3.0 SYSTEMWIDE SCENARIO DEVELOPMENT & EVALUATION

3.1 Base Conditions Data

The foundation of the corridor studies conducted in CISTMS is a complete definition of existing conditions. An inventory of physical and operating characteristics of each of the state highways in the CISTMS corridors was first presented in the Base Conditions Report. This information is included in Chapters 5 through 8 of this report. It provides a reference point for studies of future conditions within each corridor and provides base data for evaluating potential strategies for maximizing system efficiency.

The primary information sources used to identify and evaluate existing conditions in each CISTMS corridor are listed and briefly described below.

- INDOT Road Inventory Files and Videolog Data. These descriptive files (now electronic) have been maintained by INDOT over many years to describe the physical characteristics of state highways on a segment by segment basis. They provide location-specific information on pavement width, right of way width, number of lanes, speed limits, shoulders, grades, passing zones, access points and many other descriptive items. These files were the primary source of information for the physical features summaries of CISTMS.

- INDOT Traffic Data Summaries. Operational characteristics of the state highways in the CISTMS corridors are summarized based on traffic data files provided by INDOT. Traffic volumes (peak hour and daily), operating speeds, and travel times are taken or derived from these files. The INDOT traffic data summaries are the primary source of information for the traffic operations review of CISTMS.

- Aerial and Ground Photography. Aerial photography was used to identify existing conditions within each of the study corridors. At many locations, these aerial photographs are also used in this report to identify recommended improvements in the context of the surrounding area. Ground photography is used for a similar purpose—to verify or review field conditions and to describe those conditions in this report.

- Local Plans and Studies. Available transportation plans were compiled for virtually all of the communities in the CISTMS study corridors in order to supplement other data sources on community characteristics and to provide a solid base of information regarding local agency plans. In addition, studies of special topics (i.e. East – West corridor in Johnson County, White River bridge studies in Hamilton County) were provided by local agencies to support the studies of specific issues or opportunities in the corridor.

- Other Data Sources. Other information was gathered for specific elements of the review. Examples include accident data from the Indiana State Police; and population, employment and commuting data from the U.S. Census. Corridor information was supplemented by field observations of every CISTMS corridor.

3.2 Potential Strategies to Maximize System Efficiency

One of the uses of base conditions data in CISTMS is the evaluation of strategies to maximize the efficiency of the existing system. The intent is to identify lower cost, short-range improvements with a potential for improving conditions as they exist today. Options at this stage would be relatively inexpensive and easier to implement than the added travel lane or new facility options being evaluated for serving long-term needs.

Potential strategies are reviewed for each state highway corridor segment in Chapters 5 through 8 of this report based on information from the data sources described in Section 3.1. These strategies and their relationship to base conditions data are described below.

Access Management. Effective management of access can have significant impacts on safety and capacity of roadway sections. The relationship between the number of access points per mile, free flow speeds, and accident rates is indicated below:

Access Points per Mile	Reduction in Free-Flow Speeds*	Increase in Crash Rates**
0	0.0%	---
10	2.5%	base
20	5.0%	30%
30	7.5%	70%
40 or more	10.0%	110%+

Sources: *Table 7-5, 1994 Highway Capacity Manual
**Office of Access Management, Minnesota DOT, 1999

Managing access "after the fact" for an existing roadway is certainly more challenging than implementing effective access controls when a facility is constructed. Nevertheless, it is useful to identify this as an area for potential improvement should favorable conditions arise. For the purposes of this report, 20 to 40 access points per mile on rural roadway sections is considered high. More than 40 access points per mile in rural sections is considered very high. Urban areas may have even higher access density, but options for reducing access points within a street grid are virtually nonexistent.

One access management option that is often effective on existing roadways is the provision of a non-traversable median. Depending on available right of way, this may be a grassed median (typically installed with shoulder sections), a curbed island, or a barrier. Medians have the dual benefit of separating vehicles traveling in opposite directions and controlling left turning movements across the traffic stream. For the purposes of this review, medians are considered only for multilane roadways.

Traffic Engineering Improvements. These could include a range of features, such as traffic signals, auxiliary turn lanes, traffic signal retiming, pavement markings, speed limit changes, channelization, median placement, passing blisters, and other actions related to traffic control devices or localized roadway modifications. By their nature, traffic engineering improvements require a detailed understanding of site-specific operations. As such, they do not lend themselves well to systematic general planning recommendations.

For the purposes of this report, the potential for improving existing conditions by means of traffic engineering improvements is identified based on discussions with state and local personnel closely familiar with local conditions, and on observed conditions in the field. These potential locations/improvements are subject to adjustment or elimination based on more detailed field studies and evaluations.

Intelligent Transportation Systems (ITS). Intelligent transportation system actions relate to the use of technology to better manage roadway system operations. This is accomplished by monitoring roadway conditions, improving motorist information, coordinating traffic control devices, and improving incident detection and response. The most promising strategies for arterial roadways such as these are incident detection (detectors or closed circuit television/CCTV), motorist information devices (variable message signs/VMS and highway advisory radio/HAR), incident response programs, and traffic signal system coordination.

Generally, potential ITS applications do not lend themselves well to the systematically collected inventory and descriptive data compiled for this report. As with traffic engineering improvements, potential ITS actions are identified based on discussions with state and local personnel closely familiar with local conditions, and on observed conditions in the field.

Transportation Demand Management (TDM). Transportation demand management actions address the demand rather than supply side of transportation system operations. The concept is to reduce system use during peak periods when conditions are the worst. Staggered work hours, ridesharing and flexible working hours are examples of actions that impact peak hour demand. Land use changes and reductions in employment concentrations might also be considered TDM actions since the affect the “supply side” of the transportation system needs.

A potential for TDM actions is identified in this study where roadways demonstrate sharp peaking characteristics and/or land use is particularly intense, or where the potential benefits have been identified (based on more detailed area knowledge) by state and local personnel closely familiar with local conditions.

3.3 Overview of Base Conditions by Corridor

Physical and operating conditions vary widely within each of the four CISTMS corridors. Existing roadway facilities pass through both urban and rural areas with corresponding differences in traffic operations as explained in section 2.4. As might be expected, the resulting analysis of existing conditions relative to the Study Goals listed in section 1.3 is also highly varied. For this reason, each of the study routes within the corridors was divided into relatively homogeneous sections by county. Each section was then evaluated for level of service, operating speed, travel time and accident rates. In Chapters 5 through 8, both the physical features and traffic operations are described in charts correlated to location along the state highway facilities. Summary statistics are also provided on a section by section basis.

Just as conditions vary from one location to another within each corridor, the corridors themselves vary in terms of the service they provide. Table 3A summarizes levels of service (LOS) and average operating speeds for both rural and urban conditions for each of the corridors, based on existing conditions.

Table 3A Corridor Travel Characteristics Existing Conditions

	SR 32 North Corridor	SR 9 East Corridor	SR 44 South Corridor	SR 39 & SR 267 West Corridor
Percentage of Sections with Existing LOS worse than C	63%	31%	68%	40%
Average Operating Speed – Urban areas	27 mph	30 mph	29 mph	31 mph
Average Operating Speed – Rural areas	39 mph	57 mph	42 mph	39 mph

As the table indicates, the East Corridor currently provides the best level of service and the highest operating speeds. This relates to the fact that the terrain is relatively flat and much of Hancock and Shelby Counties are still not urbanized. The poorest overall service levels are in the North and South Corridors. In the North Corridor, this is a result of urbanization, particularly in the eastern half of the corridor. In the South Corridor, the poor levels of service are also related to increased urbanization. In addition, difficult terrain and poor geometrics play a significant role, particularly in the western portions of the corridor.

3.4 Forecasts of Future Conditions

Future conditions used in CISTMS analyses were estimated using travel demand and land use simulation models unique to Central Indiana. These models were developed and made available by the Indianapolis MPO, INDOT and the IUPUI Center for Urban Policy and the Environment. A brief overview of these tools is provided here. A much more detailed discussion of these models and how they were applied in CISTMS is provided in a separate Technical Memorandum entitled, "Central Indiana Suburban Transportation and Mobility Study Transportation and Land Use Assessment," dated August, 2004.

The primary tool used in CISTMS is the Indianapolis nine-county travel demand model. This newly updated version of the model was recently modified by the Indianapolis MPO to address areas beyond the MPO's ordinary planning area. The coverage area was expanded to all nine Central Indiana counties so that regional air quality issues could be properly addressed. This expanded coverage was ideal for use in CISTMS.

During the initial stages of CISTMS, a full model review was undertaken to assess the sensitivity of the travel demand model to the analysis needs of this study. The following changes to the model were made:

- Socioeconomic data was updated to provide a consistent base with the land use model used in CISTMS.

- Procedures to estimate external truck and auto traffic were adjusted to incorporate regional dynamics from INDOT's Statewide Model.

- Roadways were added to the base networks representing facilities from the long-range plan that are not yet programmed but can be expected to be in place by 2025, including the construction of I-69 toward Evansville, the upgrading of U.S. 31 in Hamilton County, the widening of I-465, and other facilities identified in coordination with INDOT and the Indianapolis MPO.

- Existing roadways in outlying areas not currently well represented in the base networks were added to provide a more comprehensive review of future needs and options.

One of the more notable technical procedures in CISTMS was the adjustment of the MPO's Nine-County travel demand model to incorporate external trip (to/from outside the area) and truck trip outputs of the INDOT Statewide Model. In this way, the strengths of both models were incorporated in the forecasting of future travel on CISTMS corridors. This was particularly important for evaluating potential effectiveness of freeway-level improvements, such as the provision of an outer belt built to Interstate highway standards.

The third model used to forecast future conditions is the Land Use in Central Indiana (LUCI) regional land use model developed by the Center for Urban Policy and Environment at IUPUI. LUCI was originally developed to evaluate the effects of policy alternatives on a 44-county area covering much of Indiana, centered on Indianapolis. For CISTMS, the LUCI model was reduced to the nine-county study area and enhanced to incorporate travel time rather than distance as a measure of accessibility. Travel times were based on outputs of the Indianapolis MPO travel demand model. An adjustment was made to input employment forecasts (developed by an expert panel for CISTMS), and the resulting modified model, referred to as LUCI/T, was used to evaluate land use impacts of an outer belt (See Chapter 4.)

3.5 Scenario Development

Using the travel demand simulation models described in Section 3.4, a range of scenarios was simulated to evaluate future operations with various levels of facility improvement. The term "scenario" is used (rather than "alternative") to identify different systemwide travel demand model networks because they are not intended to represent alternatives where one alternative would be chosen based on some areawide criteria. Rather, the intent of the scenarios is to test and evaluate different facility improvements section by section in each corridor. Generally speaking, most of the corridors will operate independently from the others and even sections within a corridor may operate independently. Thus, appropriate improvement levels may vary considerably from one section to another, even on the same route.

The base 2025 network includes the roadway improvements currently adopted for the study year by the Indianapolis MPO, INDOT and local agencies outside the Metropolitan Planning Area (MPA). This network is referred to as the Base Scenario or "Current Plan" network in this report. It is used to identify potential future problem areas as well as to serve as the "Do Nothing" alternative for comparison with other alternative improvement networks.

Initially in the scenario evaluation process only one "build" scenario (Scenario 1) was developed for travel modeling. It provided a new freeway outer loop through all of the study corridors. This was used in the "bookend" approach for initial corridor evaluations. The Base Scenario represented the do nothing end of the spectrum while Scenario 1 represented the highest or maximum transportation change that might be expected in the study corridors. Scenario 1 included a limited number of interchanges or access points to the road network with a distance of at least three miles between interchanges.

The development and analysis of Scenario 1 served three purposes:

1. To identify the maximum diversion of regional trips from the primary corridor facilities to determine if traffic operations on those facilities would improve significantly.

2. To determine whether sufficient regional travel demand was attracted to the new freeway to justify further consideration of all or part of an outer belt in INDOT long-range planning.

3. To determine if an outer belt would significantly change future land use development patterns, which would in turn affect future travel demand.

The results of the system level analysis of these "bookend" scenarios are presented in the document, "Transportation and Land Use Assessment" (August, 2004). A review of forecasted future conditions with these scenarios yielded the following conclusions:

1. Although Scenario 1 provided modest relief to some roadways estimated to have congestion related problems in the Year 2025, the overall traffic volumes using the outer loop freeway were generally very low by freeway standards, averaging less than 40,000 vehicles per day. The low estimated future traffic volumes attracted to the outer loop freeway, in combination with anticipated land use impacts and an estimated cost of approximately $1.6 billion, supported the development of other improvement scenarios.

2. Although the traffic patterns changed significantly between the Base Scenario network and Scenario 1, the maximum change scenario has a generally negligible impact on regional development patterns.

The results of the travel model simulation of the Base Scenario network and Scenario 1, plus additional traffic analysis of potential improvements using the Base Scenario estimated traffic volumes, were reviewed with INDOT District Development Engineers and other INDOT staff to determine logical improvement scenarios to be evaluated further. In addition to these meetings, discussions and meetings with local agency representatives were held to identify local planning efforts that may not be formally adopted or approved, but have a high potential for future development. These facilities included the Ronald Reagan Parkway extension in Boone County, the proposed East-West Corridor in Johnson County, and others.

Based on these discussions and reviews, two improvement scenarios were developed in addition to the Base Scenario and Scenario 1, and are described as follows:

Scenario 4 – Additional Physical Improvement. This scenario provided lane additions, reconstruction or rehabilitation improvement to selected sections in each corridor. Potential improvements were defined based on an assessment of anticipated total traffic demand, traffic operations, accident history, current physical characteristics below current design standards and potential right-of-way impacts. Roadway reconstruction assumes pavement replacement with standard lane/shoulder widths, clear zones, passing lanes and geometric improvements. Roadway rehabilitation assumes pavement resurfacing with standard lane/shoulder widths.

Scenario 5 – Physical Improvements and Bypass Routes - In locations where added travel lanes or other physical improvements would be limited by significant right-of-way impacts, bypass routes were identified and evaluated. Generally, bypass routes were considered to provide relief or diversion of traffic from sections with poor operating characteristics or to reduce traffic impacts in downtown areas. At some locations, the bypass routes were assumed to be new facilities. At other locations the "bypasses" were created by improving existing facilities, either state highways or local roadways.

In sections where bypasses were not provided as additional network improvements, the improvements considered for Scenario 4 were repeated in the creation of Scenario 5.

One additional statewide travel demand model network was prepared that included the North-South Statewide Mobility Corridor located between SR 9 and SR 3. This corridor is located east of the Indianapolis metropolitan area, as shown in Figure 4-6. Although this corridor model development and assessment is somewhat independent of the CISTMS corridors, the potential effects upon SR 9 between I-69 and I-74 were potentially significant.

3.6 Consideration of Parallel Routes

Although there is a focus on state highways in the analysis of CISTMS corridors, potential solutions considered in this study are not limited to the state highway system. The planning process and the tools used in this analysis are structured to review corridor needs and opportunities in the context of the larger *grid* of regional roadways.

The grid is the best known form of transportation network because it is the most efficient for serving the two fundamental purposes for travel—accessibility and mobility. Accessibility to property is improved by proximity to a major roadway (suggesting more major roadways), whereas mobility is improved by higher capacity roadways (suggesting bigger roadways with more lanes and more restrictive access control).

Interstate highways are an example of roadways that provide excellent mobility, but poor accessibility due to the infrequent opportunities to enter of leave the facility. Many people will drive further to be able to us an Interstate highway for part of a long trip. On the other hand, local arterials that provide lower capacity but more direct service are preferable for shorter local or regional trips.

Alternatives are formulated and evaluated in CISTMS with a recognition that regional transportation needs are typically best served by a coordinated network of roadways that balance accessibility and mobility. This requires attention beyond a single roadway corridor to consider the quality and spacing of parallel arterial roadways. In setting the standard for functional classification in suburban areas, the Federal Highway Administration has provided the following spacing guidelines for arterials:

Area Type[1]	**Arterial Spacing**[1]
Central Business District (CBD)	1/8 to1/2 – mile
Urban (central city except DBD)	1/2 to1.0 – mile
Suburban Area	1 to 2 – mile

1. Federal Highway Administration, U.S. Department of Transportation, "Highway Functional Classification – Concepts, Criteria and Procedures," 1974, revised 1989, reprinted April 2000.

Most of the CISTMS study area would be characterized as suburban, or rural with a potential of becoming suburban. This suggests that the best arterial spacing would be one to two miles. This "rule of thumb" varies according to actual density and the location of major activity centers, but the concept remains the same. Motorists making short or intermediate distance trips are better served by a parallel system of roadways that disperses traffic demand than on a single high capacity facility that concentrates these trips.

Grid system planning concepts are applied in the analysis and recommendations for each CISTMS corridor as a matter of good planning practice. This begins with a description of parallel routes and ends with the selective consideration of local routes as potential solutions to anticipated problems. No policy implications with respect to funding or jurisdiction are intended by this approach. As stated in Chapter 1, the intent is to provide input to INDOT and local agency planners as they develop long range transportation plans for the region.

3.7 Scenario Evaluation

To determine potential future problem areas, the Indianapolis MPO Travel Demand Model was utilized as the base for developing Year 2025 travel demand estimates for alternative roadway improvement scenarios. A detailed traffic operations analysis was performed on each corridor section for the following scenarios:

- Base Scenario (Current Plan Network)
- Scenario 1 – Freeway in each corridor (Outer Belt)
- Scenario 4 – Base Scenario plus additional physical improvements at selected locations. The potential improvements varied by section and included added lanes, reconstruction of the existing roadway or rehabilitation of the existing roadway.
- Scenario 5 – Generally included most of the features of Scenario 4 plus additional by-pass facilities that could include improvements to existing roadways or new roadways in some locations.

Table 3B provides systemwide model statistics for the four scenarios. The addition of 135 miles of four-lane freeway as developed in Scenario 1 was found to have a significant influence on system-wide characteristics, but not necessarily on the corridors in the study. Common to all capacity restrained travel demand model simulations, the model tries to "balance" roadway links that have estimated volumes greater than roadway capacity with any new roadway capacity available in the network.

As would be expected with the maximum change (freeway) option, Scenario 1 has fewer total system roadway miles with a volume to capacity (V/C) ratio greater than 1.00 (congested) than the other scenarios.

Table 3B Systemwide Model Statistics

Statistic	2025Base Scenario	2025 Scenario 1	2025 Scenario 4	2025 Scenario 5
VMT (1,000's)	**65,498**	**66,686**	**65,560**	**65,513**
VHT (1,000's)	**1,895**	**1,878**	**1,887**	**1,887**
Average Computed Speed (mph)	**34.5**	**35.5**	**34.7**	**34.7**
Roadway Miles @ Volume to Capacity (V/C) Ratio				
V/C 0.00 to 0.50	**5,033**	**5,412**	**5,059**	**5,155**
V/C 0.50 to 0.75	**1,166**	**1,192**	**1,172**	**1,149**
V/C 0.75 to 1.00	**1,117**	**1,152**	**1,155**	**1,172**
V/C > 1.00	**1,532**	**1,327**	**1,481**	**1,451**

Although the systemwide modeling results presented in the above table are of interest, the primary purpose for modeling the different scenarios was to support detailed traffic analysis of each corridor section to identify the benefits of potential improvement options. These modeling results were also used to evaluate system-level changes including an outer freeway loop, a potential new north-south mobility corridor east of SR 9, and the completion of I-69 between Indianapolis and Evansville. Results for these three issues are presented in the next chapter (Chapter 4). Results and recommendations for the four CISTMS corridors are presented in Chapters 5 through 8.