TRAFFIC OPERATIONS ANALYSIS

FOR

Collett Park Neighborhood and Union Hospital Expansion Plans
Terre Haute, Indiana

Prepared for:

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I certify that this TRAFFIC OPERATIONS ANALYSIS has been prepared by me or under my immediate supervision, and that I have experience and training in the field of traffic and transportation engineering.

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Jeffery R. Swenson, PE, PTOE

August 23, 2006

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EXECUTIVE SUMMARY

The City of Terre Haute has obtained the services of American Consulting, Inc. (ACE) to perform a Traffic Operations Analysis for the Collett Park Neighborhood located on the north side of Union Hospital in Terre Haute, Indiana.

Proposed Development

The Union Hospital Replacement facility is an approximately 178 million dollar project (approximate 570,000-sft development) proposed immediately to the east of the existing hospital facility. Union Hospital has requested vacation and closure of the existing link of 7th Street between 8th Avenue and Beech Street in Terre Haute, Indiana, to accommodate the new facility (See Appendix A).

Study Area

The study area is bound by US 41 to the west, 8th Avenue to the south, Maple Avenue to the north, and Ash Street/Lafayette Avenue to the east (See Figure 1). The study area includes the following intersections:

- 6th Street and Beech Street
- 7th Street and Lafayette Avenue
- 7th Street and 8th Avenue
- 7th Street and Beech Street
- 7th Street and Ash Street
- 7th Street and Maple Avenue
- 8th Avenue and 6th Street
- 8th Street and Lafayette Avenue
- 9th Street and Beech Street
- US 41 and 8th Avenue
- Lafayette Avenue and 8th Avenue
- Lafayette Avenue and Ash Street
- 9th Street and Maple Avenue

Conclusions and Recommendations

This study was conducted as an effort to analyze the traffic operations in the City of Terre Haute with the proposed closure of 7th Street link between 8th Avenue and Beech Street with the Union Hospital Replacement plans. It has been shown in this report that the proposed closure of 7th Street link does not warrant any substantial impact on the traffic operations. It has been confirmed that even with the adjustment and redistribution of the traffic in the network, the intersections will continue operating at Level of Service (LOS) "C" or better. Some roadway improvements and intersection improvements will be required along a few street segments in the study area.

This report serves as recommendation to the City of Terre Haute and the City Council to evaluate the identified impacts and help them come up with a solution that will increase the safety, convenience, and comfort of the Collett Park neighborhood community. The recommendations provided are based on an engineering assessment and careful review of the suggestions and concerns provided by the 7th Street Traffic Study Sub-Committee of Collett Park Neighborhood Association.

Identified Intersection Improvements

- Provide signal modifications to enhance safety and traffic operations at the intersection of Maple Street and US 41. The current signal indications are perceived to be confusing and may be the primary cause for the under utilization of Maple Street by the neighborhood community to commute southbound on US 41. Some intersection improvements are deemed necessary at this intersection. Any improvements involving US 41 would require meeting with INDOT officials to obtain approval.
- Provide signal modification and roadway improvements at the intersection of US 41 and 8th Avenue to provide easy access to the hospital traffic, thus reducing the overall impact of hospital traffic on the local neighborhood street network.
- Convert the intersection of 8th Avenue and Lafayette Avenue into a standard roundabout. This will enhance the intersection traffic operations and increase the overall safety as compared to the current unconventional 6-leg signalized intersection.
- Improvements are recommended along several street links in the vicinity of the Union Hospital and Collett Park, including 8th Avenue, 6th Street, Beech Street, and Ash Street. Figure 14 identifies the segments that will need improvements based on the preliminary findings of this report, which may require intersection (spot) improvements or roadway improvement, yet to be identified in detail at the later stage.

Alternative Convenient Travel Routes Identified for the Community with the Proposed Closure of 7th Street Link

- Preferred and most desirable alternative route(s) are identified in Figure 5. These route(s) will serve as the most efficient and convenient routes for the community while minimizing any impact on the local neighborhood street network.

Emergency Vehicle Access Routes

- A basic map of the emergency response street route is identified in Figure 7. It is proposed to present this map to the local Fire Department and the EMS services to inform them about the most desirable emergency access route to the hospital. The recommended streets consist of arterial and collector streets in order to minimize the impact on the local residential community streets.
- The recommended major emergency response streets, which consist of US 41, 8th Avenue, Lafayette Avenue, 6th Street and 13th Street, should be used as the primary access to the hospital. 7th Street north of Beech Street is identified as minor emergency response street (local emergency response street), which may be used as an emergency route in case of any emergency within the Collett Park Neighborhood.

Traffic Calming Options

- Hospital "way finding signs" should be installed along the US 41 and Lafayette Avenue corridors. Sufficient and well-placed "way finding signs" will help separate the hospital traffic from the residential traffic. "Way finding" should be designed such that it guides the hospital traffic to use US 41, 8th Avenue, Lafayette Avenue and 13th Street thus redirecting or preventing their intervention with the residential local street network.
- Install speed tables (i.e., speed humps) as a traffic calming measure at several locations on 8th Street and 9th Street, if necessary.
- Since 7th Street is identified as the minor emergency access route serving the Collett Park emergencies, it would not be appropriate to provide speed tables along 7th Street corridor which would hinder the emergence response services.
- Other traffic calming options, such as curb hump-outs, could be considered for use along 7th Street. Depending on the installation locations, they may or may not significantly impact on-street parking.
- If physical traffic calming measures cannot be installed without significantly impacting the utility of the street for its residents, then consideration should be given to lowering the posted speed limit. If speed control is deemed to be desirable, it is not recommended that a reduction in the posted speed limit be done arbitrarily as it would likely have little impact on actual travel speeds, unless enforced often. Rather the City of Terre Haute should evaluate the speed limit posted on 7th Street north of Beech Street by conducting a

speed study to determine if a lower speed limit is appropriate. An increase in "speed limit enforcement" and "education measures" may be required.

Roadway improvements identified in this report also provides an opportunity to address concerns provided by the neighborhood community about the neighborhood preservation plan and beautification to the existing local roads and streets in the Collett Park Neighborhood and vicinity.

INTRODUCTION

Study Purpose and Scope

The City of Terre Haute has obtained the services of American Consulting, Inc. (ACE) to perform a Traffic Operations Analysis for the Collett Park Neighborhood located on the north side of Union Hospital in Terre Haute, Indiana. The purpose of this study is to analyze the existing traffic patterns and traffic operations in the Collett Park Neighborhood inside the City of Terre Haute and to outline roadway improvements to manage new traffic patterns resulting from the proposed closure of 7th Street between 8th Avenue and Beech Street. The study area is bounded by US 41 to the west, 8th Avenue to the south, Maple Avenue to the north and Ash Street/Lafayette Avenue to the east. Figure 1 shows the Vicinity Map of the proposed site.

In order to fulfill this purpose, a detailed step-wise traffic analysis methodology and process was developed and implemented as show in Figure 2, which was also presented at one of the public open house meetings in Terre Haute.

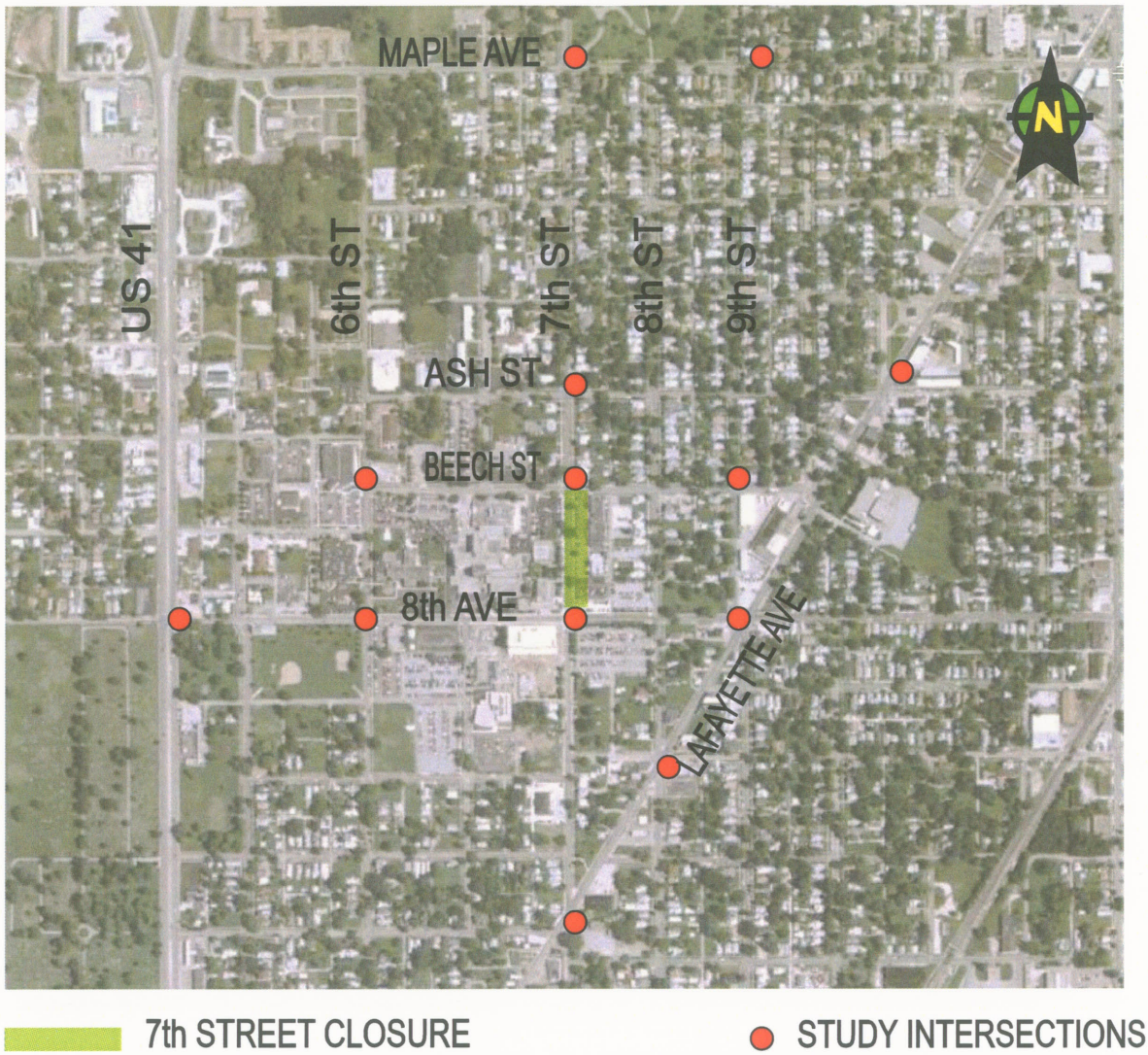
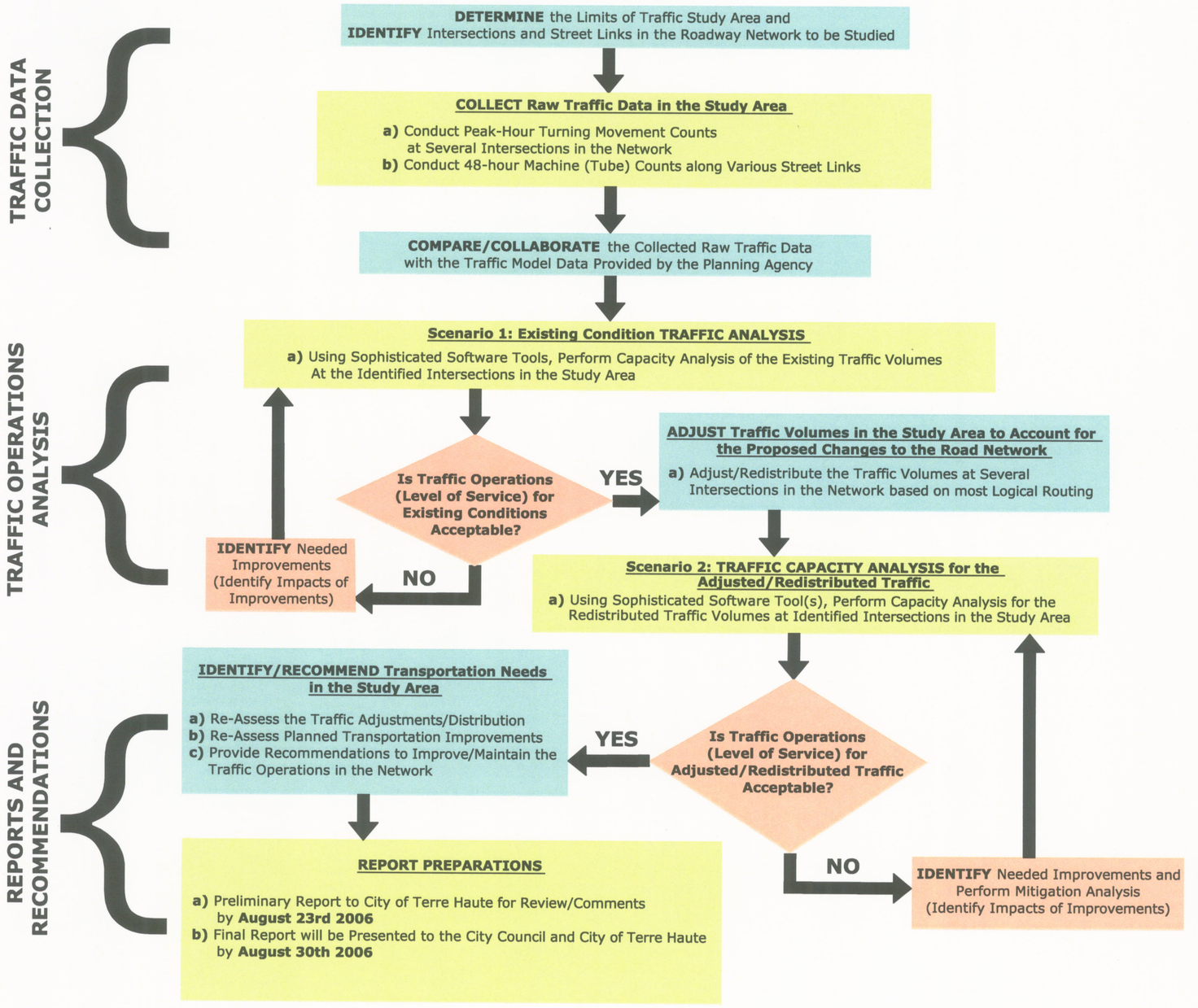


Figure 1 – Location Map

FIGURE 2 – Detailed Traffic Analysis Methodology and Process

TRAFFIC ANALYSIS METHODOLOGY AND PROCESS



COLLETT PARK NEIGHBORHOOD TRAFFIC STUDY

TRAFFIC ANALYSIS METHODOLOGY AND PROCESS

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TRAFFIC ANALYSIS

Existing Roadway System

The 7th Street corridor between Lafayette Avenue and Maple Avenue serves as a north/south collector route. As shown below, 7th Street is part of the City's north side network of collector and arterial routes, providing for the City's business and residential transportation needs.

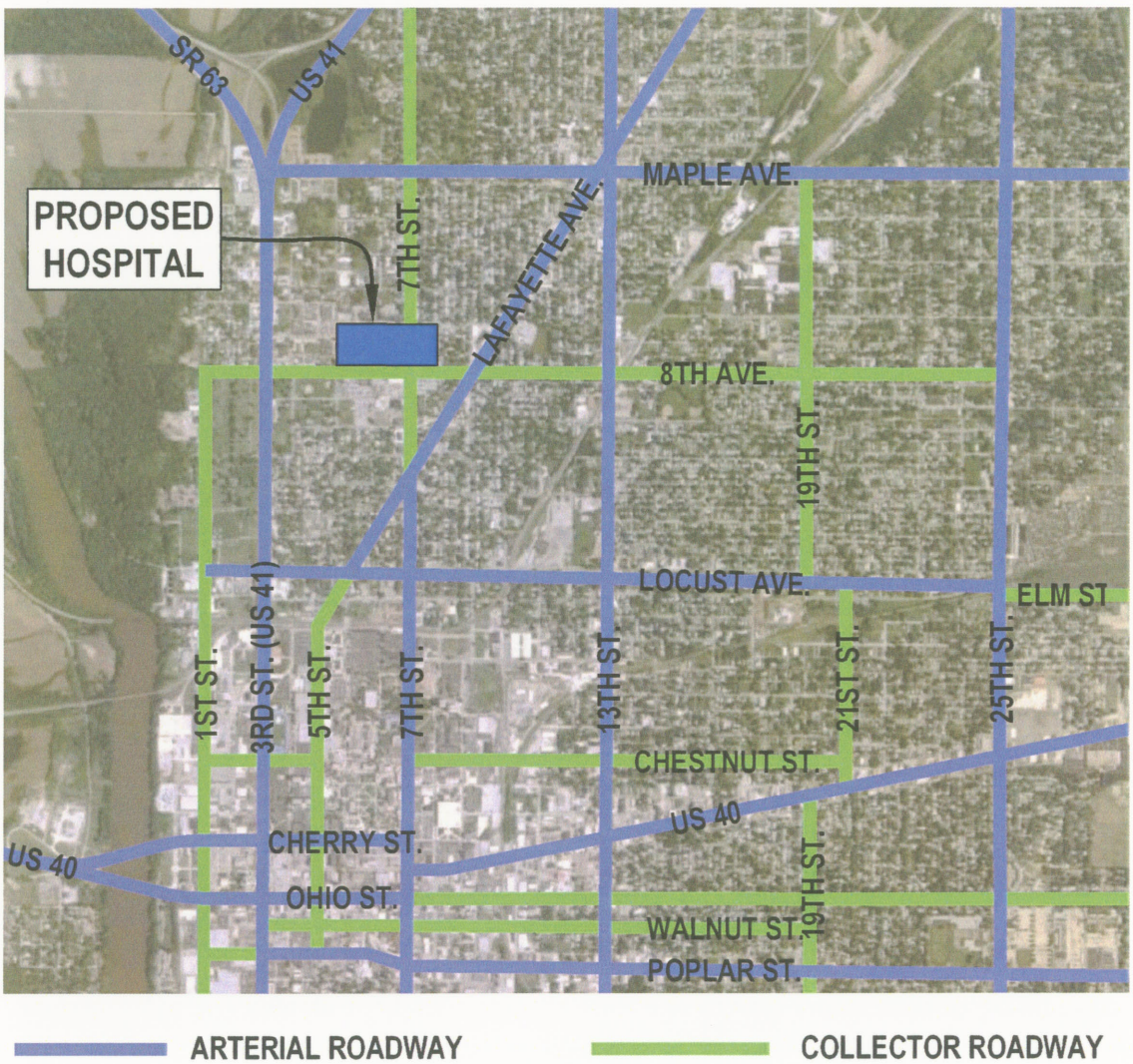


Figure 3 – Existing Road Network

Existing (Year 2006) Traffic Volumes

ACE conducted traffic counts, including 48-hour directional counts ("tube" counts) and 6-hour intersection turning movement counts (three hours in AM and three hours in PM) throughout the month of July, 2006. The turning movement counts were conducted at the intersection identified in the study area shown in Figure 1. 48-hour machine counts were conducted at several locations in the study area. ADT (Average Daily Traffic) information on several streets in the network was obtained from the historic traffic counts provided by the City of Terre Haute. The details of the traffic counts are presented in Appendix C and Appendix D. The existing 2006 AM and PM peak-hour traffic volumes for several intersections in the vicinity of the proposed 7th Street closure are presented in Figure 4. ACE also conducted 48-hour machine counts at several locations in the study area later during the month of August, 2006 to confirm if there will be a significant difference in the traffic volumes along the streets in the network, with the schools and Indiana State University being back in session.

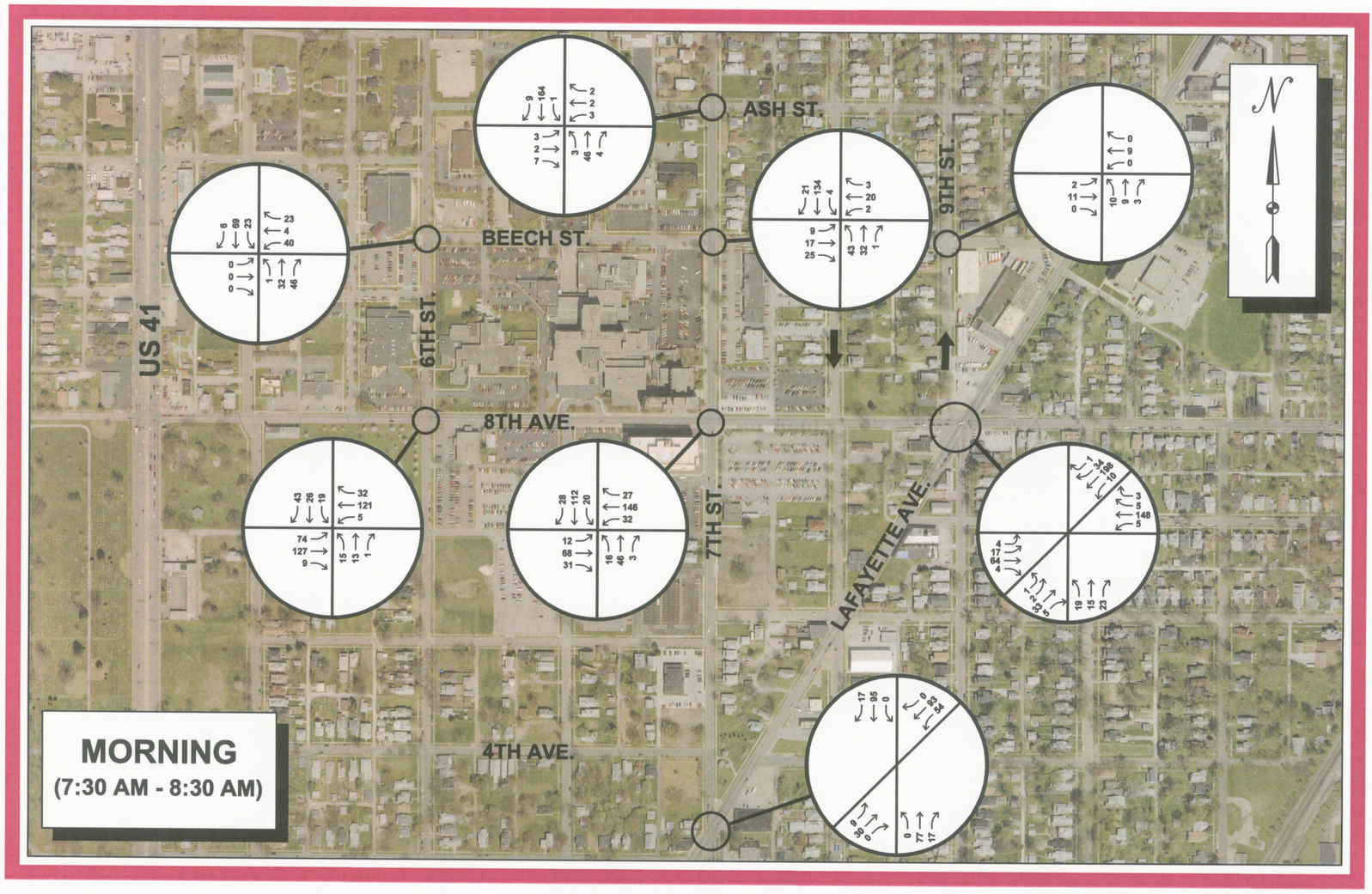
Traffic Redistribution with Proposed Closure of 7th Street Link

The directional distribution of site traffic is a function of several variables. These include the distribution of the population within the area, the operational characteristics of the roadway system, and the ease with which drivers can travel over various sections of the road system without encountering congestion. Alternate travel paths were selected by anticipating the fastest, most direct routes through and around the neighborhood.

With the proposal to eliminate the 7th Street link between 8th Avenue and Beech Street, it was necessary to adjust the thru traffic traveling northbound and southbound along the two end nodes or intersections (8th Avenue, Beech Street) of the 7th Street link and redistribute those thru traffic volumes along the most suitable and preferred logical routes within the network. Traffic distribution was performed with an anticipation that majority of the hospital related traffic would use US 41 (3rd Street), 8th Avenue, Lafayette Avenue and 7th Street. The impacted Collett Park residential traffic was redistributed along several convenient links in the vicinity depending on the direction of the commute.

A graphical representation of the primary alternate travel paths with the proposed closure of the 7th Street link is shown in Figure 5. Figure 6 shows the projected traffic volumes for several intersections in the vicinity of the proposed 7th Street closure after applying the appropriate traffic adjustments and redistribution as explained in this section.

Figure 4 – Existing 2006 AM and PM Peak-Hour Traffic Volumes


MORNING
(7:30 AM - 8:30 AM)
US 41
6TH ST.
BEECH ST.
ASH ST.
9TH ST.
8TH AVE.
7TH ST.
LAFAYETTE AVE.
4TH AVE.
N

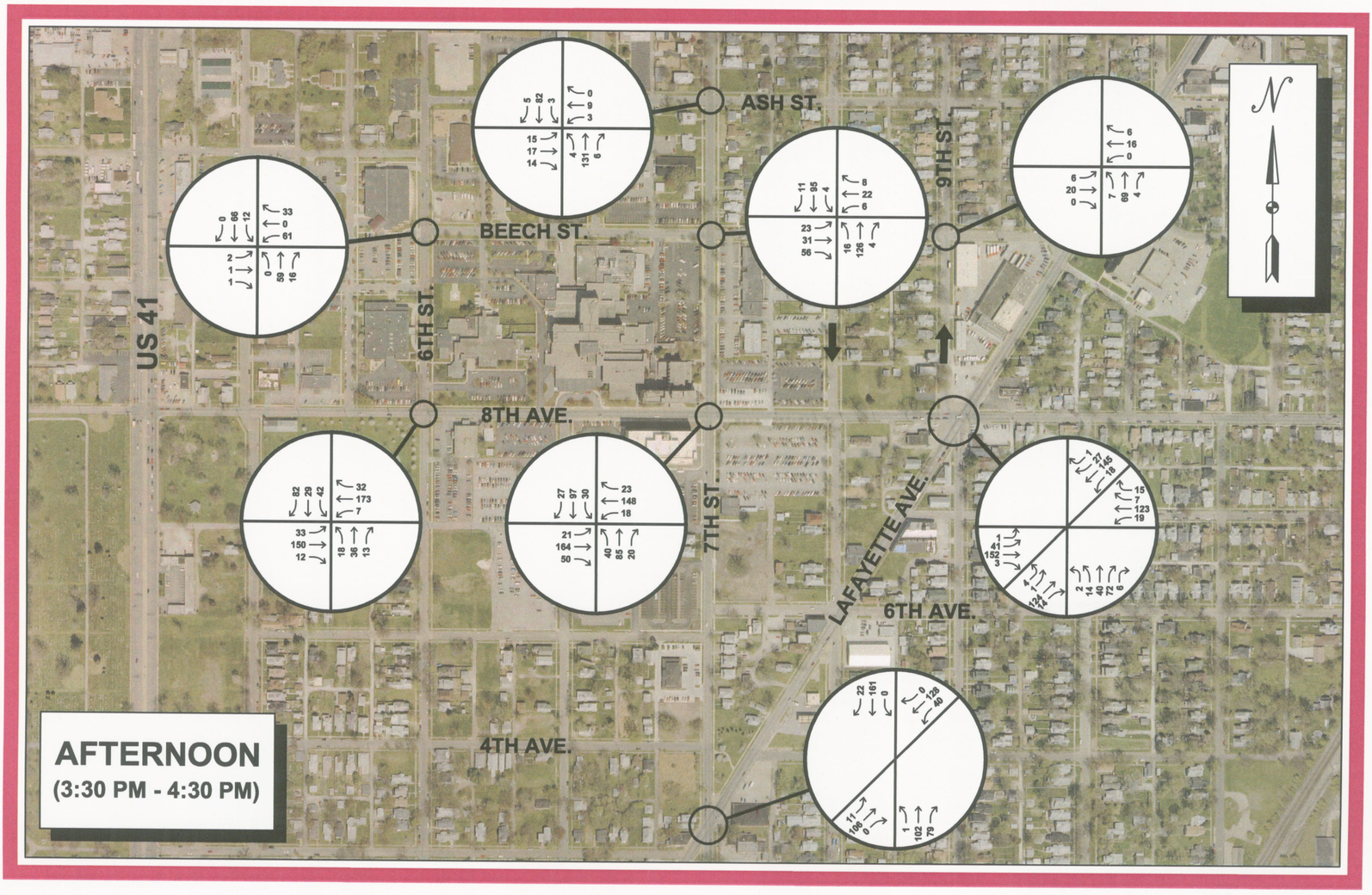
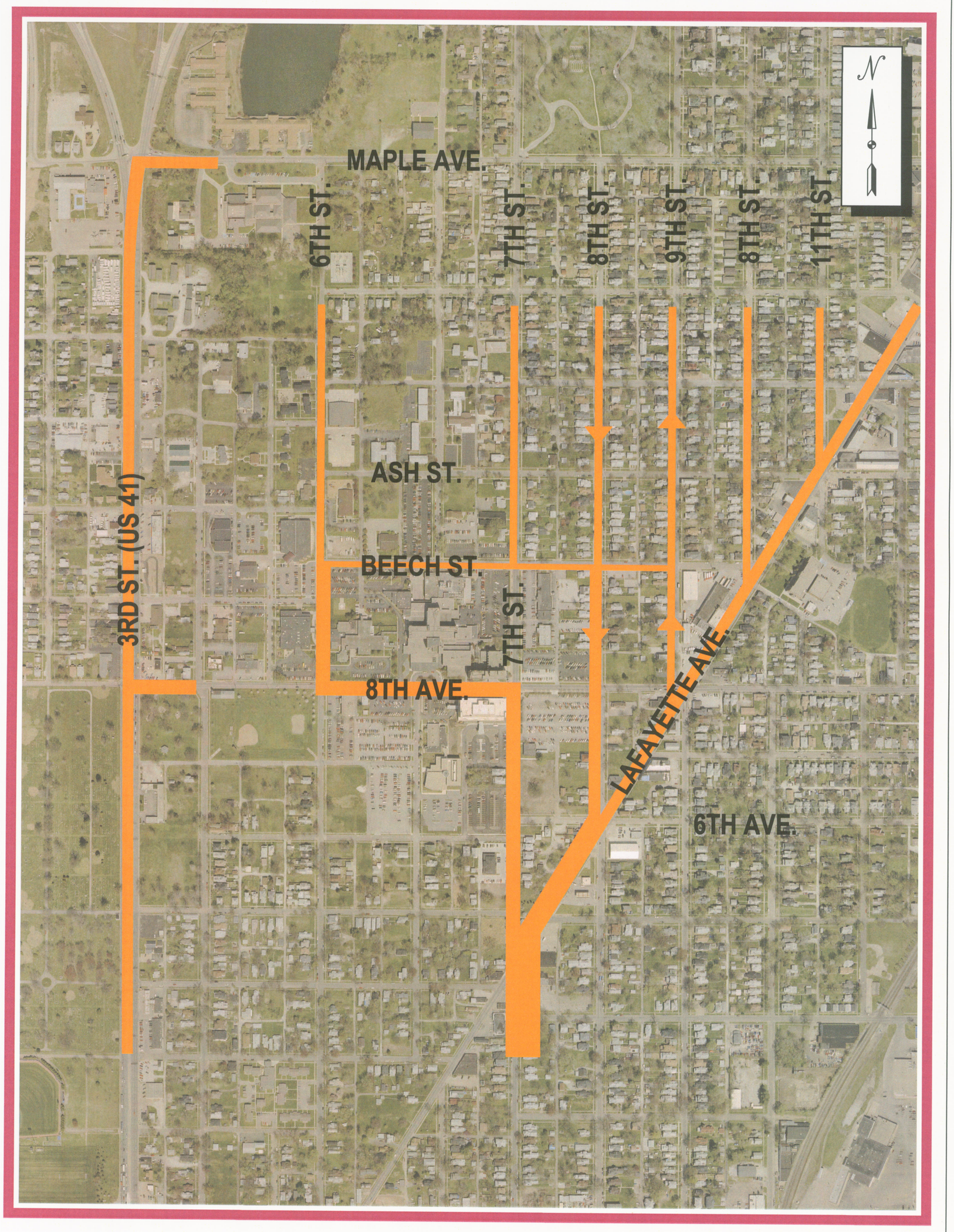

AFTERNOON
(3:30 PM - 4:30 PM)
US 41
6TH ST.
BEECH ST.
ASH ST.
9TH ST.
8TH AVE.
7TH ST.
LAFAYETTE AVE.
6TH AVE.
4TH AVE.
N

Figure 5 – Preferred Alternative Travel Route(s) with Proposed Closure of 7th Street Link



COLLETT PARK NEIGHBORHOOD TRAFFIC STUDY

PROPOSED ALTERNATE TRAVEL ROUTES

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Figure 6 – Proposed 2006 AM and PM Peak-Hour Traffic Volumes After Traffic Redistribution

MORNING
(7:30 AM - 8:30 AM)

AFTERNOON
(3:30 PM - 4:30 PM)

Trip Generation

The traffic generation characteristics of any development are based on the magnitude and character of the land use. ITE's Trip Generation Handbook (Seventh Edition, 2003) is generally used to calculate the number of trips that will be generated by a proposed site. The Trip Generation Handbook is a compilation of trip data for various land uses as collected by transportation professionals throughout the United States in order to establish the average number of trips generated by various land uses. The proposed hospital facility is a 570,000 sft development. Typically a similar size hospital facility would generate on an average approximately 10,000 daily trips and approximately 650 trips during the peak hour on a typical week day based on the ITE handbook. It should be noted, these typical peak hour trips have not been distributed and assigned to the roadway network because the proposed facility is a replacement for the existing hospital facility and the hospital administration has stated there are no plans for adding any new jobs or additional employees with this new facility. As such there will be no additional trips related to employees. Therefore the daily and hourly trips identified above can be significantly discounted or reduced and it can be anticipated from the preliminary investigation that the majority of any new traffic which may be attracted to the hospital would use the corridors of US 41, 8th Avenue and Lafayette Avenue.

Emergency Vehicle Access Route

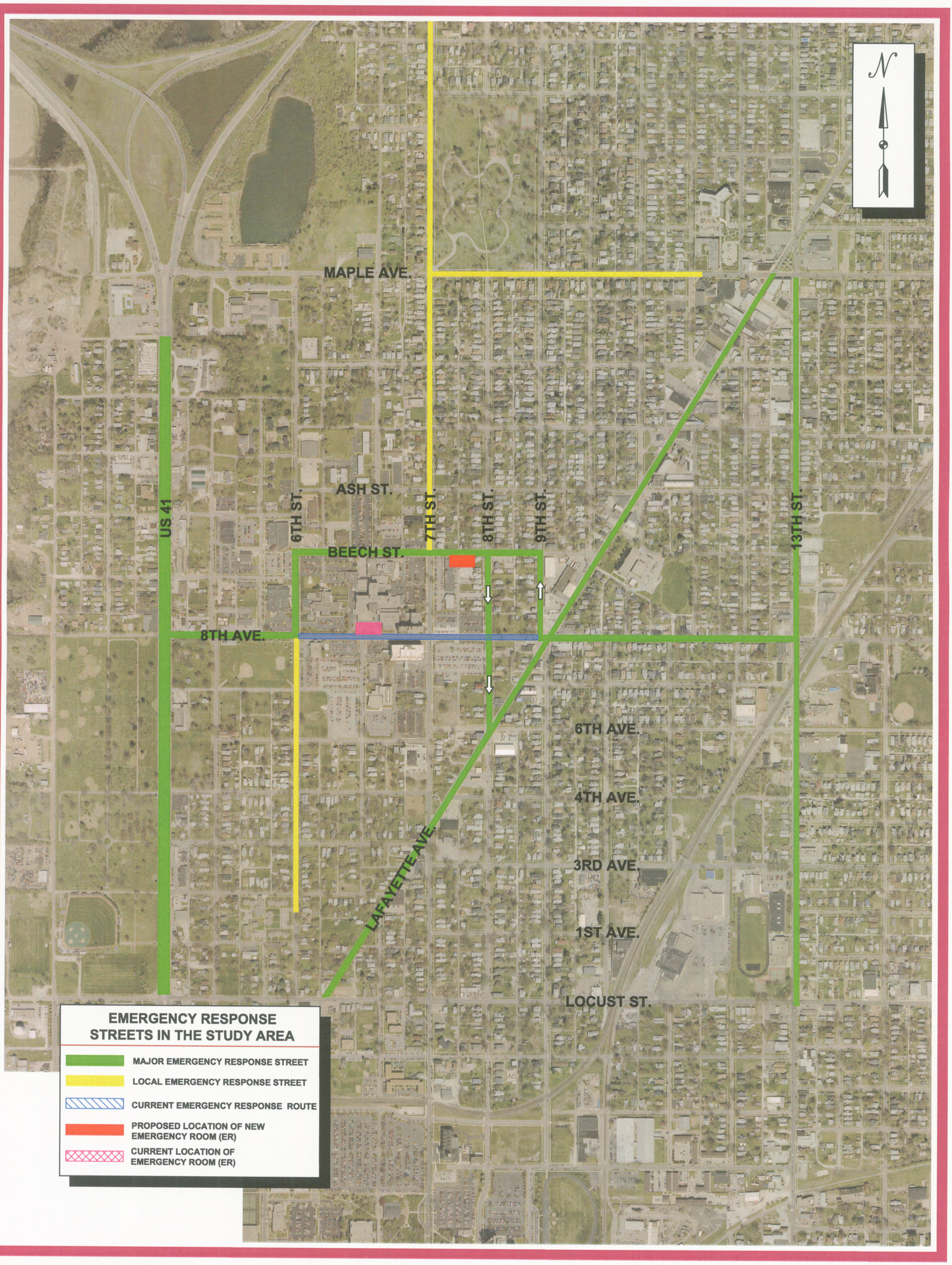
It is important to provide a transportation system that protects both the safety and livability of residential neighborhood and responds to emergency service needs. For this study it was important to provide recommendation on the classifying of city streets in the study area for emergency response in light of the proposed change in the emergency access to Union Hospital.

Currently, the hospital emergency access is located along 8th Avenue at the northeast corner of 8th Avenue and 6½ th Street. The replacement facility's emergency access is planned to be relocated along Beech Street between 7th Street and 8th Street. It was necessary to identify the preferred access route for the hospital ambulances and other emergency vehicles in order to avoid or minimize the conflict of emergency vehicles with residential traffic.

Based on the information obtained from the Terre Haute Fire Department, it was assessed that currently the main routes preferred by emergency vehicles (fire trucks, ambulances or EMS) are US 41, 8th Avenue, Lafayette Avenue and 13th Street. Figure 7 identifies the basic network of the emergency response streets. This map classifies the emergency response streets into two categories: major emergency response streets and local (minor)

emergency response streets. Major emergency response streets are intended to serve primarily the longer, most direct routes of emergency response trips. Local (minor) emergency response streets are designed and operated to provide access to individual neighborhood properties. The network showed basically serves as a recommendation to help route the emergency response vehicles to and from the hospital.

Figure 7 – Emergency Response Street Network in the Study Area



COLLETT PARK NEIGHBORHOOD TRAFFIC STUDY

UNION HOSPTIAL EMERGENCY ACCESS ROUTES

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INTERSECTION OPERATIONS ANALYSIS (CAPACITY ANALYSIS)

The standard used to evaluate traffic operating conditions is referred to as the Level of Service (LOS). This is a qualitative assessment of the quantitative effect of factors such as speed, volume of traffic, geometric features, traffic interruptions, delays, and freedom to maneuver. There are six levels of service (A through F), which relate to driving conditions from best to worst, respectively. The levels of service for signalized intersections are defined in terms of delay ("control delay"), which is a measure of driver discomfort and lost travel time. The levels of service criteria for signalized and unsignalized intersections, as defined in the Highway Capacity Manual (TRB 2000), are provided in Table 1.

In this study, Trafficware's Synchro/SimTraffic software package was used to facilitate the intersection analysis. Synchro performs the capacity analysis for signalized and unsignalized intersections based on the methodology documented in the Highway Capacity Manual. The software output includes the calculations of vehicle delay, LOS, the 50 th percentile and 95 th percentile queue lengths. SimTraffic uses the information provided by Synchro to run a traffic simulation for the street network. This allows for a visual inspection of the operation of each intersection in the study area.

TABLE 1 - LOS CRITERIA FOR SIGNALIZED AND UNSIGNALIZED INTERSECTIONS

LOS	Control Delay Per Vehicle (second)	Control Delay Per Vehicle (second)
	Signalized Intersection	Unsignalized Intersection
A	≤ 10	≤ 10
B	> 10 and ≤ 20	> 10 and ≤ 15
C	> 20 and ≤ 35	> 15 and ≤ 25
D	> 35 and ≤ 55	> 25 and ≤ 35
E	> 55 and ≤ 80	> 35 and ≤ 50
F	> 80	> 50

Four different road network scenarios were considered for Collett Park Neighborhood traffic study. Each scenario was evaluated based on traffic safety and traffic operations criteria:

- ***Scenario 1*** *– Existing Conditions with Existing Lane Configurations*
- ***Scenario 2*** *– Proposed Closure of 7th Street Segment with No Improvements*
- ***Scenario 3*** *– Proposed Closure of 7th Street Segment with Improvements & with No Change in the Existing Direction Street Operations*
- ***Scenario 4*** *– Proposed Closure of 7th Street Segment with Conversion of the 8th Street Segment between Beech Street and 8th Avenue from One-Way into Two-Way Street Operations*

Scenario 1 – Existing Conditions with Existing Lane Configurations

The capacity analysis for the existing scenario was performed for all the study intersections for 2006 AM and PM peak hours. The 2006 AM and PM peak-hour volumes, as well as the existing intersection lane configurations, were used as software input. The results of the capacity analysis showed that all the intersections are currently operating at the desirable LOS "C" or better as per the American Association of State Highway and Transportation Officials (AASHTO guidelines). The summary of the capacity analysis results are provided in Figures 8 and 9 for the AM and PM peak, respectively. The software outputs are provided in Appendix E.

Scenario 2 – Proposed Closure of 7th Street Segment with No Improvements

A capacity analysis was performed for all the study intersections in 2006 AM and PM peak hours. The adjusted AM and PM peak-hour traffic volumes were assigned to each study intersection and then used as the software input. Existing intersection lane configurations were also used as software input. The summary of the capacity analysis results for the Scenario 2 is provided in Figures 10 and 11 for the AM and PM peak, respectively. The software outputs are provided in Appendix F. The results of the capacity analysis showed that all the intersections are currently operating at the desirable LOS "C" or better as per the AASHTO. Operationally, no transportation improvements are warranted in the corridor.

Scenario 3 – Proposed Closure of 7th Street Segment with Improvements & with No Change in the Existing Direction Street Operations

A capacity analysis was performed for all the study intersections in 2006 AM and PM peak hours. The adjusted AM and PM peak-hour traffic volumes were assigned to each study intersection and then used as the software input. The proposed intersection improvements (i.e., modified lane configurations) for this scenario were developed with the following procedure:

1. Assign the adjusted 2006 AM and PM peak-hour traffic volumes to each study intersection
2. Use the existing intersection lane configurations as the "base" intersection lane configurations
3. Evaluate LOS for each intersection
4. If the LOS is worse than a desirable LOS, revise the intersection lane configurations to improve the intersection capacity
5. Repeat steps 3 and 4 until the analysis indicates every intersection will operate at a desirable LOS.

The summary of the capacity analysis results for the Scenario 3 is provided in Figures 12 and 13 for the AM and PM peak, respectively. The software outputs are provided in Appendix G. The results of the capacity analysis showed that all the intersections are currently operating at the desirable LOS "C" or better as per the AASHTO guidelines. No significant improvement would be required at any of the intersections in the study area. Operationally, it would not be necessary to perform any transportation improvements in the corridor; however, it is recommended that minor transportation improvements be conducted along 8th Avenue, Lafayette Avenue, 6th Street, Beech Street and Ash Street because of the anticipated shift in the traffic to these streets with the proposed closure of 7th Street link.

Scenario 4 – Proposed Closure of 7th Street Segment with Conversion of the 8th Street Segment between Beech Street and 8th Avenue from One-Way into Two-way Street Operations

Based on the meeting with the representatives from the neighborhood association and the City of Terre Haute, Scenario 4 was developed, analyzed, and evaluated for this study. Review of the traffic operations analysis for this scenario reveals that the intersections will continue operating at the desirable LOS "C" or better as per the AASHTO

guidelines. However, there are some concerns associated with this option; two of which are addressed below:

- It can be potentially unsafe to convert only a short section of the 1-way street operation into 2-way street operation. It can lead to driver confusion, which could result in property and personal injury crashes.
- Pedestrian-vehicle conflict points increase with the conversion of the 1-way street into 2-way street operations.

The "8th Street Option" (as shown in Appendix B) proposed by Union Hospital was briefly analyzed. Preliminary investigation based on engineering judgment reveals that in terms of roadway geometry and sight distance limitations associated with the option it would not be the most ideal solution. The resulting intersection geometrics would result in some unconventional turning movements for the drivers which can be uncomfortable and potentially unsafe. Further investigation would be required to evaluate the option in detail.

Figure 8 –Capacity Analysis Summary – Scenario 1 AM Peak

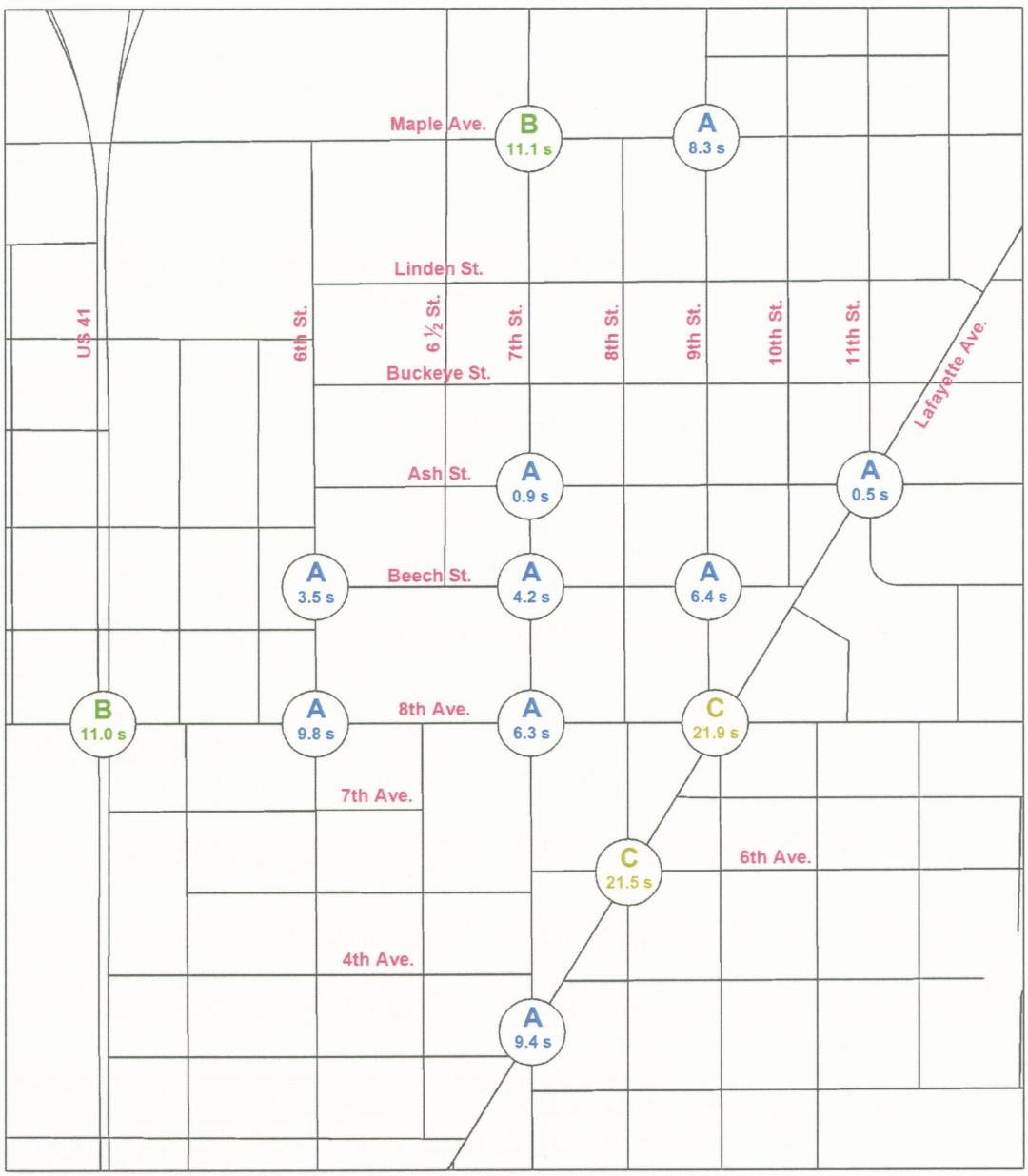


Figure 9 –Capacity Analysis Summary – Scenario 1 PM Peak

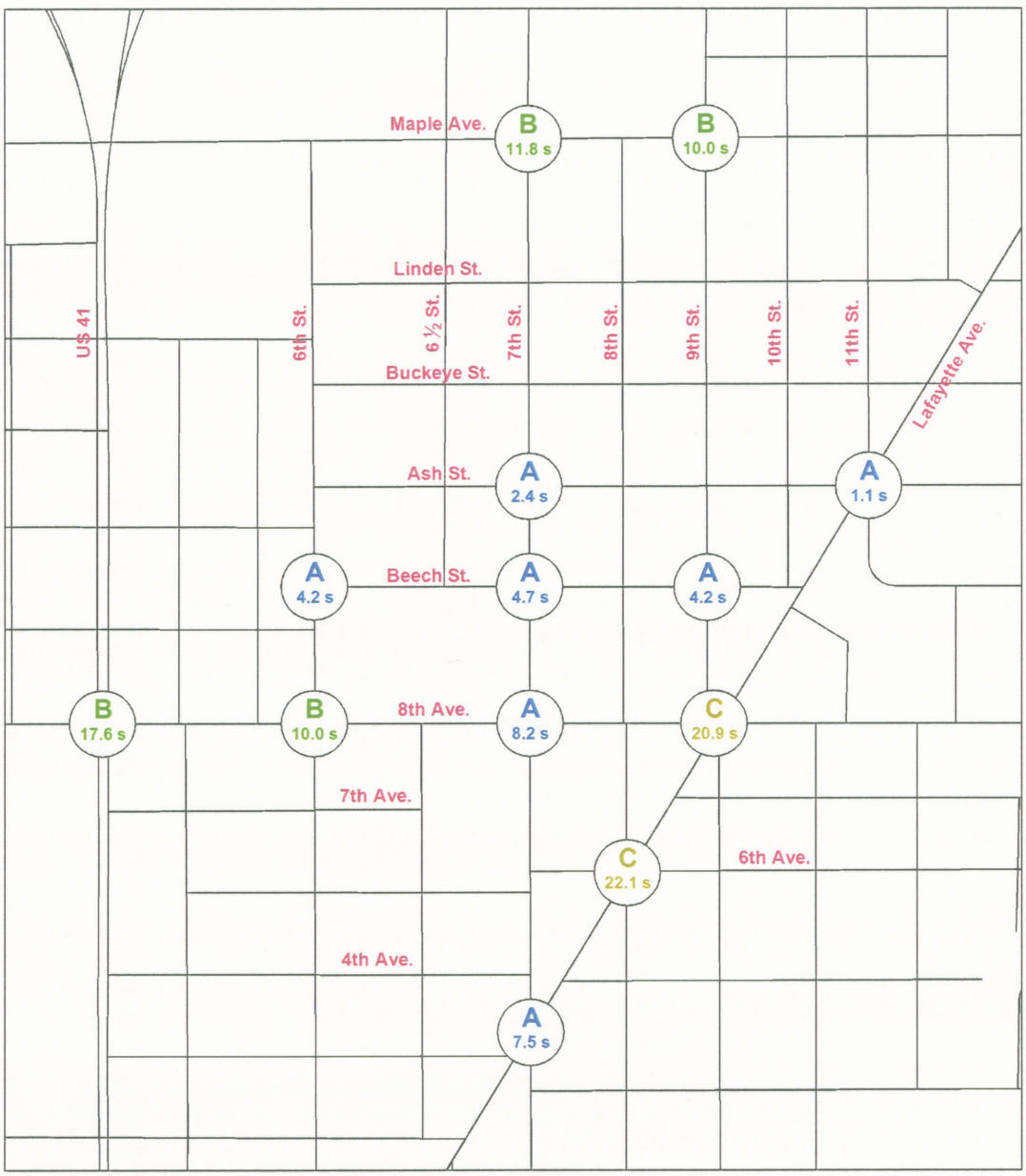


Figure 10 –Capacity Analysis Summary – Scenario 2 AM Peak

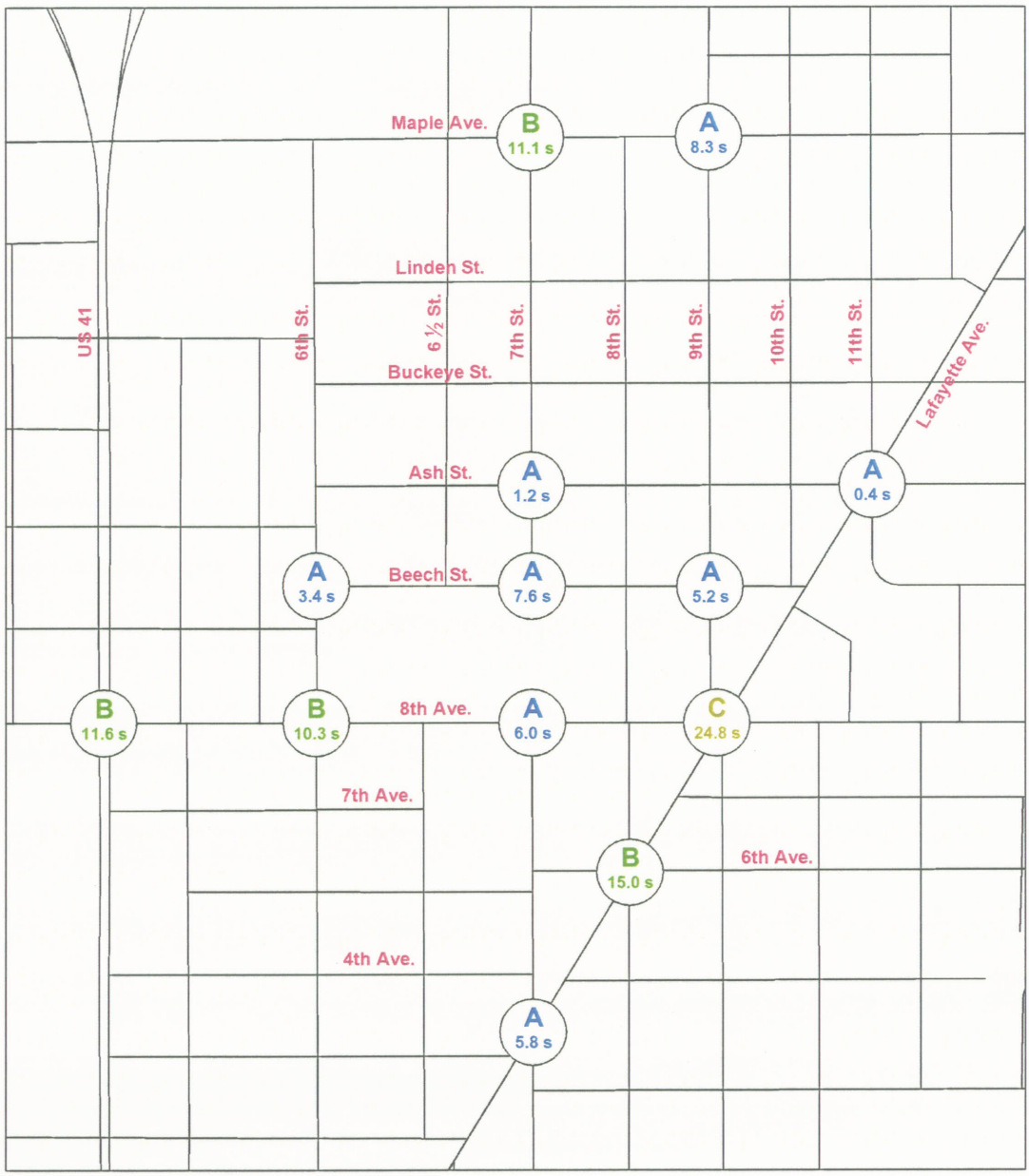


Figure 11 –Capacity Analysis Summary – Scenario 2 PM Peak

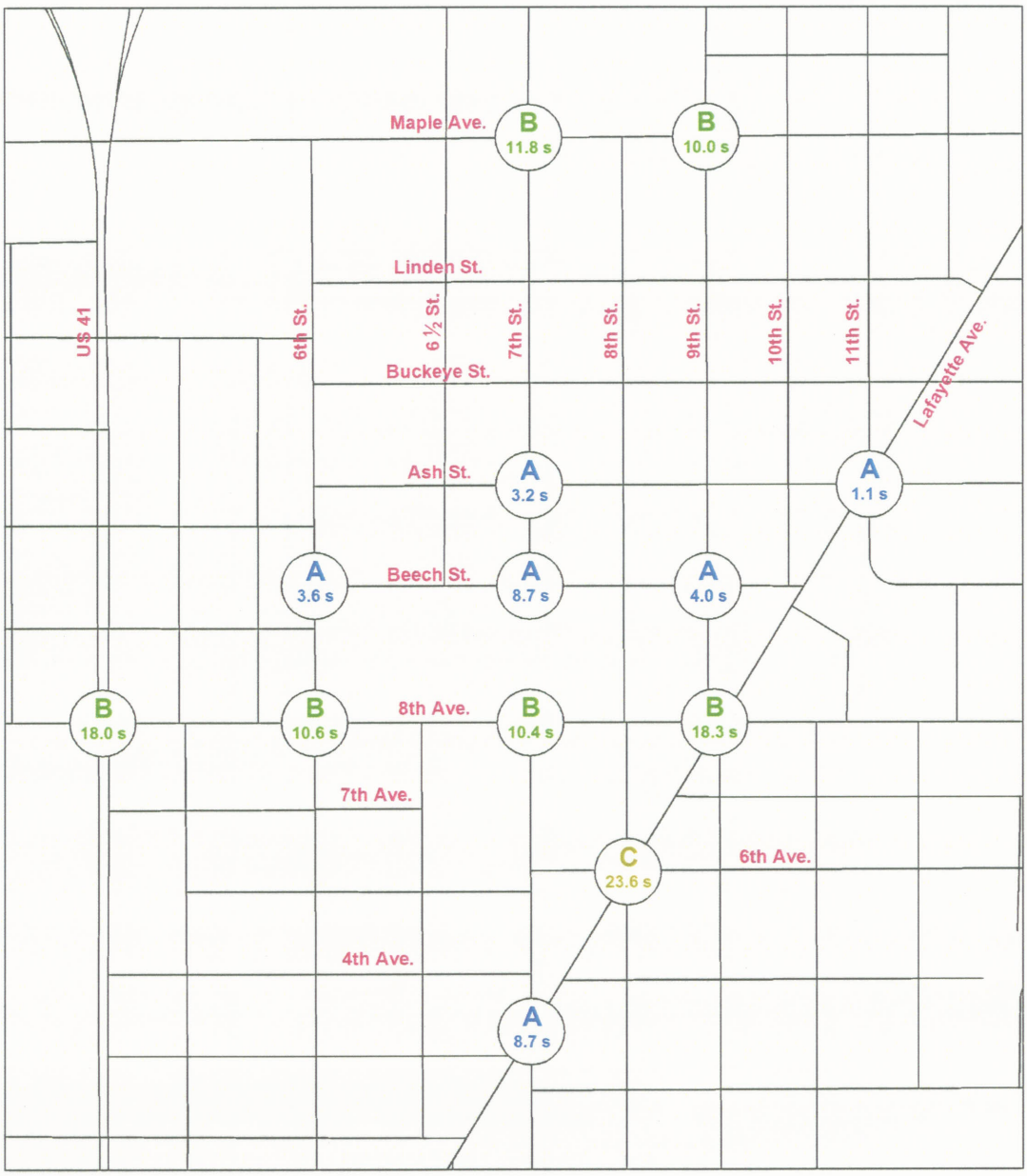


Figure 12 –Capacity Analysis Summary – Scenario 3 AM Peak

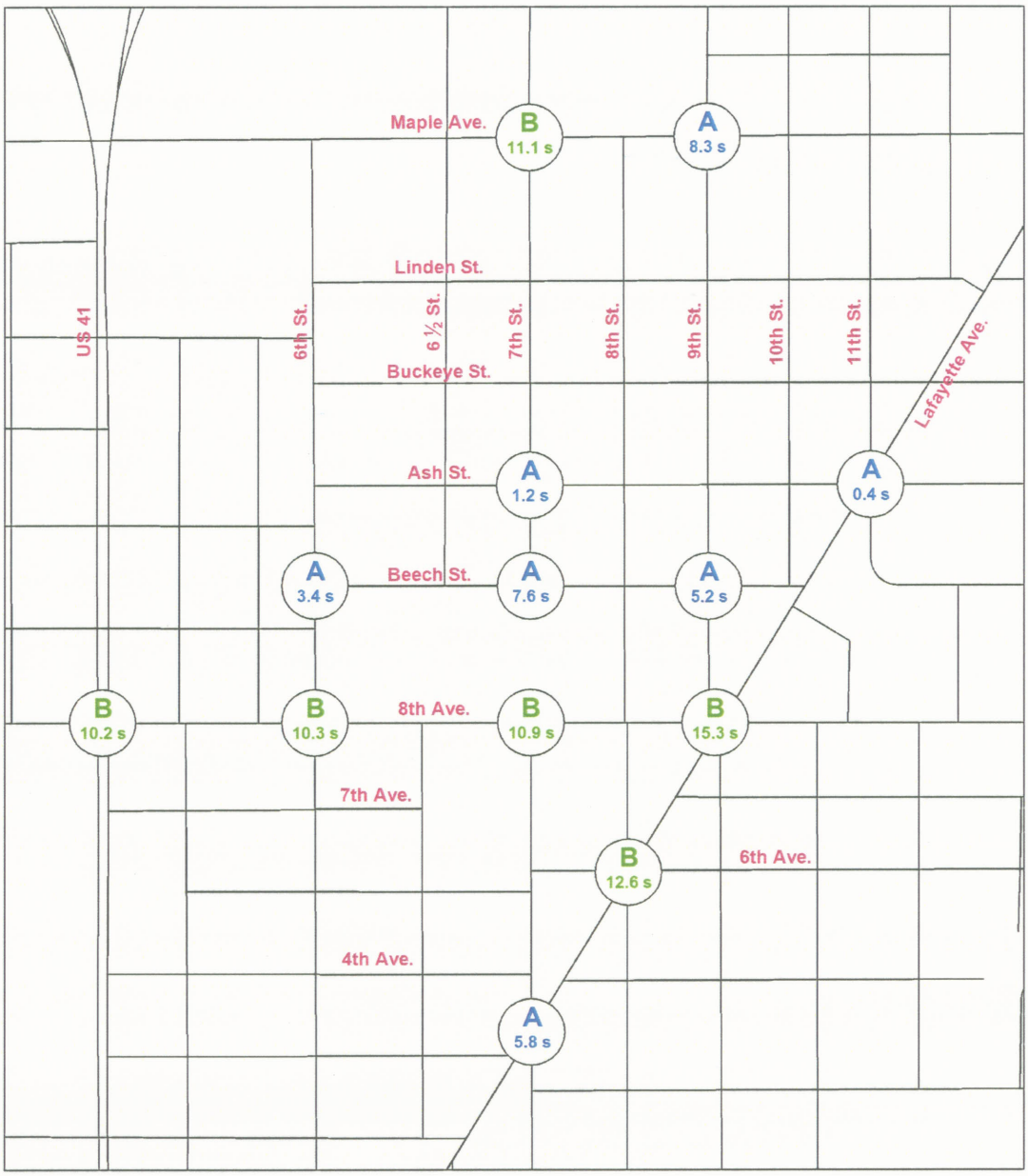
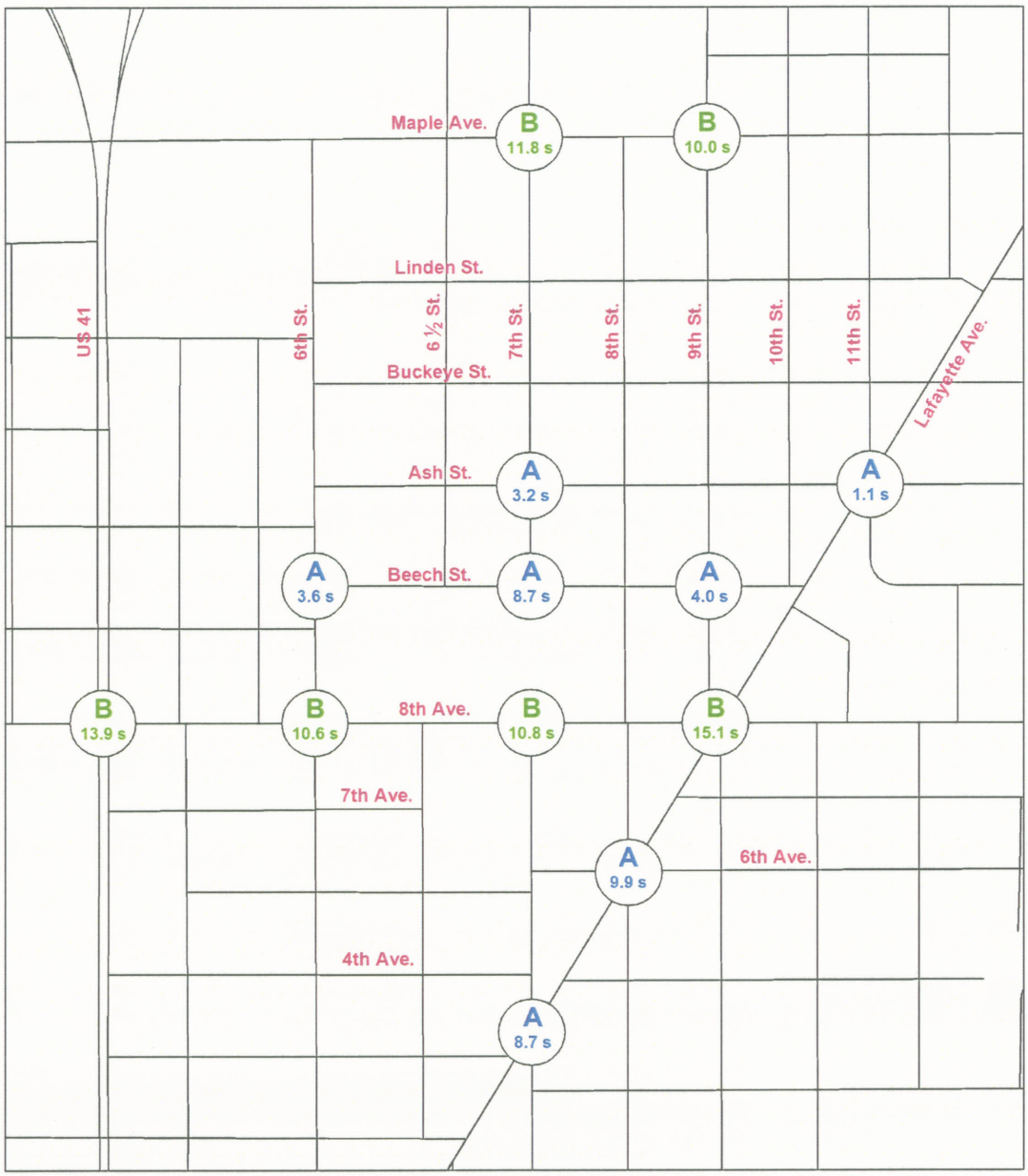


Figure 13 –Capacity Analysis Summary – Scenario 3 PM Peak



CONCLUSIONS AND RECOMMENDATIONS

This study was conducted as an effort to analyze the traffic operations in the City of Terre Haute with the proposed closure of 7th Street link between 8th Avenue and Beech Street with the Union Hospital Replacement plans. It has been shown in this report that the proposed closure of 7th Street link does not warrant any substantial impact on the traffic operations. It has been confirmed that even with the adjustment and redistribution of the traffic in the network, the intersections will continue operating at Level of Service (LOS) "C" or better. Some roadway improvements and intersection improvements will be required along few street segments in the study area. **{ISU traffic counts summary to be added later}**

This report serves as recommendation to the City of Terre Haute and City Council to evaluate the identified impacts and come up with a solution that will help increase the safety, convenience, and comfort of the Collett Park neighborhood community. The recommendations provided are based on engineering assessment and careful review of the suggestions and concerns provided by the 7th Street Traffic Study Sub-Committee of Collett Park Neighborhood Association.

Identified Intersection Improvements

- Provide signal modifications to enhance safety and traffic operations at the intersection of Maple Street and US 41. Current signal indications are perceived as confusing and may be the primary cause for the under utilization of Maple Street by the neighborhood community to commute southbound on US 41. Some intersection improvements are deemed necessary at this intersection. Any improvements involving US 41 would require meeting with INDOT officials to get approval.
- Provide signal modification and roadway improvements at the intersection of US 41 and 8th Avenue to provide easy access to the hospital traffic thus reducing the overall impact of hospital traffic on the local neighborhood street network. The current lane configurations on 8th Avenue can make left turn onto US 41 difficult and creates congestion at the intersection.
- Convert the intersection of 8th Avenue and Lafayette Avenue into a standard roundabout. This will enhance the intersection traffic operations and increase the overall safety as compared to the current unconventional 6-leg signalized intersection.
- Improvements are recommended along several street links in the vicinity of the Union Hospital and Collett Park, including 8th Avenue, 6th Street, Beech Street,

Lafayette Avenue, US 41 and Ash Street. Based on the preliminary findings of this report these segments would need improvements, which can be spot improvement or roadway improvements, yet to be identified in detail at the later stage (See Figure 14).

Alternative Convenient Travel Routes Identified for the Community with the Proposed Closure of 7th Street Link

- Preferred and most desirable alternative route(s) are identified in Figure 5. These route(s) will serve as the most efficient and convenient routes for the community while minimizing any impact on the local neighborhood street network.

Emergency Vehicle Access Routes

- A basic map of the emergency response street route is identified in Figure 7. It is proposed to present this map to the local Fire Department and the EMS services to inform them about the most desirable emergency access route to the hospital. The recommended streets consist of arterial and collector streets in order to minimize the impact on the local residential community streets.
- The recommended major emergency response streets, which consist of US 41, 8th Avenue, Lafayette Avenue, 6th Street and 13th Street, should be used as the primary access to the hospital. 7th Street north of Beech Street is identified as minor emergency response street (local emergency response street), which may be used as an emergency route in case of any emergency within the Collett Park Neighborhood.

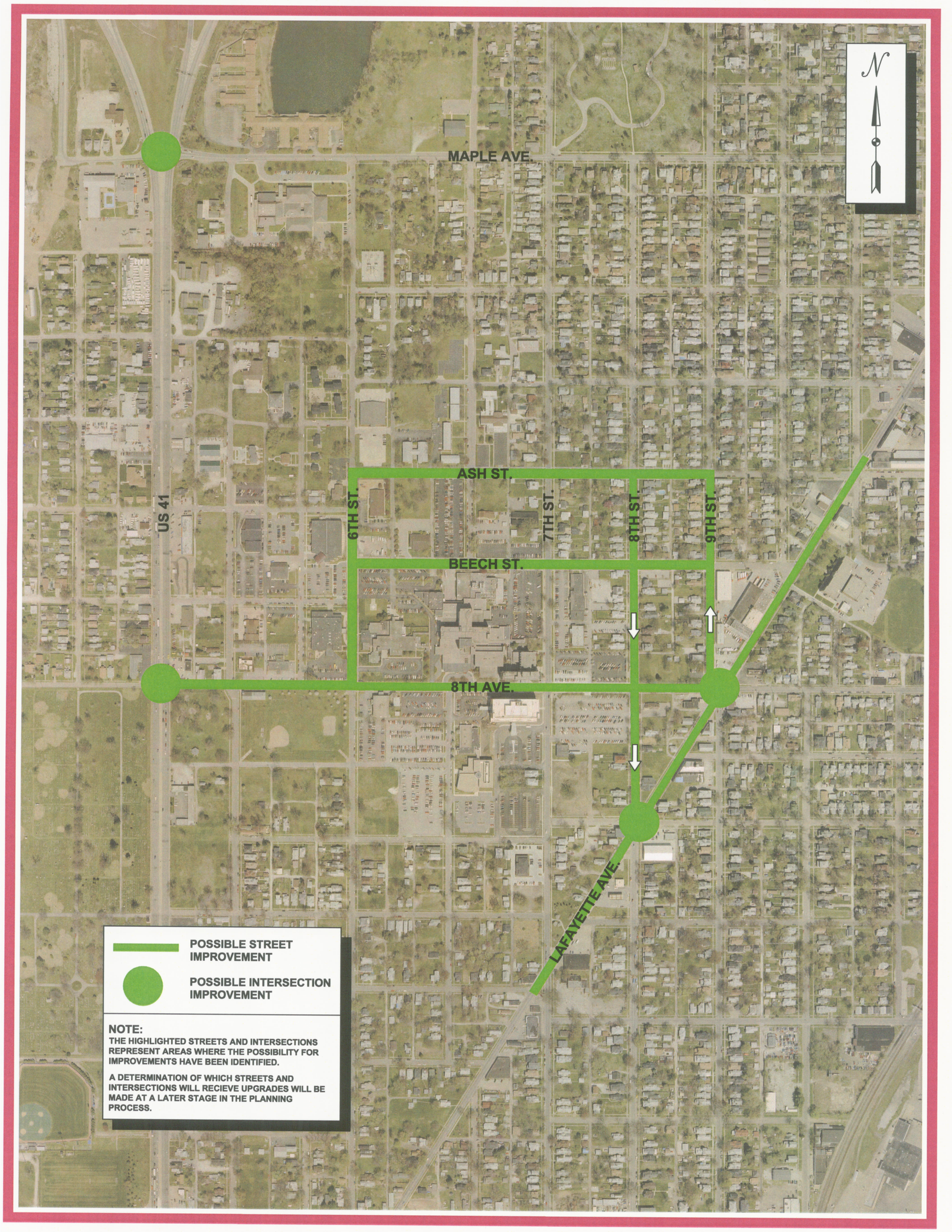
Traffic Calming Options

- Hospital "way finding signs" should be installed along the US 41 and Lafayette Avenue corridors. Sufficient and well-placed "way finding signs" will help separate the hospital traffic from the residential traffic. "Way finding" should be designed such that it guides the hospital traffic to use US 41, 8th Avenue, Lafayette Avenue and 13th Street thus redirecting or preventing their intervention with the residential local street network.
- Install speed tables (i.e., speed humps) as a traffic calming measure at several locations on 8th Street and 9th Street, if necessary.
- Since 7th Street is identified as the minor emergency access route serving the Collett Park emergencies, it would not be appropriate to provide speed tables along 7th Street corridor would hinder the emergence response services.

- Other traffic calming options, such as curb hump-outs, could be considered for use along 7th Street. Depending on the installation locations they may or may not significantly impact on street parking.
- If physical traffic calming measures cannot be installed without significantly impacting the utility of the street for its residents, then consideration should be given to lowering the posted speed limit. If speed control is deemed to be desirable it is not recommended that a reduction in the posted speed limit be done arbitrarily as it would likely have little impact on actual travel speeds, unless enforced often. Rather the City of Terre Haute should evaluate the speed limit posted on 7th Street north of Beech Street by conducting a speed study to determine if a lower speed limit is appropriate. An increase in "speed limit enforcement" and "education measures" may be required.

Roadway improvements identified in this report also provides an opportunity to address concerns provided by the neighborhood community about the neighborhood preservation plan and beautification to the existing local roads and street in the Collett Park Neighborhood and vicinity.

Figure 14 –Identified Segments Requiring Improvements



COLLETT PARK NEIGHBORHOOD TRAFFIC STUDY

POSSIBLE STREET AND INTERSECTION IMPROVEMENTS

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