APPENDIX I
PREVIOUS AREA STUDIES

CONGESTION MANAGEMENT SYSTEM (CMS) STUDY

prepared by:

EVANSVILLE URBAN TRANSPORTATION STUDY
1 NW Martin Luther King Boulevard
Room 316 - Civic Center Complex
Evansville, IN 47708

July 2004

This report financed in part through the Federal Highway Administration

and the Federal Transit Administration of U.S. Department of Transportation.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS....................i

I. INTRODUCTION....................1

II. CMS OBJECTIVES....................3

III. TYPES OF CONGESTION....................4

IV. INCIDENT MANAGEMENT....................4

V. MEASURING CONGESTION....................5

VI. CMS METHODOLOGY....................7

VII. CMS DATA ANALYSIS....................9
- A. Henderson County CMS....................9
  - 1. US 60/Green Street Corridor....................9
  - 2. US 41 Corridor....................9
  - 3. US 41A Corridor....................12
- B. Vanderburgh County CMS....................12
  - 1. Lloyd Expressway Corridor....................12
  - 2. US 41 Corridor....................12
  - 3. Darmstadt Road/First Avenue Corridor....................12

VIII. CONCLUSION....................13

APPENDIX 1: Congestion Management Strategies....................14

APPENDIX 2: Congestion Factors and Mitigation Actions....................17

TABLES:

Table 1: Incident Types....................5
Table 2: Travel Speed vs. Speed Limit Ratio Classification....................9

FIGURES:

Figure 1: EUTS Study Area....................2
Figure 2: Functional Classification Arterial and Above....................6
Figure 3: Existing Level of Service (Indiana Portion)....................8
Figure 4: Henderson County CMS Analysis....................10
Figure 5: Vanderburgh County CMS Analysis....................11

ACKNOWLEDGEMENTS

EVANSVILLE URBAN TRANSPORTATION STUDY POLICY COMMITTEE

Ms. Catherine Fanello	-	Chairperson, Vanderburgh Co. Commissioner
Mr. Stephen Melcher	-	V. Chairperson, City of Evansville
Mr. Jack Corn, Jr.	-	Evansville City Council Appointment
Mr. Jonathan Weinzapfel	-	Mayor, City of Evansville
Mr. Jeffrey Broughton	-	Henderson City Manager
Ms. Mae Mason	-	Newburgh Town Board
Mr. Lloyd Winnecke	-	Vanderburgh Co. Council
Mr. Don Williams	-	Warrick County Commission
Mr. J. Bryan Nicol	-	INDOT
Mr. Robert F.Tally, Jr.	-	Indiana FHWA (NV)
Ms. Joyce Newland	-	Indiana FHWA (NV)
Ms. Janet McCabe	-	Indiana DEM (NV)
Ms. Rhonda Reed	-	FTA (NV)
Mr. Jose Sepulveda	-	Kentucky FHWA (NV)
Mr. Maxwell Clay Bailey	-	KY Transp. Cabinet
Mr. Michael Hill	-	KY Transp. Cabinet (NV)
Mr. Edward H. Merryman	-	KY Transp. Cabinet (NV)
Mr. John Gowins	-	KY Division of Air Quality (NV)
Mr. Sandy Watkins	-	Judge Executive, Henderson County

EVANSVILLE URBAN TRANSPORTATION STUDY

Ms. Rose M. Zigenfus	-	Executive Director
Ms. Pamela Drach	-	Deputy Director/Chief Engineer
Mr. Seyed Shokouhzadeh	-	Chief Transportation Planner
Mr. Brian Howard	-	Senior Transportation Planner
Mr. Doug Lane	-	Transportation Planner
Mr. Craig Luebke	-	Transportation Planner
Ms. Melanie Wellman	-	Transportation Planner
Ms. Kari Akin	-	Accountant
Ms. Lauri Lutz	-	Secretary

(NV) = Non-Voting

TECHNICAL COMMITTEE

Mr. Patrick Keepes	-	Chairperson, Evansville City Engineer
Mr. John Stoll	-	V. Chairperson, Vanderburgh County Engineer
Mr. Brad Mills	-	Evansville-Vanderburgh Co. Area Plan Commission
Ms. Sherry Snodgrass	-	American Medical Response
Ms. Sandra Worman	-	ARC Industry
Mr. Steve Watson	-	CSX Transportation
Ms. Theo Boots	-	Evansville ARC
Mr. Rick Borries	-	Evansville Board of Public Safety
Mr. David Matthews	-	Evansville Chamber of Commerce
Mr. W. Gregg LaMar	-	Evansville Dpt. of Metropolitan Development
Mr. Ed Ziemer	-	Evansville Dpt. of Transportation & Services
Mr. Shawn Dickerson	-	Evansville Dpt. of Urban Forestry
Mr. Sherman Greer	-	Evansville Emergency Management Agency
Ms. Dona Bergman	-	Evansville Environmental Protection Agency
Mr. Glenn Boberg	-	Evansville Parks and Recreation Dept.
Lt. Andy Chandler	-	Evansville Police Department
Mr. Robert Working	-	Evansville Regional Airport
Mr. Herb Butler	-	Evansville Water & Sewer
Ms. Joyce Newland	-	Federal Highway Administration (Indianapolis)
Mr. Anthony DeSimone	-	Federal Highway Administration (Indianapolis)
Mr. Glenn Jilek	-	Federal Highway Administration (Kentucky)
Ms. Bernadette Dupont	-	Federal Highway Administration (Kentucky)
Ms. Rhonda Reed	-	Federal Transit Administration (Chicago)
Ms. Gina Boaz	-	Green River Area Development District
Ms. Pam Whitter	-	Henderson Area Rapid Transit
Ms. Peggy Wood	-	Henderson City-County Planning Commission
Mr. John Stroud	-	Henderson City Engineer
Mr. William Hubiak	-	Henderson County Engineer
Mr. William Howard	-	Henderson County Riverport
Ms. Janet McCabe	-	Indiana Dpt. of Environmental Management (Indianapolis)
Mr. Brian Jones	-	Indiana Dpt. of Transportation (Indianapolis)
Mr. Matthew Frazer	-	Indiana Dpt. of Transportation (Indianapolis)
Mr. Emmanuel Nsonwu	-	Indiana Dpt. of Transportation (Indianapolis)
Mr. Jay Mitchell	-	Indiana Dpt. of Transportation (Indianapolis)
Mr. John Curry	-	Indiana Dpt. of Transportation (Vincennes)
Mr. Dale Lucas	-	Indiana Dpt. of Transportation (Vincennes)
Mr. Jerry Russell	-	Indiana Dpt. of Transportation (Vincennes)
Mr. Charles Fooks	-	Indiana Southern Railroad
Ms. Amy Thomas	-	Kentucky Transportation Cabinet (Frankfort)
Mr. Nick Hall	-	Kentucky Transportation Cabinet (Madisonville)
Mr. Kent Cutchin	-	Metropolitan Evansville Transit System
Ms. Nancy L. Burns	-	Mt. Vernon Chamber of Commerce
Ms. Shirley James	-	Pigeon Creek Greenway Passage
Ms. Helen Hauke	-	Princeton Chamber of Commerce
Mr. Derek Dillon	-	River City Taxi
Ms. Nancy Cassidy	-	SIRS Inc.
Ms. Judith Weatherholt	-	Southwestern Indiana Regional Develop. Commission
Mr. Phil Wilzbacher	-	Southwind Maritime Centre
Mr. Jerry Hays	-	Traffic Superintendent

TECHNICAL COMMITTEE (cont'd)

Mr. Chris Gwaltney	-	University of Evansville
Ms. Sherri Phillips	-	Warrick Co. Plan Commission
Mr. Guy Gentry	-	Warrick Co. School Corporation
Mr. Fred Padget	-	Westside Improvement Association

I. INTRODUCTION

The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 and the subsequent Transportation Equity Act for the 21st Century (TEA-21) require establishment of a Congestion Management System in each Transportation Management Area (TMA) with a population over 200,000. The Evansville Urban Transportation Study (EUTS) is the designated TMA for the region including all of Vanderburgh County and Warrick County in Indiana and Henderson County, Kentucky. One of the goals of EUTS is to plan for the orderly development and improvement of all transportation facilities within the EUTS Study Area (see Figure 1). The purpose of the Congestion Management System (CMS) is to identify congested areas and devise appropriate strategies to prevent congestion if possible, or to mitigate congestion if a more desirable solution cannot be implemented. Strategies that prevent congestion from the outset are the most desirable.

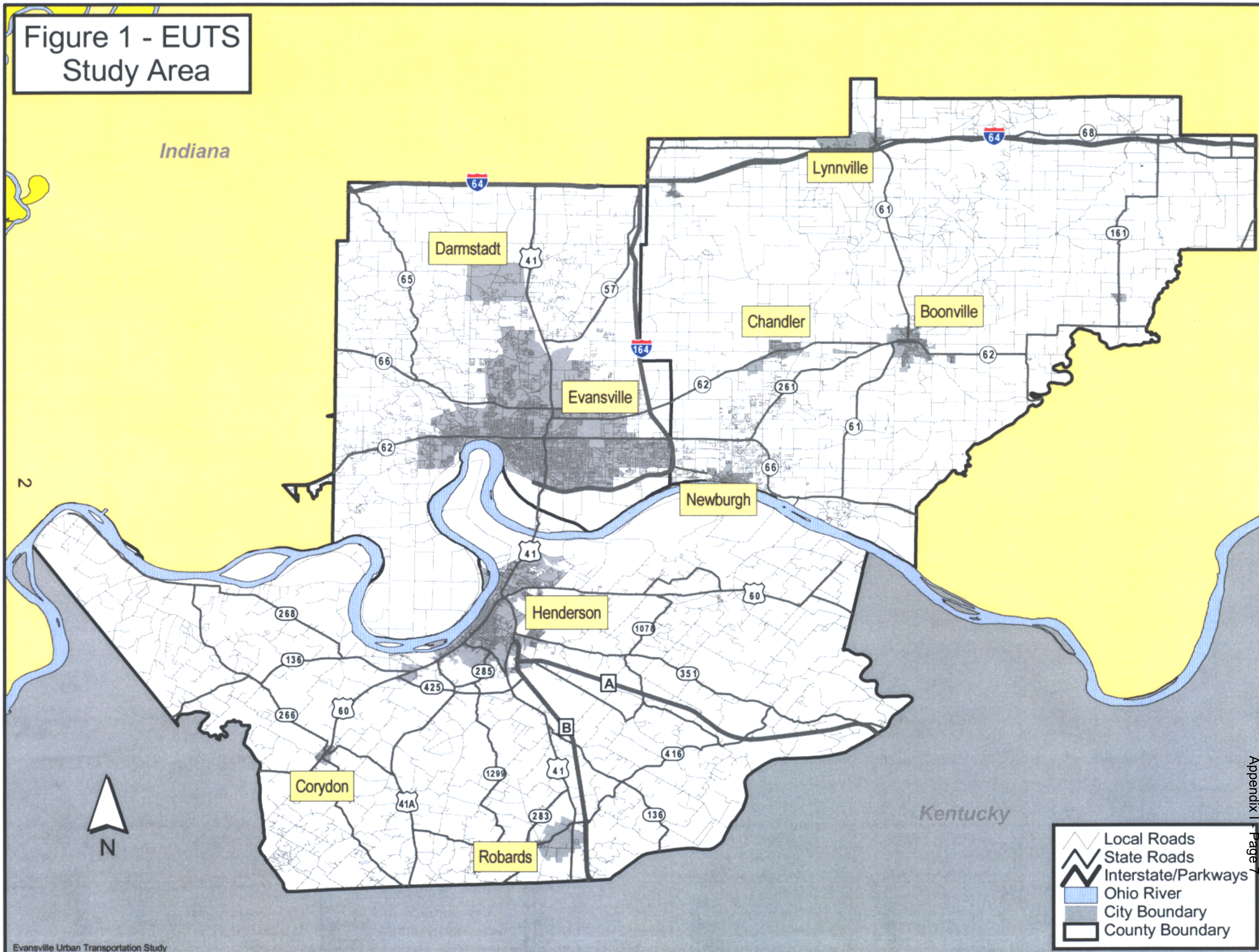
National and local trends indicate the need for capacity expansion projects. According to Census 2000 data, 39 of the nation's 50 largest metropolitan areas experienced a decline in the share of commuters using public transit to get to work (from 5.1 percent in 1990 to 4.6 percent in 2000). This national data can further be supported by local data collected and complied in the EUTS Park and Ride Feasibility Analysis. The trends show that automobile usage is on the rise which can only result in future congestion problems on our roadways. To further compound matters, the majority of automobile trips are made by single occupancy vehicles (SOVs) typically to and from work. All of the data demonstrates the need to carefully manage our existing transportation infrastructure and planned future infrastructure.

Congestion is a natural by-product of our nation's reliance on the automobile as the preferred mode of transportation. The automobile is a convenience of a modern lifestyle and as urban areas tend to promote development and urban sprawl, congestion will only continue to increase. The typical means to address roadway congestion historically has been expansion to the roadway network. However, roadway expansion involves additional right of way and constructions costs which make some projects undesirable or impossible to complete.

As a result, non-capacity expansion methods should also be evaluated as a means to reduce or eliminate congestion. Promoting access management through the reduction of curb cuts along collector and arterial roadways and minimizing the number of median breaks are both effective tools in reducing conflicts along roadways and promoting more efficient traffic flow. Every decision to allow an additional curb cut or break in a median is a another step towards more roadway congestion. Traffic signals are also a source for traffic congestion, especially when not timed correctly or when not synchronized within the entire signal network.

There are many other Travel Demand Management (TDM) and Transportation System Management (TSM) strategies that can be implemented that can improve traffic congestion without the need of additional travel lanes. Appendix 1 explains in detail various TDM, TSM and Growth management strategies while Appendix 2 details typical congestion factors and which of the mitigation actions can be taken to reduce congestion.

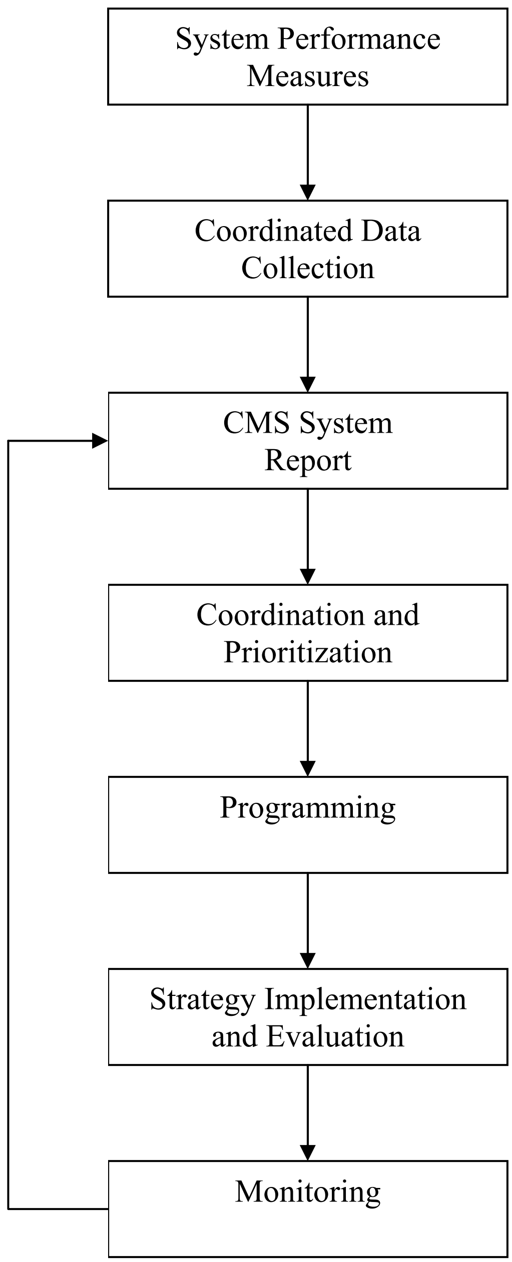
Figure 1 - EUTS Study Area



II. CMS OBJECTIVES

- To satisfy federal requirements that all Transportation Management Agencies (TMAs) develop a CMS to help guide the transportation planning process.
- To consider the CMS at the local, MPO and state level when identifying and recommending capacity expansion of either highway and/or transit systems.
- To develop a flexible CMS that can meet the changing needs of the region.
- To incorporate the CMS as an integral component of the MPO long range transportation planning process.
- To be easy to understand for both planning officials and the public.

To make the CMS process as efficient and user friendly as possible, the following flow chart was developed to show the fundamental process of the CMS analysis.



System Performance Measures identify the location, extent and severity of congestion.

Coordinated Data Collection using GeoStats GPS receivers in commuter vehicles.

CMS System Report will include updated CMS data as available and be updated on a regular basis.

Coordination and Prioritization to identify priority congestion segments and evaluate appropriate strategies.

Programming projects into the Long-Range Plan and TIP documents for construction when necessary.

Strategy Implementation and Evaluation of projects for possible funding sources.

Monitoring of projects to ensure effectiveness and reevaluation when necessary at the CMS Report stage.

III. TYPES OF CONGESTION

The Transportation Research Board (TRB) has identified two types of congestion, as it relates to travel time and speed. "Congestion is travel time or delay in excess of that normally incurred under light or free-flow travel conditions." There are two types of congestion-causing factors that fall under this definition that must be understood in order to properly evaluate overall transportation network congestion. The first and most dominant cause of congestion is inadequate road capacity or recurrent congestion. This simply means that there are more vehicles trying to utilize a roadway that it can physically accommodate at a single time. Historically, solutions for this type of congestion have focused on building new roads or adding travel lanes to existing roadway.

The second type of congestion results from random events such as accidents, spillages, vehicle breakdowns, inclement weather, special events or any other factor that cannot be anticipated on a typical day of travel. This type of congestion is called non-recurrent congestion because it is largely unpredictable as to when or where it will occur. It is estimated that more than 60 percent of traffic delay is caused from incidents in an urban area. A successful congestion management program should address both types of congestion.

Both types of congestion can be difficult to mitigate without reducing overall travel demand. For capacity expansion to occur there must be sufficient right-of-way available for acquisition for expansion or funds available to acquire the addition right-of-way needed to build a new road or add travel lanes. Often right-of-way is difficult to acquire and costs can be prohibitive for smaller roadway projects.

Sometimes minimal or temporary relief can be provided through highway performance improvements such as signalization changes, improved roadway signs and pavement markings and other low cost remedies. However, these improvements are often temporary and only serve to prolong the problem without actually fixing anything. Otherwise, meaningful reductions in congestion can only be accomplished with non-capacity expansion strategies which are described in more detail in both Appendix 1 and 2.

IV. INCIDENT MANAGEMENT

Every day traffic incidents obstruct urban, suburban and rural highways impeding mobility and disrupting the traffic. Incidents are events that reduce the traffic carrying capacity of a highway, such as spilled loads, stalled vehicles and accidents. When they occur during rush hours they cause serious congestion. Delays related to incidents increase at a faster pace with the growth of traffic volumes and it is estimated that by 2005 incidents will cause over 70% of freeway congestion.

Incident Management is defined as a sequence of pre-planned and integrated activities that, applying both human and technological resources, remove incidents as quickly and safely as possible and restore capacity to the highway. It basically applies some of the same resources that are already being used to respond to incidents but it uses these resources more effectively. Time is essential since four minutes is needed to unblock a road for each minute an incident remains obstructing a portion of it.

Incidents may be predictable or unpredictable. See Table 1 below.

TABLE 1 – INCIDENT TYPES

PREDICTABLE	UNPREDICTABLE
Maintenance Activities	Accident
Construction	Stalled Vehicle
Special Events	Weather
	Spilled Loads

Incident programs vary in cost and sophistication, but all consists of detection/verification, response, clearance, traffic management, and information/routing programs. Incident detection and verification is a procedure that informs incidents to agencies responsible for traffic flow and safe operation on roads and highways. The faster an incident is detected, the faster it is cleared. There is a diversity of methods that can improve this process such as video cameras, electronic traffic monitoring devices, CB radios, and visual observation. Dispatchers should be trained to obtain precise information on location and magnitude of the incident verifying if it is a crash or a stalled vehicle, if it is blocking the traffic, if there are injuries, the type and number of vehicles, and other issues that would help the response team.

Once the response agencies are properly notified each agency makes sure to use adequate wrecker equipment to handle the incident and fully trained certified personnel. An effective response process depends on having accurate information about the incident and resources that are necessary to clear the facility and return it to normal conditions. Incidents can be cleared with many techniques and equipment. Therefore, agencies must have adequate training to select the best response. The faster personnel and equipment reach an incident site the faster the incident is cleared, decreasing personnel costs associated with the incident management and costs to motorists associated with delay.

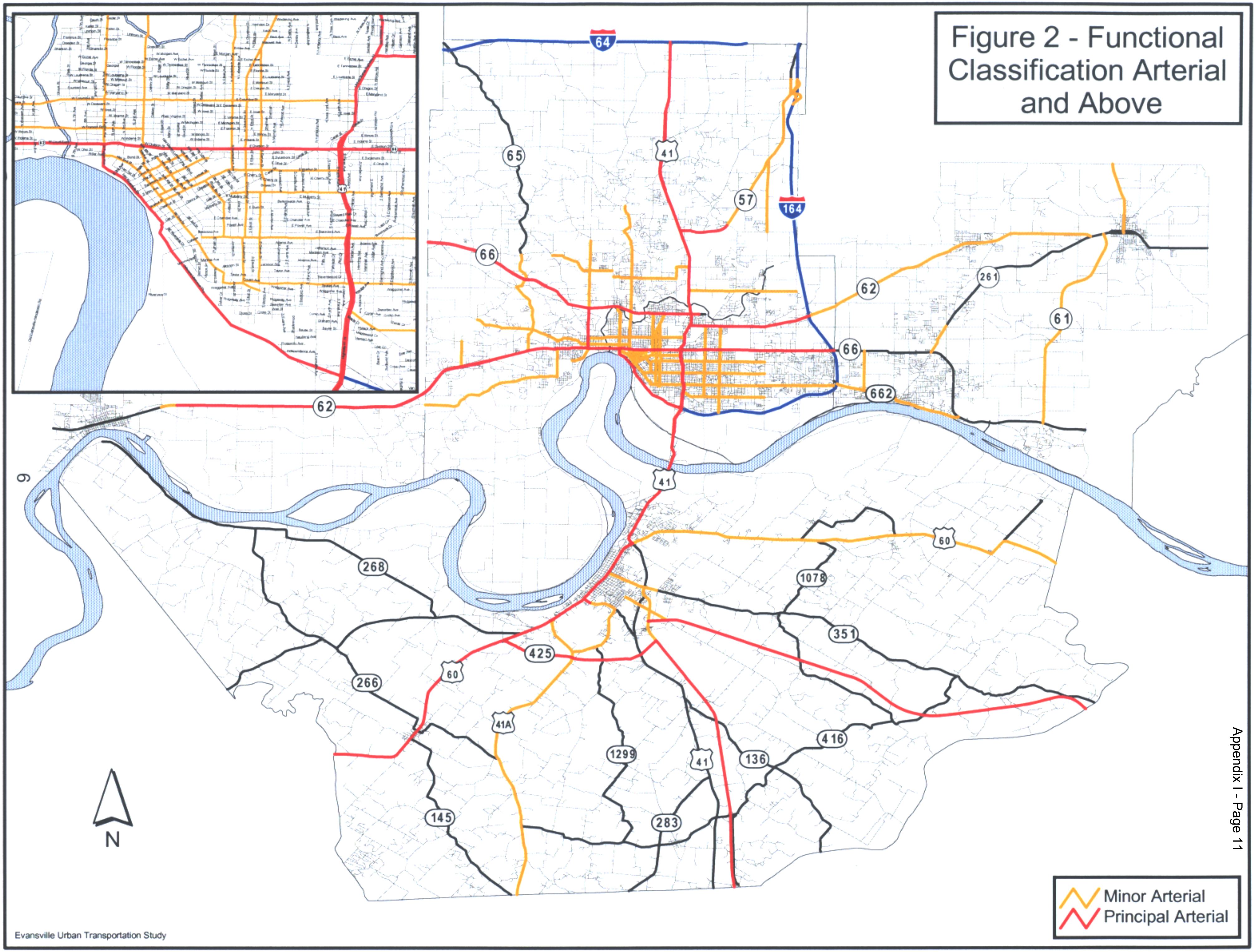
V. MEASURING CONGESTION

Before any data was collected for the CMS, a review of current roadway classifications was completed for the entire study area. Based on the information gathered, roadways classified as arterial, minor or principal, were included in the CMS study (see Figure 2). Any future updates or modifications to the roadway network classification will be updated in subsequent CMS analysis.

Participants for the study were recruited through contacts with local business to drive roadway segments during AM (6:30am to 9:00am) and PM (4:00pm to 6:00pm) peaks. Data for the study was collected for a minimum of 10 typical travel days, excluding days with snow, crashes or any other situation that would create driving conditions inconsistent with a typical daily commute. Drivers were encouraged to travel with the flow of traffic on the roadway, not to travel the posted speed limit. Data was collected on Tuesday, Wednesday, and Thursday only. Previous studies have show that driver patterns are often different on Monday and Friday so they were excluded. An attempt is made to ensure that no significant roadway projects are underway that could alter travel patterns and that local schools are in session during collection periods.

To collect accurate travel time data which can then be utilized to determine roadway congestion, drivers were instructed to install a personal Global Positioning System (GPS) in their vehicle which

Figure 2 - Functional Classification Arterial and Above



Evansville Urban Transportation Study

would collect data while the vehicle is in motion. Ten Geologger units from GeoStats were purchased for the sole purpose of collection data for the EUTS CMS study. The Geologger units include a GPS receiver and data collection device which are powered by a vehicle's cigarette lighter. The actual GPS receiver is mounted to the front windshield to provide sufficient clearance for data reception and collection. The units are programmed to collect speed, longitude, latitude, and elevation data every five seconds while the vehicle is traveling at a speed greater than two miles per hour.

Once sufficient data has been collected, the data is downloaded from the GPS receiver using a utility provided by GeoStats. The data can then be viewed in tabular form in various data base programs and it can be imported into a GIS system. The data is also divided into AM and PM peak travel times to ensure that the data analysis is completed for the travel period with the heavier peak volume.

Since traffic signals, school zones, lack of proper access management, poor signal timing and many other roadway characteristics create delay for commuters, it was decided to analyze the actual travel speed of the motor vehicle compared to the posted speed limit of the road. Every arterial corridor was split into quarter mile segments for data accuracy purposes. This relatively short segment of roadway allows for more efficient review since it is much easier to view traffic delays that could be attributed to traffic signals, school zones or any number of other roadway characteristics that hamper travel speeds. Several test corridors were evaluated with the study area and reviewed by the driver of the corridor to determine if the data output was in accordance with that actual driving conditions. The data was also compared to capacity analysis studies that have been completed for various segments previously to determine data accuracy. Once it was determined that the method of congestion analysis did accurately represent actual driving conditions, the data collection process began.

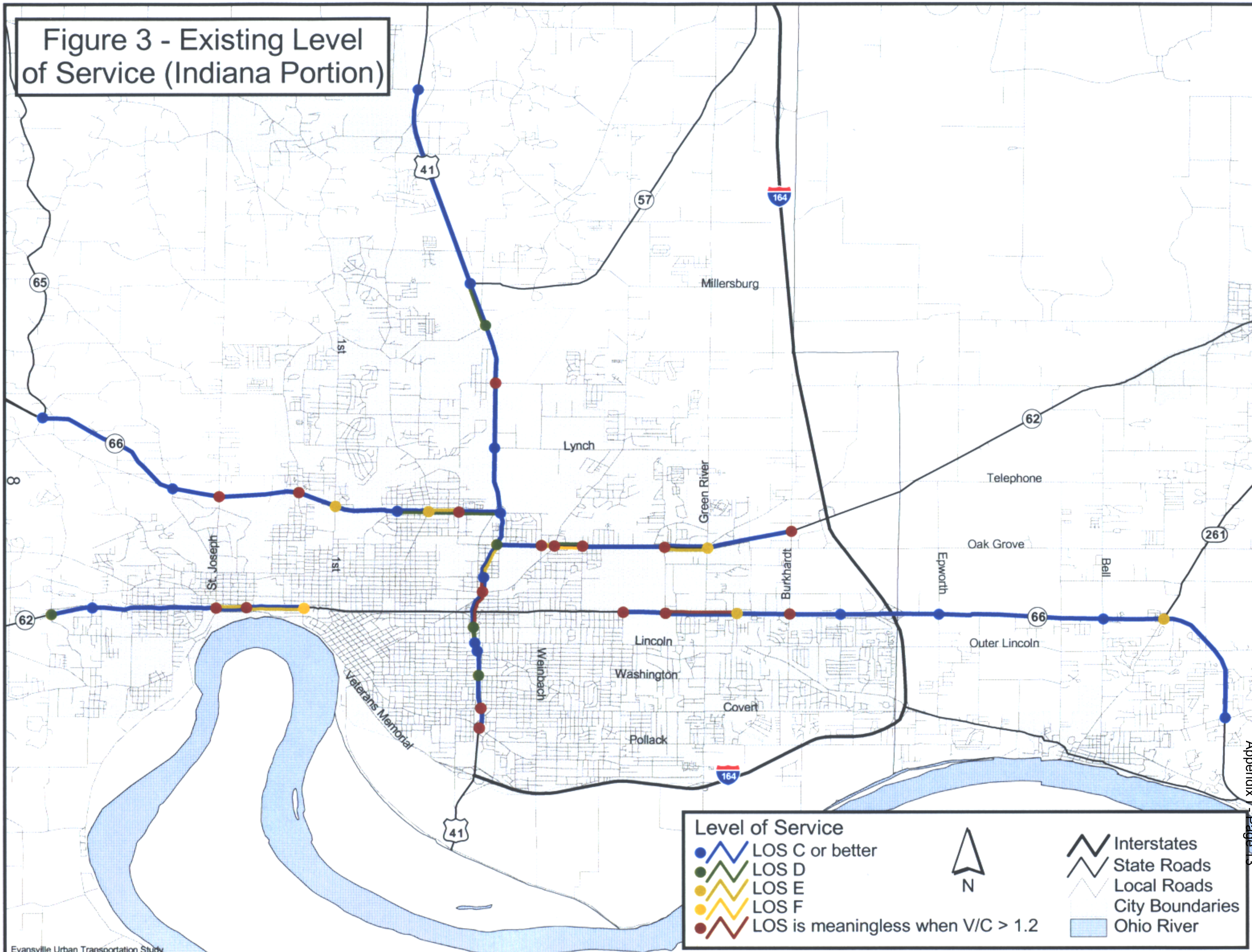
As a supplement to the GPS data collected for this study, some Level of Service (LOS) data was used to determine congestion along various corridors within the CMS study area. However, the LOS data will be replaced with GPS once new data is available.

Turning movements are used to calculate the LOS data in the study. EUTS staff manually cataloged all traffic within the study intersections for an hour and a half during the PM Peak travel period. Highway Capacity Software (HCS) was used to calculate the overall intersection LOS from the data collected. HCS also allows for corridor analysis based on LOS information collected at various intersections.

VI. CMS METHODOLOGY

A CMS study completed by EUTS in the mid 1990s included only the Vanderburgh and Warrick County portions of the EUTS Study Area. Figure 3 shows the existing LOS data for Vanderburgh and Warrick Counties. Since data already exists for the Indiana portion, it was vital that the GPS data collection begin in Henderson County, Kentucky. Some updates to the Indiana portion are included with the first stage of this CMS Study, but as more and more data is collected, the study will be revised to accurately represent current available data. The CMS development will be an ongoing process as well with data updates being made at regular intervals to ensure that the most accurate congestion data is available.

Figure 3 - Existing Level of Service (Indiana Portion)



VII. CMS Data Analysis

As previously stated, the congestion analysis is a comparison of the actual field travel speed versus the posted speed limit. The calculations to analyze the speed data gathered for the CMS study are relatively simple, but time consuming. For this portion of the CMS analysis process, over 350 quarter mile segments were analyzed to obtain the GPS data presented in this study. To analyze the data, all qualifying data, meaning the data was collected on appropriate days at appropriate times, is manually sorted to AM and PM peak travel times. For this analysis, PM Peak was chosen since data shows that overall there is more traffic during the PM Peak. Once the data has been verified and split into appropriate peak travel times, each quarter mile segment can then been analyzed. For each segment, all qualifying speed records are added, then divided by the total number of records to arrive at the average speed for the segment. To calculate the speed ratio, the average speed is then divided by the posted speed limit. The travel speed versus speed limit ratio is then used to map the data along the various arterial corridors. For mapping purposes, the speed ratios were divided into the following four groups: (see Table 2)

Table 2 – Travel Speed vs. Speed Limit Ratio Classifications

SPEED RATIO	LEVEL OF CONGESTION
25% - 49%	Highly Congested
50% - 74%	Moderately Congested
75% - 99%	Slightly Congested
Over 100%	No Congestion

Figures 4 and 5 demonstrate the congestion data collected thus far for the EUTS CMS Analysis. Individual maps were prepared for Henderson County and Vanderburgh County to make the data easier to view and understand.

A. HENDERSON COUNTY CMS

As Figure 4 shows, congestion is most prominent within the City of Henderson and along some of the major corridors into the city. Several of the most congested corridors are discussed in more detail.

1. US 60/Green Street Corridor

US 60/Green Street serves as a major east/west corridor through the city and county and serves as an important link to both Union and Daviess Counties. As seen in Figure 4, some of the most significant congestion in Henderson occurs along this corridor. The portion from the KY 425 By-Pass to Wathen Lane is characterized by almost continuous congestion during the PM Peak travel time. The corridor experiences significant commuter traffic each day and is highly commercialized which results in a significant number of access points and it is burdened with many traffic signals and which serve to slow commute travel times and promote congestion.

2. US 41Corridor

The US 41 corridor serves as the link between Henderson, KY and Evansville, IN. This highly traveled corridor is home to significant commercial and service industry land uses as well as several traffic signals and numerous curb cuts. As a result, the CMS data analysis shows the portion of US 41 from the northern city limits to the US 60 interchange is heavily congested. The portion of US 41 from KY 351/2nd Street to the KY 425 By-Pass is also slightly congested.

Figure 4 - Henderson County CMS Analysis

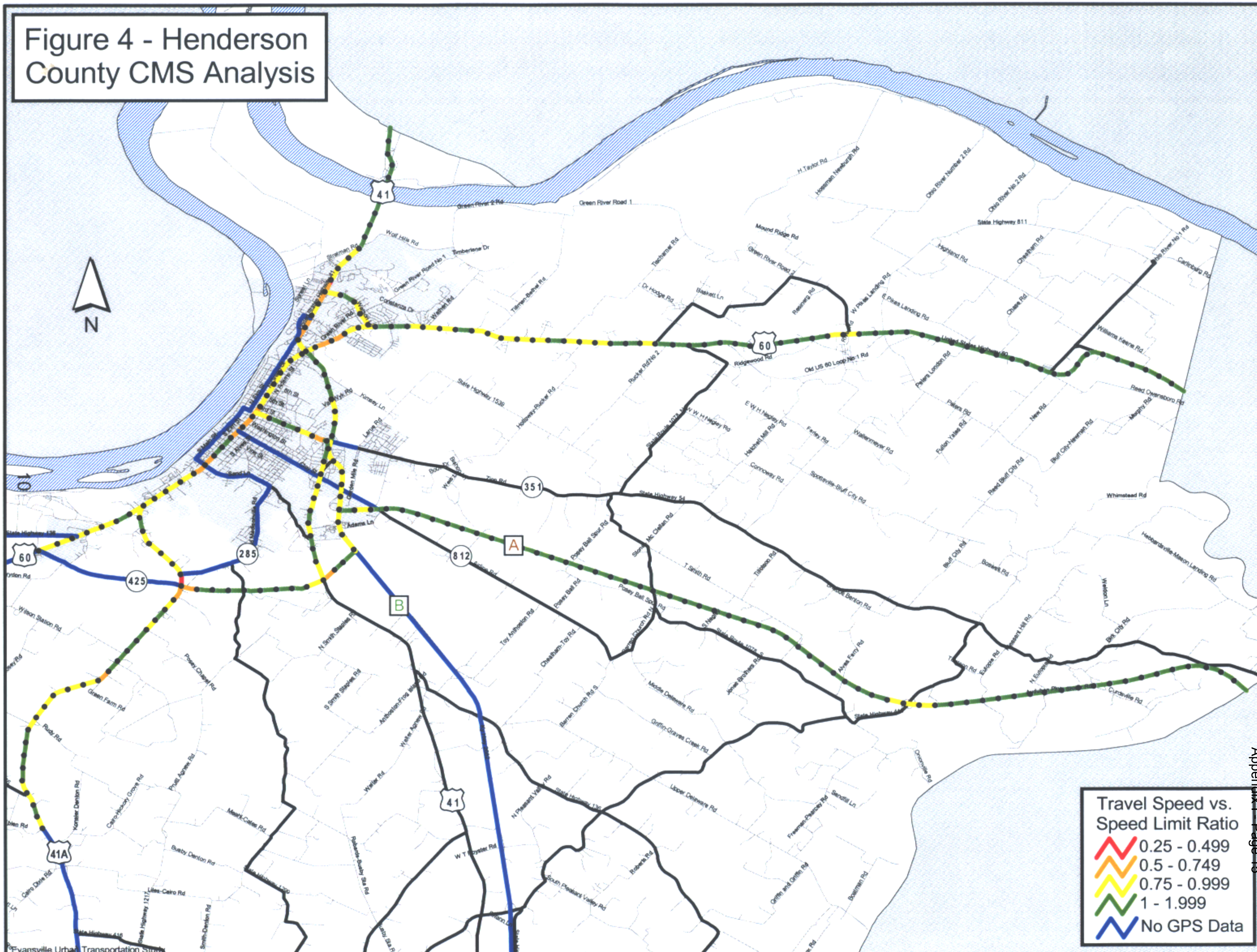
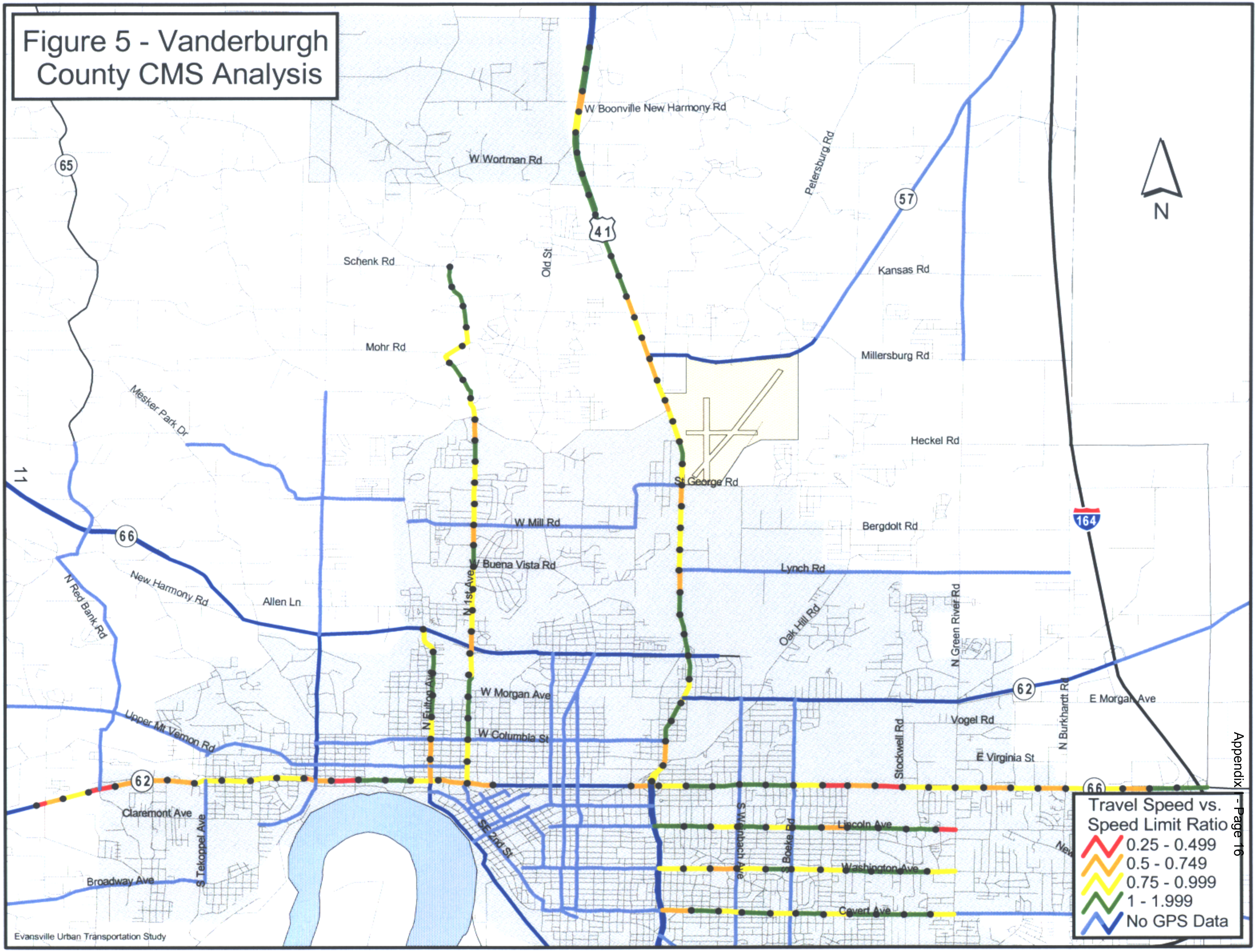


Figure 5 - Vanderburgh County CMS Analysis



3. US 41A Corridor
US 41A serves as an alternate to US 41 as a feeder road from southern and western portions of the county into the city. Congestion is prominent along the majority of the corridor and is most heavily concentrated in the vicinity of KY 425 and US 60/Green Street. Land use along this corridor is mixed with a more rural nature in the county and significantly more commercialized closer to the city.

B. VANDERBURGH COUNTY CMS

As shown in Figure 5, congestion is present on a majority of the roadway segments studied thus far. As anticipated, congestion is present along the Lloyd Expressway corridor which serves as a major east/west route and on US 41 which serves as a major north/south route through the county.

1. Lloyd Expressway Corridor
On both the east and west sides of Evansville, the Lloyd Expressway experiences a significant amount of congestion. On the west side of the city, congestion is most prominent at the major signalized intersections. At the Boehne Camp Road and Red Bank Road intersections the Lloyd Expressway is highly congested meaning that vehicles are traveling under 50 percent of the posted speed limit during peak travel times. The intersection of Rosenberger Avenue, St. Joseph Avenue and Fulton Avenue show moderate congestion as well. On the east side of Evansville, major congestion spots include US 41, Vann Avenue, Stockwell Road, Burkhardt Road and Cross Point Boulevard. Each of these intersections along the Lloyd Expressway corridor are signalized and have significant commercial activities.

Various projects are currently planned along the entire corridor which may help alleviate congestion in the future. An analysis of signal removal and roadway upgrade on the west side and improved interchanges at US 41 and Burkhardt Road should help ease congestion. However, other measures should be evaluated to monitor and improve congestion along the Lloyd Expressway Corridor.

2. US 41 Corridor
The US 41 corridor experiences some congestion just north of the Lloyd Expressway interchange but the majority of congestion takes place from just south of Lynch Road to north of SR 57 and the Evansville Regional Airport. This portion of the corridor is highly industrialized and has a significant amount of truck traffic along with several traffic signals which helps to slow traffic. According to the CMS data, the traffic signal at Boonville-New Harmony Road also serves as a major congestion point along the US 41 corridor.

3. Darmstadt Road/First Avenue Corridor
Darmstadt Road and First Avenue are typically used as alternates for commuters traveling from northern Vanderburgh County into the city without having to use US 41 or St. Joseph Avenue. First Avenue has commercial development south of Kratzville Road with many curb cuts and traffic signals. As the CMS data shows, the majority of the congestion occurs at the major intersections along the route. Mill Road, Diamond Avenue and the stretch leading into downtown Evansville all experience higher than average levels of congestion.

In all, over 350 quarter miles segments were analyzed for this phase of the EUTS Congestion Management Study.

VIII. Conclusion

The previous discussion of various roadway segments identified in the CMS Study represents only a portion of the overall congestion in the region. Many other roadway segments and especially signalized intersection, contribute heavily to overall roadway congestion. The intent of this study is to identify those locations through data analysis and use this information as a tool for future planning and project implementation. This study is not intended to fix all areas of congestion but to serve as a guide.

There are many remedies for various forms of congestion that can be implemented to help improve traffic flow. There are numerous Travel Demand Management (TDM) and Transportation System Management (TSM) strategies that are discussed in further detail in both Appendix 1 and 2. However, in most cases, the remedy will not be as simple as working with signal timing or adding a turn lane. As well, there are many forms of congestion relief that would not be appropriate for an area such as ours. The installation of High Occupancy Vehicle (HOV) lanes is not an option on any roadway within the EUTS Study Area. Road pricing is not a viable option either. Both of these concepts are typically used in larger, sprawling metropolitan areas. However, alternative work hours, encouraging the use of bicycle and pedestrian traffic, increased and more efficient public transit coverage, workplace initiated carpool programs and financial incentives for employees that participate in one of these programs are all feasible and could lead to a reduction of traffic during peak travel times.

These travel strategies are not the only possibilities though. It is inevitable that some new roadways will need to be constructed to improve traffic flow. At present, construction has begun on the Eickhoff-Koressel Corridor, which will provide an important roadway link for the western portion of Vanderburgh County. Due to development occurring on the east side of Vanderburgh County, Columbia Street is being extended west of Burkhardt Road. But it shouldn’t stop in Vanderburgh County; an additional link into Warrick County would be extremely beneficial in removing some vehicular traffic from the Lloyd Expressway. The extension of Lynch Road into Warrick County will also serve to reduce traffic volumes on SR 62.

But only so many new roads can be constructed and only so many lanes can be added to an existing facility, before expansion is no longer an option. That’s why this CMS Study is important. At the community and regional levels, transportation planners must look at current problem congestion areas and plan for the future. It will not be a simple or easy process, but it is one that must be done to ensure that traffic flow for the region is not hampered in the future due the to lack of progressive planning today.

APPENDIX 1

CONGESTION MANAGEMENT STRATEGIES

There are several innovative Transportation Demand Management (TDM) and Transportation System Management (TSM) strategies used throughout the US which can be utilized at the local level to improve roadway congestion.

Transportation Demand Management (TDM)
TDM strategies are designed to maximize the people-moving capability of the transportation network by increasing the number of persons in a vehicle, or by influencing the time of, or need to, travel. To accomplish these types of changes, TDM programs must rely on incentives or disincentives to make these shifts in behavior attraction. The primary purpose of TDM is to reduce the number of vehicles using the road system while providing the many mobility options to those who want to travel. The following are some TDM alternatives to a single occupancy vehicle:

Carpools and Vanpools
Typically utilized by commuters who may not be served by existing transit routes or those who commute long distances to a common wok place.

Public Transit
Although studies have shown that transit ridership is on the decline nationwide, transit still provides a very useful commuter alternative. Transit can be utilized when there is a demand and the SOV travel and other TDM strategies are not able to provide service to alleviate congestion.

Non-motorized Travel
Bicycling and walking are very useful in mixed land use development areas and reduce congestion and air pollution.

Parking Management
A parking management program is any plan by which parking space is provided, controlled, regulated or restricted in any manner. Communities across the US have adopted parking policies to improve environmental quality, transportation mode shifts or access preservation.

High Occupancy Vehicle Lanes (HOV)
Dedicating an existing travel lane for vehicles with multiple riders during peak travel times moves more people per vehicle and reduces the overall vehicle miles traveled.

Road Pricing
A price on using a highway or roadway facility forces the users to pay for convenience or divert to less congested roadways which reduces congestion on the principal roadway.

New Highways
When Necessary, new highways are constructed to relieve congestion by routing traffic from an existing system that is congested and contributing to air pollution.

Telecommuting
Allows employees to work from home all or some of the time which helps to reduce the amount of traffic during peak travel times.

Alternative Work Hour Programs
Compressed Work Weeks in which employees work a full 40-hours in fewer than the typical five days and a Flexible Work Schedule that shifts work start and end times to off-peak hours of the day help relieve congestion.

Financial Incentives
Preferential parking for persons sharing carpools and vanpools, subsidies for transit riders, transportation allowances, preferential access and egress to parking lots, periodic prize drawings for carpool and vanpool members, and guaranteed ride home programs help reduce traffic and congestion.

Transportation System Management (TSM)

Intelligent Transportation (ITS)
ITS technology has been a great help in relieving congestion where other solutions have failed. These intelligent transportation systems include computers, communications, and displays.

Goods Movement Management
Is a way to reduce congestion from city streets during peek hours by regulating pick up and deliver times for freight delivery.

Freeway Incident Management System
Prompt removal of disabled vehicles from travel lanes.

Geometric Design
Appropriate geometric design helps in reducing congestion and improves safety and freedom of driving.

Traffic Signal Improvements
Studies have shown that changes in a signal's physical equipment and timing optimization can help significantly in congestion mitigation. Traffic flow could be improved by equipment updates, timing plan improvements, interconnected signals, traffic signal removal, or traffic signal maintenance as needed.

Intersection Improvements
An intersection can be improved by installing traffic control devices for the smooth and safe passage of both pedestrians and vehicles. The devices used could be stop signs, yield signs, traffic signs, turning lanes, traffic islands, channelization, and improved overall design.

Planning Management

These strategies are related to zoning, land-use, and urban design techniques to avoid congestion by integrating land-use planning, site planning, and landscaping within a transportation system.

Growth Management
Is defined as "the use of public policy to regulate the location, geographic patter, quality and rate of growth of development." Travel demand modeling provides valuable information on traffic generation that could be used to implement controls over the land development and its impact on the surrounding transportation network. A tool used for growth management is site plan review and requirements in conjunction with required traffic impact analysis for high-density multi-family, commercial or industrial development.

Access Management
Access management is the art of controlling space and design of driveways, medians, and median openings, intersections, traffic signals, and freeway interchanges. Appropriate access control can decrease the number of accidents and congestion. To have a successful access management plan, both transportation planners and land use planners have to work cooperatively. The benefits of access management are fewer conflict points, fewer crashes, increased capacity, and shorter travel times.

APPENDIX 2

Congestion Factors and Mitigation Actions

SOV Travel
SOV is the predominate mode of travel with the MPO area which is a major cause of congestion and deteriorating air quality.

Action: **TDM:** Ridesharing, carpooling, vanpooling, bicycle, transit service, flexible work hour program, compressed work week, parking management, congestion pricing
TSM: Traffic signal improvement, intersection improvement, growth management, access management, Intelligent Transportation System (ITS).

Traffic Signal Synchronization
Unsynchronized signals contribute to traffic congestion. Driver experience stops, stop-delays, and longer travel time contributing to increased fuel consumption, congestion, and air pollution.

Action: **TDM:** N/A
TSM: Traffic signal improvements.

Bus Bays
Bus bays play an important part in reducing congestion on busy streets.

Action: **TDM:** N/A
TSM: Geometric design. Studies to determine possible addition bus bays where applicable.

Access Management
Closely spaced driveways and drive too near intersection on arterial streets hamper traffic movement causing congestion and air pollution.

Action: **TDM:** N/A
TSM: Geometric design, traffic signal improvements, intersection improvement, parking management, growth management (subdivision regulations).

Intersections without Right Turn Channelization
Intersections that experience heavy right turn traffic movements without dedicated right turn lanes contribute to congestion during peak hours.

Action: **TDM:** N/A
TSM: Geometric design (lane marking), traffic signal improvement, intersection improvement.

School Zones on Major Arterials
The intent of the arterial street system is to emphasize mobility rather than land accessibility within the urban area. Low driving speed limits in school zones on major arterials cause traffic delays and congestion.

Action: **TDM:** N/A
TSM: Geometric design, traffic signal improvements, intersection improvements, parking management, access management (designated crosswalks).

Walkways
Walkways that are not properly maintained, that lack ADA accessibility ramps, and that do not properly connect residential and commercial activity centers discourage potential users.
Action: **TDM:** Walkways
TSM: Traffic signal improvements, intersection improvements, growth management, access management.

Bikeways
On street and off street bicycle facilities are necessary as an alternative mode of transportation to alleviate congestion and enhance air quality.
Action: **TDM:** Bicycle routes.
TSM: Traffic signal improvements, intersection improvements, growth management, access management.

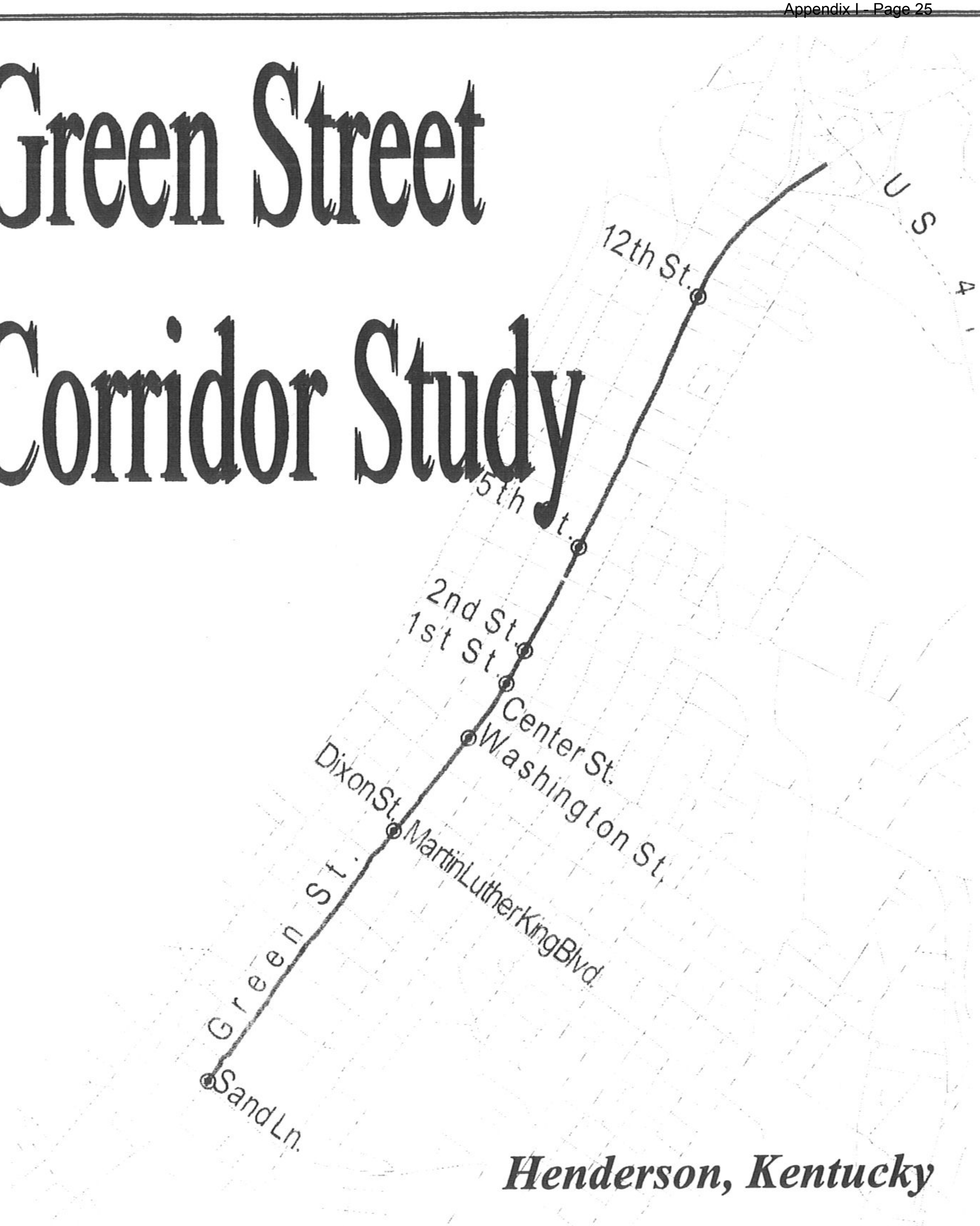
Transit Service
Enhanced travel and headway times in the urban area can mitigate congestion and improve air quality.
Action: **TDM:** Direct transit routes between activity centers and residential areas.
TSM: Growth management.

Speed Limit
Streets with higher functional classifications not posted with appropriate speed limits result in speeding violations and inefficient traffic flow.
Action: **TDM:** N/A
TSM: Speed limit revisions.

Traffic Signs
Improper placement and lack of traffic signs showing directions at intersections hinder traffic flow.
Action: **TDM:** N/A
TSM: Intersection improvement.

This Page Intentionally Left Blank

Green Street Corridor Study



Henderson, Kentucky

Prepared by:

Evansville Urban Transportation Study

TABLE OF CONTENTS

		PAGE
ACKNOWLEDGEMENT		i
I.	INTRODUCTION	1
II.	TRAFFIC CONDITION	3
	1. INTERSECTION ANALYSIS	3
	2. ROADWAY SEGMENT ANALYSIS	13
III.	SAFETY ISSUES	16
	1. INTERSECTIONS	17
	2. ROADWAY SEGMENTS	18
IV.	ANALYSIS	20
	1. CAPACITY ANALYSIS	20
	2. ACCIDENT ANALYSIS	24
V.	SUMMARY	26
APPENDIX: Signal Settings and Level of Service		28

FIGURES

PAGE

Figure I-1:	EUTS Study Area	2
Figure II-1:	Green Street Corridor Study Area	4
Figure II-2:	Traffic Volumes for Intersections & Roadway Segments	5
Figure II-3:	Turning Movement at 12th Street	6
Figure II-4:	Turning Movement at 5th Street	7
Figure II-5:	Turning Movement at 2nd Street	8
Figure II-6:	Turning Movement at 1st Street	9
Figure II-7:	Turning Movement at Washington Street	10
Figure II-8:	Turning Movement at Dixon Street/Martin Luther King Boulevard	11
Figure II-9:	Turning Movement at Sand Lane	12
Figure II-10:	Traffic Volume Distribution in Time	14
Figure III-1:	Accident Rates of Green Street and Henderson County	16
Figure III-2:	Spatial Distribution of Crash Rates	19
Figure IV-1:	Corridor Level of Service	23

TABLES

Table II-1:	Traffic Volumes by Road Section	13
Table III-1:	Signalized Intersection Accidents	17
Table III-2:	Road Section Accidents	18
Table IV-1:	Level of Service	21
Table IV-2:	Intersection Capacity	22
Table IV-3:	LOS for Road Section	22
Table IV-4:	Driveway Numbers and Spacing	25

ACKNOWLEDGEMENTS

EVANSVILLE URBAN TRANSPORTATION STUDY
POLICY COMMITTEE

Mr. Stephen Melcher	-	Chairman, City of Evansville
Mr. Jack Corn, Jr.	-	Mayoral Appointment
Mr. David Mosby	-	Evansville City Council
Mr. Jeffrey Broughton	-	Henderson City Manager
Ms. Mae Mason	-	Newburgh Town Board
Ms. Bettye Lou Jerrel	-	Vanderburgh Co. Commission
Mr. Russell Lloyd, Jr.	-	Vanderburgh Co. Council
Mr. David Rector	-	Warrick Co. Commission
Mr. Curt Wiley	-	INDOT (NV)
Mr. Clemenc Ligocki	-	INDOT (NV)
Mr. Arthur Fendrick	-	Indiana FHWA (NV)
Mr. Lawrence Tucker	-	Indiana FHWA (NV)
Ms. Janet McCabe	-	Indiana DEM (NV)
Ms. Rosemarie Jenkins	-	FTA (NV)
Mr. Jess Story	-	Kentucky FHWA (NV)
Mr. James C. Codell, III	-	KY Transp. Cabinet (NV)
Mr. Jerry D. Ross	-	KY Transp. Cabinet (NV)
Mr. Edward H. Merryman	-	KY Transp. Cabinet (NV)

EVANSVILLE URBAN TRANSPORTATION STUDY

Ms. Rose M. Zigenfus	-	Executive Director
Ms. Pamela Drach	-	Deputy Director
Mr. Yanbing He	-	Chief Transportation Engineer
Ms. Maura Carriel	-	Transportation Planner
Mr. Brian Bishop	-	Transportation Planner
Ms. Caren Whitehouse	-	Grants Manager
Mr. Seyed Shokouhzadeh	-	Computer Analyst
Ms. Charlotte Vanhooser	-	Bookkeeper
Ms. Jane Wilber	-	Secretary

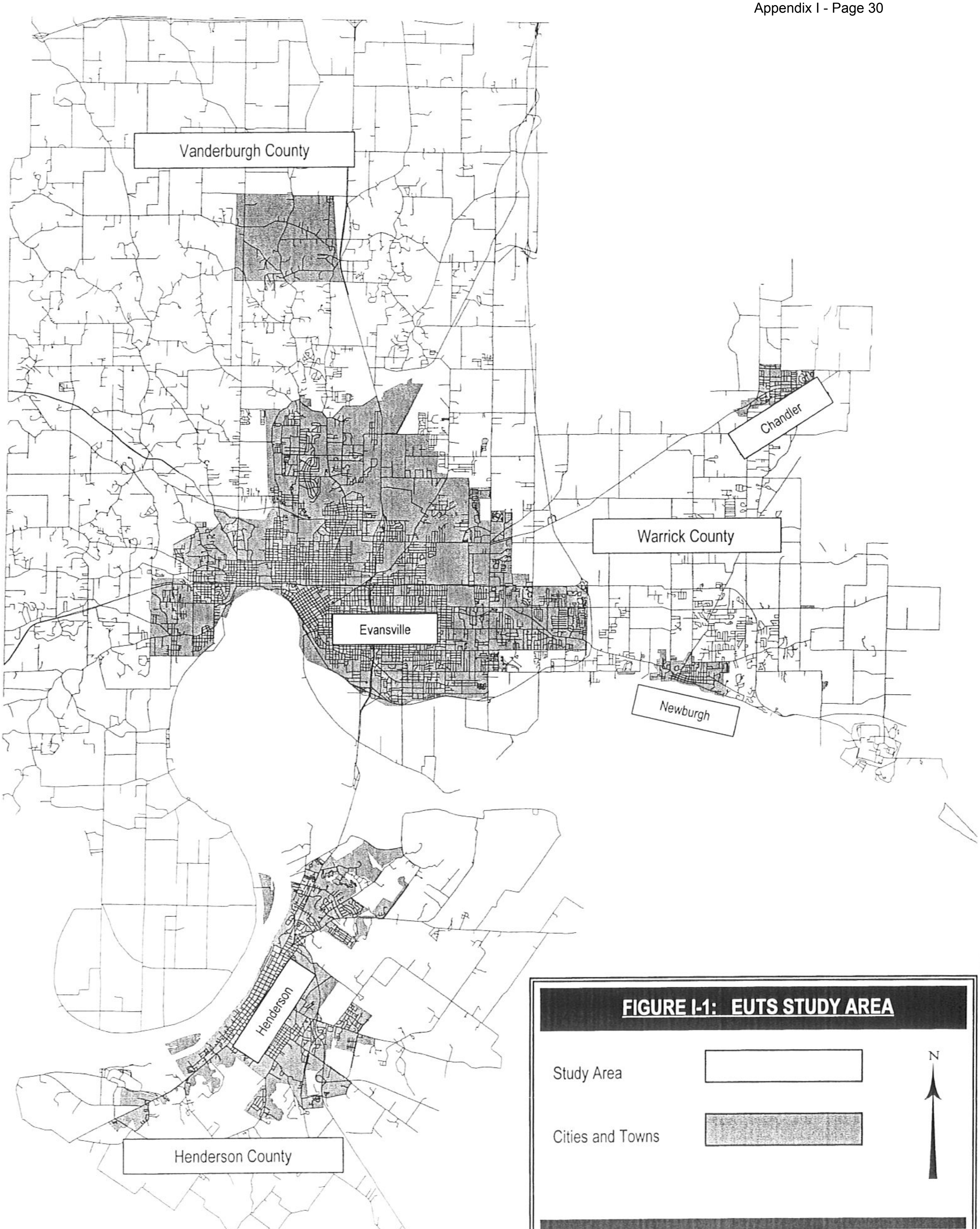
(NV) = Non-Voting

I. INTRODUCTION

The Evansville Urban Transportation Study (EUTS), designated as the Metropolitan Planning Organization (MPO) for the Evansville Urbanized Area in 1986, was created as the planning agency responsible for conducting the 3-C planning process. EUTS was associated with the Southwest Indiana Kentucky Regional Council of Governments (SWIKRCOG) until 1985, when SWIKRCOG was dissolved.

The EUTS Study Area contains approximately 308 square miles in Indiana, including the City of Evansville, all of Vanderburgh County (with the exception of Union Township), and a portion of Warrick County (including all of Ohio Township, Newburgh and Chandler, a segment of Boon Township, including Boonville, and a segment of Anderson Township). In Kentucky, the Study Area encompasses approximately 70 square miles which includes the City of Henderson and a portion of Henderson County. Figure I-1 illustrates the EUTS Study Area.

As part of the 3-C planning process and in coordination with the Henderson City Officials initiated the Green Street Corridor Study. Green Street is a major north-south arterial located in the City of Henderson, Kentucky. It connects the downtown area with various local and regional transportation facilities, including US 41 and US 60, carrying a significant amount of vehicular traffic. Many businesses have located along the Green Street corridor because of its function of mobility and accessibility provided to area residents. Unfortunately, congestion is evident and traffic accidents are prevalent along the corridor. As a result of the technical analysis, a series of recommendations have been identified for current and future mitigation.


Vanderburgh County
Chandler
Warrick County
Evansville
Newburgh
Henderson
Henderson County
FIGURE I-1: EUTS STUDY AREA
Study Area
Cities and Towns
N

II. TRAFFIC CONDITION

The corridor study area (see Figure II-1) was defined as a 2.7 mile segment of Green Street, extending from the interchange with US 41 to the intersection with KY 136 (Sand Lane). Green Street is a four lane principal arterial, which is undivided for the majority of the length of the corridor. Within the study area, there are seven signalized intersections: 12th Street, 5th Street, 2nd Street, 1st Street, Washington Street, Dixon Street/Martin Luther King Boulevard, and KY 136 (Sand Lane). In addition, there are 32 unsignalized intersections with the Green Street corridor. Numerous commercial and residential sites align the majority of the corridor. The middle segment of the corridor is adjacent to the Henderson Central business district. The traffic conditions within the study area were evaluated by intersections and roadway segments with a focus on the traffic volumes and the facility inventory.

1. Intersection Analysis

All unsignalized intersections within the study area are two way stop controlled. Given that traffic flows entering the corridor from the minor approaches to intersections are required to yield complete right-of-way to Green Street, the effect to the primary flow on Green Street is marginal. Capacity issues relating to unsignalized intersections were considered by checking traffic flow on minor approaches for potential signalization. Following a preliminary study and discussion with local officials, no intersections were found to meet warrants for signalization. Therefore, the study of corridor intersections focused on the seven signalized intersections and one interchange. These locations were assumed to have the greatest impact upon the overall corridor capacity.

The traffic signals along Green Street include two types of settings: pre-timed and traffic actuated. The pre-timed controller operates on a predetermined time schedule or series of time schedules. The signal is set to repeat a given sequence of signal indications regularly. The traffic-actuated controller operates on the basis of traffic demand, as registered by the actuation of vehicle or pedestrian detectors on one or more of the intersection approaches. Three of the seven intersections (1st Street, 2nd Street, and Washington Street) are controlled by pre-timed controllers so those signals may be synchronized. Signals at the four remaining intersections (12th Street, 5th Street, Dixon Street/Martin Luther King Boulevard, and Sand Lane) are all semi-actuated, providing green time for the cross streets only when approaching vehicles are detected.

An overview of traffic volumes over these signalized intersections is illustrated in Figure II-2, and the detailed condition at each signalized intersection is described below, beginning at the northern termini.

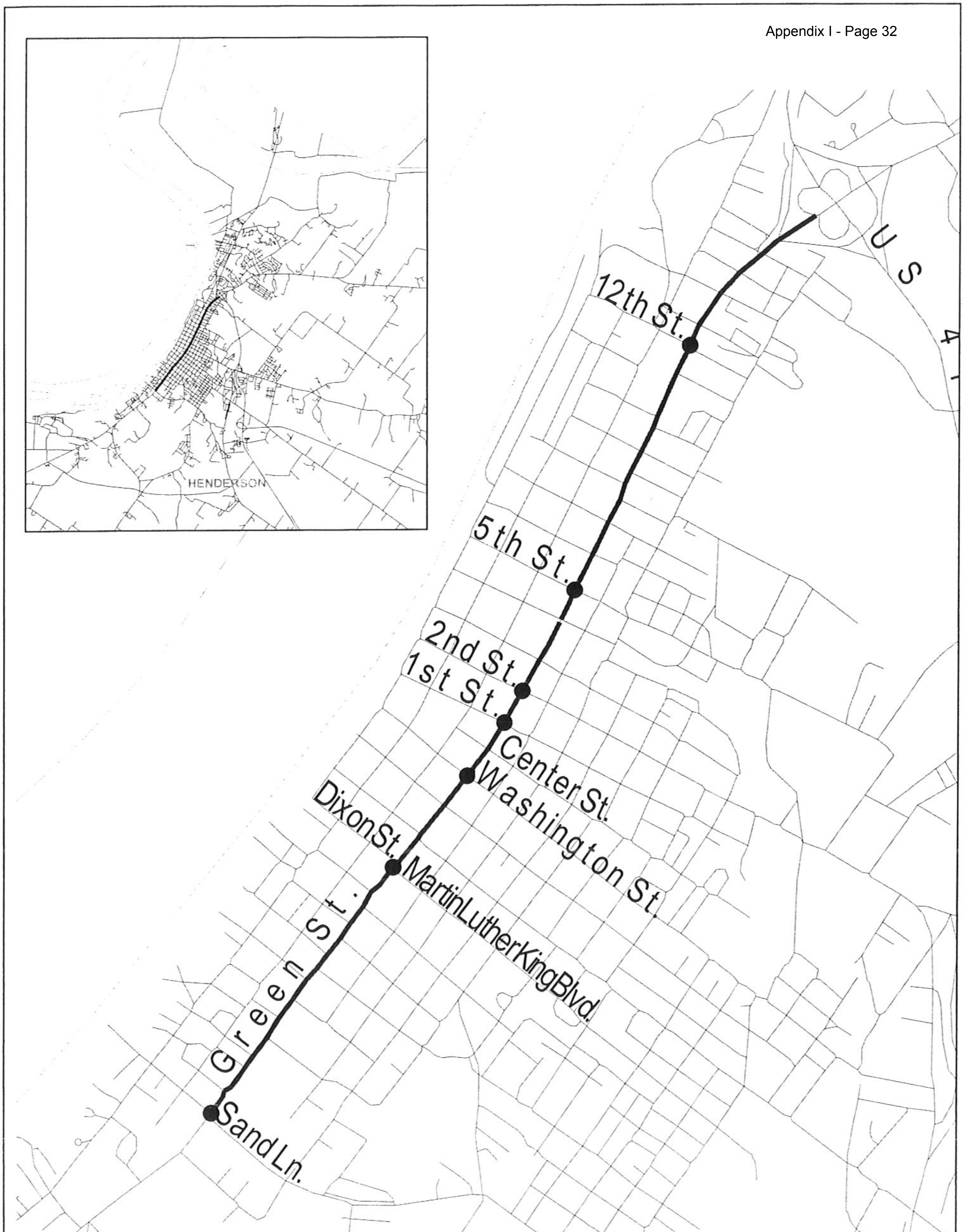


Figure II-1: Green Street Corridor Study Area

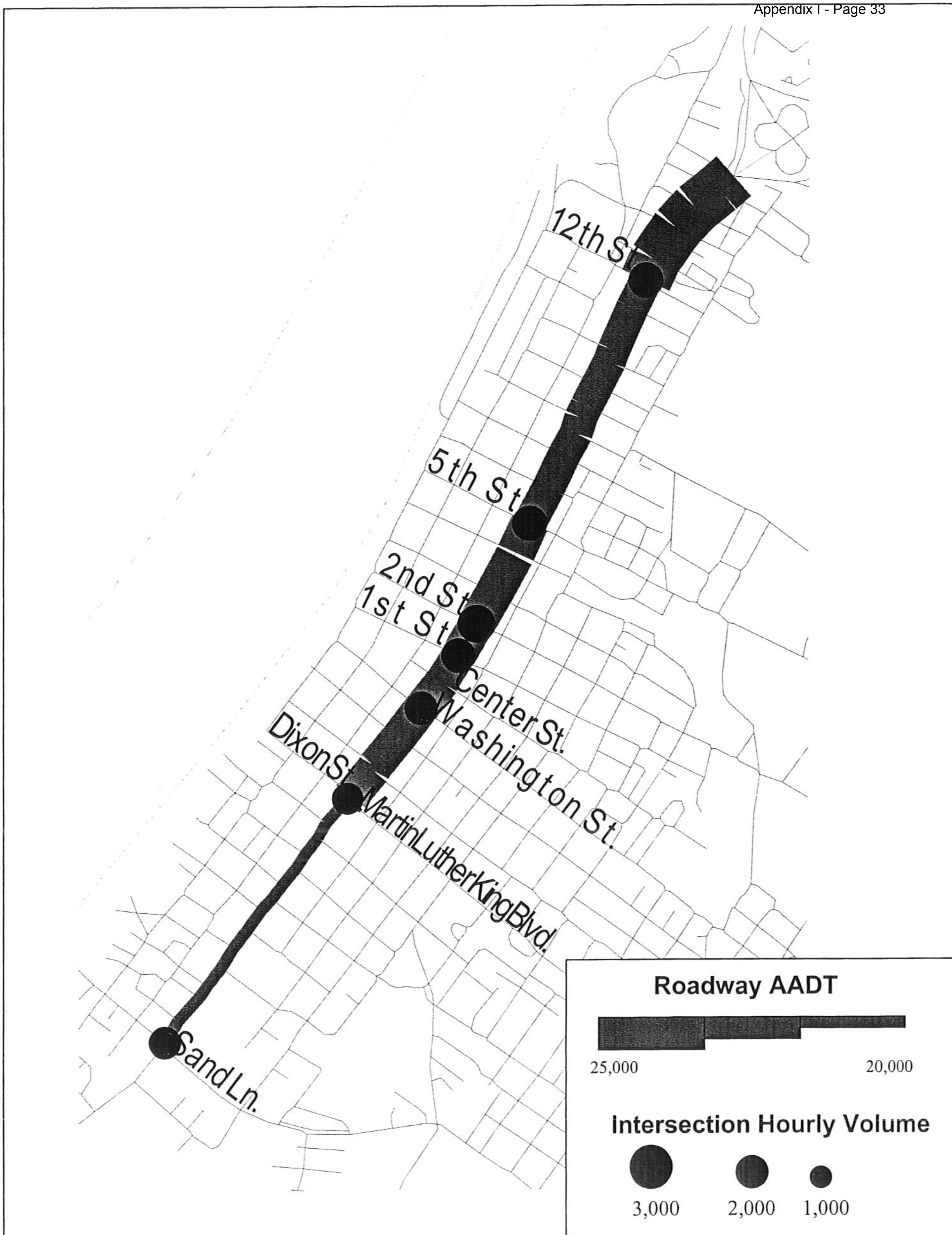


Figure II-2: Traffic Volumes for Intersections and Roadway Segments

12th Street

This at-grade intersection is controlled by a traffic semi-actuated signal. Therefore, green time for 12th Street is only provided when approaching vehicles are detected. No protected left turn movements are provided at this intersection. Green Street is the north and south approach to the intersection. Each approach is 47 feet wide, with two lanes in each direction. There are no dedicated turn lanes, so the two lanes are shared to accommodate the through/left and through/right turning movements, respectively. 12th Street is the east and west approaches. The east approach is 31 feet wide while the west approach is 37 feet wide. Each approach has one lane entering the intersection, which is shared by through, right, and left to accommodate the turn movements. The most noticeable characteristic of this intersection is the offset of 12th Street (east and west approaches of the street have a 70-foot separation between centerlines). The SE, NE, and NW quadrants of the intersection are comprised of two residences and a church. A car dealership currently occupies the SW quadrant. Given the proximity of the car dealership driveways to the intersection and the frequent vehicle turnover at the location, it is assumed to have a greater impact than the other three quadrants.

The corridor peak period was determined to be 3:00-5:00 p.m., based upon a 48 hour continuous traffic count (see Figure II-10). In addition, a turning movement survey was conducted on April 7, 1998, from 4:00-5:15 p.m. Figure II-3 represents the turning movement by magnitude and direction. As shown in the diagram, Green Street through traffic was the predominant scale. In addition, the eastbound left turn from 12th Street to northbound Green Street is also a major movement.

Figure II-3 Turning Movement at 12th Street

Company: Evansville Urban Tranaportation Study
Project: Green Street Corridor Study
Designer: Rob He   Date: 04-7-98

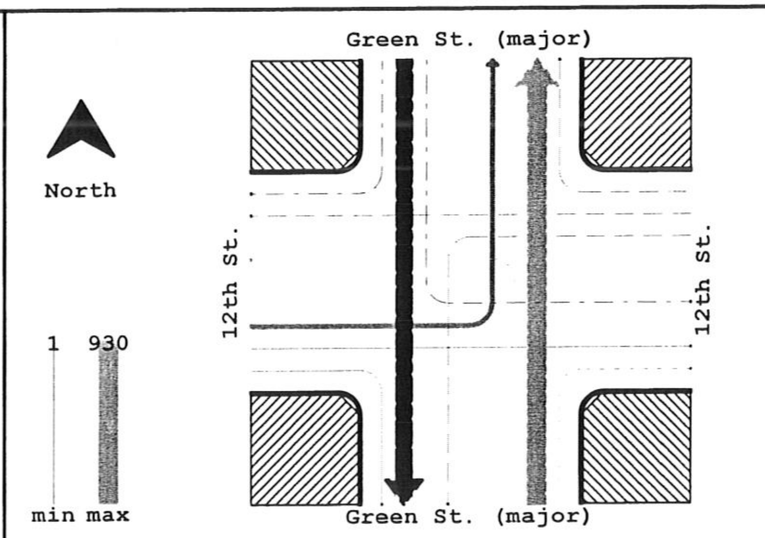
TRAFFIC VOLUME
Unit: vehicles/hour

East bound:12th St.
- Left: 317
- Thru: 16
- Right: 59

West bound:12th St.
- Left: 20
- Thru: 8
- Right: 15

North bound:Green St.
- Left: 25
- Thru: 930
- Right: 7

South bound Green St.
- Left: 1
- Thru: 826
- Right: 76

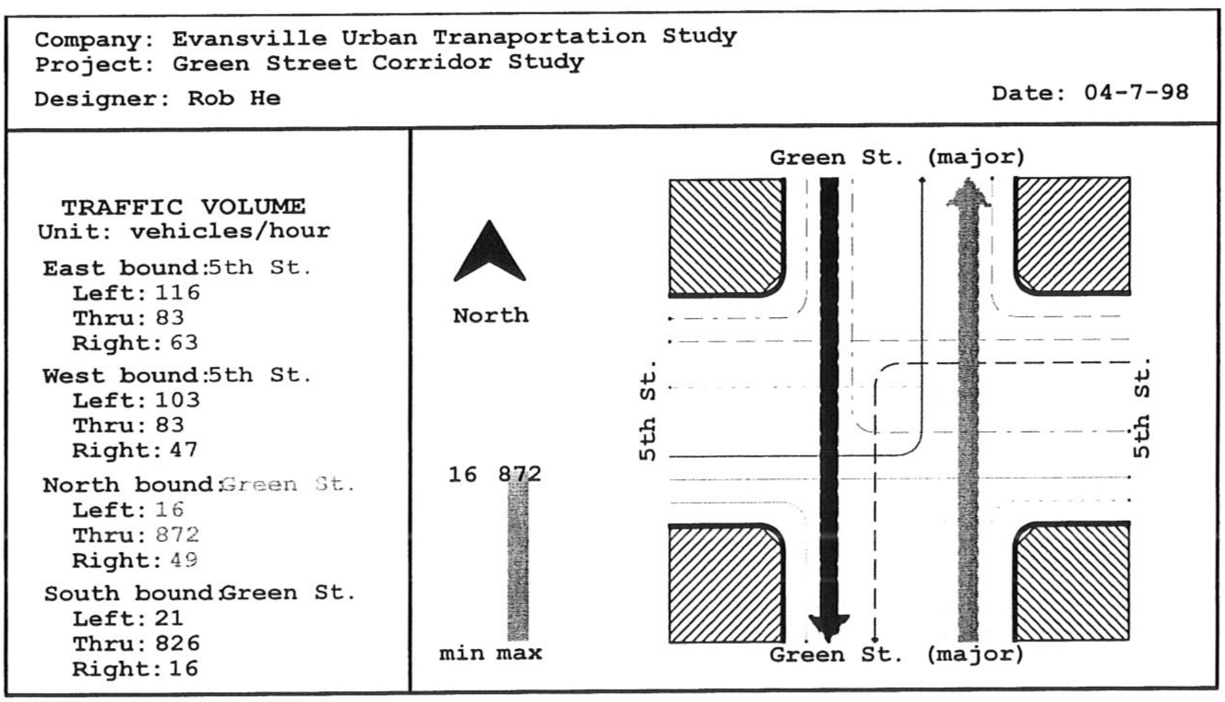


Fifth Street

This at-grade intersection is controlled by a traffic semi-actuated signal. No protected left turn movements are provided for any approach. Green Street is the north and south approaches to the intersection. Each approach is 47 feet wide, with two lanes in each direction. There are no dedicated turn lanes, so the approaching lanes are used for shared through traffic and left/right turn movements. Both east and west approaches on 5th Street are 45 feet wide. Each approach has one designated left turn lane and one lane shared by through/right turn movements. The NE quadrant of the intersection is occupied by a car dealership; the NW quadrant is occupied by a pharmacy, the SW quadrant by a fast food restaurant, and the SE quadrant by a pawnshop. It is assumed that the car dealership has traffic impacts upon the intersection.

A turning movement was conducted at this intersection on April 7, 1998, from 4:00-5:15 p.m. Figure II-4 represents the traffic movement by magnitude and direction. As shown in the diagram, through traffic on Green Street is the dominant flow.

Figure II-4 Turning Movement at 5th Street

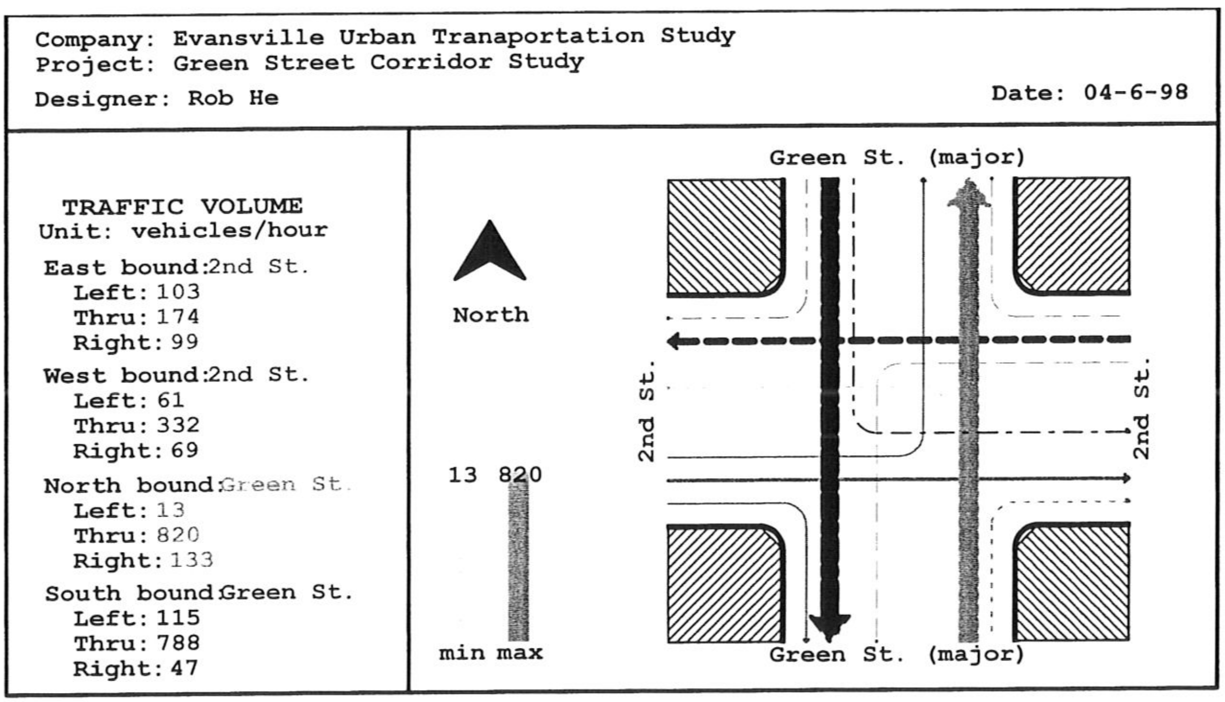


Second Street

Second Street is a four lane minor arterial, which connects the downtown central business district to the west and the Pennyrile Parkway to the east. This at-grade intersection is controlled by a pre-timed traffic signal, which is coordinated with First and Washington Streets to the south. The north approach on Green Street is 62 feet wide, with two lanes in each direction. The south approach is 75 feet wide, with three entering lanes (one left turn, one through, and one shared through/right). The west approach on Second Street is 70.5 feet wide, with two lanes (one dedicated through and one through/right). This approach provides a direct connection to the central business district of Henderson. The east approach is similar in lane configuration, but is 61 feet in width. The northwest quadrant of the intersection is currently occupied by a gas station, the northeast quadrant is vacant, the southwest quadrant is occupied by a pharmacy, and the southeast quadrant by a social club. For the purpose of this study, it is assumed that the gas station and pharmacy will attract traffic to and from the intersection.

A turning movement was conducted at this intersection on April 6, 1998, from 4:00-5:15 p.m. Figure II-5 represents the traffic movement by magnitude and direction. As shown in the diagram, through traffic on Green Street is the dominant flow and westbound through traffic on Second Street is also significant.

Figure II-5 Turning Movement at 2nd Street



First Street

This at-grade intersection is controlled by a pre-timed signal, which is coordinated with the signalized intersections at Second and Washington Streets. The north-south approaches on Green Street are 63 and 72 feet in width, respectively. Both approaches consist of a left, through and shared through/right turn lanes. The east and west approaches on First Street are 52 and 68 feet wide, respectively. Each approach consists of one dedicated left turn lane and one shared through/right turn lane. On street parking is allowed on the north and south sides of the west approach. The northwest quadrant of the intersection is currently occupied by a vacant building, the northeast quadrant by a fast food restaurant, the southwest quadrant by a small business building, and the southeast by a gas station. The gas station and fast food restaurant are assumed to have the greatest impact upon the intersection.

A turning movement was conducted at this intersection on April 6, 1998, from 4:00-5:15 p.m. Figure II-6 represents the traffic movement by magnitude and direction. As shown in the diagram, through traffic on Green Street was the dominant flow.

Figure II-6 Turning Movement at 1st Street

Company: Evansville Urban Tranaportation Study
Project: Green Street Corridor Study
Designer: Rob He   Date: 04-6-98

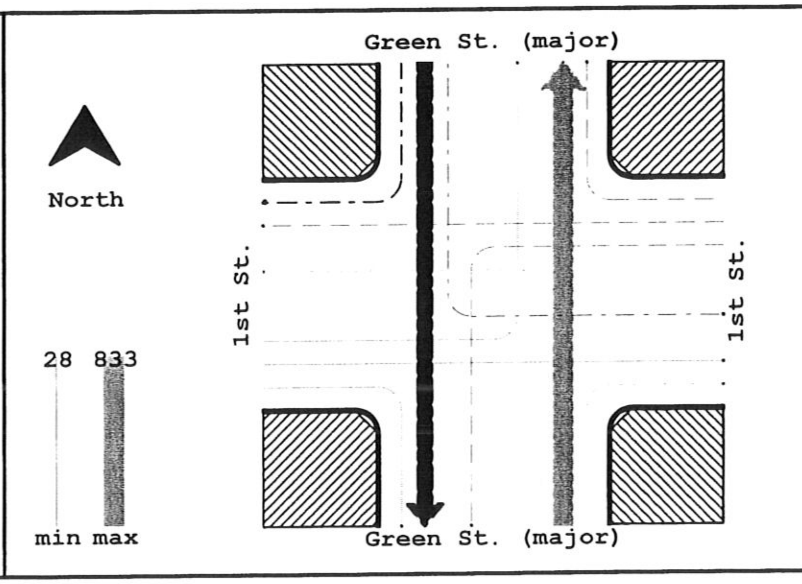
TRAFFIC VOLUME
Unit: vehicles/hour

East bound: 1st St.
Left: 72
Thru: 92
Right: 50

West bound: 1st St.
Left: 28
Thru: 75
Right: 49

North bound: Green St.
Left: 68
Thru: 833
Right: 46

South bound: Green St.
Left: 46
Thru: 714
Right: 155

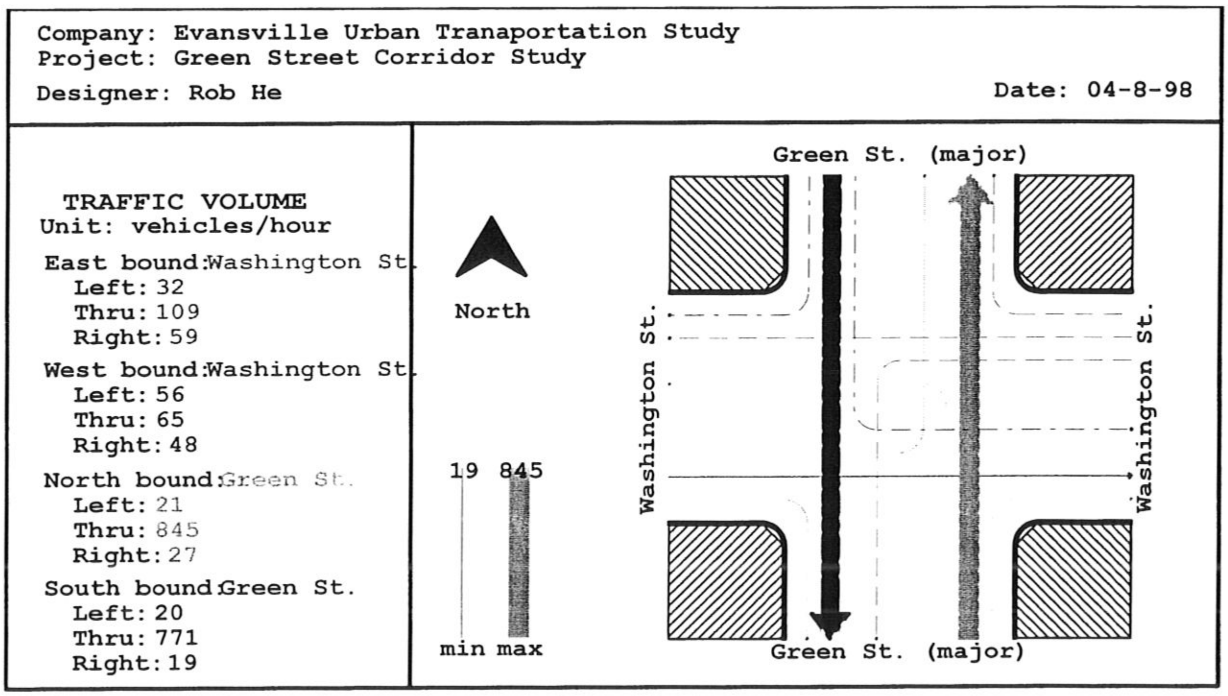


Washington Street

This at-grade intersection is controlled by a pre-timed signal, which is coordinated with the signalized intersections at First and Second Streets. The north-south approaches on Green Street are both 55 feet in width, with dedicated left, through, and a shared through/right lanes. The east and west approaches on Washington Street are 42 and 52 feet wide, respectively. Each approach has one dedicated left turn lane and one shared through/right lanes. On street parking is provided on north side of the west approach of Washington Street to the intersection. The northwest quadrant of the intersection is occupied by a parking lot, the northeast quadrant by a church, the southeast quadrant by a fast food restaurant, and the southwest quadrant by a fire station.

A turning movement was conducted at this intersection on April 8, 1998, from 4:00-5:15 p.m. Figure II-7 represents the traffic movement by magnitude and direction. As shown in the diagram, through traffic on Green Street is the dominant flow.

Figure II-7 Turning Movement at Washington Street



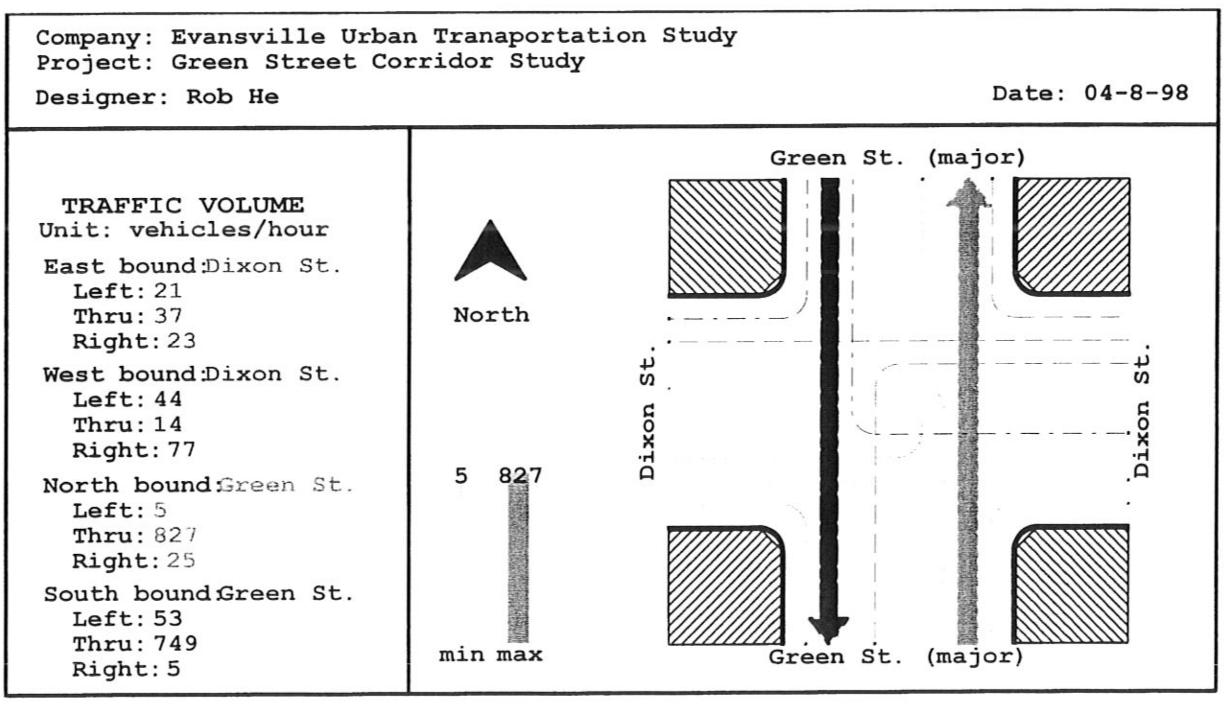
Dixon Street/ Martin Luther King Boulevard

This at-grade intersection is controlled by a traffic semi-actuated signal. The north-south approaches on Green Street are each approximately 47.5 feet wide, with two entering lanes in and two exiting. There are no dedicated turn lanes at this intersection; therefore one shared through/left turn and one shared through right turn lane exist at each north-south approach. The west approach on Dixon Street is 41 feet wide, while the east approach on Martin Luther King Boulevard. is 43 feet wide. Each approach has one lane entering the intersection, sharing through, right, and left turn movements. The most notable characteristic of the intersection is the 70-foot offset between the centerlines of Dixon Street and Martin Luther King Boulevard. This offset may complicate the traffic movements at this intersection, specifically for right or left turns, and could increase the probability of accidents.

The northwest quadrant of the intersection is currently vacant, the northeast quadrant is occupied by a carryout pizza shop, the southeast quadrant is occupied by a government office, and the southwest quadrant by a Dollar General Store. Placement of the driveways to the pizza shop could potentially influence the traffic, because of the parking space in front of the shop only accommodates two vehicles.

A turning movement was conducted at this intersection on April 8, 1998, from 4:00-5:15 p.m. Figure II-8 represents the traffic movement by magnitude and direction. As shown in the diagram, through traffic on Green Street is the dominant flow.

Figure II-8 Turning Movement at Dixon Street/ Martin Luther King Boulevard



Sand Lane

Sand Lane (KY 136) provides access from Green Street to the west and the Henderson By-pass (KY 425). This at-grade intersection is controlled by a traffic semi-actuated signal. The north-south approaches on Green Street are both 46 feet wide, with two entering lanes and two exiting lanes. Without dedicated turn lanes, left and right turning movements are shared with through traffic. The east and west approaches on Sand Lane are 36 and 47 feet in width, respectively. Each approach has one right turn lane and one shared through/left turn lane.

The northwest quadrant of the intersection is occupied by a video store, the northeast quadrant by a gas station, the southeast quadrant by a Goodwill store, and the southwest quadrant by a bank. The most noticeable feature of this intersection is the video store, which provides off-street parking, but there are no defined access points at the location. This means that vehicles are allowed to enter and exit at any point within the property frontage.

A turning movement was conducted at this intersection on April 7, 1998, from 4:00-5:15 p.m. Figure II-9 represents the traffic movement by magnitude and direction. As shown in the diagram, through traffic on Green Street and west-to-south movements on Sand Lane are the dominant flows.

Figure II-9 Turning Movement at Sand Lane

Company: Evansville Urban Tranaportation Study
Project: Green Street Corridor Study
Designer: Rob He
Date: 04-7-98

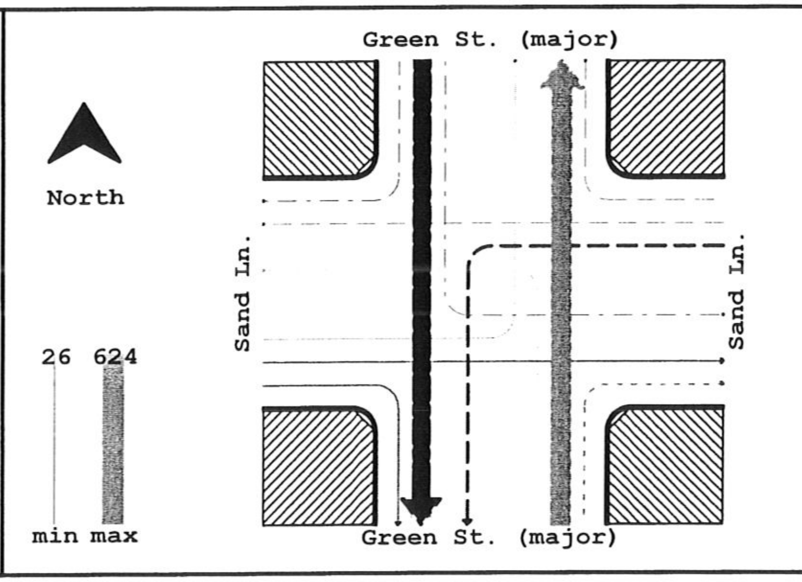
TRAFFIC VOLUME
Unit: vehicles/hour

East bound: Sand Ln.
- Left: 33
- Thru: 103
- Right: 99

West bound: Sand Ln.
- Left: 169
- Thru: 44
- Right: 48

North bound: Green St.
- Left: 55
- Thru: 624
- Right: 110

South bound: Green St.
- Left: 70
- Thru: 573
- Right: 26



Interchange with US 41

This grade-separated interchange crosses over US 41 and provides a direct connection between Green Street and US 60. Ramps provide access between Green Street and US 41, allowing a continuous merging of traffic on both roadways. Traffic flows exiting eastbound US 41 to southbound Green Street may maintain continuous movement because Green Street widens to four lanes at the point of intersection with the exit ramp. Therefore, the exit ramp becomes the outer lane on Green Street and eliminates the need for an immediate merge.

2. Roadway Segment Analysis

The study corridor was divided into seven segments, bounded by either signalized intersections or the interchange. Traffic volumes were unevenly distributed among the roadway segments, as illustrated in Figure II-2. Traffic conditions within these segments were analyzed, with the results presented in Table II-1.

Table II-1 Traffic Volumes By Road Section

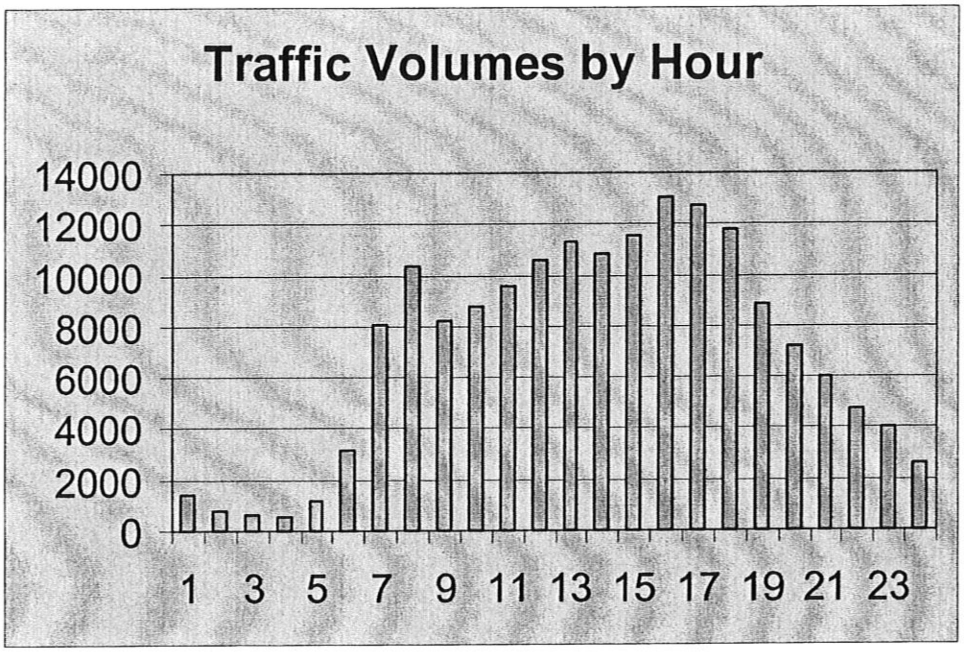
Road Section	Direction	AADT	PM PEAK	PEAK TIME	HEAVY TRUCKS	AVERAGE SPEED	85% SPEED
US 41 – 12th St.	Southbound	12321	848	1600	8.48%	42.2	46.5
	Northbound	13747	1263	1400	10.00%	42.51	47.6
12th St. – 5th St.	Southbound	11985	886	1600	11.03%	42.51	47
	Northbound	12029	961	1600	15.04%	40.36	44.2
5th St. – 2nd St.	Southbound	12748	946	1600	11.02%	34.14	38.2
	Northbound	11805	903	1600	18.39%	32.6	37.4
2nd St. – 1st St.	Southbound	12037	864	1500	10.69%	27.53	30.7
	Northbound	12252	1006	1500	19.96%	25.68	32.2
1st St. – Washington St.	Southbound	12339	910	1600	10.05%	30.6	34.8
	Northbound	11791	1009	1500	16.05%	29.23	34.4
Washington St. – Dixon St.	Southbound	11527	859	1600	11.13%	32.87	36.7
	Northbound	11745	994	1500	20.14%	34.33	39.2
Dixon St. – Sand Ln.	Southbound	11023	873	1500	11.66%	38.52	42.6
	Northbound	10585	956	1500	14.31%	37.73	42
Average	**-**	**11995**	**948**	**-**	**13.36%**	**35.09**	**39.54**

Traffic Volumes

The average annual daily traffic (AADT) represents the traffic volumes of the study corridor during a typical day (1998). The average directional (one way) AADT was 11,995 vehicles per day for the entire study corridor. The section with the highest one way volumes was between 12th Street and the US 41 interchange, with northbound traffic volumes of 13,747. The lowest one way volume was between Dixon Street and Sand Lane, with northbound volumes of 10,585. When considering the entire study corridor, the northern roadway segments showed higher average volumes than the southern segments.

Peak hours may be identified by examining the hourly traffic volume profile over a 24-hour period. Figure II-10 represents the average total traffic volumes for the corridor by hour, indicating that traffic volumes are generally higher in the afternoon hours. Specifically, the highest traffic volumes were experienced between 3:00-5:00 p.m. Only one roadway segment experienced a peak volume outside of 3:00-5:00 p.m. The segment between US 41 and 12th Street had a peak volume between 2:00-4:00 p.m. It was determined that peak hour volumes made up 7.91% of the total daily volume, which nearly doubles the 24 hour average of 4.17%. In general, peak hour volumes typically make up 10% of total daily volume, suggesting that peak hour volumes along the study corridor are lower than average.

Figure II-10 Traffic Volume Distribution in Time



Heavy truck traffic (tractor-trailer, dump truck, etc.) on the average was 13.36% of total traffic volume for the Green Street corridor. The highest proportion of heavy trucks (20.14%) was found on northbound Green Street, between Washington and Dixon Streets. The segments between First Street & Second Streets also exhibited higher than average truck volumes (7,308 trucks per day). For the entire corridor, northbound lanes generally exhibited higher truck volumes (12,574 trucks out of 83,954 AADT) than the southbound lanes (8,866 out of 83,980).

Traffic Speeds

Speed limits for the Green Street Corridor are posted as 35 miles per hour, with the exception of two school zones which are posted at 20 miles per hour. The actual average speed for the corridor (weighted by AADT) was found to be 35.09 miles per hour, however the average varied by roadway segment. The highest average speed was 42.51 miles per hour, in the segment between US 41 & Twelfth Street, while the lowest average was 25.68 miles per hour, between First and Second Streets. Generally, the segments closer to Central business district exhibit lower average speeds than those segments near the edge of the corridor. The segments of Green Street north of the intersection with 12th Street all averaged over 40 miles per hour. The 85th percentile speed was four percent higher than the average.

Access

Many businesses and residences are located along Green Street, accounting for a total of 209 driveways with direct access to the corridor. On average, there are approximately 30 access points on each roadway segment. The roadway segment between 12th and 5th Streets has the highest number with a total of 30 driveways on each side of the corridor. But in terms of the distance between the adjacent driveways, the northbound segment between 1st Street and 2nd

Street has the shortest spacing with 85.4 feet (see Table IV-4). Many of these driveways serve vehicular-related businesses, such as gas stations, drive-through pharmacies, and car dealerships, which generally have high trip generation rates. The more driveways that exist the more conflicts points to slow traffic flow and potentially cause additional traffic accidents.

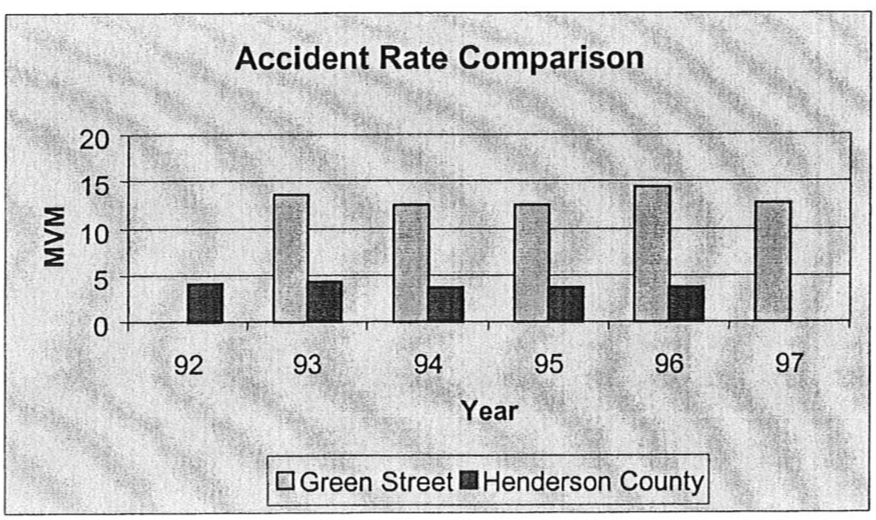
There are a variety of characteristics of these driveways, including type and width of the curb cuts and proximity to intersections and adjacent access points, which can affect traffic flow and travel behavior. The issue will be discussed in detail.

III. Safety Issues

Safety issues along the Green Street Corridor were also considered. Accident data from 1992 through 1997 were collected from the City and County of Henderson and Kentucky State Police agencies. The average yearly number of accidents for the corridor was 303, with an average of 2,024 for the county as a whole. The data sets were then calculated as accident rates (the number of accidents per one million vehicle miles traveled (MVM[1]) for the purpose of comparison, making it possible to track changes in pattern and relative severity. Figure III-1 illustrates the findings for both the Green Street Corridor and the county. Accident data for the study period suggests that no significant changes occurred in accident patterns, however it was determined that the annual accident rate was significantly higher for Green Street (13.11) when compared to the entire county (3.90). It was also higher than the average of the Commonwealth of Kentucky which was 6.44 for the urban 4-lane highway between 1991 and 1995.

A thorough review of the individual accident reports from the Henderson Police Department for the period of 1996-97 revealed that the accident occurrences were higher in October and on Fridays. For a typical weekday, accident frequency was higher between 3:00 and 4:00 p.m., which is consistent with peak traffic volume periods for the corridor. Approximately 58.66% of the accidents occurred at intersections, while 41.34% occurred within the roadway segments. Usually, the ratio of accidents at intersections compared to roadway segments is 2:1, however the Green Street corridor exhibits a 3:2 intersection-to-roadway ratio. This suggests that safety problems between intersections should be specifically examined in this corridor study.

Figure III-1 Accident Rates of Green Street and Henderson County



---

[1] Rate per MVM == $\frac{\text{number of accidents x 1 million}}{\text{Total VMT}}$

1. Intersections

Approximately 30% of the accidents recorded at intersections involved personal injury and very few involved non-vehicle victims (pedestrians, bicyclists, etc.). 46.64% of accidents occurred at signalized intersections, while 53.36% occurred at unsignalized intersections.

Among incidents at signalized intersections (see Table III-1), Fifth and Second Streets experienced the highest number of accidents. This may be attributed to the high traffic volumes at these intersections. Taking the traffic volumes into account, Fifth Street was still the most probable accident site with a rate of 1.77 based on accident rates[2], while Dixon Street at 1.11 exceeded the rate of Second Street of 0.99. The intersection with First Street had the lowest accident rate among the signalized intersections.

Table III-1 Signalized Intersection Accidents

Intersection	Frequency (2 Years)	Rank by Frequency	Traffic Volume (PM Peak)	Rate	Rank by Rate
12th Street	18	4	2,300	0.86	5
5th Street	37	1	2,295	1.77	1
2nd Street	25	2	2,754	0.99	3
1st Street	11	7	2,236	0.54	7
Washington Street	16	5	2,072	0.69	4
Dixon/Martin Luther King Boulevard	19	3	1,880	1.11	2
Sand Lane	13	6	1,960	0.89	6
Total	**139**	-	**15,497**	-	-
Average	**20**	-	**2,214**	**0.98**	-

Clay and Richardson Streets experienced more accidents than many other signalized or unsignalized intersections, with 26 and 21 accidents respectively. When considering intersection approaches, the number of accidents on Green Street (68.27%) was higher than those on the intersecting streets.

The data for vehicular activity shows that 29% of incidents were attributed to conflicts between left-turn and through movements, 9% were attributed to collisions between right-turn and through movements, and 16% were attributed to right angle collisions by through movements on approaches,. These accidents were most likely caused by failure to yield the right of way. Conversely, 19% of accidents were attributable to "straight-stopping/stopped" collisions. This type of collision could be reduced with increased driver attention to changes in intersection situations and enhanced defensive driving skills. Although mechanical malfunction was not a major contributor, environmental changes (wet/icy surfaces, obstructed views, etc.) did directly contribute to some incidents. Impaired driving accounted for less than one percent of all accidents.

---

[2]

$$\text{Intersection accident rate} = \frac{\text{Annual accident numbers} \times 1 \text{ million}}{\text{Daily traffic volume} \times 365}$$

Peak hour factor == 0.08

2. Roadway Segments

Approximately 20% of accidents on the roadway segments involved personal injury. This figure is lower than the percentage at intersections (30%). However, two fatalities were recorded between First and Center Streets, as well as between 14th Street and Herron Street in 1997.

Approximately 90% of all accidents involved multiple vehicles. As shown in Table III-2, the roadway segment between Washington and Dixon Streets experienced the most accidents in 1996 and 1997, followed by the segment between Fifth and Twelfth Streets. The segment between First and Second Streets had the highest accident rate, followed by the segment between Washington and Dixon Streets. The spatial distribution of accident rates is shown in Figure III-2.

Table III-2 Road Section Accidents

Road Section	Frequency (2 Years)	Rank by Frequency	Vehicle Miles Traveled	Rate (MVM)	Rank by Rate
US 41 – 12th Street	26	5	9,392.76	3.80	4
12th Street – 5th Street	42	2	16,795.87	3.44	5
5th Street – 2nd Street	35	4	7,172.98	6.69	3
2nd Street – 1st Street	19	6	2,357.20	11.05	1
1st Street – Washington Street	6	7	4,079.66	2.02	7
Washington St. – Dixon St.	45	1	6,845.50	9.01	2
Dixon St. – Sand Ln.	37	3	17,424.11	2.91	6
Total	**210**	-	**64,068.08**	-	-
Average	**30**	-	-	**4.49**	-

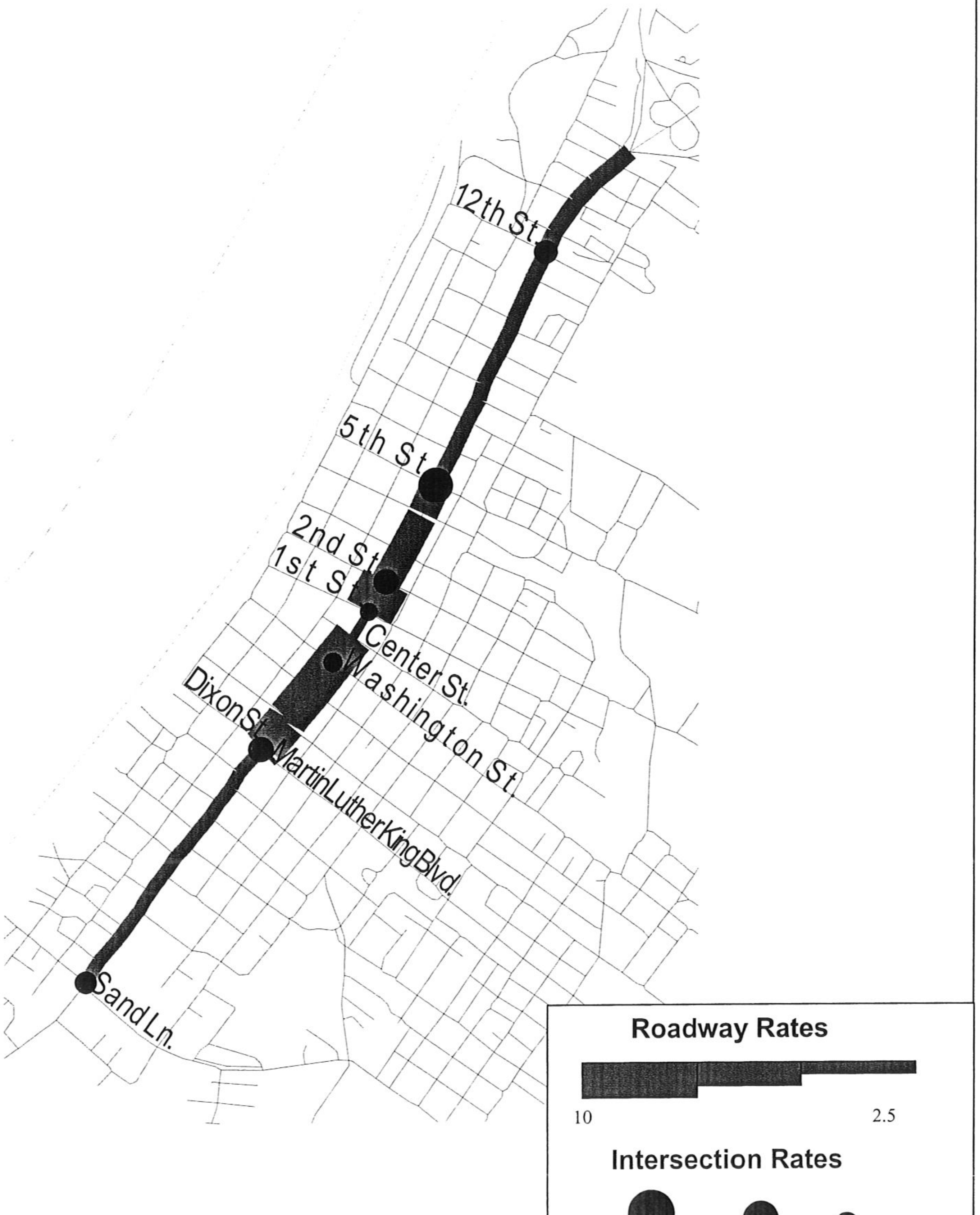


Figure III-2: Spatial Distribution of Accident Rates

IV. Analysis

To evaluate the existing operational conditions for the Green Street Corridor, capacity analyses were performed for the signalized intersections and for the entire corridor. The Level of Service (LOS) for each individual intersection and roadway segment was determined through the capacity analysis based on the Highway Capacity Manual. Additionally, an accident analysis was performed to identify safety problems associated with the corridor.

1. Capacity Analysis

Prior to conducting the capacity analysis, a corridor should be classified according to its function and design characteristics. A set of evaluation criteria from the Highway Capacity Manual of 1994, Table 11-2 and 3 (TRB Special Report 209, 1996) can be cited as a standard with which to compare the actual data obtained from the corridor.

Function
Functional classification was determined by evaluating mobility and access functions, the geographic points that a roadway connects, and the predominant trips it serves. The corridor mobility function is especially important for Green Street because it connects the regional highways of US 41 and US 60. The access function was also considered to be extremely important. Since the opening of the Henderson Bypass (KY 425), a considerable amount of through traffic has been diverted from the study corridor. The majority of the traffic flow served by Green Street is generated by and/or attracted to the local area, producing moderate trip lengths. As a result of these characteristics, the Green Street Corridor should be classified as a minor arterial for study purpose.

Design
The corridor was also classified by its design category, driveway access density, arterial type, parking characteristics, separated turn lane availability, speed limits, pedestrian activity, and residential development.

As stated previously, Green Street:

- is a multiple (4) lane, mostly undivided highway with no shoulders;
- has no specific access control imposed upon the corridor and no on-street parking provided;
- has only two dedicated left-turn lanes among the seven signalized intersections;
- has the average distance between signalized intersections of 0.42 miles and speed limits of 35 miles per hour for the entire corridor;
- has rare pedestrian interference to the corridor, with the only exception being the intersections of First and Second Streets; and
- roadside development is concentrated in the northern portion of the corridor.

Comparing these conditions with the Highway Capacity Manual standards, the corridor should be classified as intermediate (between typical urban-suburban categories) design.

Classified as a minor arterial function and intermediate design, the Green Street Corridor was classified as a Type III arterial. This classification was used to establish the arterial LOS definitions (see Table IV-1). With a Type III arterial classification, the free-flow speed should range between 25 to 35 miles per hour, with a default of 30 miles per hour, and running time between 122 to 165 seconds per mile, with the actual value depending upon segment length.

A capacity analysis was conducted to determine if the road facility is capable of accommodating traffic flows. The LOS is used to indicate how capable a facility is of meeting the needs of traffic. For signalized intersections, the LOS is determined by the average delay a vehicle may experience while waiting at an intersection. But for road sections, the LOS is determined by the average speed. Table IV-1 shows the criteria to determine LOS for both.

Table IV-1 Level of Service

Level of Service (LOS)	Signalized Intersection Average Delay (second)	Road Section Average Speed (Type III, mph)
A	<= 5.0	>= 25
B	> 5.0 and <= 15.0	>= 19
C	> 15.0 and <= 25.0	>= 13
D	> 25.0 and <= 40.0	>= 9
E	> 40.0 and <= 60.0	>= 7
F	> 60.0	< 7

LOS has 6 categories, ranging from A to F, among which A represents the ideal situation while F denotes a fail status to function properly. LOS C is generally accepted as a reasonable LOS, and has been adopted as the standard for the entire metropolitan area. By conducting capacity analyses based on current traffic data, the LOS was determined for signalized intersections and road sections in the Green Street corridor.

Traffic counts, as well as signal timing, physical configurations, etc., have been analyzed according to the Highway Capacity Manual 1994 edition and associated by running a traffic analysis software (TEAPAC/Signal94). The average delay of a vehicle at each intersection was calculated. The LOS for each intersection was determined based upon this average vehicle delay (Table VI-2). Of the seven signalized intersections, only the 2nd Street and Sand Lane intersections appeared to have capacity problems in PM peak hour with a LOS worse than C. Typically, alternatives are developed starting from simple and progressing to sophisticated. Improving signal timing and phasing is the simplest and least costly solution available. Signal optimizations were conducted for both deficient intersections using TEAPAC/Signal94 (see Appendix for the optimized timing/phasing schedules). As a result of the signal optimization, it is projected that the intersection with 2nd Street could be improved to LOS C and Sand Lane improved to LOS B without any additional physical improvements. Therefore, all 7 signalized intersections were capable of accommodating current traffic demands during P.M. peak period.

Table IV-2 Intersection Capacity

Intersection	Traffic Volume	Volumes/Capacity	Delay (second)	Level of Service (optimized)
12th Street	2300	0.673	11.2	B
5th Street	2295	0.516	8.2	B+
2nd Street	2754	0.927	29.8	D (C)
1st Street	2236	0.468	9.9	B+
Washington Street	2072	0.434	8.3	B+
Dixon/MLK Street	1880	0.607	8.7	B+
Sand Lane	1960	0.725	31.3	D (B)

The road segment capacity analysis depends heavily upon the LOS at the signalized intersections of the corridor. The HCS software was used to conduct the analysis. The current LOS for the study corridor is illustrated in Figure IV-1. As shown in Table IV-3, the majority of the road segments were operating at LOS A or B, except for the segment between First Street and Second Street, which had LOS D for southbound and E for northbound. Collectively, the entire arterial LOS was B, with an average speed of 23 mph. Although two segments of the Green Street corridor are currently operating at a deficient LOS, simple signal optimization could improve the corridor to a satisfactory level.

Table IV-3 LOS for Road Section

Road Section	Southbound		Northbound	
	Arterial Speed	LOS	Arterial Speed	LOS
12th Street – 5th Street	26.5	A	25.2	A
5th Street – 2nd Street	19.5	B	23.2	B
2nd Street – 1st Street	12.2	D	8.4	E
1st Street – Washington Street	20.3	B	20.2	B
Washington St. – Dixon St.	21.8	B	24.5	B
Dixon St. – Sand Ln.	25.2	A	26.8	A
The Corridor	**22.9**	**B**	**23.0**	**B**

The EUTS 2020 Transportation Plan projects that traffic volumes on the Green Street corridor will increase by an average of 10% during the next 20 years. Data were modified to reflect this projected increase and a second capacity analysis was performed to estimate future performance. The results showed that LOS for the signalized intersections and the roadway segments would retain a LOS C or better, with the exception being the intersection with 2nd Street. The intersection with Second Street would experience a projected LOS D even with signal optimization. This problem would be attributable to southbound traffic on Green Street, contributing a LOS of E. Therefore, alternatives beyond signal optimization should be considered for this intersection.

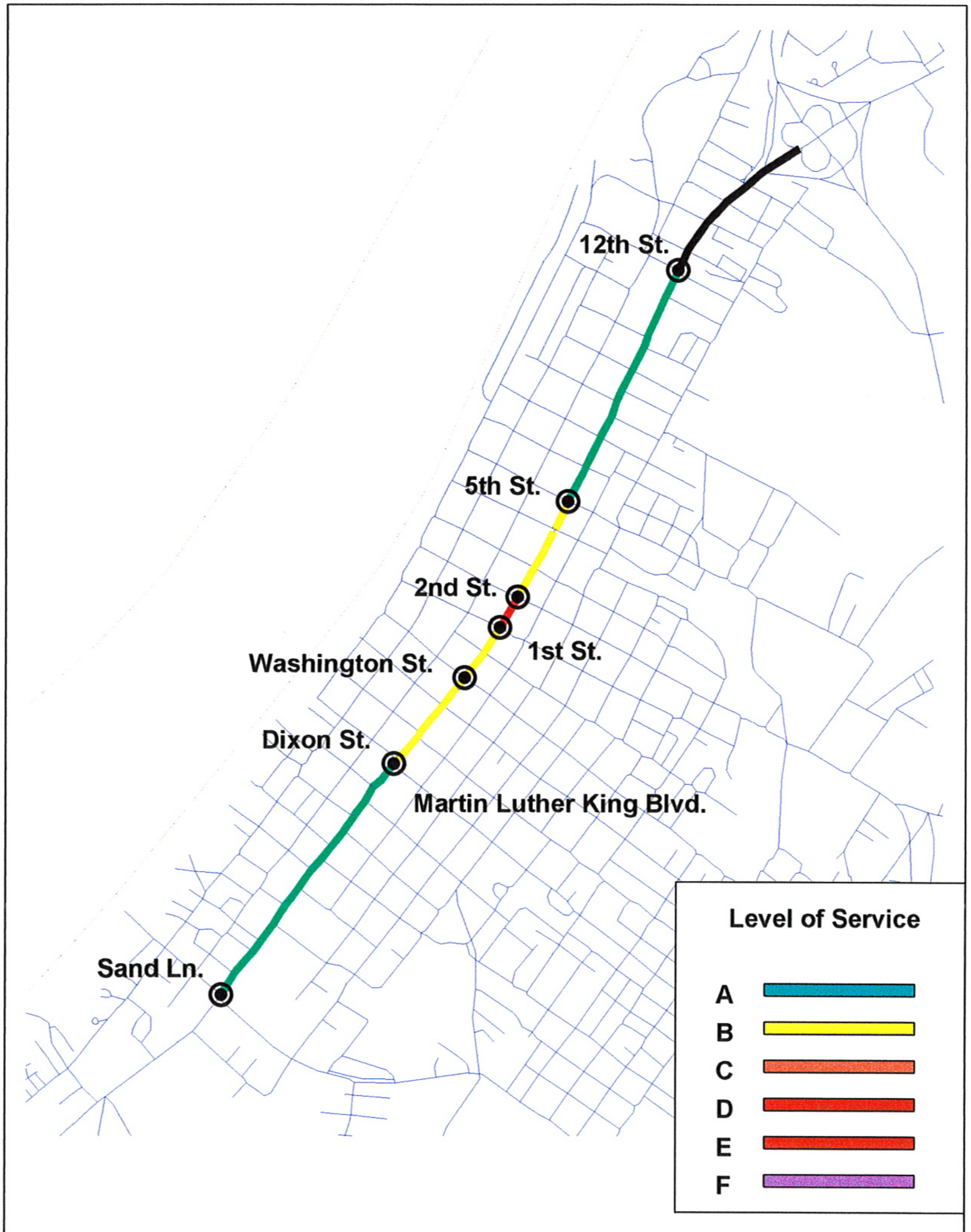


Figure IV-1: Corridor Level of Service

2. Accident Analysis

Accidents can be attributed to driver inattention or failure to follow the traffic rules. Among the accidents occurring at intersections, 39% were caused from driver inattention and 31% from failure-to-yield. In the roadway segments, the proportions were 45% and 15% respectively. Proper improvements to roadway facilities can provide for a safer driving environment and, in turn, reduce the possibility of accidents by:

- minimizing potential conflict points, to simplify traffic flow;
- making efforts to increase drivers' awareness of changes on roadway by improving information/warning signs; and
- improving traffic control techniques.

As mentioned previously, the number of accidents for the Green Street Corridor was unusually high in the past few years, especially in the road sections. Three possible factors were examined to determine their relationship with road section accidents:

- traffic volume;
- speed; and
- number of accesses.

Traffic Volume

Generally, higher traffic volumes will result in increased traffic accidents. Of the three roadway segments with the most accidents, two had higher vehicle miles traveled than all the other segments. However, looking at the accident rates, drivers in these segments actually had less of a chance of being involved in an accident (see Table III-2) as demonstrated by the significantly lower accident rates. Therefore, as long as the road capacity is not exceeded, reducing traffic volumes may not be an appropriate solution to the safety problem.

Speed

The average speed in each roadway segment was selected as a candidate to determine whether it could be statistically related to the occurrence of accidents. Assuming that a driver has less control of a vehicle at higher speeds, speed could be a factor in accident rates. A statistical analysis was performed based on collected data, and the mono-increasing line, logarithm, power, and exponential curves were tested to see how well these curves could represent the relationship between speed and accident rate. The accident/speed diagrams against the curves didn't show good matches since the coefficients of determination[3], or R^2s, were relatively low. That is to say, none of the curves could satisfactorily describe the relationship of accident with speed. As a result, higher speed does not necessarily lead to increased accidents in the study corridor.

[3] The value of R^2 in statistics provides a goodness-of-fit measure to the relationship between studied variables. It ranges in value from 0 (indicating no relation) to 1 (full relation).

Number of Accesses

Vehicles entering or exiting the corridor through driveway accesses cause interruptions to the traffic of the primary roadway. Excessive access points result in increased turning movements/conflict points, thereby increasing the potential for crashes. In addition, the lack of dedicated turn lanes slows traffic and reduces the carrying capacity of the roadway. This prospect has been proven by sound traffic engineering studies. In the case of Green Street, the relationship between the number of access points per mile and the accident rates (MVM) was examined using regression analysis similar to what was used for the speed analysis described above. The result strongly indicates that the more driveways, the greater probability of a traffic accident. Therefore, the number of driveways along the corridor, or their spacing, was a major factor in the high accident rates.

The number of driveways on each side of the road segments is listed in the Table IV-4. By comparing the actual access spacing with the current EUTS Access Standard Manual, 57.14% of the sections had shorter average distance between driveways than 150 feet minimum. When considering the spacing of the unsignalized intersections, the percentages could be even higher. One fatal accident over past two years was caused in part by the access point. A car suddenly stopped to attempt to make a left turn into a driveway which caused the motorbike to crash into the rear of the vehicle. Therefore, it is important that the number and density of driveways along Green Street and the turning movement be reduced when possible.

Table IV-4 Driveway Numbers and Spacing

Road Section	Direction	Length (foot)	Number of Driveway	Driveway Spacing (ft)	Maximum Number of Driveways	Number of Driveways to Be Reduced
US 41 – 12th St.	Southbound	1900.8	11	172.8	12	0
	Northbound	1900.8	19	100.0	12	7
12th St. – 5th St.	Southbound	3674.9	30	122.5	24	6
	Northbound	3674.9	30	122.5	24	6
5th St. – 2nd St.	Southbound	1541.8	15	102.8	10	5
	Northbound	1541.8	12	128.5	10	2
2nd St. – 1st St.	Southbound	512.2	3	170.7	3	0
	Northbound	512.2	6	85.4	3	3
1st St. – Washington St.	Southbound	892.3	3	297.4	5	0
	Northbound	892.3	8	111.5	5	3
Washington St. – Dixon St.	Southbound	1552.3	13	119.4	10	3
	Northbound	1552.3	8	194.0	10	0
Dixon St. – Sand Ln.	Southbound	4255.7	26	163.7	28	0
	Northbound	4255.7	25	170.2	28	0
Total	-	**28659.84**	**209**	-	-	**36**
Average	-	-	-	**137.1**	-	-

V. Summary

Findings:
Through the capacity analyses and accident analyses described in this report, the safety problem in the study area was found to be serious. Specifically, some major findings are summarized as follows:

1. All of the signalized intersections are capable of carrying the existing traffic, except 2nd Street and Sand Lane which exhibit a LOS worse than C. Through signal optimization, each intersection can be improved to C or B. However, the intersection of 2nd Street will deteriorate to a condition of poor if traffic volumes increase by 10% or more as estimated over the next 20 years and no physical improvements are made;

2. The arterial capacity was found to meet the existing traffic demands, except for the section between 1st Street and 2nd Street. Because this is the shortest section of roadway carrying a similar amount of traffic as other sections, the higher density actually reduces the average speed, causing poor LOS;

3. Safety was an overwhelming problem, as the accident rates in the study area were about twice as high as the county average over the past 5 years. Unlike some other corridors in this area, the number of accidents occurring in mid-block were almost the same as those at the intersections;

4. Even though the average speed through a 48-hour observation was slightly more than the posted speed limit of 35 mph, it implies that a sizable amount of vehicles were driving too fast, especially in the northern part of the corridor between 5th Street and the US 41 interchange where the average speeds were more than 40 mph.

Recommendations:
Based on these findings, a series of preliminary recommendations were developed, including engineering, management and policy measures. To improve the deficiencies in road capacity, the following solutions are suggested:

1. Optimize signal timing and phasing for the intersections with 2nd Street and Sand Lane. Computer generated signal timing and phasing patterns for these two intersections are suggested and attached to this report in the Appendix. The patterns were optimized based on the peak hour turning movements and the intersection geometric arrangements. Some of the specific characteristics can not be taken into account by the computer software; therefore, adjustments may be necessary in practical operations;

2. Add a left-turn lane for the southbound approach of the 2nd Street intersection, since the signal optimization alone was not able to improve this particular movement when traffic volumes increase.

To improve safety, the following recommendations are considered to be effective in reducing traffic accidents and should be phased according to available funding:

1. Review and modify traffic signs for proper location of speed limit and other advance warning signs;

2. Prohibit through traffic at the offset intersections, especially those at 12th Street, Dixon/Martin Luther King Boulevard, and Clay Street;

3. Close the median opening at Richardson Street due to proximity to the US 41 interchange. By using the raised median, it will visually remind drivers of the blocked intersection. However, the Fire Department vehicles can roll over the barrier in an emergency;

4. Access control is a major component of a long term solution to improve safety throughout the corridor. In accordance with the EUTS Access Standard Manual, and when possible, effort should be made to reduce at least 36 openings to the corridor while encouraging entry/exit to the side streets.

5. EUTS has thoroughly examined and discussed with local and state officials construction of a median barrier treatment, or continuous left-turn lane. While a median barrier is more effective and less costly, the continuous turn lane is more feasible. According to state and local officials there is adequate right-of-way along the corridor to provide for an continous turn lane, therefore, we recommend construction of a continuous left-turn lane between 1st Street and 12th Street.

APPENDIX: Signal Settings and Level of Service

Second Street

- Current
- Optimized current
- Optimized with 10% of increased traffic volumes
- Optimized with 10% of increased traffic volumes and an additional southbound turn lane

Sand Lane

- Current
- Optimized current
- Optimized with 10% of increased traffic volumes

Green Street Corridor Study, Henderson City
Signalized Intersection Capacity Analysis
Green Street/2nd Street (current)

04/15/98
15:57:07

SIGNAL94/TEAPAC[Ver 1.20] - Capacity Analysis Summary

Intersection Averages for Int # 205 - MINUTP number without "5"
Degree of Saturation (v/c) 0.93 Vehicle Delay 29.8@ Level of Service D+
@ expect more delay due to extreme v/c's (see EVALUATE)

```
        ---------------------------------------------------
Sq 32  |  Phase 1   |  Phase 2   |  Phase 3   |  Phase 4   |
LD/LD  ---------------------------------------------------
       |            | + + +      |        ^   |        ^   |
   .   |            | + + +      |       ++++ |       ++++ |
  /|\  |            |<+ + +>     |      <++++ |      <++++ |
   |   |            |   v        |       ++++ |    ^  ++++ |
   |   |     ^      |        ^   |       v    |++++   v    |
North  |   <+ + +>  |     <+ + +>|            |++++>       |
   |   |    + + +   |      + + + |            |++++        |
       |    + + +   |      + + + |            |   v        |
        ---------------------------------------------------
       | G/C=0.076  | G/C=0.341  | G/C=0.076  | G/C=0.306  |
       | G=   6.5"  | G=  29.0"  | G=   6.5"  | G=  26.0"  |
       | Y+R= 3.0"  | Y+R= 5.5"  | Y+R= 3.0"  | Y+R= 5.5"  |
       | OFF=81.2%  | OFF=92.4%  | OFF=32.9%  | OFF=44.1%  |
        ---------------------------------------------------
```

C= 85 sec G= 68.0 sec = 80.0% Y=17.0 sec = 20.0% Ped= 0.0 sec = 0.0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
N Approach								58.6@	E	
LT+TH+RT	24/2	0.594	0.371	570	679	1039	1.530	58.6@	E	391 ft
S Approach								13.3	B	
TH+RT	24/2	0.358	0.482	1500	1583	1031	0.651	13.3	B	319 ft
LT	12/1	0.000	0.076	164	206	13	0.063	10.9	B	25 ft
E Approach								12.7	B	
TH+RT	12/1	0.282	0.447	631	716	329	0.459	12.8	B	216 ft
LT	12/1	0.025	0.076	211	258	124	0.481	12.4	B	81 ft
W Approach								20.6	C	
LT+TH+RT	24/2	0.298	0.335	631	762	533	0.699	20.6	C	210 ft

Green Street Corridor Study, Henderson City
Signalized Intersection Capacity Analysis
Green Street/2nd Street (Optimized)

04/16/98
15:01:29

SIGNAL94/TEAPAC[Ver 1.20] - Capacity Analysis Summary

Intersection Averages for Int # 205 - MINUTP number without "5"
Degree of Saturation (v/c) 0.73 Vehicle Delay 18.8 Level of Service C+

```
        -------------------------
Sq 11 |  Phase 1    |  Phase 2   |
LD/LD -------------------------
      | * * *       |          ^ |
  .   | * * *       |       ++++|
 /|\  |<* * *>      |      <++++|
  |   |   v         |    ^  ****|
  |   |      ^      |++++   v   |
North |    <+ + +>  |++++>      |
  |   |     + + +   |++++       |
      |     + + +   |   v       |
        -------------------------
      | G/C=0.586   | G/C=0.320  |
      | G=  49.8"   | G=  27.2"  |
      | Y+R= 4.0"   | Y+R= 4.0"  |
      | OFF=81.2%   | OFF=44.5%  |
        -------------------------
```

C= 85 sec G= 77.0 sec = 90.6% Y= 8.0 sec = 9.4% Ped= 0.0 sec = 0.0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
N Approach								26.3	D+	
LT+TH+RT	24/2	0.602	0.598	1031	1080	1039	0.962	26.3	*D+	250 ft
S Approach								7.8	B+	
TH+RT	24/2	0.358	0.598	1928	1962	1031	0.525	7.8	B+	248 ft
LT	12/1	0.130	0.598	84	106	13	0.116	5.6	B+	25 ft
E Approach								23.6	C	
TH+RT	12/1	0.282	0.332	420	531	329	0.620	19.7	C+	261 ft
LT	12/1	0.369	0.332	105	150	124	0.780	33.8	*D	98 ft
W Approach								21.5	C	
LT+TH+RT	24/2	0.305	0.332	603	734	533	0.726	21.5	C	211 ft

Green Street Corridor Study, Henderson City
Signalized Intersection Capacity Analysis
Green Street/2nd Street (optimized, +10%)

07/08/98
09:41:43

SIGNAL94/TEAPAC[Ver 1.20] - Capacity Analysis Summary

Intersection Averages for Int # 205 - MINUTP number without "5"
Degree of Saturation (v/c) 0.87 Vehicle Delay 26.6@ Level of Service D+
@ expect more delay due to extreme v/c's (see EVALUATE)

```
        -------------------------
Sq 11  |  Phase 1    |  Phase 2     |
LD/LD  -------------------------
       |  * * *      |         ^    |
   .   |  * * *      |         ++++|
  /|\  |<* * *>      |        <++++|
   |   |    v        |     ^   ****|
   |   |        ^    |++++     v    |
North  |     <+ + +> |++++>         |
   |   |       + + + |++++          |
       |       + + + |   v          |
        -------------------------
       | G/C=0.496   | G/C=0.410    |
       | G=   42.2"  | G=   34.8"   |
       | Y+R= 4.0"   | Y+R= 4.0"    |
       | OFF=81.2%   | OFF=35.5%    |
        -------------------------
```

C= 85 sec G= 77.0 sec = 90.6% Y= 8.0 sec = 9.4% Ped= 0.0 sec = 0.0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
N Approach								50.9@	E	
LT+TH+RT	24/2	0.685	0.508	796	868	1143	1.317	50.9@	*E	336 ft
S Approach								12.7	B	
TH+RT	24/2	0.385	0.508	1595	1667	1135	0.681	12.8	B	334 ft
LT	12/1	0.131	0.508	59	77	14	0.165	8.6	B+	25 ft
E Approach								16.2	C+	
TH+RT	12/1	0.300	0.422	584	675	361	0.535	14.6	B	248 ft
LT	12/1	0.391	0.422	152	199	136	0.667	20.5	*C	93 ft
W Approach								15.5	C+	
LT+TH+RT	24/2	0.320	0.422	851	953	587	0.616	15.5	C+	202 ft

Green Street Corridor Study, Henderson City 07/08/98
Signalized Intersection Capacity Analysis 09:57:50
Green Street/2nd Street (optimized, +10%, +SB Left Lane)

SIGNAL94/TEAPAC[Ver 1.20] - Capacity Analysis Summary

Intersection Averages for Int # 205 - MINUTP number without "5"
Degree of Saturation (v/c) 0.66 Vehicle Delay 17.1@ Level of Service C+
@ expect more delay due to extreme v/c's (see EVALUATE)

```
        -----------------------
Sq 11  |  Phase 1   |  Phase 2   |
LD/LD  -----------------------
       |  * * +     |        ^   |
   .   |  * * +     |       ++++ |
  /|\  |<* * +>     |     <++++ |
   |   |    v       |    ^  **** |
   |   |       ^    |++++   v    |
North  |    <+ + +> |++++>       |
   |   |     + + +  |++++        |
       |     + + +  |   v        |
        -----------------------
       | G/C=0.496  | G/C=0.410  |
       | G=  42.2"  | G=  34.8"  |
       | Y+R= 4.0"  | Y+R= 4.0"  |
       | OFF=81.2%  | OFF=35.5%  |
        -----------------------
```

C= 85 sec G= 77.0 sec = 90.6% Y= 8.0 sec = 9.4% Ped= 0.0 sec = 0.0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
N Approach								22.7@	C	
TH+RT	24/2	0.347	0.508	1616	1688	1005	0.595	11.6	*B	295 ft
LT	12/1	0.982	0.508	59	77	132	1.553	107.2@	F	78 ft
S Approach								12.7	B	
TH+RT	24/2	0.385	0.508	1595	1667	1135	0.681	12.8	B	334 ft
LT	12/1	0.131	0.508	66	86	14	0.149	8.5	B+	25 ft
E Approach								16.2	C+	
TH+RT	12/1	0.300	0.422	584	675	361	0.535	14.6	B	248 ft
LT	12/1	0.391	0.422	152	199	136	0.667	20.5	*C	93 ft
W Approach								15.5	C+	
LT+TH+RT	24/2	0.320	0.422	851	953	587	0.616	15.5	C+	202 ft

Green Street Corridor Study, Henderson City
Signalized Intersection Capacity Analysis
Green Street/Sand Lane (current)

04/17/98
08:06:36

SIGNAL94/TEAPAC[Ver 1.20] - Capacity Analysis Summary

Intersection Averages for Int # 217 - MINUTP number without "5"
Degree of Saturation (v/c) 0.73 Vehicle Delay 31.3@ Level of Service D+
@ expect more delay due to extreme v/c's (see EVALUATE)

```
        ----------------------------------
Sq 71  |  Phase 1   |  Phase 2   |  Phase 3   |
**/**  ----------------------------------
       | + + + ^    |            |        ^   |
   .   | + + + ++++ |            |       ++++ |
  /|\  |<+ + +>     |            |      <++++ |
   |   |   v        |            |    ^  ++++ |
   |   |            |         ^  |++++    v   |
North  |            |     <+ + +>|++++>       |
   |   |            |++++ + + +  |++++        |
       |            |    v + + + |   v        |
        ----------------------------------
       | G/C=0.333  | G/C=0.333  | G/C=0.190  |
       | G=  35.0"  | G=  35.0"  | G=  20.0"  |
       | Y+R= 5.0"  | Y+R= 5.0"  | Y+R= 5.0"  |
        ----------------------------------
       C=105 sec   G= 90.0 sec = 85.7%   Y=15.0 sec = 14.3%   Ped= 0.0 sec =  0.0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
N Approach								18.6	C+	
LT+TH+RT	24/2	0.275	0.352	1124	1298	773	0.596	18.6	C+	369 ft
S Approach								21.3	C	
LT+TH+RT	24/2	0.322	0.352	1108	1281	974	0.760	21.3	C	465 ft
E Approach								108.1@	F	
RT	12/1	0.157	0.590	888	944	54	0.057	5.9	B+	32 ft
LT+TH	12/1	0.400	0.210	76	150	239	1.466	131.2@	F	277 ft
W Approach								20.9	C	
RT	12/1	0.184	0.590	888	944	122	0.129	6.2	B+	73 ft
LT+TH	12/1	0.250	0.210	117	225	168	0.715	31.6	D+	195 ft

Green Street Corridor Study, Henderson City
Signalized Intersection Capacity Analysis
Green Street/Sand Lane (optimized)

04/17/98
08:18:19

SIGNAL94/TEAPAC[Ver 1.20] - Capacity Analysis Summary

Intersection Averages for Int # 217 - MINUTP number without "5"
Degree of Saturation (v/c) 0.60 Vehicle Delay 13.2 Level of Service B

```
         -------------------------
Sq 11   |  Phase 1   |  Phase 2   |
**/**    -------------------------
        |  * * *     |         ^  |
   .    |  * * *     |       ++++ |
  /|\   |<* * *>     |      <**** |
   |    |   v        |    ^  **** |
   |    |       ^    |++++   v    |
North   |    <+ + +> |++++>       |
   |    |     + + +  |++++        |
        |     + + +  |  v         |
         -------------------------
        | G/C=0.521  | G/C=0.403  |
        | G=  54.7"  | G=  42.3"  |
        | Y+R= 4.0"  | Y+R= 4.0"  |
         -------------------------
```

C=105 sec G= 97.0 sec = 92.4% Y= 8.0 sec = 7.6% Ped= 0.0 sec = 0.0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
N Approach								12.9	B	
LT+TH+RT	24/2	0.414	0.530	1060	1133	773	0.682	12.9	*B	268 ft
S Approach								12.7	B	
LT+TH+RT	24/2	0.408	0.530	1355	1428	974	0.682	12.7	B	338 ft
E Approach								15.6	C+	
RT	12/1	0.157	0.413	559	660	54	0.082	12.1	B	47 ft
LT+TH	12/1	0.323	0.413	346	428	239	0.558	16.4	*C+	206 ft
W Approach								13.0	B	
RT	12/1	0.184	0.413	559	660	122	0.185	12.7	B	105 ft
LT+TH	12/1	0.208	0.413	547	647	168	0.260	13.2	B	145 ft

Green Street Corridor Study, Henderson City
Signalized Intersection Capacity Analysis
Green Street/Sand Lane (optimized, +10%)

07/08/98
09:35:41

SIGNAL94/TEAPAC[Ver 1.20] - Capacity Analysis Summary

Intersection Averages for Int # 217 - MINUTP number without "5"
Degree of Saturation (v/c) 0.71 Vehicle Delay 15.9 Level of Service C+

```
        -------------------------
Sq 11  |   Phase 1   |   Phase 2  |
**/**  -------------------------
       | * * *       |         ^  |
   .   | * * *       |       ++++ |
  /|\  |<* * *>      |      <**** |
   |   |   v         |    ^  **** |
   |   |       ^     |++++    v   |
North  |    <+ + +>  |++++>       |
   |   |     + + +   |++++        |
       |     + + +   |    v       |
        -------------------------
       | G/C=0.521   | G/C=0.403  |
       | G=  54.7"   | G=  42.3"  |
       | Y+R= 4.0"   | Y+R= 4.0"  |
        -------------------------
     C=105 sec   G= 97.0 sec = 92.4%  Y= 8.0 sec =  7.6%  Ped= 0.0 sec =  0.0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
N Approach								15.4	C+	
LT+TH+RT	24/2	0.461	0.530	1014	1087	849	0.781	15.4	*C+	294 ft
S Approach								16.8	C+	
LT+TH+RT	24/2	0.479	0.530	1216	1289	1072	0.832	16.8	C+	372 ft
E Approach								17.3	C+	
RT	12/1	0.159	0.413	559	660	60	0.091	12.2	B	52 ft
LT+TH	12/1	0.357	0.413	326	406	263	0.648	18.5	*C+	227 ft
W Approach								13.1	B	
RT	12/1	0.190	0.413	559	660	135	0.205	12.8	B	116 ft
LT+TH	12/1	0.219	0.413	534	633	184	0.291	13.4	B	159 ft

This Page Intentionally Left Blank

GREATER HENDERSON BICYCLE AND PEDESTRIAN PLAN

JUNE 2003

EVANSVILLE URBAN TRANSPORTATION STUDY
Civic Center Complex, Room 316
1 NW Martin Luther King, Jr. Blvd.
Evansville, Indiana 47708-1833
(812) 436-7833

This report was financed in part through the Federal Highway Administration and the Federal Transit Administration of the U.S. Department of Transportation.

Table of Contents

Page

Introduction ... 1

PART 1 – BICYCLE PLAN

Chapter 1 History of Local Bicycle Planning ... 4

Chapter 2 Current Conditions
A. Bicycle Crashes ... 5
B. Existing Roadway Network and Bikeway Facilities ... 8
C. Bicycle Parking and Other Supporting Amenities ... 9
D. Community Attitudes ... 10

Chapter 3 Bicycle Plan Recommendations
A. Planning Activities ... 11
B. Bikeway Network ... 11
C. Bicycle Parking and Other Supporting Amenities ... 17
D. Bikes and Transit ... 17
E. Education and Encouragement ... 17
F. Laws and Law Enforcement ... 18

Chapter 4 Implementing the Bicycle Plan
A. Priorities ... 20
B. Funding ... 24

PART 2 – PEDESTRIAN PLAN

Chapter 1 Background ... 26

Chapter 2 Current Conditions
A. Pedestrian-Auto Crashes ... 27
B. Existing Facilities ... 28

Chapter 3 Pedestrian Plan Recommendations
A. Planning and Development Review ... 30
B. Sidewalk Construction and Maintenance ... 31
C. Pedestrian Crossings ... 32
D. Education and Encouragement ... 32
E. Law Enforcement ... 33

Chapter 4 Implementing the Pedestrian Plan
A. Priorities ... 34
B. Funding ... 35

LIST OF FIGURES

Page

Figure 1. Study Area 3
Figure 2. Reason for Bike-Auto Crashes, EUTS Study Area, 1996-97 6
Figure 3. Proposed Bikeway Network .... insert
Figure 4. Types of Bikeway Facilities 13
Figure 5. 5-Year Bikeway Recommendations 21
Figure 6. Status of 5-Year Bikeway Recommendations 22

LIST OF TABLES

Table 1. Cause of Bike-Auto Crashes Involving Cyclists, Age 16+ 7
Table 2. Cause of Bike-Auto Crashes Involving Cyclists, Age 15 and Under 7
Table 3. General Bicyclist Accident Rates 8
Table 4. Bicycle Plan Priorities 20
Table 5. Pedestrian-Auto Crash Types, 1990s 27
Table 6. Pedestrian Plan Priorities 34

APPENDICES

Appendix A Bicycle Parking Guidelines 37
Appendix B Bikeway Network Street Listing 39

ACKNOWLEDGEMENTS

EVANSVILLE URBAN TRANSPORTATION STUDY
POLICY COMMITTEE

Mr. Stephen Melcher	-	Chairperson, City of Evansville
Ms. Catherine Fanello	-	V. Chairperson, Vanderburgh County Commissioner
Mr. Jack Corn, Jr.	-	Evansville City Council Appointment
Mr. Russell G. Lloyd, Jr.	-	Mayor, City of Evansville
Mr. Joe Kiefer	-	Mayoral Alternate
Mr. Jeffrey Broughton	-	Henderson City Manager
Ms. Mae Mason	-	Newburgh Town Board
Mr. Lloyd Winnecke	-	Vanderburgh Co. Council
Mr. Carl Conner	-	Warrick County Commission
Mr. Steve Sherwood	-	Warrick County Highway Engineer
Mr. J. Bryan Nicol	-	INDOT (NV)
Mr. John Baxter	-	Indiana FHWA (NV)
Ms. Joyce Newland	-	Indiana FHWA (NV)
Ms. Janet McCabe	-	Indiana DEM (NV)
Ms. Rhonda Reed	-	FTA (NV)
Mr. Jose Sepulveda	-	Kentucky FHWA (NV)
Mr. James C. Codell, III	-	KY Transp. Cabinet (NV)
Mr. Michael Hill	-	KY Transp. Cabinet (NV)
Mr. Edward H. Merryman	-	KY Transp. Cabinet (NV)
Mr. John Gowins	-	KY Division of Air Quality (NV)

EVANSVILLE URBAN TRANSPORTATION STUDY

Ms. Rose M. Zigenfus	-	Executive Director
Ms. Pamela Drach	-	Deputy Director/Chief Engineer
Mr. Seyed Shokouhzadeh	-	Senior Transportation Planner
Mr. Brian Howard	-	Transportation Planner
Mr. Doug Lane	-	Transportation Planner
Mr. Craig Luebke	-	Transportation Planner
Ms. Kari Schneider	-	Accountant
Ms. Lauri Lutz	-	Secretary

(NV) = Non-Voting

TECHNICAL COMMITTEE

Mr. Patrick Keepes	-	Chairperson, Evansville City Engineer
Mr. John Stoll	-	Vice-Chairperson, Vanderburgh County Engineer
Mr. Brad Mills	-	Evansville-Vanderburgh Co. Area Plan Commission
Ms. Sherry Snodgrass	-	American Medical Response
Ms. Sandra Worman	-	ARC Industry
Mr. Steve Watson	-	CSX Transportation
Ms. Theo Boots	-	Evansville ARC
Mr. Brent Grafton	-	Evansville Board of Public Safety
Mr. Mike Feltz	-	Evansville Chamber of Commerce
Mr. David Matthews	-	Evansville Chamber of Commerce
Mr. Matthew Meadors	-	Evansville Chamber of Commerce
Mr. Peggy Braun	-	Evansville Dpt. of Metropolitan Development
Mr. Peter Swaim	-	Evansville Dpt. of Transportation & Services
Mr. Shawn Dickerson	-	Evansville Dpt. of Urban Forestry
Ms. Dona Bergman	-	Evansville Environmental Protection Agency
Mr. Glenn Boberg	-	Evansville Parks and Recreation Dept.
Lt. Andy Chandler	-	Evansville Police Department
Mr. Robert Working	-	Evansville Regional Airport
Mr. Herb Butler	-	Evansville Water & Sewer
Ms. Joyce Newland	-	Federal Highway Administration (Indianapolis)
Mr. Anthony DeSimone	-	Federal Highway Administration (Indianapolis)
Mr. Glenn Jilek	-	Federal Highway Administration (Kentucky)
Ms. Bernadette Dupont	-	Federal Highway Administration (Kentucky)
Ms. Rhonda Reed	-	Federal Transit Administration (Chicago)
Ms. Gina Boaz	-	Green River Area Development District
Ms. Pam Whitter	-	Henderson Area Rapid Transit
Mr. John Stroud	-	Henderson City Engineer
Mr. William Hubiak	-	Henderson County Engineer
Mr. William Howard	-	Henderson County Riverport
Ms. Janet McCabe	-	Indiana Dpt. of Environmental Management (Indianapolis)
Mr. Brian Jones	-	Indiana Dpt. of Transportation (Indianapolis)
Mr. Emmanuel Nsonwu	-	Indiana Dpt. of Transportation (Indianapolis)
Mr. Jay Mitchell	-	Indiana Dpt. of Transportation (Indianapolis)
Mr. John Curry	-	Indiana Dpt. of Transportation (Vincennes)
Mr. Dale Lucas	-	Indiana Dpt. of Transportation (Vincennes)
Mr. Jerry Russell	-	Indiana Dpt. of Transportation (Vincennes)
Mr. Charles Fooks	-	Indiana Southern Railroad
Ms. Amy Thomas	-	Kentucky Transportation Cabinet (Frankfort)
Mr. Nick Hall	-	Kentucky Transportation Cabinet (Madisonville)
Mr. Kent Cutchin	-	Metropolitan Evansville Transit System
Ms. Nancy L. Burns	-	Mt. Vernon Chamber of Commerce
Ms. Shirley James	-	Pigeon Creek Greenway Passage
Ms. Helen Hauke	-	Princeton Chamber of Commerce
Mr. Derek Dillon	-	River City Taxi
Ms. Nancy Cassidy	-	SIRS Inc.
Mr. Phil Wilzbacher	-	Southwind Maritime Centre
Mr. Jerry Hays	-	Traffic Superintendent
Mr. Chris Gwaltney	-	University of Evansville
Ms. Sue Gibbons	-	Warrick Co. Economic Development
Ms. Sherri Phillips	-	Warrick Co. Plan Commission
Mr. Fred Padget	-	Westside Improvement Association

ACKNOWLEDGMENTS

Evansville Urban Transportation Study wishes to acknowledge and thank the Bicycle/Pedestrian Advisory Committee for its efforts in guiding the development of the Bicycle and Pedestrian Plan. The assistance of the Committee, in combination with input from various other organizations, City and County departments, was beneficial in developing a plan to address the needs of bicyclists and pedestrians in the region. The following representatives participated on the Henderson Bicycle/Pedestrian Advisory Committee:

John Talbert, *Henderson Community Development Department*
Emily Gilliam, *Henderson Parks Department*
Mark Simmons, *Henderson Parks Department*
Buzzy Newman, *Henderson Parks Department/City Commission*
C. A Honaker, *Citizen*
Dr. Mero Nunez, *Citizen*
Bart T. Moore, *Citizen*
Terry N. Todd, *Citizen*
David Latham, *Citizen*
Tony Gager, *Citizen*
Officer Anthony Purcell, *Henderson Police Department*
Officer James Burke, *Henderson Police Departmant*

INTRODUCTION

The *Bicycle and Pedestrian Plan* is a planning effort to make the Henderson area more bicycle- and pedestrian-friendly. The *Plan* is designed to improve the safety and viability of bicycling and walking, first for their value as modes of transportation, and second as forms of recreation. This *Plan* supplements the regional *2025 Transportation Plan*, which identifies current and future transportation needs and recommends projects to address those needs. The EUTS Study Area includes the City of Evansville, Vanderburgh Co., a portion of Warrick Co. including the Towns of Newburgh, Chandler and Boonville, as well as the City of Henderson and Henderson County in Kentucky. Figure 1 illustrates the Kentucky portion of the EUTS Study Area. Separate bicycle and pedestrian plans were developed for the Indiana and Kentucky portions of the Study Area.

While autos will undoubtedly continue to be the main mode of transportation in the region, improving conditions for bicyclists and pedestrians is important for many reasons:

- **To improve the safety of those who currently bicycle and/or walk.** Many residents currently rely on bicycling and/or walking to get to their job, the store, the bus stop, or wherever else they need to go. They need safe facilities.
- **To improve accessibility for all residents.** In particular, older residents, children, citizens with low incomes, and citizens with functional disabilities require safe and affordable alternatives to driving. This need will increase over the next few decades as the Baby Boom generation enters retirement age.
- **To achieve more efficient use of the existing transportation system.** Bicyclists and pedestrians require less space than do autos, meaning that more travelers can be accommodated in less space, with less auto congestion. In addition, bicycling and walking reduce the amount of wear and tear on roads. Greater use of these modes of travel can help delay the need for major roadway widening and construction.
- **To enhance the region's quality of life.** Bicycling and walking encourage interaction between residents, promote a sense of community, and add recreational value. A recent study by the Real Estate Research Corp. calls pedestrian-friendly neighborhood developments the "newest market to watch". The study found that roadway congestion and dependence on the auto decrease the "livability" of an area.[1]
- **To encourage more active and healthier residents.** Walking and bicycling are excellent physical activities, and their use can help improve the public's health.
- **To help address the local air quality problem.** Unlike auto travel, bicycling and walking do not produce harmful emissions. If the Kentucky portion of the EUTS study area is designated as being in nonattainment of federal air quality standards, the region will need to develop strategies to reduce vehicle emissions.

Interest in bicycle and pedestrian planning in the region has fluctuated over the last three decades. However, a particularly strong resurgence in interest has taken place within the last decade, in part because of the Federal Highway Administration's (FHWA) increased emphasis on bicycling and walking as critical elements of a balanced transportation system. The federal government's current transportation bill, the Transportation Equity Act for the 21st Century (TEA-21), specifically requires that bicycling and walking are considered in the planning, design and construction of all federally funded transportation projects.

This Plan was undertaken in part to fulfill TEA-21's requirements. It also serves as an update to the 1979 *Evansville Bikeway Master Plan*, the 1977 *Henderson Bicycle Facility Plan*, and expands bicycle planning activities to include the entire EUTS Study Area.

---

[1] *Emerging Trends in Real Estate 1998*, Real Estate Research Corporation, Chicago, IL

EUTS helped organized a Bicycle/Pedestrian Advisory Committee to assist in developing the *Bicycle and Pedestrian Plan*. Committee members (listed on page v of this document) included bicycle and pedestrian advocates, as well as representatives from the City of Henderson, Henderson Police Department, the Henderson-Henderson County Area Plan Commission, and Methodist Hospital. The Advisory Committee, in combination with input from various other organizations, and City and County departments, assisted in developing a plan that addresses the needs of bicyclists and pedestrians. A committee focused on the specific needs of the Henderson Area met during 2002-2003 to help develop the network presented for Henderson.

The following are the bicycle and pedestrian goals for the region over the next twenty years:

- Recognize bicycling and walking as valid modes in the overall transportation system.
- Recognize that education, enforcement, and encouragement programs are all vital components of a successful bicycle and pedestrian program.
- Consistently consider and accommodate bicyclists and pedestrians, as appropriate, in the design, construction/reconstruction and maintenance of roadways and sidewalks.
- Reduce the number of bicycle- and pedestrian-related crashes.
- Increase bicycling and walking from less than 1% of all trips in 2000[2] to 5% of all trips in the region by the year 2030.

Recommendations to reach these goals include **physical improvements** such as the repair or construction of new sidewalks, creation and maintenance of on-street and separated bikeway facilities, installation of bike storage racks, **policy changes** including new planning activities, revised roadway design standards, support for modifications to local subdivision and zoning ordinances, and **education, enforcement and encouragement** activities to promote and encourage safe bicycling and walking. The support, involvement and action of public agencies and groups including City and County officials, the Area Plan Commission, City and County Engineers, local police department and the general public will be crucial in implementing the recommendations contained in this *Plan*.

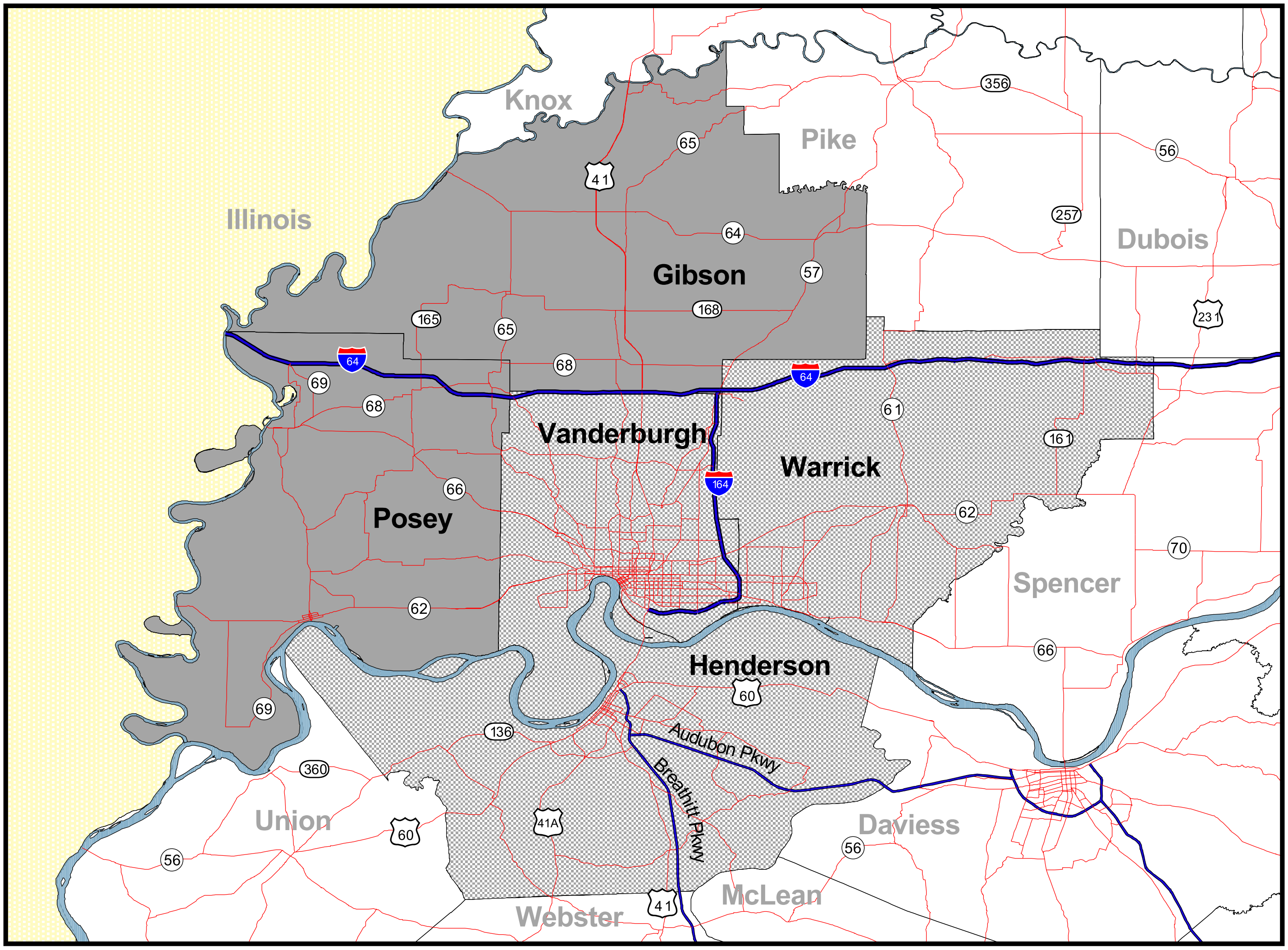
This *Plan* is divided into two sections: Part 1 deals with bicycle issues and Part 2 with pedestrian issues. Each part contains an inventory of existing conditions, and a detailed listing of recommendations for new facilities, and education, encouragement and enforcement activities. As with any plan, the Bicycle and Pedestrian Plan should be revisited periodically. It is recommended that an update be undertaken whenever the regional *Transportation Plan* is updated.

[2] U.S. Census Bureau

Figure 1

Evansville Urban Transportation Study Study Area

Gibson, Henderson, Posey, Vanderburgh and Warrick Counties

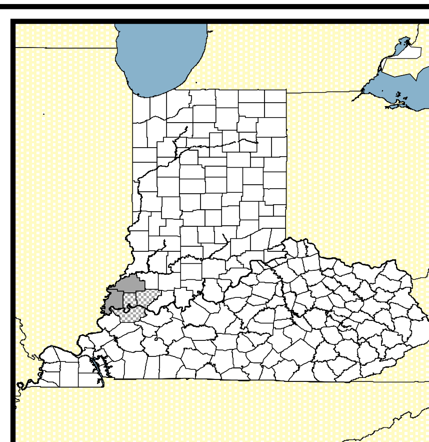


Kentucky Parkways
Interstates
Major Roads
Kentucky/Indiana Counties
EUTS Urban Counties
EUTS Rural Counties
States/Provinces
Rivers/Lakes

N
W E
S

8 0 8 Miles

8 0 8 Kilometers



PART 1
BICYCLE PLAN

CHAPTER 1. HISTORY OF LOCAL BICYCLE PLANNING

Bicycle planning in the Evansville-Henderson urbanized area is not a new concept. There have been several attempts in the City of Evansville over the past 30 years to improve the safety of, and encourage, bicycle travel. Those efforts, described in the *EUTS Regional Bicycle and Pedestrian Plan*, focused on creating bicycle routes along selected City streets, and separated trails on levee property and other public rights of way. Few of the improvements that were implemented survive today.

The City of Henderson has also made efforts to establish bicycle planning in the past. A lack of physical improvements from previous plans creates minimal awareness of the efforts, of which there were two. The first was a preliminary bikeway plan produced in 1975 for the Henderson Parks and Recreation Department. The plan consisted primarily of on street bike facility linkages to park and recreation areas within the city. The plan classified routes as proposed and alternate routes (which presumably could be implemented without road improvements), and proposed and alternate routes with improvements. No design standards or cost estimates were developed for the plan. It appears that the ‘75 plan proceeded no further than the preparation of the preliminary plan.

A second bicycle facility plan was produced by the Green River Area Development District in 1977. This plan was more fully developed than the ‘75 plan; including an inventory of trip generators and existing roadway conditions and traffic volumes. A substantial amount of design criteria; including location guidance, facility warrants, designs standards and cost estimates, was present in the plan. The importance of an appropriate safety initiative was also discussed.

The physical network in the ‘77 plan consisted of a short and long range plan. The ‘75 network was also evaluated for feasibility and found to be less than desirable without major improvements to the existing streets. The ‘77 short range plan focused on the cities core, and was termed as “very implementable”. The short range plan was broken down into eleven segments and described individually. Comments on each segment and facility type recommendations were included, along with illustrative maps. The long range plan, while more comprehensive, was viewed as speculative due to significant improvements required for its implementation. Of note in the long term plan is the idea of recreational development along Canoe Creek, as this is an idea generating interest today. Substantial public involvement and support was deemed necessary for the long range plan to move forward. Although the short term plan was deemed ready for implementation, no improvements were realized at that time.

A strong resurgence in bicycle and pedestrian planning came about in the early 1990’s, with the passage of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), and continues under the subsequent renewal in 1998 (TEA-21). Recent efforts by the city have capitalized on programs available under TEA-21, resulting in enhancements to the City of Henderson riverfront, including a pedestrian trail corridor.

The field of bicycle planning has seen significant change and growth over the past decade. Experience with projects implemented in the 1970s and ‘80s have added to the knowledge base of engineers and planners. New research continues to shed light on which approaches to bicycle planning have and have not worked, and facility design standards continue to be modified to reflect what has been learned. This *Plan* draws on both new information and past planning efforts to create a current plan to address the needs of bicyclists.

CHAPTER 2. CURRENT CONDITIONS

Currently only a small number of local trips are made on a bicycle, less than 1% in 2000.[3] However, the Evansville-Henderson urbanized area has the potential to convert many local trips to bicycle. The area has relatively flat terrain, a well-developed grid street network, and a mild climate that allows for bicycling 9 or more months out of the year. To make cycling a more viable means of transportation, though, it is necessary to understand and address the impediments that prevent more people from choosing a bicycle instead of an auto for shorter, local trips. This chapter looks at the current environment and assesses how it either discourages or accommodates bicycling.

A. Bicycle Crashes

Many people seriously overestimate the level of danger involved in cycling, and have misconceptions about what hazards they may encounter while riding a bicycle. Unfortunately, these misconceptions influence the decision of many people about whether or not to bicycle, and on how to operate a bike in traffic. *But the public's perceptions of dangers do not match the facts.* Having a clear understanding of the real safety problems related to cycling is the first step towards developing a legitimate plan for improving the safety of bicycle travel in the region.

One of the first steps in developing the Bicycle Plan was to obtain and analyze information on reported bicycle crashes in the City of Evansville, Vanderburgh County, Town of Newburgh and the City of Henderson for the period 1996-97. More recent information for the Henderson area was unable to be utilized for this plan due to changes in the statewide accident database structure. For this reason, the 1996-97 data is used as a sample of local cycling accidents. Virtually all of the reported incidents occurred in urban areas of the study area: City of Evansville (72), remainder of Vanderburgh Co. (1), Town of Newburgh (0), and the City of Henderson (13). The information is used in the following discussion to discount some of the most common misconceptions relating to bicycling.

MISCONCEPTION #1 ***The greatest danger when cycling is getting hit by an auto.***

There are two main types of cycling accidents – falls and crashes. A "fall" is a single-bicycle accident. A "crash" involves an additional object; for example another cyclist, a pedestrian, a vehicle, parked car, or loose dog.

Many potential bicyclists cite the fear of traffic as their main objection to riding a bicycle. However, national studies estimate that 80% of accidents involving cyclists involve a fall or a collision with another cyclist or some object. While crashes between cyclists and moving autos can result in more severe injuries than falls or collisions with other objects, they occur much less frequently than many people believe. Cyclists who focus all of their attention on dangers that are least likely to produce an accident expose themselves to more real hazards.

MISCONCEPTION #2 ***A crash involving a cyclist and an auto will result in a fatality.***

A total of 86 bicycle-auto crashes were reported in the study area during the time period 1996-97, resulting in 1 fatality and 63 injuries to cyclists. Many times cyclist injuries are not severe. According to national studies, the most common reason for the death of a cyclist in a bike-auto

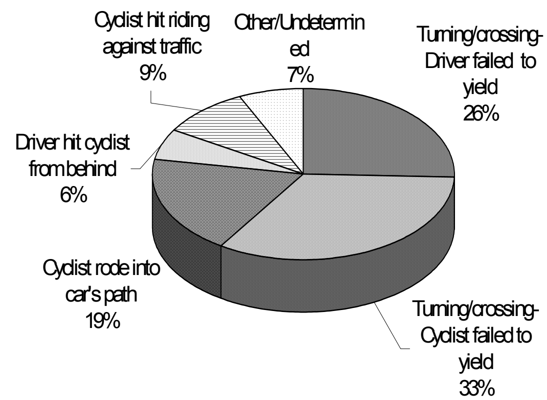
[3] U.S. Census Bureau

crash is brain injury. This can be addressed by promoting the use of bicycle helmets, which can reduce the risk of brain injury by 88%.[4]

MISCONCEPTION #3 ***A cyclist riding in traffic is most likely to be hit from behind by an auto.***

Cyclists are rarely hit from behind by an auto. On the contrary, if they are involved in a bicycle-auto crash, it will more than likely be caused by what is in front of them—intersections, driveways and alleys where bicycles and autos turn or cross each others' paths. As shown in Figure 2, over half of all local bicycle-auto crashes involved a turning or crossing movement, where either the driver or cyclist failed to properly yield the right of way. This is in contrast to 6% of crashes in which a cyclist was hit from behind.

Figure 2
Reason For Bicycle/Auto Crashes
EUTS Study Area, 1996-97



Total of 86 accidents

The fear of being hit from behind causes some cyclists to illegally ride against the flow of traffic in the belief that they will avoid an accident if they can see oncoming traffic. In fact, more cyclists are hit while riding *against* traffic (9%) than are hit while riding *with* traffic (6%).[5]

MISCONCEPTION #4 ***Bicyclists are always at fault in crashes. Or, motorists are always at fault in crashes. (depending on whether you are a cyclist or a motorist!)***

In reality, the blame goes to both motorists and cyclists. As shown in Table 1 below, motorists were responsible for 49% of all crashes involving adult cyclists from 1996-97, with cyclists responsible for another 40%. As evidenced in Table 2, however, in crashes involving child cyclists (under 16 years of age), the cyclist was at fault in 70% of the crashes.

Regardless of age of the motorist or cyclist, most crashes result from easily identifiable and avoidable habits. The vast majority of accidents would have been avoided had both users adhered to the established rules of the road.

---

[4] Thompson, Robert S., M.D., F.P. Rivara, M.D., D. C. Thompson, M.S., "A Case-Control Study of the Effectiveness of Bicycle Safety Helmets," *New England Journal of Medicine* v 320 n 21 (1989)

[5] "Wrong way cycling" exposes cyclists to the danger of being struck by an auto making a right turn from a side street. Right-turning drivers will check for vehicles approaching from their left, but will not expect a cyclist approaching on their right.

Table 1. Cause of Bike-Auto Crashes Involving Cyclists Age 16+* EUTS Study Area, 1996-97

# of crashes	Reason for crash
12	Driver failed to yield right of way
7	Cyclist failed to yield right of way
5	Cyclist riding against traffic
3	Driver passed too closely, struck cyclist
2	Cyclist failed to obey traffic control
1	Driver backing up – didn't see cyclist
1	Driver failed to obey traffic control
0	Cyclist rode into path of auto
4	Other/Undetermined
35	**TOTAL CRASHES**

* Only includes crashes where age could be determined

Table 2. Cause of Bike-Auto Crashes Involving Cyclists Age 15 and Under* EUTS Study Area, 1996-97

# of crashes	Reason for crash
11	Cyclist rode into path of auto
7	Cyclist failed to obey traffic control
6	Cyclist failed to yield right of way
5	Driver failed to yield right of way
2	Cyclist riding against traffic
2	Driver backing up – didn't see cyclist
1	Driver hit cyclist from rear
1	Driver failed to obey traffic control
2	Other/Undetermined
37	**TOTAL CRASHES**

* Only includes crashes where age could be determined

MISCONCEPTION #5 **Child cyclists are safe as long as they only ride in their neighborhood.**

Accidents involving child cyclists are most likely to occur on neighborhood streets, because that's where children do most of their bicycling. And child cyclists are their own worst enemy. Younger children, in particular, often don't have the cognitive ability, judgment, or bike handling skills to safely and properly ride their bikes on the street. As mentioned above, about 70% of all bike-auto crashes involving a child cyclist were the fault of the cyclist. The most common reasons for crashes are the child riding into the street without looking for cars, failing to stop at Stop signs and red lights, and failing to properly yield to autos at intersections.

Child cyclists need to understand bicycle rules of the road and learn proper bike handling skills before being allowed to ride unsupervised.

MISCONCEPTION #6 ***Cyclists are best accommodated on separated paths.***

Separated trails can supplement, but not substitute for, a good network of on-street bikeways. Cyclists have always, and will continue to, use the street system to get where they need to go. The road network offers the greatest choice of routes and shortest, quickest path to almost any destination. While many people believe that separated bike paths are the safest facility for bicyclists, they have been found to have a higher accident rate than on-street facilities--292 accidents per million bike-miles, or 260% of the basic average.[6]

MISCONCEPTION #7 ***There will be an increase in the number of bike-auto crashes as more residents bicycle.***

As the number of bicyclists increases and roadway design incorporates more bikeway facilities, there will likely be a greater awareness among motorists of bicyclists' rights. In Portland, Oregon bike-auto crashes appear to be leveling off even though the number of cyclists has more than tripled.[7]

[6] *Bicycle Transportation: A Handbook for Cycling Transportation Engineers*, John Forester, M.S., P.E. (1994)
[7] *Bicycle Master Plan*, City of Portland, Ore. (July 1998)

National data also suggests that accident rates drop as cyclists improve cycling skills and gain more experience riding in traffic. As shown in Table 3 below, "club-level" cyclists (members of a recreational and/or racing cycling club), despite averaging more than 4 times the miles of "college-associated" adult cyclists, have only ¼th the number of accidents.

Table 3. General Bicyclist Accident Rates

Type of Cyclist	Miles ridden per year	Accidents per million miles
Elementary school	580	720
College-associated adult	600	500
Club cyclists (League of American Wheelmen)	2,400	113

Source: *Bicycle Transportation*, John Forester, M.S., P.E. (1994)

Clearly, no education or training program will eliminate all cycling crashes. However, national studies have shown that developing proper cycling skills in a population can reduce bike-auto crashes by about 80%.[8] Perhaps the most effective way to reduce crashes is to teach cyclists proper cycling habits so they will be less likely to make errors that now cause many bike-auto crashes, and to recognize and avoid motorist errors that lead to crashes.

B. Existing Roadway Network and Bikeway Facilities

Cyclists rely heavily on the existing roadway network to get where they need to go. And overall, the study area has a well-developed network of city, county and state roadways that can be used by bicyclists. Many roadways--those that carry a low volume of traffic, have paved shoulders or wider travel lanes—already safely accommodate cyclists. However, many other roadways--those with narrow travel lanes or no paved shoulders—put bicyclists and motorists in conflict by forcing them to compete for roadway space.

Sidewalks should not be considered an acceptable bicycle facility, except possibly for children. The use of sidewalks by cyclists introduces many safety problems, such as the speed differences between cyclists and pedestrians, conflict at driveways where drivers don't expect fast-moving cyclists on the sidewalk, and the presence of obstructions such as light poles, signposts, fire hydrants, etc.

In addition to the roadway network, there are two existing separated shared use paths in Henderson. Both of these trails are located in Newman Park:

- An approximately ½ mile trail is shared use along the entire length
- A short (.11 mile) section of the park's nature trail is shared use

For a good cycling network, *selected* collector, arterial and rural streets must be designed to accommodate cyclists.[9] While young and/or less experienced cyclists may choose to ride only on local streets, many other cyclists want to travel on collector and arterial roadways for the same reasons as do motorists—they provide the quickest, most direct route to their destinations.

[8] "Defects of the Design-Cyclist Approach as Adopted by the 1991 *AASHTO Guide for the Development of Bicycle Facilities*", John Forester, M.S., P.E.

[9] Roadways are categorized by use and function into several different classifications: local, collector and arterial roadways. Local streets generally serve residential areas or other low-volume uses. Local streets feed into collectors, which have better connectivity and carry more traffic. Collectors in turn feed into arterials, which are intended to carry traffic longer distances at higher speeds and with fewer interruptions.

Cyclists are accommodated on a roadway by providing room for a cyclist and motorist to operate side by side, and for the motorist to safely pass the cyclist without having to cross lane lines.

In addition to providing adequate roadway space for cyclists, attention needs to be given to the condition of that portion of the roadway used by cyclists--typically the outer 4 feet of a travel lane, or paved shoulder where present. The pavement should be kept smooth and clear of wide cracks, joints, drop-offs, as well as gravel, glass, leaves, trash, and other debris that can cause a bicyclist to lose control. Poor patching jobs and potholes will force a cyclist to ride further into the travel lane.

The type and location of drainage inlet grates and utility covers also needs to be considered. In particular, parallel bar drainage grates can catch a bicycle tire, creating the likelihood of a crash. Drainage grates should be a bicycle-friendly design that is flush with the pavement. Retrofitting parallel bar grates with welded cross bars is less desirable, but acceptable. Utility covers are best located outside of the area that cyclists will use. They are particularly dangerous when the roadway is wet.

Lastly, diagonal railroad crossings present a serious safety problem for cyclists. These crossings, if not approached by the cyclist at a right angle, can divert the front wheel of the bicycle and cause a crash. The problem is greatest on roadways where there is no room for the cyclist to maneuver in order to approach the crossing at a right angle. The installation of smooth rubberized crossings is the preferred solution, but is often cost-prohibitive. Paving a tapered approach on either side of the crossing is an acceptable substitute.

C. Bicycle Parking and Other Supporting Amenities

Every bicycle trip has two basic components: the route chosen by the cyclist, and available facilities at the end of the trip. The importance of the most basic of amenities--convenient, secure bicycle parking--can't be overemphasized. If there is no bike parking available at a particular destination, few people will decide to make the trip by bicycle. Additional amenities such as showers and lockers at the workplace (or at a nearby health club) are ideal, but not critical, for cyclists who commute by bike.

Finding secure bike storage is often the most difficult part of making a bicycle trip. Few public libraries, government offices, schools, park & recreation facilities, large shopping areas and post offices offer bike parking. When bike racks are available, they are generally the older "schoolyard" type, which can damage bike frames and don't accommodate the high-security "U-locks" which many bicyclists today use.

Many communities throughout the country require bicycle parking facilities in commercial or large-scale apartment developments as part of their development permitting process. Requirements generally include a minimum number of bike parking spaces based on a percentage of auto parking spaces, and specifications on rack design. While local ordinances do regulate parking for autos, they don't currently require bicycle parking.

Guidelines for the design of the bike racks are included in Appendix A. In general, however, bike racks should be designed so that they:

- Don't bend wheels or damage the bicycle
- Accommodate high security U-shaped bike locks
- Allow the bicyclist to secure both the frame and both wheels
- Do not interfere with pedestrian traffic
- Are easily accessible and protected from autos

A more recent national development in bicycle planning has been the creation of better linkages between public transit and bicycling. A growing number of public transit providers are realizing the benefits of installing bike racks on buses, and providing secure bike parking at major transit stops and transfer centers. This makes transit an option for those who either live beyond walking distance of a bus route, or whose final destination is beyond walking distance of the closest bus stop. In addition, cyclists caught by inclement weather or equipment problems have the option of using public transit and being able to bring their bike with them.

D. Community Attitudes

New bikeways and ample bike parking will vastly improve local conditions for bicycling, and by themselves will be enough to spur some residents to use a bicycle for recreation and travel purposes. Obviously, not all residents can be expected to bicycle because of physical and health reasons, distance barriers, schedule constraints, or a lack of interest. For many others, however, the choice not to bicycle is determined by two attitudes: fear of traffic, and the stigma associated with not driving a car.

Probably the most deeply ingrained public belief is that roadways are not safe for cyclists. As discussed earlier in this chapter, many people overestimate or have mistaken beliefs about the risks involved in cycling. This affects their decision on whether to bicycle, as well as how they operate their bicycle in traffic. Seasoned cyclists will attest that learning to ride in traffic is similar to learning how to drive a car. New drivers and bicyclists both start out by learning the rules of the road and riding on low-volume streets. With practice and experience, new cyclists and drivers overcome their fears by acquiring the skills and confidence to operate in heavier traffic.

Another detrimental attitude is the stigma associated with not driving a car. Bicycling for transportation is often considered a last resort, and outside of bicycle enthusiast circles cycling generally has a low social status. Many people assume that someone who uses a bicycle for transportation can't afford a car, isn't able to drive for some reason or another, or is simply "odd".

Bicycling has become a popular form of recreation, and is increasingly being recognized as a legitimate form of travel. Good public education and promotion campaigns should be used to build upon the growing interest in cycling, and will be needed for bicycling to gain a significant foothold in the local transportation mix.

CHAPTER 3. BICYCLE PLAN RECOMMENDATIONS

Chapter 2 of the Bicycle Element highlighted numerous problems and deficiencies that impact the safety, attractiveness, viability and levels of use of bicycling in the Henderson area. The following recommendations address those problems. These recommendations were developed with extensive assistance from the EUTS Bicycle/Pedestrian Advisory Committee, and with input from the general public.

Bicycle recommendations are separated into 6 categories: Planning Activities; Bikeway Network; Bike Parking and Supporting Amenities; Transit Interface; Education and Encouragement; and Enforcement. Recommendations in each category are further grouped into Phases I, II or III for priority of implementation. The exception to the three phase implementation schedule is the Bikeway Network, which is divided into short and long-term phases. Both the need and the feasibility of each recommendation were taken into consideration in assigning it to an implementation phase. As such, a Phase III recommendation might be a high priority, but the feasibility of implementing it at this point in time is low.

A. Planning Activities

The first step towards making the EUTS Study Area bicycle-friendly is to incorporate bicycling issues as a standard consideration in all transportation planning activities and roadway projects (both local and state). Bicycle and pedestrian advocates should have consistent opportunity to provide input into public decisions that affect these modes of travel.

Phase I:

- Organize and conduct Bicycle/Pedestrian Advisory Committee meetings on a semi-annual basis to assist in implementing recommendations in the Bike/Pedestrian Plan, review road/bridge project plans, and provide input into other transportation planning activities.
- Consider bicycle issues in the early planning and design of all locally funded transportation construction, reconstruction, maintenance (i.e. resurfacing) or intersection improvement projects to ensure accommodation of bicyclists, as appropriate.
- Encourage local jurisdictions to develop roadway inventories including number of travel lanes, lane width, shoulder width, shoulder type (paved or unpaved), surface condition, posted speed limit, availability of on-street parking, traffic volumes, and presence/condition of sidewalks.

Phase II-III:

- Monitor status of bike projects, level of use and community response.
- Update the Bicycle/Pedestrian Plan as appropriate.

Continue current practices:

- Participate in early planning and design phases of all federal- and state-funded transportation construction, reconstruction, maintenance and intersection improvement projects to ensure accommodation of bicyclists is appropriately considered.

B. Bikeway Network

Throughout the process of developing this *Plan*, the comment heard most by EUTS is the need for dedicated space on roadways for bicyclists. This is supported by national polls, which frequently cite the lack of bikeways as the primary reason more people don't bicycle for travel purposes. Safe, convenient and well-designed bikeway facilities are essential to encourage bicycle use. In addition to benefiting bicyclists, bikeway facilities such as wide curb lanes and paved shoulders benefit the non-cycling public. National research has found that widening a travel lane by one foot can reduce accidents by 12%, a figure that jumps to 23% when widened by two feet. Widening a shoulder has been found to reduce fatal crashes by 20%.[10]

While all streets except limited access highways should be accessible by bicycle, this Plan includes a network of selected roadways that are recommended for improvements to better accommodate bicyclists. (see Figure 3, insert in rear pocket) Streets on the bikeway network were selected because they provide the best connections between residential areas, schools, parks, commercial areas and other popular destinations, and because adequate, parallel facilities are not available.

On-street bikeways can be developed either by reallocating space on existing roadways, or by incorporating bikeways into new construction or reconstruction projects. There are a variety of treatments that are recommended by the American Association of State Highway and Transportation Officials (AASHTO) to accommodate bicyclists: designated bike routes, wide curb lanes, paved shoulders, bike lanes, and separated paths. (see Figure 4)

Another possible bikeway treatment would be the installation of “Share the Road” (W16-1) signs along corridors where bike use is expected, auto traffic volumes are high, but where physical constraints rule out other treatments. The W16-1 sign is intended for use in situations where there is a need to warn motorists to watch for bicyclists traveling along the roadway. As with all traffic control devices, the W16-1 sign should only be used as directed by MUTCD guidance. It is not intended to serve as a replacement for other, more appropriate bikeway treatments.

This *Plan* does not suggest the type of treatment for each roadway on the bikeway network. It describes a network of streets/roads which, upon improvements, will serve to provide accommodations for cyclist mobility throughout the community. The appropriate treatment will be determined upon more detailed study as individual projects are moved towards implementation. This approach allows greater flexibility and the opportunity to gauge the effectiveness of the first bikeway “demonstration” projects that are implemented. The Plan identifies roadway segments where additional studies would need to be conducted to determine which, if any, bikeway treatments would be appropriate and acceptable. While bike lanes and/or wide curb lanes might be warranted based on auto traffic volumes, parking restrictions or the removal of a travel lane may not be possible. Other facilities may require widening of the roadway to meet minimum recommended bikeway standards. In these cases, consideration should be given to either installing “Share the Road” signs (would not require parking removal or travel lane reduction) or selecting an alternative route.

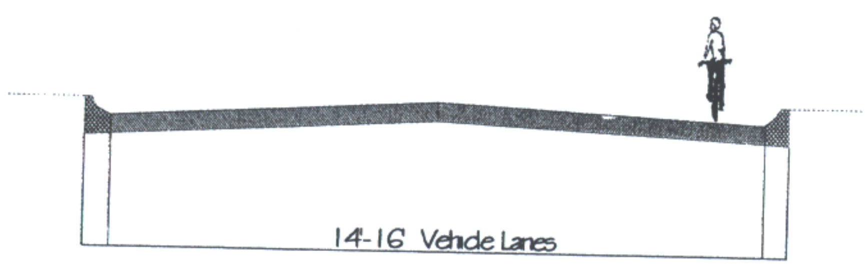
The recommended bikeway network is broken into two phases: Short-Term 5 year horizon (by 2008); and Long-Term 5+ year horizon. This list should be used as a general guide to prioritize each project; however, no matter where a project is on the list, implementation should be pursued at each opportunity. On-street bikeways can be implemented in many ways: as a stand-alone project, as part of a repaving project, or by incorporating bikeways into new construction or reconstruction projects. As roadways designated as being on the Bikeway Network are resurfaced, reconstructed, widened or otherwise improved, an appropriate bikeway treatment should be included. Bikeway projects can be as simple as striping a bike lane during a routine resurfacing project and adding appropriate street signs, or more costly, such as adding paved shoulders into the design of a roadway reconstruction project.

[10] National Transportation Website

Figure 4:

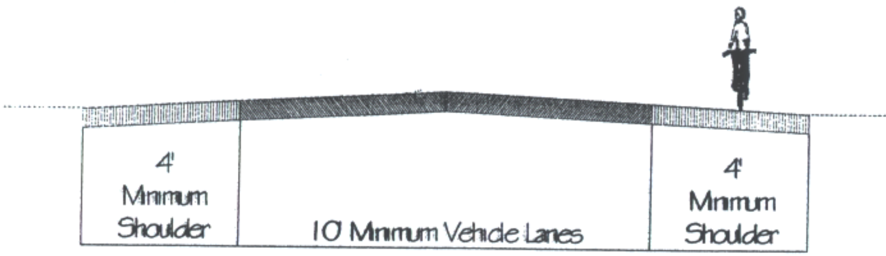
Types of Bikeway Facilities

BIKE ROUTE: Signs direct cyclists along a particular route to schools, shopping areas or other major destinations, utilizing low-volume local streets instead of parallel and adjacent roadways.
PROS: Provides direction to new or inexperienced cyclists who are learning to operate in traffic; low implementation cost (requires no improvements other than signs); low maintenance costs if signs are not overused; signs (theoretically!) increase motorist awareness of the presence of bicyclists.
CONS: Typically less direct and less convenient travel route, as they rely on rerouting to avoid higher volume roadways; may limit access to major destinations without traveling on higher volume roadways.

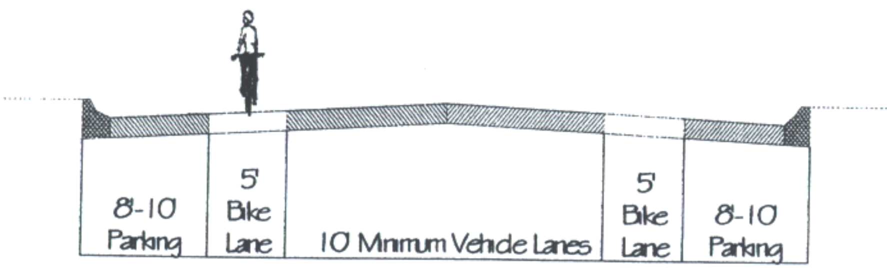


WIDE CURB LANE: Outside travel lane of 14-16' which allows autos room to pass cyclists without changing lanes or crossing over center line; does not utilize any additional pavement markings or signs; typically used in urban areas on roadways with curbs and gutters.
PROS: Low maintenance costs (no signs or pavement markings to upkeep); bicycle travel area kept cleaner because of sweeping action of cars; provides cyclists with high level of access; beneficial to autos as is provides more maneuvering room when drivers are exiting from driveways or in areas with limited sight distance.
CONS: New cyclists may not recognize as a bike facility.

Figure 4: Continued

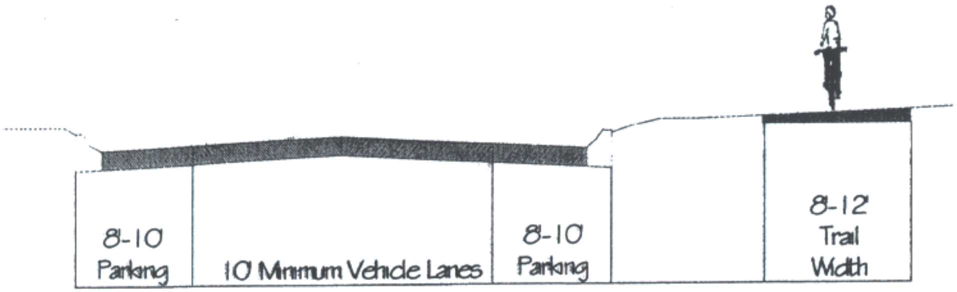


<u>PAVED SHOULDER</u>: Paved shoulder of 4'+ which accommodates cyclists; does not utilize any additional pavement markings or signs; typically used in rural areas.
<u>PROS</u>: Low maintenance costs (no signs or pavement markings to upkeep); beneficial to both motorized and non-motorized traffic (emergency pull-off area for autos, shoulders improve safety for all users, improve traffic flow); provides cyclists with high level of access.
<u>CONS</u>: Glass/gravel/debris tends to accumulate on outside of shoulder because of lack of sweeping action by motorized traffic.



<u>BIKE LANE</u>: A 4'+ strip on the edge of the roadway, delineated by a solid line, dedicated for bicycles only; utilizes special pavement markings and signs. Typically used in urban areas on streets with curbs and gutters.
<u>PROS</u>: Visible, dedicated roadway space will likely attract new cyclists who are uncomfortable riding in traffic; increases motorist awareness of the presence of cyclists.
<u>CONS</u>: Debate continues over whether bike lanes improve safety; additional striping can create confusion among both motorists and cyclists and complicate turning movements at intersections (where nearly all bike/auto crashes occur); additional pavement markings mean new "rules of operation" for both cyclists and motorists to learn; can give cyclists a false sense of security, as few bike/auto crashes involve being hit from behind or from the side; higher maintenance costs (signs and pavement markings to upkeep).

Figure 4: Continued



<u>SHARED-USE TRAIL</u>: An 8-10' trail constructed for non-motorized users, separated from a roadway, often along an abandoned railroad corridor, levee, or other linear easement.

<u>PROS</u>: Good facility for new, inexperienced and child cyclists to learn basic cycling skills away from traffic; provides for recreational use and open space; can provide access in corridors where bicycle access is limited for some reason;

<u>CONS</u>: Highest construction and maintenance costs; provides lower levels of access than on-street facilities as users are limited by trail access points; often less direct, less convenient and slower for cyclists than riding on roadways; accident rates often higher on trails than on street because of conflict caused by different users (pedestrians, rollerbladers, joggers, cyclists, strollers), different speeds, varying skill levels, and lack of established rules of operation (i.e. rules of the road).

Just as important as creating bikeways is keeping them in good condition. Poor maintenance will deter cyclists and can contribute to accidents. Bikeways will see greater use if they are kept smooth and free of glass, gravel, leaves and other debris.

Development of Facilities

Phase I:

- Adopt the American Association of State Highway and Transportation Officials (AASHTO), the Manual on Uniform Traffic Control Devices (MUTCD) standards and any Kentucky State Transportation Cabinet addendums for the design and development of all bicycle-related transportation improvements.
- Pursue the accommodation of bicyclists as part of all federal, state and locally funded transportation construction, reconstruction or intersection projects on roads and bridges where cyclists are currently, or will be, allowed.
- Implement bikeway facilities that are appropriate to street classification, traffic volume and speed for the Short Term portion of the proposed Bikeway Network.
- Give streets on the Bikeway Network high priority in annual asphalt resurfacing programs.

Phase II-III:

- Continue to implement bikeway facilities that are appropriate to street classification, traffic volume and speed.

Continue current practices:

- Coordinate with rail companies to remove railroad crossings that are no longer in use, and install/repair crossings to current standards.

Maintenance of Facilities

Phase I:

- Review/improve process for street sweeping, giving priority to those roadways on the Bikeway Network.
- Review/improve process for clean-up of glass/debris from auto crashes.
- Review/improve the process for public review and acceptance of roadway patching jobs after road or utility work has been done.
- Update / distribute a “Who To Call” directory for cyclists to report spot problems.

Phase II-III:

- Incorporate bikeway pavement marking maintenance and sign replacement costs into appropriate local budgets.
- Identify lighting problems along bikeways and improve as necessary.

Continue current practices:

- Continue use of the local pothole reporting programs to identify pavement surface problems.

C. Bicycle Parking and Other Supporting Amenities

Chapter 2 of this *Plan* outlined the need for convenient and secure bike parking and, ideally, the provision of showers and locker facilities at employment sites. The importance of the most basic of amenities--convenient, secure bicycle parking--can't be overemphasized. If there is no bike parking available at a particular destination, few people will decide to make the trip by bicycle. Additional amenities such as showers and lockers at the workplace (or at a nearby health club) are ideal, but not critical, for cyclists who commute by bike.

<u>Phase I:</u>

- Seek funding for the purchase and installation of bike racks at major public activity centers.
- Recommend bicycle racks in development projects, as part of the local development review process.
- Support changes in local Zoning Ordinances, in the form of either an incentive or a requirement, to provide for bicycle racks in major commercial and employment centers, and at government buildings.

<u>Phase II-III:</u>

- Encourage employers to provide bike racks, showers and locker facilities for commuting cyclists.
- Begin to monitor bike rack usage and community response, and pursue funding for additional racks as appropriate for rest of study area.

D. Bikes and Transit

As was discussed in Chapter 2, many public transit providers in the country are installing bike racks on buses, and providing secure bike parking at major transit stops and transfer centers. This makes transit an option for those who either live beyond walking distance of a bus route, or whose final destination is beyond walking distance of the closest bus stop. In addition, cyclists caught by inclement weather or equipment problems have the option of using public transit and being able to bring their bike with them. EUTS recommends that Henderson Area Rapid Transit (HART) consider the provision of bicycle racks on their transit vehicles and at transfer centers.

E. Education and Encouragement

Creating bikeways is a major step in encouraging bicycle use and improving safety. Equally important, however, are efforts to educate bicyclists and motorists on how to safely and properly coexist, as well as promotional efforts to encourage the use of bicycles.

Education programs can help to dispel misconceptions about cycling, improve the skill level of cyclists, and encourage more courteous and lawful interaction between cyclists and motorists. There are currently many education efforts in the region, such as through local police departments, bike retailers, schools, hospitals, bike clubs and other groups. Coordination of the various efforts could help to increase coverage, ensure a consistent message, and allow for sharing of resources.

Education efforts should center on three main elements: developing safe cycling skills in children; educating adult cyclists about their rights and responsibilities; and, educating motorists about cyclists' rights, and how to share the road with cyclists.

Encouragement efforts could include: provision of bike racks (Section C above) and bike racks on buses (Section D above); events to promote the use of bicycles; and, printed maps with street recommendations and connections with any local trails.

Recommendations regarding education and encouragement activities are as follows:

<u>Phase I:</u>

- Create a regional inventory of programs aimed at bicycle and traffic safety education.
- Organize public/private support for, and develop, a public campaign and/or printed materials to educate children and adult citizens about bicycle and pedestrian safety issues.
- Coordinate with local school officials, KYTC and the UK Cooperative Extension Service Bicycle/Pedestrian Education Service to develop a bike safety education curriculum targeting elementary school students, for use in both public and private school systems.

<u>Phase II:</u>

- Develop a public education campaign to educate motorists of bicyclists' legal right to use roadways, and on how to safely operate a vehicle around bicyclists.
- Ensure that all bicyclists under the age of 16 have access to a low-cost or free bicycle helmet.
- Develop and distribute a pocket-size bike map which shows existing bikeway facilities, any trail connections, a "bike suitability" rating for local roadways, and information on bike-related traffic laws, bike safety tips, and a "Who to Call" list for reporting spot roadway problems, harassment by motorists, etc.

<u>Phase III:</u>

- Encourage the Kentucky Department of Motor Vehicles to update the driver's manual to incorporate bicycle-related information, and to include related questions on the written drivers' license exam.
- Develop and promote a program that publicly recognizes businesses that encourage their employees and/or customers to bicycle and walk. The participation of local government offices should be encouraged.
- Organize and promote an annual local "Bike to Work Week" event to coincide with other state and national promotional events.

<u>Ongoing:</u>

- Continue to support and promote bike safety education efforts by local Police Departments, bike retailers and others. Bike safety should be aimed at increasing the knowledge and skills of children cyclists through bike rodeos, classroom education, and other opportunities.
- Encourage the Kentucky Transportation Cabinet Bicycle and Pedestrian Coordinator to organize and coordinate statewide educational and promotional programs, and act as clearinghouse for information.

F. Laws and Law Enforcement

The adequacy of laws relating to cycling, and the support of law enforcement personnel in enforcing those laws, has a great effect on the safety and attractiveness of bicycle travel. State and local laws clearly state that the same traffic rules that apply to motorists apply to bicyclists. The support of law enforcement personnel will be critical in developing and maintaining a safe and attractive bicycling environment. The potential role of local law enforcement personnel is:

- **Enforce traffic laws** – Irresponsible cycling and driving is the source of much of the conflict between bicyclists and motorists. It is important that traffic laws are enforced equally against all violators--motorists *and* cyclists—in order to prevent injuries and deaths. This means citing motorists who disobey traffic laws in such a way as to adversely affect a bicyclist, and citing cyclists who disobey a rule for drivers of vehicles. The traffic system will only work properly if both motorists and bicyclists adhere to the rules of the road.

- **Public education and information dispersal** – Most police departments offer some level of bicycle education, typically targeting children. Local data on bicycle accidents should be used to help refine education programs and target the greatest safety problems.
- **Bicycle patrols** – Police bicycle patrols, used by the City of Henderson Police Department, improve police work, improve public relations, and provide personal contact with the public. Benefits to cyclists include greater police officer understanding of how cyclists should operate in traffic, and helping improve the legitimacy of cycling.

Recommendations regarding local laws and law enforcement departments are as follows:

Phase I:

- Review appropriateness of City of Henderson ordinance [Sec. 22-155]: The portion stating: *Whenever a usable path for bicycles has been provided adjacent to a roadway, bicycle riders shall use the path and shall not use the roadway.* (Few states still have these "mandatory sidepath" laws. Mandatory sidepath laws are increasingly being abolished to give cyclists the choice of riding on the path or the road. This is particularly applicable when the path is poorly designed or maintained.)

Phase II:

- Review/revise bicycle-related information in local police department officer training programs, such as issues concerning bicyclist safety, the importance of traffic law enforcement, and the role officers play in promoting bicyclist safety.
- Implement an annual police department enforcement blitz targeting those violations that have the greatest implications for bicyclist injuries and fatalities.
- Local police departments should develop and distribute an annual bike-auto crash data summary to identify spot problems, develop targeted enforcement programs and improve public education efforts.

Phase III:

- Encourage consistent and regular enforcement of motorist/ bicyclist traffic laws by citing both motorist and cyclist violations, targeting those violations that have the greatest implications for bicyclist injuries and fatalities.

Continue current practices:

- Continue the City of Henderson Police Department Bike Patrol program to improve community policing, promote safe bicycle habits and help promote the legitimacy of bicycling.

CHAPTER 4. IMPLEMENTING THE BICYCLE PLAN

The Bicycle Plan outlines a comprehensive approach for addressing bicycle issues. Because the Plan's recommendations are too numerous to implement all at once, recommendations presented in Chapter 3 were divided into three suggested phases of implementation. This chapter summarizes the 5-Year Bikeway Network and other high-priority recommendations, and identifies implementing bodies and possible funding sources.

A. Priorities

Priority projects include the first 5 years of the recommended Bikeway Network (Table 4), necessary roadway maintenance, planning activities, bicycle parking, bike/transit improvements, education and encouragement activities, and laws and law enforcement. All are summarized below.

The recommended 5-Year Bikeway Network is shown in Figure 5. It is a proposed system of on-street bikeways that would provide for basic travel routes in the city, with an emphasis on north/south travel from Atkinson Park to Drury Lane. Bikeway improvements would improve bike access between residential areas and downtown Henderson, numerous schools, recreation facilities including Atkinson, Sunset and Audubon Mill Parks and the Henderson Riverwalk pedestrian path.

Appropriate bikeways treatments would be a combination of bike lanes or wide curb lanes, and signed bike routes. Bikeways could be implemented either as stand-alone projects or as part of repaving/resurfacing projects. The ease of developing bike lanes and wide curb lanes varies from street to street, depending on existing pavement width, number of travel lanes, and presence of on-street parking. As shown in Figure 6, a number of roadways on the 5-Year Bikeway Network could be easily retrofitted with bikeways. However, other roadway segments would require additional parking and engineering studies to determine the feasibility of parking restrictions, lane widening and/or the removal of travel lanes.

TABLE 4. Bicycle Plan Priorities

Recommendation	Implementing Body	Funding Source
Implement bikeway facilities on the 5-Year recommended Bikeway Network.	EUTS, local jurisdictions	Existing agency bud-gets, special grants
Adopt AASHTO and IMUTCD standards for the design of bikeway projects.	Local jurisdictions	Existing budget
Review/improve street-sweeping process, give priority to roads on Bikeway Network.	Local jurisdictions	Existing budget
Review/improve process for clean-up of glass/debris from auto crashes.	Local jurisdictions	Existing budget
Review/improve process for public acceptance of roadway patching jobs.	Local jurisdictions	Existing budget
Update / distribute "Who to Call" directory for cyclists to report spot problems.	EUTS, local jurisdictions	Existing budget, special grants
Give streets on the Bikeway Network high priority in annual asphalt resurfacing programs.	Local jurisdictions	Existing budget
Pursue the accommodation of bicyclists as part of all transportation construction, reconstruction or intersection projects on facilities where cyclists are, or will be, allowed	EUTS, local jurisdictions	Existing budget

Figure 5: Short and Long Term Bikeway Network

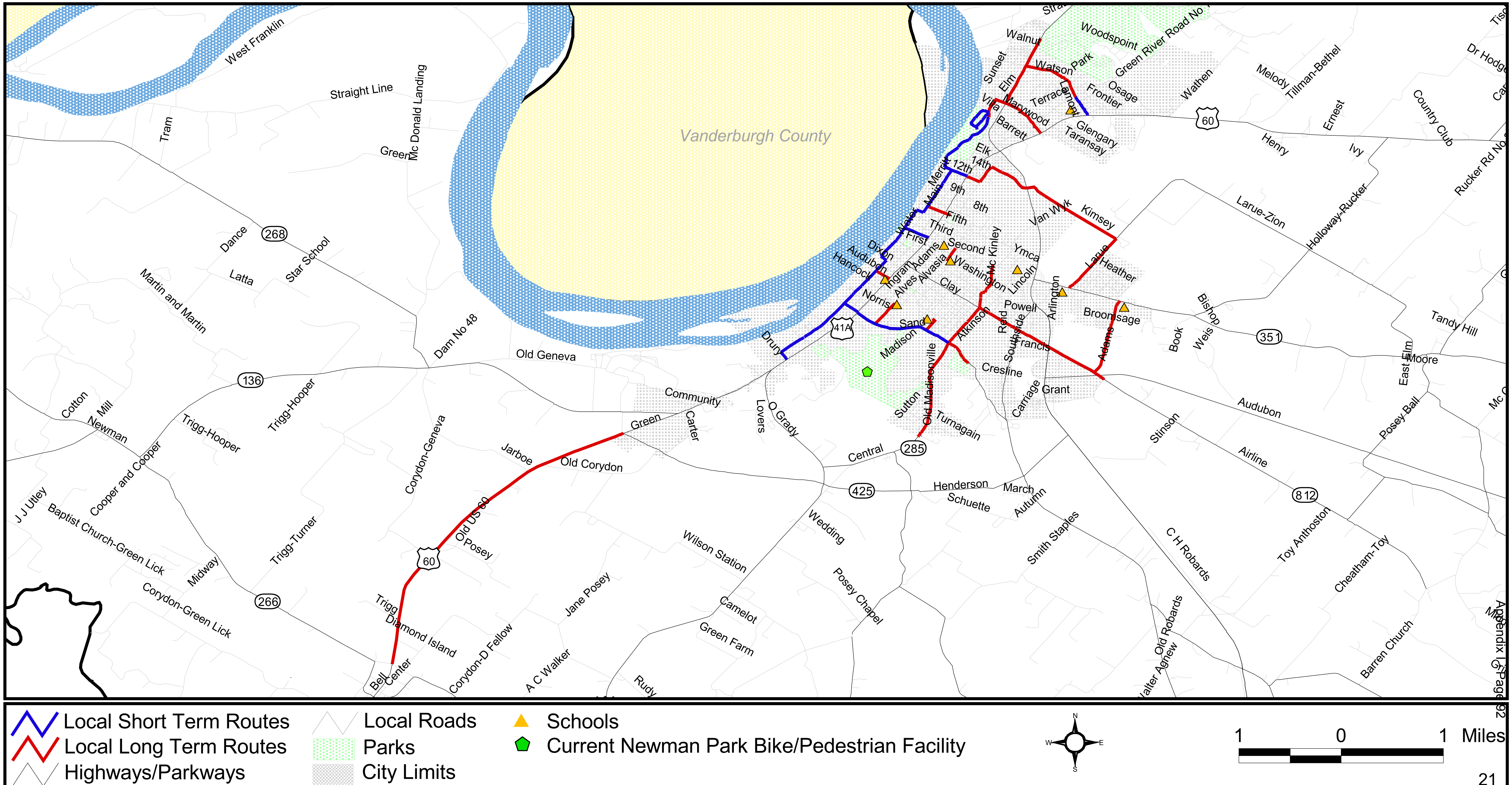
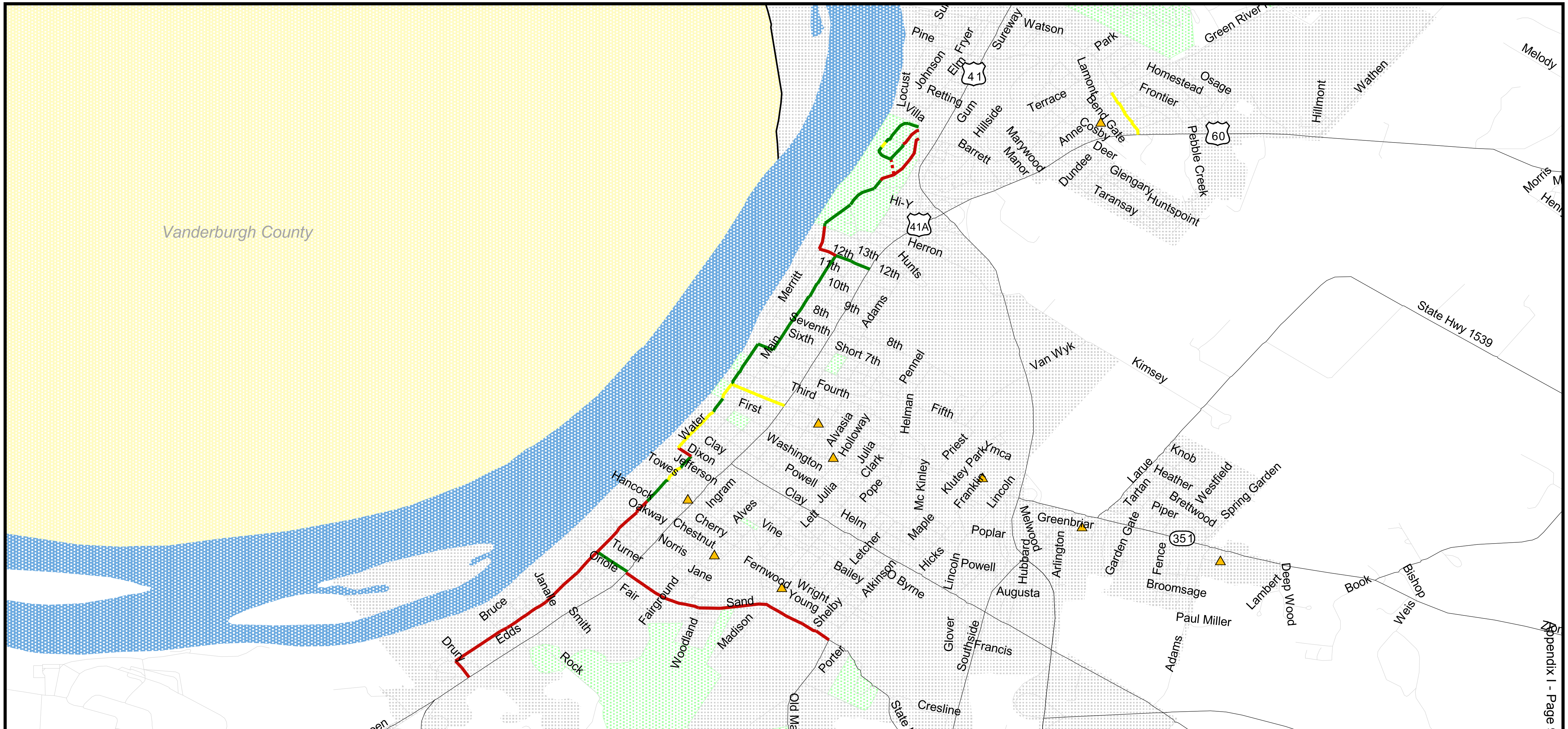


Figure 6: Status of Short Term Bikeway Network



Require Removal/Redesign of Parking, or Improvements
Ready To Proceed
Require Improvements

Local Roads
Highways/Parkways
Schools

Parks
City Limits

1 0 1 Miles

A. Priorities, cont.

Planning Activities

Recommendation	Implementing Body	Funding Source
Organize and conduct Bicycle/Pedestrian Advisory Committee meetings on as needed basis.	EUTS	Existing agency budget
Consider bicycle issues in the early planning and design of all locally funded transportation construction, reconstruction, maintenance, or intersection improvement projects.	Local jurisdictions	Project budget
Develop roadway inventories to support transportation planning efforts, including bicycle planning.	Local jurisdictions	Existing budget

Bicycle Parking

Recommendation	Implementing Body	Funding Source
Purchase and install bike racks in the City of Henderson – funding to be determined.	EUTS, City of Henderson	City of Henderson, Grants
Recommend bike racks in development projects as part of review process	EUTS, Area Plan Comm.	Existing agency / department budgets
Explore feasibility of modifying local zoning ordinances to encourage or require bike parking at major centers.	EUTS, Area Plan Comm.	Existing agency / department budgets

Bikes and Transit

Recommendation	Implementing Body	Funding Source
Consider the installation of bike racks for HART buses and at transfer centers.	HART, City of Henderson	HART, City of Henderson

Education and Encouragement

Recommendation	Implementing Body	Funding Source
Develop regional inventory of bicycle and traffic safety education programs	EUTS, school districts, local jurisdictions	Existing agency bud-gets
Organize public campaign and/or printed materials on bicycle and pedestrian safety	EUTS, local jurisdictions	Existing agency / department budgets, special grants, business sponsors
Coordinate with local school districts, KYTC and the UK Cooperative Extension Service to develop a bike safety education curriculum	School districts, KYTC, UK Coop. Extension Service, EUTS	Existing budgets, special grants

A. Priorities, cont.

Laws and Law Enforcement

Recommendation	Implementing Body	Funding Source
Review appropriateness of City of Henderson ordinance [Sec. 22-155]: The portion stating: *Whenever a usable path for bicycles has been provided adjacent to a roadway, bicycle riders shall use the path and shall not use the roadway. **	City of Henderson	Existing budget

*Few states still have these "mandatory sidepath" laws. They are increasingly being abolished to give bicyclists the choice of where to ride. This is particularly applicable in the case of a poorly designed or maintained path.

B. Funding

Although funds for infrastructure improvements are limited at this time, it is still possible to make real progress in improving conditions for bicycling. Local jurisdictions should focus on including bikeway projects in the course of routine maintenance projects (i.e. striping bike lanes or wide curb lanes when roads are resurfaced) and road improvement projects (i.e. adding wide curb lanes or paved shoulders in new roadway or reconstruction projects). In this way, bicycle improvements can be made in the course of regular development and maintenance, and funds can be used more effectively.

A range of local funding sources can be utilized for bicycle-related improvements. They include:

- **General revenues**
- **General transportation funds**
- **Annual street and highway improvements**
- **Capital improvement projects budget requests**
- **Developer contributions**
- **Designated bond funds**

The Transportation Efficiency Act for the 21st Century (TEA-21) provides a major opportunity for the region to fund strategic parts of its proposed bicycle plan. All of these funds require some contribution of local funds, typically 20% of the total project cost.

- **National Highway System (NHS).** NHS funds may be used to construct bicycle transportation facilities and pedestrian walkways on land adjacent to any highway on the National Highway System, including Interstate highways. NHS roadways in Henderson County are: US Hwy 41 (from the state line to the Breathitt Parkway), US Hwy 41A/60 (from US 41 to KY-425), KY-425 (from US Hwy 41A/60 to the Breathitt Parkway), the Breathitt Parkway and the Audubon Parkway.
- **Surface Transportation Program (STP).** STP funds may be used for either the construction of bicycle transportation facilities and pedestrian walkways, or non-construction projects (such as brochures, public service announcements, and route maps) related to safe bicycling and walking.
- **Transportation Enhancements.** Ten percent of the STP allocations are used for Transportation Enhancements, which include the provision of facilities, and safety and educational activities for bicyclists and pedestrians. Most of Evansville's Pigeon Creek Greenway project is being funded with Enhancements funding.
- **Congestion Mitigation and Air Quality (CMAQ).** CMAQ funds are only available in those areas designated as being in non-attainment of federal air quality standards. Henderson County is currently in attainment and is therefore not eligible for CMAQ funds. CMAQ funds

may be used for the construction of bicycle transportation facilities and pedestrian walkways, bicycle racks, and non-construction projects (such as brochures, public service announcements, and route maps) related to safe bicycling and walking.

- **Hazard Elimination and Railway-Highway Crossing programs.** Another ten percent of the STP allocations are set aside for the Hazard Elimination program. These funds can be used for activities including surveying hazardous locations, projects on any publicly owned bicycle or pedestrian pathway or trail, or any safety-related traffic calming measure.
- **Federal Transit Funding.** Transit funds can be used for bicycle and pedestrian access to transit facilities, to provide shelters and parking facilities for bicycles in or around transit facilities, or to install racks or other equipment for transporting bicycles on transit vehicles.

Other non-transportation funding sources are also available, particularly for safety and education programs. For example, hospitals and bicycle retailers sometimes fund education efforts targeting child cyclists' use of bicycle helmets, and provide free or discounted helmets.

While special grants are available to help fund the development of bicycle improvements, they cannot be used for routine maintenance of existing facilities. Ideal maintenance of a bikeway averages about $2,000/mile per year.[11] This includes street sweeping, street repair and restriping. Much of this cost is already covered by routine street maintenance work. However, communities interested in developing bikeway projects must address long-term funding for bikeway maintenance, and dedicate bicycle funding as a regular component of its general and capital funds.

[11] *Bicycle Master Plan*, City of Portland, Ore. (July 1998)

PART 2
PEDESTRIAN PLAN

CHAPTER 1. BACKGROUND

Walking is the oldest and most basic form of transportation. And everyone is a pedestrian at some point in every trip, whether it's walking to the convenience store to buy a newspaper, or just from one's car across a parking lot. Nationally, about 5% of all trips are made on foot.[12] As was stated in the Introduction to this *Bicycle and Pedestrian Plan*, improving conditions for pedestrians (and bicyclists) is important for many reasons:

- To improve the safety of those who currently bicycle and/or walk.
- To improve accessibility for all residents.
- To achieve more efficient use of the existing transportation system.
- To enhance the region's quality of life.
- To encourage more active and healthier residents.
- To help address the local air quality problem.

A look at our older neighborhoods and downtown areas shows how pedestrians were taken into consideration as our communities originally developed: sidewalks are found on both sides of streets, and commercial buildings are oriented towards the street, making walking both easy and pleasant. As our communities continue to grow and develop today, though, walking often receives little or no attention.

Over the past 50 years the Evansville-Henderson region, like much of the nation, has become heavily dependent upon the private auto. New residential and commercial developments and roadway improvements are often designed around the automobile, creating obstacles and deterrents to walking, such as:

- Lack of sidewalks along roadways and bridges
- Narrow sidewalks (particularly a problem for people in wheelchairs)
- Poorly constructed and/or maintained sidewalks
- Difficult street crossings (too wide)
- High-speed and high-volume traffic near schools, parks, shopping and residential areas
- Sprawl-type development in which distances are too great for walking and/or developments lack safe pedestrian access

This Pedestrian Plan identifies opportunities to improve conditions for walking. Included are recommendations for incorporating pedestrian considerations into land use planning and development decisions, improving sidewalk construction and maintenance, better integrating pedestrian improvements into roadway design, and developing education, encouragement and enforcement programs to improve pedestrian and motorist safety.

[12] *1995 National Personal Transportation Survey*, Federal Highway Administration

CHAPTER 2. CURRENT CONDITIONS

To plan for pedestrians, it is necessary to understand and address the problems and barriers that prevent more residents from walking. This chapter looks at the existing environment and identifies pedestrian safety problems and other factors that make walking unsafe or unattractive.

A. Pedestrian-Auto Crashes

EUTS staff could not obtain complete data on local pedestrian-auto crashes due to inconsistencies in accident report coding. In lieu of local data, national data on pedestrian-auto crashes is used here to discuss pedestrian-related safety issues.

Most pedestrian-auto crashes happen in urban areas (80%), and at non-intersection locations (68%). Even though the greatest single "type" of pedestrian-auto crashes involves a pedestrian crossing at an intersection (32.1%), more pedestrians are actually hit at non-intersection locations.

Table 5. Pedestrian-Auto Crash Types
Stratified Sample of National Crash Data, 1990s

Type of Crash	% of all crashes
Pedestrian crossing at intersection	32.1
Pedestrian crossing at midblock location (not at an intersection)	26.4
Pedestrian hit by driverless or backing vehicle, or police car in pursuit	9.1
Pedestrian not in road (waiting to cross street, crossing a driveway)	8.6
Pedestrian walking along road	7.4
Pedestrian working or playing in road	3.0
Pedestrian going to/from school or commercial bus or ice-cream vendor, or entering/exiting a parked vehicle	2.6
Other/Undetermined	10.8
TOTAL	**100%**

Source: *Pedestrian Crash Types: A 1990s Informational Guide*, Federal Hwy. Admin. (April 1997)

Common causes of pedestrian-auto crashes include:

- Driver inattention
- Pedestrians darting out into the street at midblock locations (most common type of crash involving child pedestrians)
- Motorists speeding
- Motorists backing up (difficult to see children and others walking behind)
- Pedestrians at midblock locations misjudging gaps in traffic

Children and older adults are the highest risk groups of pedestrians. While accident rates are higher for children, older adult pedestrians are more vulnerable to serious injury or death when hit by a motor vehicle.[13]

[13] *Pedestrian and Bicycle Crash Types of the Early 1990s*, National Highway Traffic Safety Administration (1995)

B. Existing Facilities

There is currently no complete inventory of sidewalks and other pedestrian facilities in the region, which makes it difficult to assess the extent and condition of the existing pedestrian network. Ideally, an inventory would be developed by each community to identify existing sidewalks, sidewalk width, pavement condition, the presence or absence of curb ramps, and “pinchpoints” created by difficult crossings and/or significant physical obstructions (utility poles, newspaper sales boxes, fire hydrants). Because this information can be time consuming and expensive for a community to collect and maintain, it is generally a low priority.

However, members of the Bicycle/Pedestrian Advisory Committee and individual citizens identified numerous concerns with the existing pedestrian network:

- Commercial developments typically lack pedestrian-friendly features (buildings are set back far from the street in the middle of a parking lot, with no safe pedestrian passage from the street to building entrances).
- New neighborhoods, commercial areas and roadways often lack sidewalks.
- Areas with missing sidewalk segments.
- Sidewalks are poorly maintained.
- Too few curb ramps (ramps that transition from sidewalk to street, needed by pedestrians using wheelchairs or walkers, or pushing strollers).
- Too many obstacles on sidewalks (newspaper vending machines, utility poles, fire hydrants).
- Need to improve pedestrian crossings.

Most of these problems center on a lack of sidewalks, and poor sidewalk conditions. The solution – more sidewalk construction, maintenance and repair - is relatively straightforward. However, a lack of funding has been and will continue to be the biggest hurdle to making these improvements.

Obstacles on sidewalks present a significant problem in areas with narrow sidewalks and for pedestrians in wheelchairs. While obstructions such as vending machines and private mailboxes can be controlled through encroachment permit processes and enforcement, utility poles and fire hydrants are not easily relocated.

Other problems will require more than just a one-shot solution. For example, safe roadway crossings for pedestrians are clearly a critical part of any pedestrian network. While there are a variety of pedestrian crossing treatments, the design can’t compensate for driver or pedestrian inattention or poor judgment.[14] Continuous public education and enforcement are part of the solution.

The general rule regarding pedestrian crossings is that unmarked crosswalks exist at all roadway intersections. Pedestrian crossings can also be physically designated, such as with marked crosswalks (i.e. painted, raised), pedestrian crossing signals (Walk/Don’t’ Walk signals), and grade-separated crossings (overpasses and underpasses). Each of these treatments has its advantages and disadvantages, and is intended for use under certain conditions.

Grade-separated crossings, such as pedestrian overpasses or underpasses, allow pedestrians and vehicles to cross at different levels. These types of crossings have limited application. When used in the proper situation and designed correctly, grade-separated crossings can reduce

[14] Some agencies in the United States believe that crosswalks can actually result in greater danger to pedestrians by giving them a false sense of security, as pedestrians begin to expect motorists to stop for them. They advocate that removing pedestrian crossings will improve safety by forcing pedestrians to use more caution when crossing streets.

pedestrian-auto conflicts, lessen vehicle delay, and help maintain the continuity of neighborhoods divided by high-traffic roads. However, they are extremely costly to construct, and are often considered pedestrian *un*friendly because pedestrians are forced to travel out of their way to use them. Studies have shown that the effectiveness of a grade-separated crossing depends on whether pedestrians perceive that it is *easier to use* than a street crossing.[15]

One area that is often overlooked in pedestrian planning is access to transit. A transit system can't be effective unless people can get to bus stops easily and safely. Pleasant walking conditions, wide sidewalks, safe street crossings, good lighting, informative signs, bus shelters, benches and landscaping are all important features.

As in many other parts of the country, the EUTS Study Area is facing rapid growth, and has the opportunity to ensure that new developments are easily accessible by pedestrians, transit riders, people being dropped off or picked up, people in wheelchairs or baby strollers. The following chapter presents strategies for addressing the problems identified in this chapter.

[15] *Planning Design and Maintenance of Pedestrian Facilities*, Federal Highway Administration (1989)

CHAPTER 3. PEDESTRIAN PLAN RECOMMENDATIONS

Chapter 2 of the Pedestrian Element highlights reasons for developing a more pedestrian-friendly community, and identifies problems and deficiencies that impact the safety, attractiveness, viability and levels of use of walking in the EUTS Study Area. The following recommendations are aimed at addressing those problems. These recommendations were developed with assistance from the EUTS Bicycle/Pedestrian Advisory Committee, and with input from the general public.

Pedestrian recommendations are divided into 5 categories: Planning and Development Review; Sidewalk Construction and Maintenance; Pedestrian Crossings; Education and Encouragement; and Law Enforcement. Recommendations in each category are further grouped into Phases I, II or III for priority of implementation. Both the need and the feasibility of each recommendation were taken into consideration in assigning it to an implementation Phase. As such, a Phase III recommendation might be a high priority, but the feasibility of implementing it at this point in time is low.

A. Planning and Development Review

One of the keys to creating pedestrian-friendly communities is to ensure that pedestrian issues are addressed in the development and planning process. Pedestrian issues should be a standard consideration in all planning and development activities, to ensure that pedestrians are accommodated as the community continues to grow and develop.

Phase I:

- Organize and conduct Bicycle/Pedestrian Advisory Committee meetings on an as needed basis to assist in implementing recommendations in the Bike/Pedestrian Plan, review road/bridge project plans, and provide input into other transportation planning activities.
- Consider pedestrian issues in the early planning and design of all locally funded transportation construction, reconstruction, maintenance (i.e. resurfacing), or intersection improvement projects to ensure accommodation of pedestrians, as appropriate.
- Support changes in local Subdivision Ordinances to strengthen requirements for pedestrian facilities in new or redeveloped areas. This would include sidewalks on both sides of streets and features which support walking (i.e. interconnecting streets between neighboring developments, connector pathways between cul-de-sacs and to connect to abutting schools, parks, shopping centers, etc.).
- Support changes in local Zoning Ordinances that will encourage pedestrian-oriented features in new or redeveloped commercial areas. This could include sidewalk connections to the street, sidewalks throughout the site, and buildings located adjacent to the street and sidewalks.

Phase II:

- Establish a legal process for maintaining pedestrian connections that are not on streets, such as connector pathways.
- Educate the general public and developers about the benefits of pedestrian-friendly residential and commercial design features.
- Encourage a mix of housing types, including smaller residential lot sizes in conjunction with amenities such as dedicated areas of common open space, bikeway/pedestrian connectors.
- Support the development of a landscape ordinance targeting commercial development, and a tree ordinance. Tree-lined streets create a friendly, walkable environment, make outdoor spaces cooler and more inviting, and have been shown to help reduce vehicle speeds.

Phase III:

- Encourage the development of a model pedestrian-friendly development.

Continue current practices:

- Continue to require/recommend sidewalks and other pedestrian accommodations as part of the Subdivision, Rezoning and Site Plan review process.
- Participate in the early planning and design phases of all federal- and state-funded transportation construction, reconstruction, maintenance, or intersection improvement projects to ensure that pedestrians are accommodated, as appropriate.
- Encourage the development of land uses and design features which foster pedestrian activity, such as appropriate mixed-use developments, and residential developments offering a mix of housing types and pedestrian amenities (i.e., dedicated areas of common open space, bikeways and pedestrian connectors).

B. Sidewalk Construction and Maintenance

The most basic facility for pedestrians is a well-connected sidewalk network in good repair. A lack of sidewalks, missing sidewalk segments, deteriorating pavement, a lack of smooth curb ramps, and obstacles (newspaper vending machines, utility poles, fire hydrants) make walking unsafe and uninviting. This section provides recommendations for maintaining and improving the sidewalk network.

Phase I:

- Review/modify local encroachment permitting processes to minimize the number of obstructions on public sidewalks, and to strengthen the enforcement process for removing illegal obstructions.
- Support the construction of sidewalks as part of all locally funded roadway construction, reconstruction or intersection improvement projects, as appropriate.
- Create and distribute a “Who To Call” list for citizens to identify sidewalk problems.
- Incorporate ADA requirements into all sidewalk projects.
- Develop an inventory of the existing sidewalk network and identify missing sections and areas of disrepair.

Phase II:

- Develop annual municipal/county programs to identify and construct missing sidewalk segments, retrofit intersections with curb ramps where they currently do not exist, replace inadequate curb ramps, and maintain sidewalks as appropriate. This should include a process for evaluating and prioritizing projects.
- Research and identify additional funding options for implementing municipal/county sidewalk construction programs.
- Establish a process for maintaining pedestrian connections that are not on streets, such as connector pathways.

Phase III:

- Implement annual municipal/county sidewalk construction/maintenance programs, and update as needed.
- Identify lighting problems and repair or improve as necessary, with priority going to areas with high pedestrian activity.
- Review/improve process for cleaning glass/debris from auto crashes.

Continue current practices:

- Require/recommend sidewalks as part of new or redevelopment projects.
- Support the construction of sidewalks as part of all state and federally funded roadway construction, reconstruction or intersection improvement projects, as appropriate.
- Follow appropriate local sidewalk design and construction guidelines, including the incorporation of ADA requirements, in all sidewalk projects.
- Use Community Development Block Grant funds for sidewalk repair projects in designated focus areas of the City of Henderson.

C. Pedestrian Crossings

Safe roadway crossings for pedestrians are a critical part of any pedestrian network. As discussed in Chapter 2 of this Pedestrian Plan, 32% of all pedestrian-auto crashes involved a pedestrian crossing the street at an intersection, and 26% involved a pedestrian crossing the street at a “midblock” location (between intersections). Clearly, education is needed to make pedestrians aware of the risk of crossing the street at a midblock location, teach them how to properly cross at designated pedestrian crossings, and to increase motorists’ awareness of pedestrians. However, creating and maintaining safe pedestrian crossings should continue to be a priority for the region.

Phase I:

- Update and distribute a “Who to Call” list for citizens to identify problematic pedestrian crossings.
- Explore the feasibility of posting signs near pedestrian crossing buttons with the “Who to Call” telephone number.

Phase II:

- Educate the public on how to properly use pedestrian crossing signals and crosswalks.

Phase III:

- Research the applicability of new pedestrian signal technology, surface treatments or paint design for crosswalks as part of new roadway, reconstruction or intersection improvement projects.

Continue current practices:

- Improve the visibility of pedestrians at intersections by trimming vegetation and restricting obstructions such as fences and parked cars.
- Repair broken pedestrian crossing signals.
- Modify traffic signal timing phases, as possible, to increase crossing time for pedestrians at large intersections.
- Identify and improve pedestrian crossings in areas with high pedestrian activity, as part of all new roadway, reconstruction or intersection improvement projects.
- Coordinate with local agencies and the Kentucky Transportation Cabinet (KYTC) to evaluate requests for new pedestrian overpasses/underpasses and/or crosswalks, using KYTC and American Association of State and Highway Officials (AASHTO) standards to determine the appropriate treatment.

D. Education and Encouragement

Education and encouragement efforts will be critical in improving the safety of walking in the region, and in promoting walking as a means of transportation, exercise and recreation.

Phase I:

- Organize public/private support for, and develop a public campaign and/or printed materials to educate all citizens about pedestrian safety issues.
- Produce brochures and other materials to be distributed in order to promote walking for both health benefits and as alternative transportation.
- Develop and seek funding for a highly visible pedestrian pilot project linking neighborhoods and shopping areas, as a demonstration of a safe and attractive pedestrian facility. Such an effort could be a publicly funded stand-alone project, or coordinated as part of a privately funded demonstration model of a pedestrian-friendly development.

Phase II:

- Organize and promote an annual local “Walk Your Children to School” event to coincide with other state and national promotions.
- Sponsor special events to publicize the health benefits of walking, and promote walking as an alternative to driving for short trips.
- School districts and other educational institutions should use local auto-pedestrian crash data to develop educational programs to improve child pedestrian safety.

Phase III:

- Encourage the Kentucky Department of Motor Vehicles to update the driver’s manual to incorporate pedestrian-related information, and to include related questions on the written drivers’ license exam.
- Develop and promote a program that publicly recognizes companies that encourage their employees and/or customers to walk. Local government offices should be encouraged to participate.
- Sponsor walking events to publicize walking for both health benefits and as alternative transportation.

Continue current practices:

- Educate children about pedestrian safety through school, Police Dept. and other programs.

E. Law Enforcement

The support of law enforcement agencies is necessary in creating a safe pedestrian environment.

Phase I:

- Local police departments should structure accident report databases to allow for complete sorting and retrieval of auto-pedestrian accident reports.

Phase II:

- Local police departments should develop and distribute an annual auto-pedestrian crash data summary to identify spot problems, develop targeted enforcement programs, and improve community education efforts.
- Incorporate pedestrian-related information in local police department officer training programs, such as issues concerning pedestrian safety, the importance of pedestrian and traffic law enforcement, and the role that officers play in promoting pedestrian safety.

Phase III:

- Encourage consistent and regular enforcement of traffic laws by citing both motorist and pedestrian violations, targeting those violations that have the greatest implications for pedestrian injuries and fatalities.

CHAPTER 4. IMPLEMENTING THE PEDESTRIAN PLAN

The Pedestrian Plan outlines a comprehensive approach for addressing pedestrian issues in the region. Because the Plan's recommendations are too numerous to implement all at once, recommendations presented in Chapter 3 were divided into three suggested phases of implementation. This chapter summarizes the suggested priorities, and identifies implementing bodies and possible funding sources. (Table 6)

A. Priorities

TABLE 6. Pedestrian Plan Priorities

Recommendation	Implementing Body	Funding Source
Organize and conduct Bicycle/Pedestrian Advisory Committee meetings on as needed basis.	EUTS	Existing agency budget
Consider pedestrian issues in the early planning and design of all locally funded transportation construction, reconstruction, maintenance, or intersection improvement projects.	Local jurisdictions	Project budget
Support changes in local Subdivision Ordinances to strengthen requirements for pedestrian facilities in new /redeveloped areas.	Area Plan Comm. / local planning staff	Existing department budgets
Support changes in local Zoning Ordinances that will encourage pedestrian-oriented features in new or redeveloped commercial areas.	Area Plan Comm. / local planning staff	Existing department budgets

Sidewalk Construction and Maintenance

Recommendation	Implementing Body	Funding Source
Modify / create local encroachment permitting processes to minimize the number of obstructions on public sidewalks, and to strengthen the enforcement process for removing illegal obstructions.	Local jurisdictions	Existing department budgets
Support the construction of sidewalks as part of all locally funded roadway construction, reconstruction or intersection improvement projects, as appropriate.	Local jurisdictions	Construction project budget
Create and distribute a "Who To Call" list for citizens to identify sidewalk problems.	EUTS, local jurisdictions	Existing budgets
Incorporate ADA requirements into all sidewalk projects.	Local jurisdictions	Project budget
Develop an inventory of the existing sidewalk network identifying missing segments and areas of disrepair	EUTS, local jurisdictions	Existing budgets

Pedestrian Crossings

Recommendation	Implementing Body	Funding Source
Update and distribute a "Who to Call" list for citizens to identify problematic pedestrian crossings.	EUTS, local jurisdictions	Existing budgets
Explore the feasibility of posting signs near pedestrian crossing buttons with the "Who to Call" telephone number.	Local jurisdictions	Existing budgets

Education and Encouragement

Recommendation	Implementing Body	Funding Source
Organize and develop a public campaign and/or printed materials to educate citizens about pedestrian safety issues.	EUTS, local jurisdictions, police department, school systems	Existing department budgets, special grants, business sponsors
Produce and distribute printed materials that promote walking for both health benefits and as an alternative to driving for short trips.	Public health department, local hospitals, public health organizations	Existing department budgets, special grants, business sponsors
Develop a highly visible pedestrian pilot project linking neighborhoods and shopping areas, as a demonstration of a safe and attractive pedestrian facility.	EUTS, Area Plan Commission, local planning staff	Existing department budgets, special grants, business sponsors

Law Enforcement

Recommendation	Implementing Body	Funding Source
Local police departments should structure accident report databases to allow for complete sorting and retrieval of auto-pedestrian accident reports.	Local police departments	Existing budgets

B. Funding

Many of the priority recommendations involve policy changes or planning activities that could be pursued using existing staff and agency/department budgets. Sidewalk construction can continue to be accomplished through local funds, as well as through the development process, and by consistently incorporating sidewalks into roadway construction projects. Recommendations for education and encouragement strategies will generally require funding beyond what is currently available. In those cases, special grants and/or participation from the private sector should be sought.

A range of local funding sources can be utilized for pedestrian improvements. They include:

- **General revenues**
- **General transportation funds**
- **Annual street and highway improvements**
- **Capital improvement projects budget requests**
- **Developer contributions**
- **Designated bond funds**

In the City of Henderson, the Community Development Department of also funds sidewalk improvements in qualifying “focus areas” using Community Development Block Grants (CDBG). The focus areas are low-moderate income areas that have been identified as eligible for federal CDBG funds. Blocks of sidewalks are replaced, as opposed to spot improvements based on requests from individual property owners. Priority has been given to areas that currently lack sidewalks, with additional focus on providing access to public facilities.

The Transportation Efficiency Act for the 21st Century (TEA-21) provides funding opportunities for pedestrian improvements and safety education efforts. All of these funds require some contribution of local funds, typically 20% of the total project cost.

- **National Highway System (NHS).** NHS funds may be used to construct bicycle transportation facilities and pedestrian walkways on land adjacent to any highway on the National Highway System, including Interstate highways. NHS roadways in Henderson County are: US Hwy 41 (from the state line to the Breathitt Parkway), US Hwy 41A/60 (from US 41 to KY-425), KY-425 (from US Hwy 41A/60 to the Breathitt Parkway), the Breathitt Parkway and the Audubon Parkway.
- **Surface Transportation Program (STP).** STP funds may be used for either the construction of bicycle transportation facilities and pedestrian walkways, or nonconstruction projects (such as brochures, public service announcements, and route maps) related to safe bicycling and walking.
- **Transportation Enhancements.** Ten percent of the STP allocations are used for Transportation Enhancements, which include the provision of facilities, and safety and educational activities for bicyclists and pedestrians. Most of the Pigeon Creek Greenway project is being funded with Enhancements funding.
- **Congestion Mitigation and Air Quality (CMAQ).** CMAQ funds may be used for either the construction of bicycle transportation facilities and pedestrian walkways, bicycle racks, and non-construction projects (such as brochures, public service announcements, and route maps) related to safe bicycling and walking. This funding source is only available in those areas designated as being in non-attainment of federal air quality standards. Henderson County is in attainment of the standards and is not currently eligible.
- **Hazard Elimination and Railway-Highway Crossing programs.** Another ten percent of the STP allocations are set aside for the Hazard Elimination program. These funds can be used for activities including surveying hazardous locations, projects on any publicly owned bicycle or pedestrian pathway or trail, or any safety-related traffic calming measure.
- **Federal Transit Funding.** Transit funds can be used for bicycle and pedestrian access to transit facilities, to provide shelters and parking facilities for bicycles in or around transit facilities, or to install racks or other equipment for transporting bicycles on transit vehicles.

Other non-transportation funding sources are also available, particularly for safety and education programs. For example, in Indiana the Governor’s Council on Impaired and Dangerous Driving offers funds for certain efforts to improve cyclist and pedestrian safety.

APPENDIX A
BIKE PARKING GUIDELINES

Bike Parking Guidelines

Good bike parking facilities are an essential part of any effort to promote bicycling. Most people won't use a bicycle for travel if there isn't safe bike storage at their destination. Bike parking should be designed and located to protect bicycles from a cyclist's two major concerns - theft and damage.

There are two classes of bike parking: short-term and long-term. *Short-term* parking racks allow the cyclist to lock the bike frame and both wheels, but generally don't provide weather protection (unless the area is covered by a building canopy). These facilities should be used where bicycles will be left for a few hours or less.

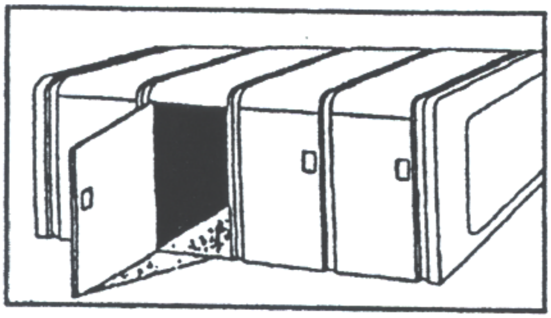
The design of bike racks is very important. Traditional bike racks that support only the wheel of a bike are no longer considered acceptable. Newer racks, such as ribbon racks, bike rails and posts, are better because they support the entire bike frame, will not bend wheels (today's bikes often have light alloy rims), and accommodate the popular, high-security U-shaped bike locks.

Just as important as design is the location of bike racks. Parking that is not in a good location will not be used. It's important that racks are located in a highly visible area, near a building's entrance. Areas with heavier foot traffic are generally better, as pass-by traffic helps "police" the area. However, bike racks should not be placed so that they obstruct sidewalks or pedestrian traffic.

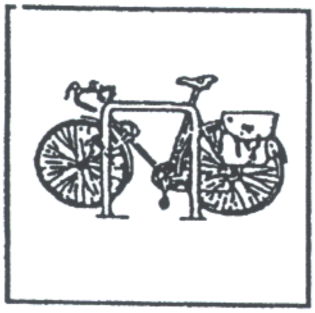
Long-term parking provides a greater degree of security and protection from the weather. Long-term facilities should be used where bicycles will be left unattended for longer periods of time (all day or overnight). Examples are bike lockers, enclosed "cages", or a room inside a building.

Bike parking should be easy to use. If possible, simple instructions on how to use the rack or locker should be posted.

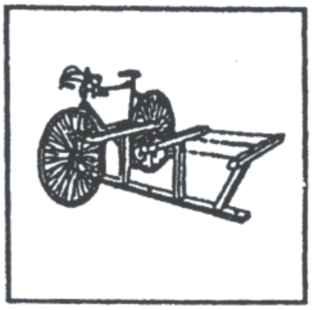
Bicycle Parking Facilities



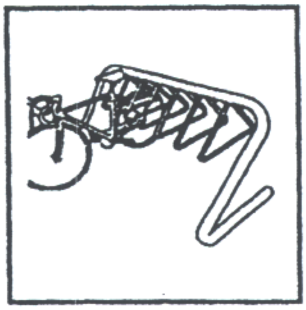
Bicycle Locker



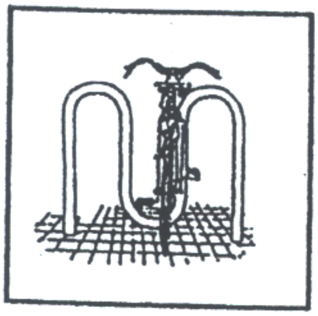
Bike Rail



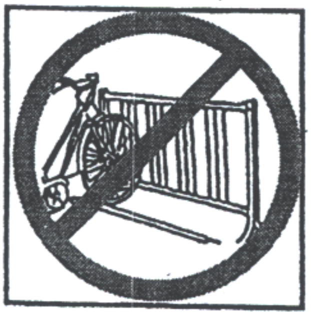
3-pt. Locking



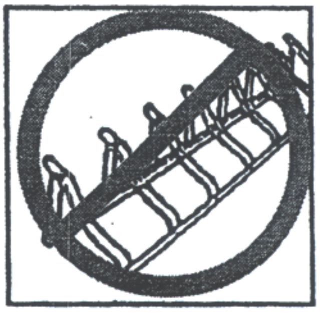
Freestanding



Ribbon Rack



Traditional
(SUBSTANDARD)



Wheelholder
(SUBSTANDARD)

Taken from Portland, Oregon "Bicycle Master Plan" (1998)

APPENDIX B
BIKEWAY NETWORK STREET LISTING

Planned Roadway Improvements On Bikeway Network

HENDERSON
SHORT TERM BIKEWAY NETWORK

Road	From	To	Any planned roadway improvements	Year
Atkinson Park Roads	Park Road Network		None currently	---
Merritt Drive	12th Street	Atkinson Park South Exit	None currently	---
12th Street	Merritt Drive	Green Street	None currently	---
Main Street	12th Street	5TH Street	None currently	---
5th Street	Main Street	Water Street	None currently	---
Water Street	5th Street	Dixon Street	None currently	---
Dixon Street	Water Street	Main Street	None currently	---
Main Street	Dixon Street	Drury Lane	None currently	---
Drury Lane	Main Street	US 41A/Green Street	None currently	---
Sand Lane/Madison Street	Main Street	Atkinson Street	Widen to 4 lanes from Green Street to Atkinson Street	2015
Watson Lane	Green River Road	US 60	None currently	---
2nd Street	Water Street	US 41A/Green Street	None currently	---

HENDERSON
LONG TERM BIKEWAY NETWORK

Road	From	To	Any planned roadway improvements	Year
US 41	Audubon Park Entrance	Rettig Road	None currently	---
Rettig Road	US 41	Elm Street	None currently	---
Elm Street	Rettig Road	Atkinson Park Entrance (North and South)	Upgrade from Watson Lane to 12th Street	2015
Marywood Drive	US 41	US 60	None currently	---
12th Street	US 41A/Green Street	Adams Street	None currently	---
Adams Street	12th Street	Kimsey Lane	None currently	---
Kimsey Lane	Adams Street	KY 1539/Larue Road	None currently	---
KY 1539/Larue Road	KY 351/ Second Street	Kimsey Lane	Upgrade	2025
Adams Lane	KY 351	KY 812/Airline Road	None currently	---
KY 812/Airline Road	City Limits/	Atkinson Street	None currently	---
Mckinley Avenue	KY 351/ Second Street	Washington Street	None currently	---
Atkinson Street	Washington Street	Madison Street	Widen to 4 lanes from Washington Street to Madison Street	2015
KY 136/ Madison Street	Atkinson Street	Community Park	None currently	---

Planned Roadway Improvements On Bikeway Network

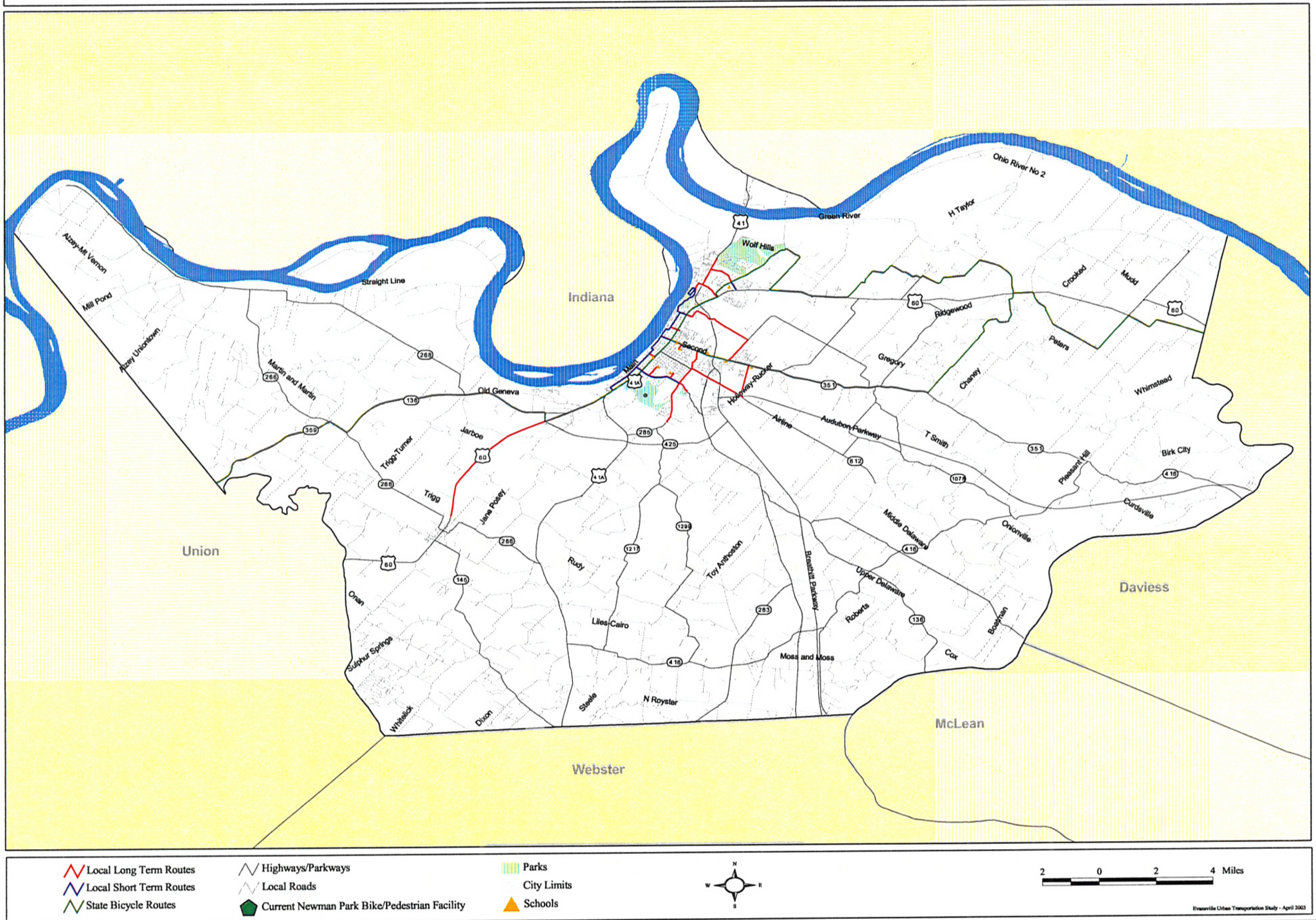
HENDERSON
LONG TERM BIKEWAY NETWORK Cont.

Road	From	To	Any planned roadway improvements	Year
KY 285/ Old Madisonville Road	Madison Steet	City Limits/ Moss Lane	None currently	---
Mill Street	Madison Street	South Heights Elementary	None currently	---
Alves Street	Sand Lane	South Jr. High	None currently	---
Audubon Street	Main Street	Jefferson School	None currently	---
Alves Street	2nd Street	Central Elementary	None currently	---
Sixth Street	Main Street	Ingram Street	None currently	---
US 60	KY 425/ Henderson By-Pass	Corydon	None currently	---

ADOPTED STATE BIKEWAY NETWORK

Road	From	To	Any planned roadway improvements	Year
Reed-Owensboro Road	Daviess County Line	Reed-Bluff City Road	None currently	---
Reed-Bluff City Road	Reed-Owensboro Road	Peters Road	None currently	---
Peters Road	Reed-Bluff City Road	US 60	None currently	---
US 60	Peters Road	KY 1078	None currently	---
KY 1078	US 60	KY 2243	None currently	---
Hatchett Mill Road	KY 2243	KY 351	None currently	---
KY 351/Second Street	Hatchett Mill Road	US 41A/Green Street	None currently	---
KY 1078	US 60	Dr. Hodge Street	None currently	---
Dr. Hodge Street	KY 1078	Tscharner Road	None currently	---
Tscharner Road	Dr. Hodge Street	US 60	None currently	---
US 60	Tscharner Road	Wathen Lane	Widen to 4 lanes from Wathen Lane to KY 2183/ Holloway-Rucker Road	2015
Wathen Lane	US 60	Green River Road	None currently	---
Green River Road	Wathen Lane	US 60	Upgrade from Osage Drive to Wathen Lane	2015
US 60	Green River Road	US 41	None currently	---
US 41A/Green Street	US 41	US 60	Add Left Turn Lane from US 60 to US 41	2025
US 60	US 41A	KY 425/Henderson By-Pass	Reconstruct from KY 425 to US 41A	FY 2004
KY 136	US 60	KY 359	None currently	---
KY 359	KY 136	Union County Line	None currently	---

Greater Henderson Bicycle and Pedestrian Plan
Local and State Designated Bicycle Routes



This Page Intentionally Left Blank