**The I-69 Evansville-to-Indianapolis Study**
**Tier 1 Environmental Impact Statement**

# Task 3.3.4 Technical Report Regional Transportation Needs Analysis

**September 26, 2001**

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# 1.0 Introduction

As part of the Purpose and Need Analysis for the I-69, Evansville to Indianapolis Study, a comprehensive transportation needs analysis was conducted for the 26 county Study Area. This analysis studied four issues:

- Evansville to Indianapolis Connection
- Regional Accessibility
- Travel Efficiency (Congestion)
- Safety

The analysis of Safety in the Study Area has been published as *Task 3.3.4.1 Technical Report - Regional Safety Analysis*. This technical report will document the detailed analysis conducted for the other three areas. A chapter is devoted to each of the first three bulleted points listed above.

For purposes of this analysis, a 26-county Study Area was defined, as shown in Figure A1, Study Area, contained in the Appendix. The Study Area was defined to include all counties within the area between I-70 on the north, State Route 37 on the east, and the state boundaries on the south and west. The range of alternatives considered will be somewhere within this area.

The analysis examined both existing and future conditions. "Existing" conditions are for a base year of 1998, and "future" conditions are for a forecast year of 2025. This forecast year is being used as the design year for this study. This design year, which typically is 15 - 20 years from project construction, will be used to determine the future needs which a proposed transportation project may address.

The evaluation of the transportation conditions was conducted using the latest version of the Indiana Statewide Travel Demand Model. The model used for this study is completely different from, and much more advanced, than the model used in the 1996 Draft EIS for the Southwest Indiana Highway Project. The new model is much more detailed, and covers a much wider geographic area. It uses hundreds of traffic analysis zones (TAZs) and captures many more shorter distance trips that previously would have been ignored (because they would have occurred within a single zone). The new model includes many more highways, to more accurately model traffic flows. Within the 26 county Study Area, all rural roads of functional classification Major Collector and above are included. In addition, the model now accounts for trips coming from or going to states adjacent to Indiana. The model includes substantial portions of Kentucky, Illinois, Michigan, and Ohio, as well as all of Indiana. See Figure A2 in the Appendix for a map showing the modeled area and travel network.

This information supplements and provides added background to what is contained in the Purpose and Need Statement.

# 2.0 Evansville to Indianapolis Connection

## 2.1 Introduction

Indianapolis has a unique and central role in the economic, government, and culture of Indiana. It is Indiana's capital city, located in the center of the state. It is also the center of Indiana's economic and cultural activities. With a population of nearly 800,000, it is four times as populous as the next largest city in Indiana (Fort Wayne, approximately 200,000). Given its central location and prominence, it is important that all Indiana residents have quick, safe, and dependable access to their state capital.

For many years, residents and businesses in the Evansville have stated that the city of Evansville has an unacceptably poor connection to Indianapolis. The Purpose and Needs Analysis set out to determine how the connection of Evansville and Indianapolis compared with the connection which other major cities in Indiana have to Indianapolis.

## 2.2 Methodology

The Indiana Statewide Travel Demand Model was used to evaluate the efficiency of the existing transportation linkage between Evansville and Indianapolis. As a point of reference, the connection between Evansville and Indianapolis was compared with the connection which other major cities in Indiana enjoy. Major cities were designated as those which were part of a Metropolitan Planning Organization (MPO). These included the cities of Anderson, Bloomington, Fort Wayne, Kokomo, Lafayette / W. Lafayette, Muncie, Gary / Hammond / E. Chicago, South Bend and Terre Haute in Indiana. In addition, Cincinnati, Ohio and Louisville, Kentucky were included.

In order to make this comparison, both travel time and travel distance were considered. The major components of travel cost are related to time and distance. The cost of user travel time is related to the vehicle travel time. Vehicle operating cost and safety (accident) cost are related to the distance traveled.

Since these cities are at varying distances from Indianapolis, a straight line path from each city to Indianapolis was used as a basis of comparison. The most efficient connection (allowing a trip to be made for the least amount of travel time and miles) between any two points is via a straight line. This straight line from each city to Indianapolis was not used to represent an actual route. Rather, it is a basis of comparison, so that the relative efficiency of each city's connection to Indianapolis could be made.

The method to compare each city's connection to Indianapolis used a straight line from the

CBD of that city to the closest point on I-465.[1] The ideal mileage between each city and Indianapolis was specified as the mileage on this straight line connection. The ideal travel time on this straight line connection was specified as the time it would take to travel this straight line path at a speed of 70 miles per hour.[2]

Using the Statewide Travel Model, the actual quickest path from each city to I-465 was determined. This quickest path uses that combination of roads which provides the quickest trip between each city and I-465. This quickest path was determined for both the base (1998) and forecast year (2025). Since certain roads which do not exist at present are assumed to be built by 2025, the quickest path may be different in the base and forecast years. For example, the quickest path between Evansville and Indianapolis in the base year is via US 41 to I-70. In the forecast year, it is via US 41 to SR 641 to I-70 in the forecast year. SR 641 (the Terre Haute Bypass) is assumed to exist in the forecast year, and the quickest path between Evansville and Indianapolis would use this route.

The efficiency of the connection of each city was determined by comparing the travel time and travel distance via the straight line route with the actual travel time via the quickest path in the highway network. The closer the actual highway travel time and travel distance are to the straight line time and distance, the more efficient that city's connection to Indianapolis. If the actual highway travel time and distance differ significantly from the straight line travel time and travel distance, the connection of that city to Indianapolis is less efficient.

In order to account for the fact that these cities are at differing distances from Indianapolis, straight line and actual travel were compared in two ways. First, the difference between the actual and straight line time and distance were computed. For example, the straight line distance between downtown Terre Haute and I-465 is 63.6 miles. The travel time on that route is 54.5 minutes. The actual driving distance via the fastest path is 68.6 miles, and the actual travel time is 69.2 minutes. The difference in mileage is 5.0 miles, and the difference in travel time is 14.7 minutes.

In order to take into account the fact that cities are at different distances from Indianapolis, indices were also computed. These indices are computed by dividing the straight line time or distance by the actual time or distance. For example, the ratio of the straight line and actual distance for Terre Haute is (63.6 / 68.6) = 0.93. The ratio of the straight line and actual travel

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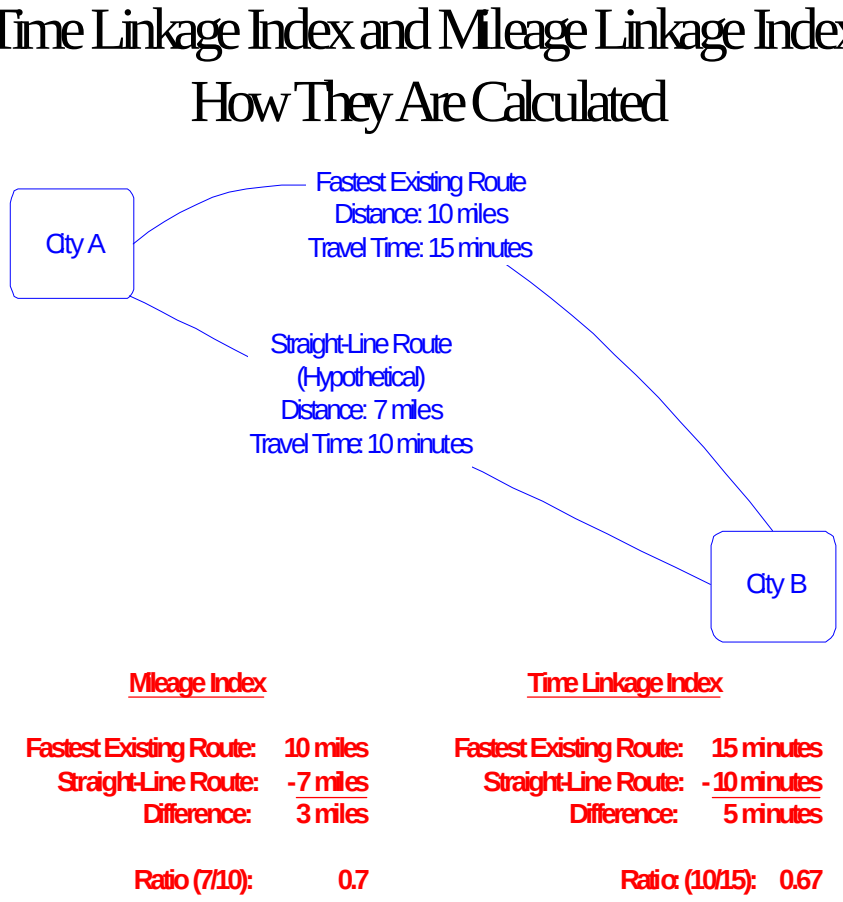
1 The connection was analyzed using a straight-line route to I-465, rather than a straight-line route to downtown Indianapolis. The termini of the proposed I-69 project goes only to I-465. Within Indianapolis, the time required (and delay encountered) in traveling between I-465 and downtown can vary considerably, depending upon the orientation of their travel. For example, travelers from the west, northwest and east have direct Interstate access to downtown Indianapolis, while travelers with other orientations do not have such access.

2 Travel time surveys taken to determine the free flow speeds in the travel model showed that typical free flow speeds on rural Interstate Highways in Indiana are about 70 mph.

time for Terre Haute is (54.5 / 69.2) = 0.79. The closer the value of the index is to 1.00, the closer the actual time or distance is to the straight line time or distance. Computing this index "normalizes" the difference and accounts for the different distances these communities are from Indianapolis. Figure 1 displays graphically how this index is calculated.

**Figure 1 - Description of Time and Mileage Linkage Index**



### 2.2.1 Mileage Comparison

Tables 1 - 3 summarize the comparison of actual and straight line mileages, and Tables 4 - 6 summarize the comparison of actual and straight line travel times.

## Table 1 – Comparison of Actual and Straight Line Highway Mileage to Indianapolis from Various Cities: 1998

| Metropolitan Area | 1999 Population | Straight Line Distance (mi) | Minimum Time Path Distance (mi) | Mileage Difference Straight Line vs. Actual | Mileage Linkage Index (S.L./Actual) |
|---|---|---|---|---|---|
| Anderson | 58,000 | 25.3 | 29.3 | 4.0 | 0.87 |
| Bloomington | 67,000 | 41.1 | 47.0 | 5.9 | 0.88 |
| Cincinnati | 331,000 | 92.9 | 103.2 | 10.3 | 0.90 |
| **Evansville** | **122,000** | **138.8** | **172.7** | **33.9** | **0.80** |
| Fort Wayne | 197,000 | 94.8 | 110.2 | 15.4 | 0.86 |
| Kokomo | 45,000 | 37.8 | 43.1 | 5.3 | 0.88 |
| Lafayette/W. Lafayette | 80,000 | 50.3 | 53.1 | 2.8 | 0.95 |
| Louisville | 253,000 | 101.8 | 106.7 | 4.9 | 0.95 |
| Muncie | 67,000 | 43.0 | 49.3 | 6.3 | 0.87 |
| Gary, Hammond, E. Chicago | 218,000 | 133.3 | 142.8 | 9.5 | 0.93 |
| South Bend | 99,000 | 120.8 | 129.1 | 8.3 | 0.94 |
| Terre Haute | 53,000 | 63.6 | 68.6 | 5.0 | 0.93 |

## Table 2 – Comparison of Actual and Straight Line Highway Mileage to Indianapolis from Various Cities: 2025

| Metropolitan Area | 1999 Population | Straight Line Distance (mi) | Minimum Time Path Distance (mi) | Mileage Difference Straight Line vs. Actual | Mileage Linkage Index (S.L./Actual) |
|---|---|---|---|---|---|
| Anderson | 58,000 | 25.3 | 29.6 | 4.3 | 0.86 |
| Bloomington | 67,000 | 41.1 | 46.9 | 5.8 | 0.88 |
| Cincinnati | 331,000 | 92.9 | 103.2 | 10.3 | 0.90 |
| **Evansville** | **122,000** | **138.8** | **169.7** | **30.9** | **0.82** |
| Fort Wayne | 197,000 | 94.8 | 110.2 | 15.4 | 0.86 |
| Kokomo | 45,000 | 37.8 | 43.1 | 5.3 | 0.88 |
| Lafayette/W. Lafayette | 80,000 | 50.3 | 53.1 | 2.8 | 0.95 |
| Louisville | 253,000 | 101.8 | 106.7 | 4.9 | 0.95 |
| Muncie | 67,000 | 43.0 | 49.3 | 6.3 | 0.87 |
| Gary, Hammond, E. Chicago | 218,000 | 133.3 | 142.7 | 9.4 | 0.93 |
| South Bend | 99,000 | 120.8 | 131.1 | 10.3 | 0.92 |
| Terre Haute | 53,000 | 63.6 | 68.6 | 5.0 | 0.93 |

## Table 3 - Ranking of Cities by Average Mileage Difference and Mileage Index to Indianapolis, 1998 and 2025

| Metropolitan Area | 1999 Population | Average Mileage Difference | Mileage Difference Rank | Average Mileage Linkage Index | Mileage Index Rank |
|---|---|---|---|---|---|
| Anderson | 58,000 | 4.1 | 2 | 0.86 | 10 |
| Bloomington | 67,000 | 5.8 | 6 | 0.88 | 8 |
| Cincinnati | 331,000 | 10.3 | 10 | 0.90 | 6 |
| **Evansville** | **122,000** | **32.4** | **12** | 0.81 | **12** |
| Fort Wayne | 197,000 | 15.4 | 11 | 0.86 | 11 |
| Kokomo | 45,000 | 5.3 | 5 | 0.88 | 7 |
| Lafayette/W. Lafayette | 80,000 | 2.8 | 1 | 0.95 | 2 |
| Louisville | 253,000 | 4.9 | 3 | 0.95 | 1 |
| Muncie | 67,000 | 6.3 | 7 | 0.87 | 9 |
| Gary, Hammond, E. Chicago | 218,000 | 9.5 | 9 | 0.93 | 3 |
| South Bend | 99,000 | 9.3 | 8 | 0.93 | 4 |
| Terre Haute | 53,000 | 5.0 | 4 | 0.93 | 5 |

This analysis reveals that Evansville is last among the 12 cities by both measures. The actual distance from Evansville to Indianapolis is 32 miles longer than the straight line distance. The difference between the actual and straight-line distances for the next-worst city, Fort Wayne, is only 15.5 miles - or less than half as large. In other words, the gap between the actual and straight-line distances between Evansville and Indianapolis is more than twice as large as the comparable measurement for any of the other 12 cities studied.

### 2.2.2 Travel Time Comparison

Using the methods described above, the time it would take to travel the straight line distance at Interstate travel times was compared with the actual daily travel time using the quickest available route. The differences in actual and straight-line travel time were compared using the same two methods - the absolute difference, and the index (ratio of straight-line travel time to actual travel time). Tables 4 - 6 give the results of this analysis.

## Table 4 - Comparison of Actual and Straight Line Highway Travel Time to Indianapolis from Various Cities: 1998

| Metropolitan Area | 1999 Population | Straight Line Travel Time (mins) | Actual Travel Time (mins) | Mileage Difference Straight Line vs. Actual | Time Linkage Index (S.L./Actual) |
|---|---|---|---|---|---|
| Anderson | 58,000 | 21.7 | 29.1 | 7.4 | 0.75 |
| Bloomington | 67,000 | 35.3 | 53.8 | 18.5 | 0.65 |
| Cincinnati | 331,000 | 79.6 | 95.8 | 16.2 | 0.83 |
| **Evansville** | **122,000** | 118.9 | 174.5 | **55.6** | **0.68** |
| Fort Wayne | 197,000 | 81.2 | 102.6 | 21.4 | 0.79 |
| Kokomo | 45,000 | 32.4 | 48.4 | 16.0 | 0.67 |
| Lafayette/W. Lafayette | 80,000 | 43.1 | 56.3 | 13.2 | 0.77 |
| Louisville | 253,000 | 87.2 | 108.1 | 20.9 | 0.81 |
| Muncie | 67,000 | 36.8 | 48.0 | 11.2 | 0.77 |
| Gary, Hammond, E. Chicago | 218,000 | 114.2 | 130.8 | 16.6 | 0.87 |
| South Bend | 99,000 | 103.6 | 134.4 | 30.8 | 0.77 |
| Terre Haute | 53,000 | 54.5 | 69.2 | 14.7 | 0.79 |

## Table 5 - Comparison of Actual and Straight Line Highway Travel Time to Indianapolis from Various Cities: 2025

| Metropolitan Area | 1999 Population | Straight Line Travel Time (mins) | Actual Travel Time (mins) | Mileage Difference Straight Line vs. Actual | Time Linkage Index (S.L./Actual) |
|---|---|---|---|---|---|
| Anderson | 58,000 | 21.7 | 30.5 | 8.8 | 0.71 |
| Bloomington | 67,000 | 35.3 | 58.5 | 23.2 | 0.60 |
| Cincinnati | 331,000 | 79.6 | 94.1 | 14.5 | 0.85 |
| **Evansville** | **122,000** | **118.9** | **168.7** | **49.8** | **0.71** |
| Fort Wayne | 197,000 | 81.2 | 106.3 | 25.1 | 0.76 |
| Kokomo | 45,000 | 32.4 | 52.7 | 20.3 | 0.61 |
| Lafayette/W. Lafayette | 80,000 | 43.1 | 55.7 | 12.6 | 0.77 |
| Louisville | 253,000 | 87.2 | 110.3 | 23.1 | 0.79 |
| Muncie | 67,000 | 36.8 | 48.4 | 11.6 | 0.76 |
| Gary, Hammond, E. Chicago | 218,000 | 114.2 | 128.4 | 14.2 | 0.89 |
| South Bend | 99,000 | 103.6 | 139.9 | 36.3 | 0.74 |
| Terre Haute | 53,000 | 54.5 | 64.4 | 9.9 | 0.85 |

**Table 6- Ranking of Cities by Average Travel Time Difference and Travel Time Index to Indianapolis, 1998 and 2025**

| Metropolitan Area | 1999 Population | Average Time Difference | Time Difference Rank | Average Time Linkage Index | Time Linkage Index Rank |
|---|---|---|---|---|---|
| Anderson | 58,000 | 8.1 | 1 | 0.73 | 9 |
| Bloomington | 67,000 | 20.9 | 8 | 0.63 | 12 |
| Cincinnati | 331,000 | 15.4 | 5 | 0.84 | 2 |
| **Evansville** | **122,000** | **52.6** | **12** | **0.69** | **10** |
| Fort Wayne | 197,000 | 23.2 | 10 | 0.78 | 5 |
| Kokomo | 45,000 | 18.2 | 7 | 0.64 | 11 |
| Lafayette/W. Lafayette | 80,000 | 12.9 | 4 | 0.77 | 6 |
| Louisville | 253,000 | 21.9 | 9 | 0.80 | 4 |
| Muncie | 67,000 | 11.3 | 2 | 0.76 | 7 |
| Gary, Hammond, E. Chicago | 218,000 | 15.4 | 6 | 0.88 | 1 |
| South Bend | 99,000 | 33.6 | 11 | 0.76 | 8 |
| Terre Haute | 53,000 | 12.2 | 3 | 0.82 | 3 |

The travel time analysis shows Evansville is last and third-last among the 12 cities by these two measures. The difference between the actual and straight-line travel times between Evansville and Indianapolis is, on average, more than 52 minutes. The difference is the largest of any of the 12 cities analyzed. For the city ranked next-to-last, South Bend, the difference was only 33 minutes. With respect to the Time Linkage index, Kokomo and Bloomington are ranked below Evansville due to congestion and delay on US 31 and SR 37, respectively.

## 2.3 Summary

Compared to the other metropolitan areas in Indiana, as well as two which border Indiana, the connection between Indianapolis and Evansville is the worst of any large city. INDOT has no standards suggesting by how much this connection should be improved. However, if the difference between the straight line and actual time and mileage for Evansville were halved, the mileage and travel time savings for a trip between the two cities would be reduced by about 16 miles and 26 minutes, respectively. Even then, the difference between the actual and straight line time and distance would be near the highest for any of the cities studied.

# 3.0 Regional Accessibility

## 3.1 Introduction

The concept of personal accessibility relates to the ease with which residents of a particular region can travel to population and employment centers and other types of attractions. The other types of attractions include health facilities, educational institutions, airports, and cultural events. Generally, a region which is well-connected internally and externally to common travel destinations has a high degree of accessibility. By contrast, a region that has a less-well-developed highway network will generally have a low degree of accessibility.

The concept of accessibility as a measurable factor comes from the study of geography. It measures *how easy* it is for people to reach destinations that they need to get to. It also measures the *relative attractiveness* of these destinations based upon their size.

An *accessibility index* provides a quantitative measure of the *attractiveness* of destinations of a particular kind, and *how quickly* travelers can get there. It does this by using mathematical calculations which take into account both travel time and the size of the attraction to which people travel.

We will now explain some key concepts in the calculation of the accessibility index. Then, we will describe the various accessibility calculations. Then, we will provide the results in both graphic and table format.

## 3.2 Key Concepts

The accessibility indices were calculated using the Indiana Statewide Travel Demand Model. Given below are some key concepts involved in using the Model to calculate accessibility indices.

- Traffic Analysis Zone (TAZ). The entire modeled area (See Figure A2 in the Appendix) was divided into traffic analysis zones (TAZs). Each TAZ represents a portion of a county (TAZs do not cross county boundaries). TAZs follow census geography. TAZs are characterized by a relatively consistent type of land use. For example, urban and rural areas generally would not be included within the same TAZ. Within the Study Area, there are 229 Traffic Analysis Zones.

- Attractive Force (AF). For the purposes of each index, each TAZ was assigned an "Attractive Force" (AF). This AF measures the amount of a particular attraction contained in each zone. For each of the accessibility measures, the AF was defined as follows:

  - **Access to Population.** For each TAZ, AF was defined as the population in that zone. Separate analyses were done using 1998 and forecasted 2025 population.
  - **Access to Employment.** For each TAZ, AF was defined as the employment in that zone. Separate analyses were done using 1998 and forecasted 2025 employment.
  - **Access to Urban Areas.** AF is a binary variable. If the TAZ were the CBD of an urban area (defined as a city with a population of at least 50,000), then AF is equal to 1. Otherwise, AF is equal to 0.
  - **Access to Airports.** If a TAZ contains an airport with scheduled commercial passenger service, AF is the annual number of air passenger enplanements. Otherwise, AF is equal to 0.
  - **Access to Universities.** If a TAZ contains a college or university with an enrollment of at least 2,500 students, AF is the number of students enrolled. Otherwise, AF is equal to 0.
  - **Access to Indianapolis.** The TAZ for downtown Indianapolis has an AF of 1,000. All other TAZs have an AF of 0.

  AF is specified for all TAZs in the model, including those outside of the State of Indiana. The model includes large portions of Michigan, Ohio, Kentucky, and Illinois. Thus, for example, the calculations of accessibility to Airports would include enplanements at Chicago O'Hare and Midway Airports. Thus, regions of Indiana near its borders are not at a disadvantage, since their accessibility to attractions outside of Indiana are taken into account.

- Network Travel Time (t). For each TAZ, the model calculated the average travel time (for 24 hours) between that TAZ and each of the other TAZs in the entire model. The travel time used reflects traffic and intersection delays - it is the average time it would take during the day to travel between two TAZs. The travel time between the TAZs was adjusted by an impedance exponent, to reflect the fact that people do not respond to variations in travel time in a purely linear fashion. This impedance exponent is used to reflect people's actual behavior, in that drivers' willingness to travel to destinations drops significantly past a certain point. For this analysis, the value of the exponent is 0.5.

- Accessibility Index (AI). This is a formula which uses the factors described above to measure the relative access which a TAZ (and those living in it) have to various attractions. For a given TAZ, the attractive force in every *other* TAZ is divided by the

travel time to that zone (raised to an exponent). These quotients are computed for all TAZs, and then summed. This sum represents the accessibility of that TAZ to a given attraction. If the value of this index is high for a TAZ, that TAZ has *high* accessibility to that attraction. If the value of this index is low for a TAZ, that TAZ has *low* accessibility to that attraction. The formula to calculate the AI for a given zone is as follows:

$$AI = \sum_{j} \frac{AF_j}{t_{ij}^{x}}$$

$AI$ = Accessibility Index
$AF_j$ = Attractive force at zone j
$t_{ij}$ = Network travel time between i and j
$x$ = Impedance exponent

These indices showed that, compared with the rest of Indiana, the I-69 Study Area has significantly poorer accessibility. Tables 7 - 12 summarize the results of the accessibility computations for accessibility to population, employment, urban areas, airports, and universities. The accessibility to Indianapolis analysis is addressed in a following section. The accessibility analyses are given for all TAZs, as well as rural and urban TAZs separately.

## 3.3 Summary of Results

**Table 7 - 1998 Overall Accessibility Analysis**

| Accessibility Measure | All Study Area Zones | | Indiana Zones Outside of Study Area | | Difference Statistically Significant? |
|---|---|---|---|---|---|
| | Mean Accessibility Index | Number of Zones | Mean Accessibility Index | Number of Zones | |
| Population | 1,622,576 | 229 | 1,785,439 | 474 | Yes |
| Employment | 981,617 | 229 | 1,078,266 | 474 | Yes |
| Urban Area | 1,732 | 229 | 1,854 | 474 | Yes |
| Airport | 1,081 | 229 | 1,218 | 474 | Yes |
| University | 22,311 | 229 | 22,137 | 474 | No |

## Table 8 - 2025 Overall (No Build) Accessibility Analysis

| | All Study Area Zones | | Indiana Zones Outside of Study Area | | |
|---|---|---|---|---|---|
| Accessibility Measure | Mean Accessibility Index | Number of Zones | Mean Accessibility Index | Number of Zones | Difference Statistically Significant? |
| Population | 1,864,105 | 229 | 2,050,464 | 474 | Yes |
| Employment | 1,303,116 | 229 | 1,078,266 | 474 | Yes |
| Urban Area | 1,740 | 229 | 1,874 | 474 | Yes |
| Airport | 1,100 | 229 | 1,242 | 474 | Yes |
| University | 22,435 | 229 | 22,115 | 474 | No |

## Table 9 - 1998 Urban Zone Accessibility Analysis

| | All Study Area Zones (Excluding Marion Co.) | | Indiana Zones Outside of Study Area | | |
|---|---|---|---|---|---|
| Accessibility Measure | Mean Accessibility Index | Number of Zones | Mean Accessibility Index | Number of Zones | Difference Statistically Significant? |
| Population | 1,631,779 | 37 | 1,878,490 | 115 | Yes |
| Employment | 988,765 | 37 | 1,138,495 | 115 | Yes |
| Urban Area | 1,830 | 37 | 1,969 | 115 | Yes |
| Airport | 1,081 | 37 | 1,314 | 115 | Yes |
| University | 23,858 | 37 | 23,704 | 115 | No |

## Table 10 - 2025 (No Build) Urban Zone Accessibility Analysis

| | All Study Area Zones (Excluding Marion Co.) | | Indiana Zones Outside of Study Area | | |
|---|---|---|---|---|---|
| Accessibility Measure | Mean Accessibility Index | Number of Zones | Mean Accessibility Index | Number of Zones | Difference Statistically Significant? |
| Population | 1,880,704 | 37 | 2,160,480 | 115 | Yes |
| Employment | 1,315,025 | 37 | 1,517,806 | 115 | Yes |
| Urban Area | 1,848 | 37 | 1,997 | 115 | Yes |
| Airport | 1,100 | 37 | 1,340 | 115 | Yes |
| University | 24,106 | 37 | 23,738 | 115 | No |

| Table 11 - 1998 Rural Zone Accessibility Analysis | | | | | |
|---|---|---|---|---|---|
| | All Study Area Zones | | Indiana Zones Outside of Study Area | | |
| Accessibility Measure | Mean Accessibility Index | Number of Zones | Mean Accessibility Index | Number of Zones | Difference Statistically Significant? |
| Population | 1,568,842 | 164 | 1,755,632 | 359 | Yes |
| Employment | 945,109 | 164 | 1,058,972 | 359 | Yes |
| Urban Area | 1,655 | 164 | 1,818 | 359 | Yes |
| Airport | 1,039 | 164 | 1,187 | 359 | Yes |
| University | 20,958 | 164 | 21,635 | 359 | Yes |

| Table 12 - 2025 (No Build) Rural Zone Accessibility Analysis | | | | | |
|---|---|---|---|---|---|
| | All Study Area Zones | | Indiana Zones Outside of Study Area | | |
| Accessibility Measure | Mean Accessibility Index | Number of Zones | Mean Accessibility Index | Number of Zones | Difference Statistically Significant? |
| Population | 1,804,202 | 164 | 2,014,958 | 359 | Yes |
| Employment | 1,256,138 | 164 | 1,406,807 | 359 | Yes |
| Urban Area | 1,669 | 164 | 1,834 | 359 | Yes |
| Airport | 1,061 | 164 | 1,211 | 359 | Yes |
| University | 21,292 | 164 | 21,595 | 359 | No |

## 3.4 Analysis of Accessibility Results

Following are some key points regarding this analysis:

- The "accessibility measure" refers to the analysis of accessibility to each factor indicated. See bullet point "Attractive Force (AF)" above for more information.

- The "Mean Accessibility Index" refers to the average value of that index in all TAZs indicated. For example, in Table 12, the mean accessibility index for access to universities for rural Study Area zones is 21,292. This means that the average value for this index in the 164 rural Study Area TAZs is 21,292.

- "Number of zones" refers to how many TAZs are in that category. For example, Table 12 indicates that there are 164 rural TAZs in the Study Area.

- The test of statistical significance was done using a t test for a difference of means. "Yes" indicates that the Study Area and the rest of the state had accessibility indices which are significantly different from each other. The judgments regarding "statistical difference" have been made with 95% confidence.

- When analyzing urban TAZs, any TAZs in Marion County were excluded from the analysis. This was done because highly urbanized Marion County is unique within the state of Indiana. Due to its sheer size, its inclusion would distort All other counties in the Indianapolis MSA were included in this analysis. This allows a fair comparison to be made between urban regions in the Study Area and the rest of the state.

- This analysis was done both for the existing (1998) network, as well as for the 2025 network which includes committed projects (but no I-69).

Following is a summary of key conclusions from this analysis.

- TAZs in the Study Area have a lower level of accessibility to population, employment, urban areas, and airports. This is true for both urban and rural TAZs. This is true both in the base year (1998), as well as the forecast year (2025).

- Generally, the Study Area has a similar level of accessibility to higher education as the rest of the state. The central location of Indiana University within the Study Area provides a level of accessibility to higher education comparable to that which the rest of the state enjoys.

- Even though regional airports are found in Evansville and Louisville, they provide significantly lower access to air travel, compared with that enjoyed in the rest of Indiana. Specifically, the much larger number of travel choices available in Indianapolis and Chicago area airports provide much more access to air travel than do airports in Evansville and Louisville.

- Lower levels of access to all attractions becomes more pronounced for TAZs in the Study Area further to the south and west. See Figures A3 - 7 in the Appendix.

## 3.5 Accessibility to Indianapolis

A separate accessibility-to-Indianapolis analysis was performed. In this analysis, TAZs in both the Study Area and the rest of the state were grouped into concentric rings, based upon their distance from downtown Indianapolis. The accessibility formula given above was used to perform this analysis. The value of the Attractive Force (AF) was set equal to 1000 for the TAZ

containing downtown Indianapolis, and was set equal to 0 for all other zones. Table 13 gives a summary of the results.

**Table 13 - 1998 Accessibility to Indianapolis Analysis**

| Distance from Indianapolis | All Study Area Zones | | Indiana Zones Outside of Study Area | | Difference Statistically Significant? |
|---|---|---|---|---|---|
| | Mean Accessibility Index | Number of Zones | Mean Accessibility Index | Number of Zones | |
| 0 - 50 miles | 206.76 | 93 | 181.36 | 186 | Yes |
| 50 - 100 miles | 105.47 | 70 | 108.33 | 278 | Yes |
| 100 - 150 miles | 79.04 | 66 | 84.28 | 239 | Yes |

For TAZs which are very close to Indianapolis (within 50 miles), the Study Area has better accessibility to Indianapolis. However, for TAZs 50 miles away and greater, the Study Area has poorer accessibility. Also, this gap in accessibility grows wider as you get further from Indianapolis. See Figures A8 - 10 in the Appendix map the statistics presented here.

## 3.6 Accessibility and Regional Economics

One other step in the accessibility analysis was to examine the relationship between accessibility and income. TAZs throughout the state were examined to determine the relationship between their accessibility, and the median household income in that TAZ. The analysis demonstrated that there is a demonstrable relationship *throughout the state* between a TAZ's accessibility, and the median household income in that TAZ. Table 14 gives the results of a correlation analysis measuring the relationship between accessibility and median household income.

**Table 14 - Connection Between Accessibility and Economic Development**

| Variables (Median Household Income Estimated for 1998) | Correlation | Statistical Significance ? |
|---|---|---|
| Population Accessibility vs. Median Income (all Indiana zones) | 0.384 | Yes |
| Population Accessibility vs. Median Income (Study Area only) | 0.448 | Yes |
| Population Accessibility vs. Median Income (all rural Indiana zones) | 0.302 | Yes |
| Population Accessibility vs. Median Income (rural zones, Study Area only) | 0.181 | Yes |

Note: Similar results are obtained from employment accessibility measures, due to very strong collinearity between population and employment accessibility.

This analysis shows that for a variety of geographical groupings, a statistically demonstrable relationship exists between accessibility and median household income. Economic development measures (income) have a valid statistical connection with accessibility, but only explain a portion of the spatial variation of economic development. Nevertheless this shows that, all other things being equal, there is a positive relationship between regional accessibility and levels of household income. The relationship is stronger in urban areas than in rural areas, but exists to some degree in both urban and rural settings.

## 3.7 Summary

By nearly all measures examined, the Study Area has statistically poorer accessibility than the rest of Indiana. It has poorer accessibility to population, employment, urban areas, and airports. The portions of the Study Area which are more than 50 miles from Indianapolis have poorer accessibility to Indianapolis than similarly situated areas elsewhere in the state.

In addition, there is a demonstrable, though not overpowering, relationship throughout Indiana between accessibility and median household income. A region's accessibility, or lack thereof, partially explains the income level of its residents. The greater a region's accessibility, the greater its median household income tends to be.

# 4.0 Travel Efficiency (Congestion)

## 4.1 Introduction

Any major highway project has the potential to increase travel efficiency by relieving congestion. The I-69 project from Evansville to Indianapolis is not proposed as a travel efficiency project. However, given the magnitude of the highway investment which may result from this project, it is prudent to consider whether there are now or may in the future be significant travel efficiency problems which could be addressed by the proposed project.

Travel efficiency refers to the level of traffic congestion on a particular roadway or network. In technical terms, travel efficiency reflects the difference between traffic volume and roadway capacity. If the traffic volumes on a highway system exceed the system's capacity, the level of traffic congestion will be relatively high and the travel efficiency will be low. By contrast, if traffic volumes are significantly *below* the capacity of the system, the level of traffic congestion will be relatively low and the travel efficiency will be high.

Travel efficiency is measured in different ways. In this study, two separate measures are used:

- Level of Service (LOS). The level-of-service rating is a simple, widely-accepted method for describing traffic conditions. The scale ranges from Level of Service A (free-flowing traffic) to Level of Service F (highly congested conditions). Generally, when designing a highway to accommodate future traffic flows, the minimum acceptable condition in rural areas is Level of Service C. For a full discussion of levels of service, see *Technical Report 3.2, Project Issues and Performance Factors*, September 5, 2000, pp. 15 - 16. For this discussion, we cite the description from this report of Levels of Service E. Level of Service E represents the level of traffic at which a road operates at maximum capacity - that is, the road serves the maximum number of vehicles which it physically can accommodate. However, at Level of Service E, vehicle speeds are noticeably reduced from those which are possible under free-flowing conditions.

- Volume-to-Capacity Ratio (v/c). Volume-to-capacity ratios provide more precise measurements of traffic conditions than level-of-service ratings. Each level-of-service category includes a range of traffic conditions - some at the "low" end of that category, and others at the "high" end of that category. A volume-to-capacity ratio, by contrast, provides a more precise measurement for each roadway. It is calculated by comparing the roadway's traffic volume (the actual number of vehicles per day) to the roadway's capacity (the number of vehicles that can be accommodated each day at Level of Service E).

The starting point for calculating level of service and volume-to-capacity ratios is to determine the traffic volumes on roadways within Southwest Indiana. Traffic volumes are measured in two ways:

- Average Daily Traffic (ADT). The average daily traffic (ADT) is the average number of vehicles that use a particular roadway segment each day.

- Vehicle Miles Traveled (VMT). The vehicle miles traveled (VMT) for a roadway segment is calculated by multiplying the ADT for that segment by the length of the segment. The sum of the VMT for all segments in a region produces estimated VMT for that entire region.

## 4.2 Analysis

Both ADT and VMT for roadways in Southwestern Indiana were calculated for the base year (1998) and the design year (2025), using the Indiana Statewide Travel Model.

Table 15 summarizes the changes in forecasted daily VMT between 1998 and 2025, comparing the Study Area to the rest of Indiana. These are based upon assignments from the Indiana Statewide Travel Demand Model. It shows that the compounded annual increase in VMT in the Study Area is about one-half that of Indiana as a whole. For purposes of this comparison, the nine counties of the Indianapolis MSA are excluded from both categories.

**Table 15 - Growth in Daily Forecasted VMT between 1998 and 2025**

| | Vehicle Miles of Travel (VMT) | | | |
|---|---|---|---|---|
| | 1998 Assignment | 2025 Assignment | Difference | Compounded Annual Growth Rate |
| Study Area | 17,163,000 | 19,294,000 | 2,131,000 | 0.43% |
| Indiana | 84,061,000 | 103,701,000 | 19,640,000 | 0.78% |

Table 16 gives a key set of efficiency measures, volume/capacity ratio (v/c) by functional classification. The other travel efficiency measures show similar results in comparing the Study Area with the rest of the state.

**Table 16 - V/C by Functional Classification**

| | Base Year (1998) | | Future Year (2025) | |
|---|---|---|---|---|
| **V/C For (Functional Classification)** | **Study Area** | **All of Indiana** | **Study Area** | **All of Indiana** |
| Rural Interstates | 0.35 | 0.53 | 0.44 | 0.68 |
| Other Rural Principal Arterials | 0.41 | 0.40 | 0.47 | 0.50 |
| Rural Minor Arterials | 0.26 | 0.31 | 0.28 | 0.39 |
| Rural Major Collectors | 0.16 | 0.17 | 0.15 | 0.20 |
| | | | | |
| Urban Interstates | 0.40 | 0.88 | 0.45 | 0.90 |
| Urban Freeways | 0.52 | 0.55 | 0.62 | 0.53 |
| Urban Principal Arterials | 0.81 | 0.66 | 0.53 | 0.75 |
| Urban Minor Arterials | 0.47 | 0.43 | 0.57 | 0.50 |

As Table 16 shows, roads generally are *less* congested in the Study Area than in the rest of the state. Both rural and urban interstates are significantly more congested elsewhere in the state than they are in the Study Area. However, it is expected that there will be areas with significant traffic congestion by the forecast year of 2025. Figure A11 in the Appendix shows some roads forecasted to be highly congested by the year 2025. Areas of forecasted high congestion include many roads near Indianapolis, SR 37 north of Bloomington, US 41 in various locations between Evansville and Vincennes, and US 231 in much of the Study Area.

## 4.3 Summary

While congested conditions are not forecasted to be a major problem throughout the Study Area, some areas are forecasted to be highly congested by 2025. While congestion relief does not need to be a primary focus of this project, it would be prudent to evaluate alternative routes as to whether they would address any of these forecasted congestion problems noted above.

# 5.0 Conclusion

The Regional Transportation Needs Analysis Summarizes the major findings of the transportation needs analysis, conducted as part of the Purpose and Need Analysis for the I-69, Evansville to Indianapolis Study. The major conclusions reached include the following:

- The connection which Evansville has to Indianapolis is the worst of any major city in Indiana. The quality of its connection, as measured by comparing a straight line connection with the actual quickest route, shows that the existing connection which Evansville has to Indianapolis is significantly worse than that enjoyed by any other major city in Indiana.

- By nearly all measures examined, the Study Area has statistically poorer accessibility than the rest of Indiana. It has poorer accessibility to population, employment, urban areas, and airports. The portions of the Study Area which are more than 50 miles from Indianapolis have poorer accessibility to Indianapolis than similarly situated areas elsewhere in the state.
- There is a demonstrable, though not overpowering, relationship throughout Indiana between accessibility and median household income. A region's accessibility, or lack thereof, partially explains the income level of its residents. The greater a region's accessibility, the greater its median household income tends to be.

- While congested conditions are not forecasted to be a major problem throughout the Study Area, some areas are forecasted to be highly congested by 2025. While congestion relief does not need to be a primary focus of this project, it would be prudent to evaluate alternative routes as to whether they would address any of these forecasted congestion problems noted above.

This analysis suggests that major issues to be addressed by the proposed project should include improving the connection of Evansville to Indianapolis, as well as improving accessibility throughout the region. Addressing congestion is a secondary issue, although it will be useful to determine whether routes would help alleviate certain localized congestion which has been forecasted. Regional safety issues, the other part of the Regional Transportation Needs Analysis, have been addressed in a separate report, *Task 3.3.4.1 Technical Report, Regional Safety Analysis.*