2011	59.06	61.46	78.05	0.00	0.00	0.00	61.46	78.05	3.14
2012	59.00	63.30	80.39	0.00	0.00	0.00	63.30	80.39	3.22

Problem Number 1 Central Route Alternative .
PROPOSED Route proposed central route .
Segment 4 prop_IH820 .

WITH Improvment

Year	Major Route			HOV Facility			Combined Total		Minor Route
	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)
1992									
1993	59.67	36.55	46.42	0.00	0.00	0.00	36.55	46.42	44.80
1994	59.65	37.65	47.82	0.00	0.00	0.00	37.65	47.82	46.26
1995	59.63	38.78	49.25	0.00	0.00	0.00	38.78	49.25	47.76
1996	59.61	39.94	50.73	0.00	0.00	0.00	39.94	50.73	49.32
1997	59.58	41.14	52.25	0.00	0.00	0.00	41.14	52.25	50.92
1998	59.56	42.38	53.82	0.00	0.00	0.00	42.38	53.82	52.58
1999	59.53	43.65	55.43	0.00	0.00	0.00	43.65	55.43	54.29
2000	59.50	44.96	57.10	0.00	0.00	0.00	44.96	57.10	56.06
2001	59.47	46.31	58.81	0.00	0.00	0.00	46.31	58.81	57.88
2002	59.44	47.70	60.57	0.00	0.00	0.00	47.70	60.57	59.76
2003	59.40	49.13	62.39	0.00	0.00	0.00	49.13	62.39	61.71
2004	59.36	50.60	64.26	0.00	0.00	0.00	50.60	64.26	63.71
2005	59.32	52.12	66.19	0.00	0.00	0.00	52.12	66.19	65.79
2006	59.28	53.68	68.18	0.00	0.00	0.00	53.68	68.18	67.93
2007	59.24	55.29	70.22	0.00	0.00	0.00	55.29	70.22	70.14
2008	59.19	56.95	72.33	0.00	0.00	0.00	56.95	72.33	72.42
2009	59.14	58.66	74.50	0.00	0.00	0.00	58.66	74.50	74.77
2010	59.09	60.42	76.73	0.00	0.00	0.00	60.42	76.73	77.21
2011	59.03	62.23	79.04	0.00	0.00	0.00	62.23	79.04	79.72
2012	58.97	64.10	81.41	0.00	0.00	0.00	64.10	81.41	82.31

Problem Number 1 Central Route Alternative .
PROPOSED Route proposed central route .
Segment 5 prop_IH 820 .

WITH Improvment

Year	Major Route			HOV Facility			Combined Total		Minor Route
	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)
1992									
1993	59.61	39.98	50.78	0.00	0.00	0.00	39.98	50.78	4.96
1994	59.58	41.18	52.30	0.00	0.00	0.00	41.18	52.30	5.08
1995	59.56	42.42	53.87	0.00	0.00	0.00	42.42	53.87	5.20
1996	59.53	43.69	55.49	0.00	0.00	0.00	43.69	55.49	5.32
1997	59.50	45.00	57.15	0.00	0.00	0.00	45.00	57.15	5.45
1998	59.47	46.35	58.87	0.00	0.00	0.00	46.35	58.87	5.58
1999	59.43	47.74	60.63	0.00	0.00	0.00	47.74	60.63	5.71
2000	59.40	49.17	62.45	0.00	0.00	0.00	49.17	62.45	5.85
2001	59.36	50.65	64.32	0.00	0.00	0.00	50.65	64.32	5.99
2002	59.32	52.17	66.25	0.00	0.00	0.00	52.17	66.25	6.14
2003	59.28	53.73	68.24	0.00	0.00	0.00	53.73	68.24	6.28
2004	59.24	55.34	70.28	0.00	0.00	0.00	55.34	70.28	6.43
2005	59.19	57.00	72.39	0.00	0.00	0.00	57.00	72.39	6.59
2006	59.14	58.71	74.56	0.00	0.00	0.00	58.71	74.56	6.75
2007	59.09	60.47	76.80	0.00	0.00	0.00	60.47	76.80	6.91
2008	59.03	62.29	79.10	0.00	0.00	0.00	62.29	79.10	7.08
2009	58.97	64.15	81.47	0.00	0.00	0.00	64.15	81.47	7.25
2010	58.91	66.08	83.92	0.00	0.00	0.00	66.08	83.92	7.42
2011	58.84	68.06	86.43	0.00	0.00	0.00	68.06	86.43	7.60
2012	58.76	70.10	89.03	0.00	0.00	0.00	70.10	89.03	7.78

Problem Number 1 Central Route Alternative .
PROPOSED Route proposed central route .
Segment 6 prop_robert's .

WITH Improvment

Year	Major Route			HOV Facility			Combined Total		Minor Route
	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)
1992									
1993	59.52	43.92	55.78	0.00	0.00	0.00	43.92	55.78	2.76
1994	59.49	45.24	57.45	0.00	0.00	0.00	45.24	57.45	2.83
1995	59.46	46.59	59.17	0.00	0.00	0.00	46.59	59.17	2.90
1996	59.43	47.99	60.95	0.00	0.00	0.00	47.99	60.95	2.97
1997	59.39	49.43	62.78	0.00	0.00	0.00	49.43	62.78	3.04
1998	59.36	50.91	64.66	0.00	0.00	0.00	50.91	64.66	3.11
1999	59.32	52.44	66.60	0.00	0.00	0.00	52.44	66.60	3.19
2000	59.27	54.01	68.59	0.00	0.00	0.00	54.01	68.59	3.26
2001	59.23	55.63	70.65	0.00	0.00	0.00	55.63	70.65	3.34
2002	59.18	57.30	72.77	0.00	0.00	0.00	57.30	72.77	3.42
2003	59.13	59.02	74.95	0.00	0.00	0.00	59.02	74.95	3.51
2004	59.08	60.79	77.20	0.00	0.00	0.00	60.79	77.20	3.59
2005	59.02	62.61	79.52	0.00	0.00	0.00	62.61	79.52	3.68
2006	58.96	64.49	81.90	0.00	0.00	0.00	64.49	81.90	3.76
2007	58.89	66.42	84.36	0.00	0.00	0.00	66.42	84.36	3.85
2008	58.82	68.42	86.89	0.00	0.00	0.00	68.42	86.89	3.95
2009	58.75	70.47	89.49	0.00	0.00	0.00	70.47	89.49	4.04
2010	58.67	72.58	92.18	0.00	0.00	0.00	72.58	92.18	4.14
2011	58.59	74.76	94.94	0.00	0.00	0.00	74.76	94.94	4.24
2012	58.50	77.00	97.79	0.00	0.00	0.00	77.00	97.79	4.34

Problem Number 1 Central Route Alternative .
PROPOSED Route proposed central route .
Segment 7 prop_skyline .

WITH Improvment

Year	Major Route			HOV Facility			Combined Total		Minor Route
	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)
1992									
1993	59.54	43.12	54.76	0.00	0.00	0.00	43.12	54.76	2.76
1994	59.51	44.41	56.40	0.00	0.00	0.00	44.41	56.40	2.83
1995	59.48	45.74	58.09	0.00	0.00	0.00	45.74	58.09	2.90
1996	59.45	47.11	59.83	0.00	0.00	0.00	47.11	59.83	2.97
1997	59.42	48.53	61.63	0.00	0.00	0.00	48.53	61.63	3.04
1998	59.38	49.98	63.48	0.00	0.00	0.00	49.98	63.48	3.11
1999	59.34	51.48	65.38	0.00	0.00	0.00	51.48	65.38	3.19
2000	59.30	53.03	67.34	0.00	0.00	0.00	53.03	67.34	3.26
2001	59.26	54.62	69.36	0.00	0.00	0.00	54.62	69.36	3.34
2002	59.21	56.25	71.44	0.00	0.00	0.00	56.25	71.44	3.42
2003	59.16	57.94	73.59	0.00	0.00	0.00	57.94	73.59	3.51
2004	59.11	59.68	75.79	0.00	0.00	0.00	59.68	75.79	3.59
2005	59.06	61.47	78.07	0.00	0.00	0.00	61.47	78.07	3.68
2006	59.00	63.31	80.41	0.00	0.00	0.00	63.31	80.41	3.76
2007	58.93	65.21	82.82	0.00	0.00	0.00	65.21	82.82	3.85
2008	58.87	67.17	85.31	0.00	0.00	0.00	67.17	85.31	3.95
2009	58.80	69.19	87.87	0.00	0.00	0.00	69.19	87.87	4.04
2010	58.72	71.26	90.50	0.00	0.00	0.00	71.26	90.50	4.14
2011	58.64	73.40	93.22	0.00	0.00	0.00	73.40	93.22	4.24
2012	58.56	75.60	96.01	0.00	0.00	0.00	75.60	96.01	4.34

Problem Number 1 Central Route Alternative .
PROPOSED Route proposed central route .
Segment 8 prop_SH183 .

WITH Improvment

Year	Major Route			HOV Facility			Combined Total		Minor Route
	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Aver. Speed (mph)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)	Num. Pers. (000)	Num. Veh. (000)
1992									
1993	59.19	42.74	54.29	0.00	0.00	0.00	42.74	54.29	9.73
1994	59.14	44.03	55.91	0.00	0.00	0.00	44.03	55.91	9.96
1995	59.09	45.35	57.59	0.00	0.00	0.00	45.35	57.59	10.20
1996	59.03	46.71	59.32	0.00	0.00	0.00	46.71	59.32	10.45
1997	58.97	48.11	61.10	0.00	0.00	0.00	48.11	61.10	10.70
1998	58.91	49.55	62.93	0.00	0.00	0.00	49.55	62.93	10.95
1999	58.84	51.04	64.82	0.00	0.00	0.00	51.04	64.82	11.22
2000	58.76	52.57	66.76	0.00	0.00	0.00	52.57	66.76	11.49
2001	58.69	54.15	68.77	0.00	0.00	0.00	54.15	68.77	11.76
2002	58.60	55.77	70.83	0.00	0.00	0.00	55.77	70.83	12.04
2003	58.52	57.44	72.95	0.00	0.00	0.00	57.44	72.95	12.33
2004	58.42	59.17	75.14	0.00	0.00	0.00	59.17	75.14	12.63
2005	58.32	60.94	77.40	0.00	0.00	0.00	60.94	77.40	12.93
2006	58.22	62.77	79.72	0.00	0.00	0.00	62.77	79.72	13.24
2007	58.10	64.65	82.11	0.00	0.00	0.00	64.65	82.11	13.56
2008	57.98	66.59	84.57	0.00	0.00	0.00	66.59	84.57	13.89
2009	57.85	68.59	87.11	0.00	0.00	0.00	68.59	87.11	14.22
2010	57.71	70.65	89.72	0.00	0.00	0.00	70.65	89.72	14.56
2011	57.57	72.77	92.41	0.00	0.00	0.00	72.77	92.41	14.91
2012	57.41	74.95	95.19	0.00	0.00	0.00	74.95	95.19	15.27

Problem Number 1 Central Route Alternative .

Summary of Discounted Benefits (Thous. $)

Year	Delay Savings	Red Veh Op Cost	Red Acc Cost	Total Benefits
1992	0.00	0.00	0.00	0.00
1993	25997.44	3939.70	456.76	30393.89
1994	26421.10	3861.80	434.96	30717.85
1995	26536.22	3767.01	414.20	30717.44
1996	26607.70	3671.23	394.43	30673.36
1997	26828.09	3595.12	375.61	30798.83
1998	26786.40	3506.43	357.69	30650.53
1999	26886.05	3428.92	340.63	30655.61
2000	26559.34	3333.47	324.39	30217.20
2001	26354.38	3240.78	308.92	29904.08
2002	26045.65	3145.67	294.19	29485.51
2003	25658.11	3040.92	280.16	28979.18
2004	25341.06	2942.66	266.80	28550.53
2005	24989.19	2848.97	254.09	28092.24
2006	24884.68	2768.18	241.98	27894.84
2007	24525.21	2682.40	230.45	27438.06
2008	24139.08	2590.75	219.47	26949.30
2009	23754.48	2508.74	209.01	26472.24
2010	23288.78	2425.59	199.05	25913.42
2011	22923.18	2349.50	189.57	25462.25
2012	22365.26	2270.19	180.55	24815.99
Total	506891.40	61918.03	5972.90	574782.40

Total Discounted User Benefits (Millions $) : 574.78
Total Discounted Reduction in Maint/Rehab Costs (Millions $) : -3.32
Discounted Construction Cost (Millions $) : 145.89
Net Present Value (Millions $) : 425.57
Benefit-Cost Ratio : 3.92