State of Louisiana

Department of Transportation and Development

Continuous Flow Intersection (CFI) Report

US 61(Airline Highway) @ LA 3246 (Siegen Lane)

District 61

East Baton Rouge Parish

October 2007

FOREWORD

History

Like many intersections in Baton Rouge, Airline Highway at Siegen Lane/ Sherwood Forest Boulevard was plagued with congestion. Even prior to Hurricane Katrina, heavy queues and delay extended for approximately 12 hours of the day. Post-Katrina, things only got worse. Airline at Siegen had been studied for years, and the only potential fix appeared to be a grade-separated interchange. Right-of-way and adjacent property owner impacts, combined with the cost of an overpass made this fix seem impossible. The Continuous Flow Intersection (CFI) concept was introduced by ABMB Engineers as an 'out-of-the-box' alternative to ease congestion at the intersection. One of the biggest supporters of trying this innovative concept was the former Deputy Secretary of LADOTD, Blaise Carrierre. Unfortunately, Mr. Carrierre's premature death occurred shortly after the opening of the CFI in March of 2006. His perseverance in bringing this project through construction helped to overcome many hurdles and obstacles.

CFI Concept

The CFI design centers on the concept of removing the left-turn conflict from the main intersection. This is accomplished by crossing the left-turning traffic and the oncoming through traffic at a signalized left-turn bay placed several hundred feet before the intersection. Traffic from the left-turn bay crosses the opposing traffic and continues down the CFI leg until it reaches the main intersection. This allows through traffic and left-turning traffic to move simultaneously. The net result is that the opposing traffic no longer has to be stopped to accommodate left-turning vehicles, eliminating a signal phase and increasing through traffic movement at the main intersection.

The project initiated with a corridor study performed for the five mile segment of Airline Highway between Florida Boulevard and Jefferson Highway. In the original study, the CFI concept was proposed at four locations along Airline:

- Airline Highway at Goodwood Boulevard
- Airline Highway at Old Hammond Highway
- Airline Highway at Bluebonnet Boulevard / Coursey Boulevard
- Airline Highway at Siegen Lane / Sherwood Forest Boulevard.

This study analyzed the CFI concept at these four locations as an alternative to a six-lane widening project. Study results using VISSIM traffic modeling software showed that implementing a two-legged CFI along Airline at the four locations would reduce travel time along Airline and side street delay at all intersections in the study corridor. As a result of this study, the CFI at Airline and Siegen/ Sherwood was selected as a potential pilot project to determine the actual operational characteristics of the concept as applied to this corridor.

Construction

The Airline at Siegen project was funded through the Congestion Mitigation and Air Quality (CMAQ) program. The project originally went to bid in late 2004. and resulted in only one contractor with a bid amount well over the estimated amount. The overrun was credited to the short construction period that was proposed in order to have the intersection under traffic before the six-laning project began. For the second letting, the short construction period was removed, and the bids came in close to the estimate of $4.4 million. This price included approximately $1 million to construct a frontage road to service business that would have their access from Airline Highway restricted. Construction began in summer of 2005. Traffic was fully maintained throughout the construction. In August 2005, midway through construction, Hurricane Katrina devastated New Orleans, LA and much of the Gulf Coast. As a result, construction at the intersection was halted to work on emergency projects, and overnight, traffic volumes reached

operation for only 16 months, there is not yet enough data available to sufficiently evaluate its safety performance. In order to properly evaluate the safety performance of this CFI, the LADOTD Highway Safety Section recommends a minimum of three years of post crash data. This preliminary report measured accidents for the same time period for three years, and found that accidents were reduced after the opening of the CFI.
March 21, 2002 - August 30, 2003 (pre-CFI) Total Accidents: 185
March 21, 2004 - August 30, 2005 (pre-CFI) Total Accidents: 200
March 21, 2006 - August 30, 2007 (POST-CFI) Total Accidents: 146
This represents a 21% and 27%, respectively, reduction in accidents after the opening of the CFI. Similarly, there was 17% reduction in serious injury accidents.

Impacts on Congestion

The CFI intersection made significant improvement in traffic flow at the intersection for the p.m. peak period, which is the worst congestion period. Travel time was reduced by almost 40% for the heavy direction, and traffic throughput increased by about 10%. For future intersection improvement projects, it is recommended that CFI be compared to other types of improvements to determine the most suitable alternative. Some factors to consider in selecting CFI or another alternative include: access issues and the potential for additional mitigation improvements, mainline left-turn volumes as a percent of the total mainline volumes, mainline total volumes versus side street total volumes, mainline left-turn volumes versus side street left-turn volumes, and comparison of the most desirable traffic legs for CFI implementation versus the most desirable right-of-way legs.

Driver/Business Acceptance

The CFI Task Force conducted a Business and Driver Acceptance Survey for the Continuous Flow Intersection Improvements at Airline Highway and Siegen Lane / Sherwood Forest Boulevard in Baton Rouge, Louisiana. Driver Survey cards were distributed to approximately 3,300 drivers at the CFI approximately one year after its opening. The results indicated that the majority of drivers were pleased with the operation of the intersection since the implementation of the CFI.

- 87% of drivers thought that traffic congestion was better
- 68% of drivers thought that traffic safety was better
- 74% of drivers thought that their travel time had decreased
- 92% of drivers were satisfied with the operation of the CFI

Over 60 adjacent businesses were offered the chance for an interview to determine if they perceived any changes to their business and if so, if the effects were positive or negative. The results indicated that most businesses did not feel that the CFI changes had any affect their business, and for those that did perceive changes, most thought that the changes were positive.

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CFI Safety Report

INTRODUCTION

A partial (two legged) Continuous Flow Intersection (CFI) has been constructed in East Baton Rouge Parish. CFI's are gaining in popularity and are also referred to as crossover-displaced left-turn intersection.

The CFI being studied has been operational since March 21, 2006. The CFI is located at US 61 (Airline Highway) and LA 3246 (Siegen Lane) /Sherwood Forest Boulevard. Prior to construction of the CFI, this location was a four-leg signalized intersection. Each approach consisted of two through lanes, two left-turn lanes and a dedicated right turn lane. There were continuous two-way frontage roads on US 61.

Reducing crashes should always be one of the major objectives whenever the design or operational characteristics of a signalized intersection are modified. As identified by the Federal Highway Administration (FHWA), "The mission is not simply to improve mobility and productivity, but to ensure that improved mobility and productivity come with improved safety."

Due to the limited number of CFIs currently in operation, there is minimal safety performance history available. Also, the collected safety data on CFI in Baton Rouge for Louisiana Department of Transportation and Development (LADOTD) is in the preliminary stages. Since this particular CFI has been in operation for only 16 months, there is not yet enough data available to sufficiently evaluate its safety performance. In order to properly evaluate the safety performance of this CFI, the LADOTD Highway Safety Section recommends a minimum of three years of post crash data. Future evaluations (after March 21, 2009) should include:

- Crash analysis
- Law enforcement input and observation
- Effectiveness of signing and striping
- Field conflict measurements
- Large vehicle maneuverability

CRASH ANALYSIS

A CFI removes the conflict between left-turning vehicles and oncoming traffic by introducing a left-turn bay placed to the left of oncoming traffic. The CFI's design improves efficiency and alleviates congestion by removing the left-turn conflict from the intersection, changing the signal timing, and devoting more time to the green signal. At the Baton Rouge CFI, motorists turning left from Airline Highway complete the turn in a two-step process. First, they are routed into a left-turn bay before the main intersection. When the Sherwood-Siegen cross-traffic light turns green, so does the left-turn bay light, bringing motorists waiting in the bay forward to a second signal. Then, when Sherwood-Siegen cross traffic stops on red and Airline through traffic has a green signal, motorists on Airline complete the left turn.

Improved safety may be experienced by the relocation of the left turn lane and rear-end crashes involving through vehicles may be reduced since stop-and-go conditions occur less often. Other type of crashes should be considered as well. This include serious injury crashes based on type of collision.

Table 1 shows a before and after comparison of reported type of collision at the Airline Highway and Siegen Lane/Sherwood Forest intersection. All crashes are for the time period of March 21through September 20 in each of the respective years. This 18 months time period was selected because of the availability of after project crash data. Crash data on Airline Highway is from Sherwood Common to LA 73 and on Sherwood Forest from March 21, 2006 through September 20, 2007, with two-18 months before periods and one-18 months after period.

Table1. Before and After Crash Data

Type of Collision	Four-Leg Signalized March 21-September 20 2002/2003			2004/2005			CFI March 21-September 20 2006/2007		
	Serious Injuries	PDO	Total	Serious Injuries	PDO	Total	Serious Injuries	PDO	Total
Rear End	18	68	86	33	75	108	21	63	84
Merging/Diverging/Side Swiping	4	21	25	4	34	38	1	22	23
Crossing(Left Turn)	7	9	16	3	5	8	6	2	8
Crossing (angle)	2	9	11	0	4	4	1	5	6
Right Angle	17	27	44	8	31	39	10	13	23
Right Turn	0	3	3	0	3	3	1	1	2
Total	48	137	185	48	152	200	40	106	146

There were no head-on collisions reported in any given year and there were no fatalities.

Figure 1a, figure 1b, and figure 1c illustrate the number of total crashes, serious injury, and property damage only crashes. These crashes are based on type of collision.

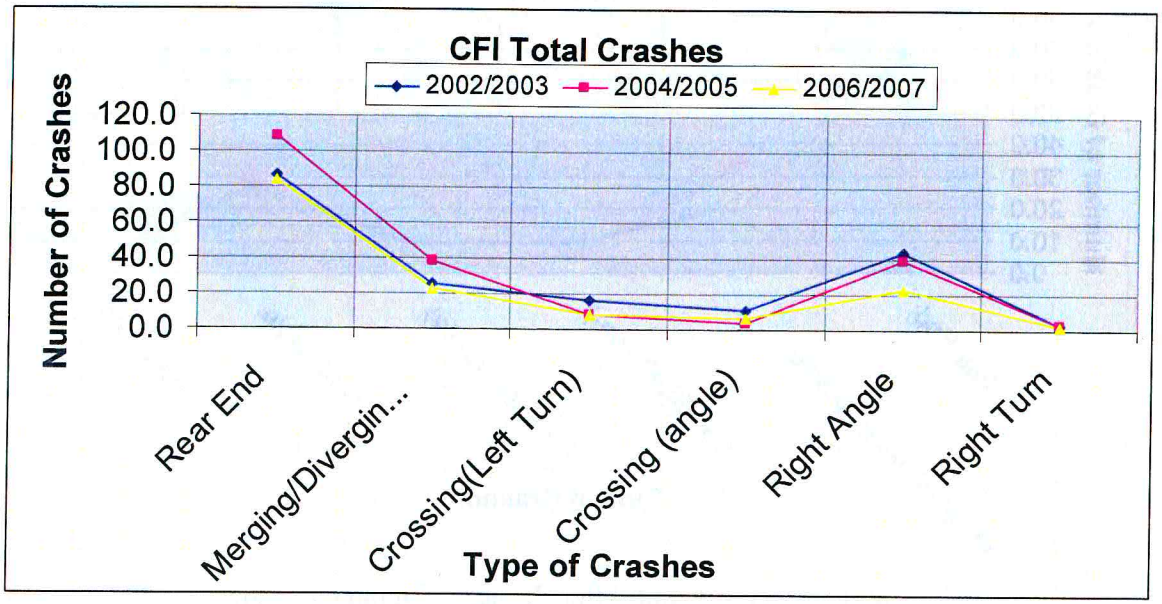

Figure 1a Before and After Total Crashes

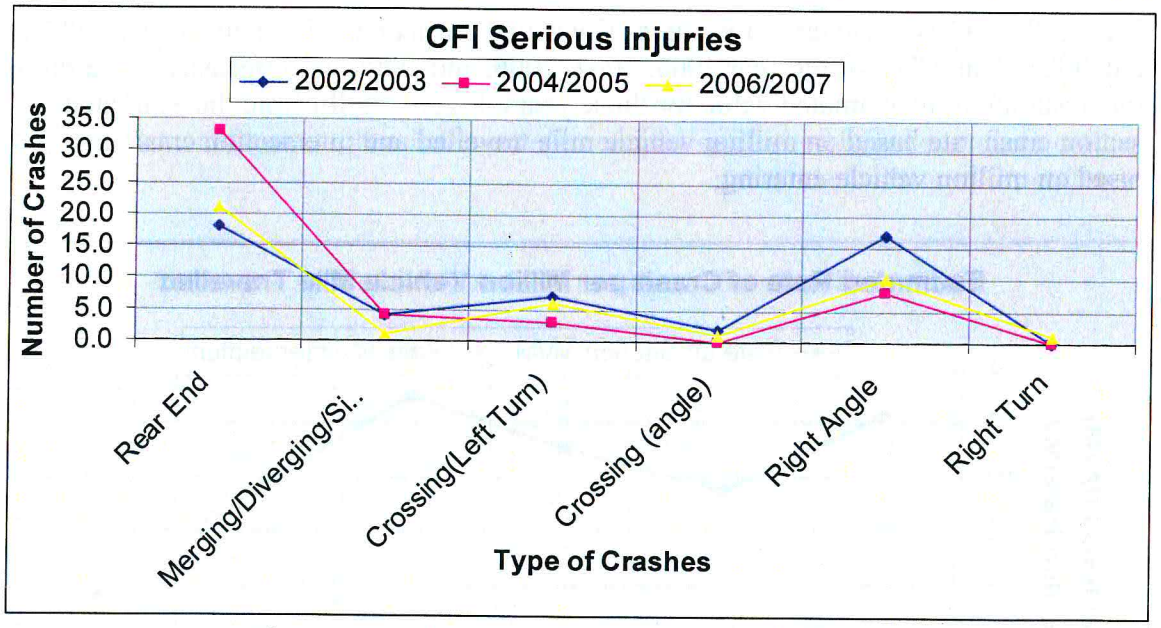

Figure 1b Before and After Serious Injury Crashes

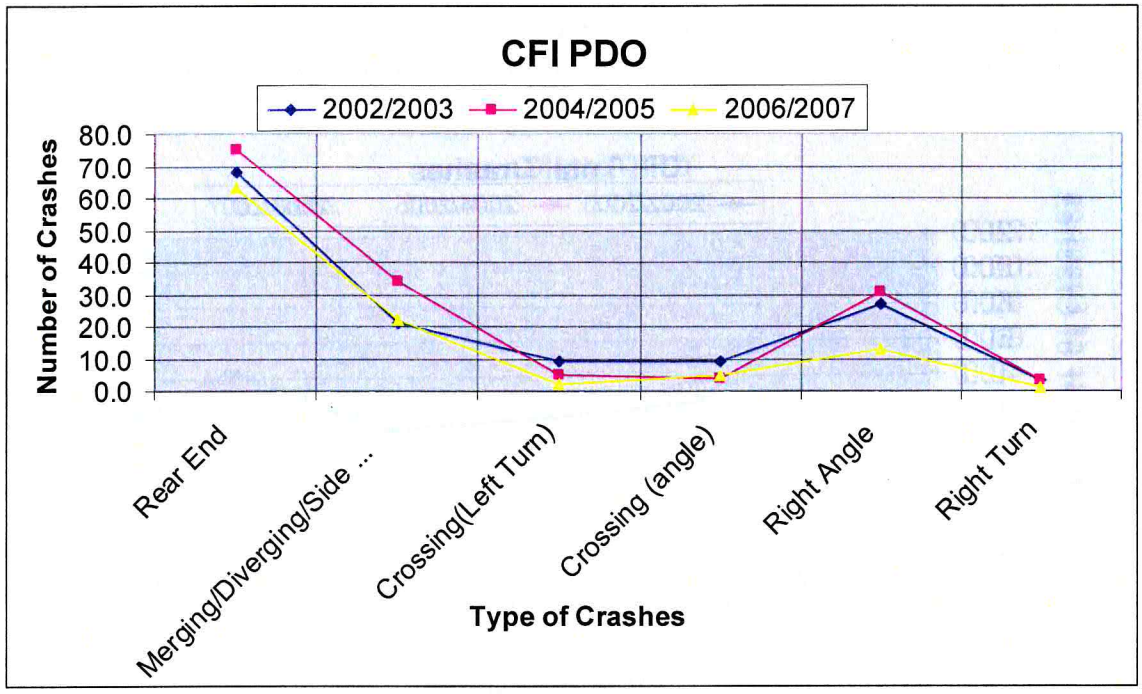

Figure 1c Before and After Property Damage Crashes

The ADT is measured every three years. The actual measured ADT is from year 2002 and 2005. The ADT for the year 2003, 2004, 2006, and 2007 was forecasted. Therefore, the crash rate is an estimated value for those years. Figure 1d illustrate the estimated section crash rate based on million vehicle mile travelled and intersection crash rate based on million vehicle entering.

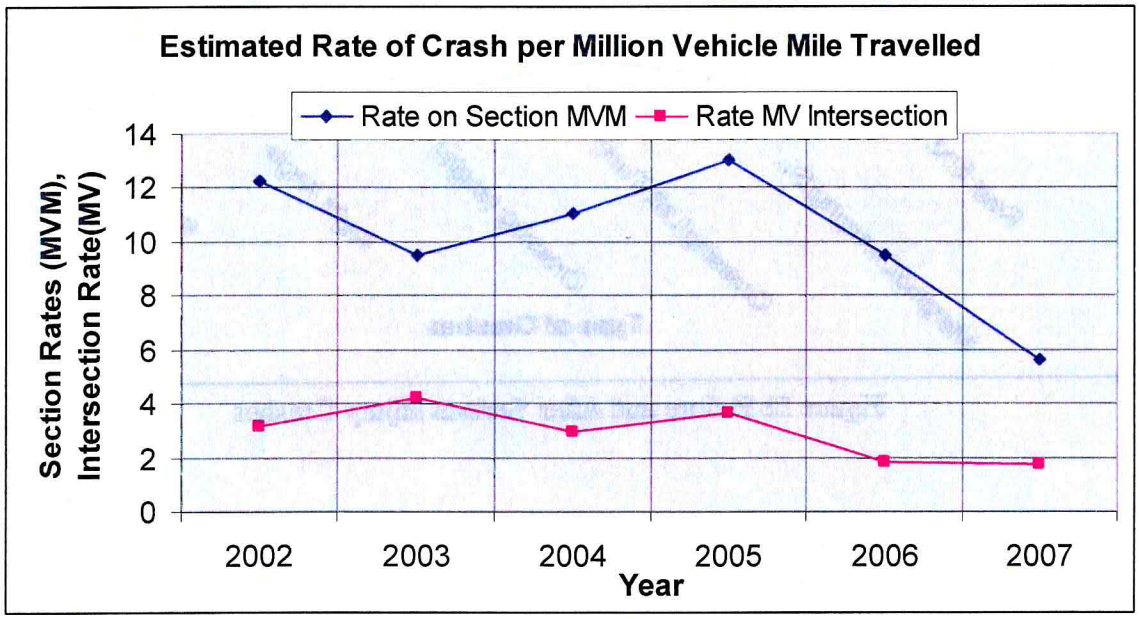

Figure 1d Crash Rate based on estimated ADT

Based on the limited data available for analysis, it is difficult to evaluate the safety performance evaluation of the CFI. As data becomes available additional analyses will be conducted to determine the safety performance of the CFI.

LAW ENFORCEMENT INPUT AND OBSERVATION

The Louisiana State Police (LSP) is the law enforcement agency that investigates the crashes that occur at the intersection of Airline Highway and Siegen Lane/Sherwood Forest Boulevard. The LSP has been requested to provide input based upon their observations regarding the operation of the CFI.

According to LSP, it appears that traffic congestion has been reduced in the area of the CFI particularly during peak hours. In the 18 months that the CFI has been operating, there does not appear to be an increase in the number or severity of crashes in the study area. According to the LSP, they have not investigated any head-on or fatal crashes resulting from drivers traveling the wrong way on the crossovers. The LSP also believes a longer time frame for collecting crash data is needed before the safety performance of the CFI can be determined.

All traffic signals have a backup power system consisting of batteries and a natural gas generator. The purpose of this system is to provide backup emergency power to the CFI traffic signals in the event of power failure. In the event that the backup power system fails, the number of the law enforcement personnel needed to control the traffic will be six to eight. This includes blocking the crossovers with barricades and treating the intersection as a traditional four-leg intersection with left turns in all four directions. Another approach would be to prohibit left turns in all directions resulting in the need for less law enforcement personnel.

EFFECTIVENESS OF SIGNING AND STRIPING

The signing and striping is in excellent condition providing for an intersection that is well marked for the drivers. The overhead signs are properly placed and provide positive guidance for vehicles maneuvering through the intersection. Motorists appear to understand the signing and striping resulting in good compliance

There are no documented crashes where the cause was due to lack of traffic control devices.

FIELD CONFLICT MEASUREMENT

There is not enough data available for the evaluation at this time.

LARGE VEHICLES MANEUVERABILTY

Large vehicle maneuverability does not seem to be a problem since there haven't been any reported crashes or incidents involving large commercial vehicles.

Business and Driver Acceptance Survey

Executive Summary

The CFI Task Force conducted a Business and Driver Acceptance Survey for the Continuous Flow Intersection Improvements at Airline Highway and Siegen Lane / Sherwood Forest Boulevard in Baton Rouge, Louisiana. The surveys were conducted as part of a Task Force evaluation of the operations of the CFI. They were used to determine how the driving public and the adjacent business owners view the operations of the intersection before and after the roadway changes.

The perception before the opening of the CFI seemed to indicate that some adjacent businesses felt that they would be negatively impacted by the design, and that drivers would be confused and possibly make non-compliant movements in the intersection. After the intersection opened, there was no backlash from the public, which signified that most were content with the operation. Two of the most concerned businesses have subsequently publicly stated their happiness with the end result. The survey was conducted to test how the public perceived the intersection.

Driver Survey cards were distributed to approximately 3,300 drivers at the CFI approximately one year after its opening. The results indicated that the majority of drivers were pleased with the operation of the intersection since the implementation of the CFI.

- 87% of drivers thought that traffic congestion was better
- 68% of drivers thought that traffic safety was better
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Over 60 adjacent businesses were offered the chance for an interview to determine if they perceived any changes to their business and if so, if the effects were positive or negative. The results indicated that most businesses did not feel that the CFI changes had any affect their business, and for those that did perceive changes, most thought that the changes were positive.

Introduction

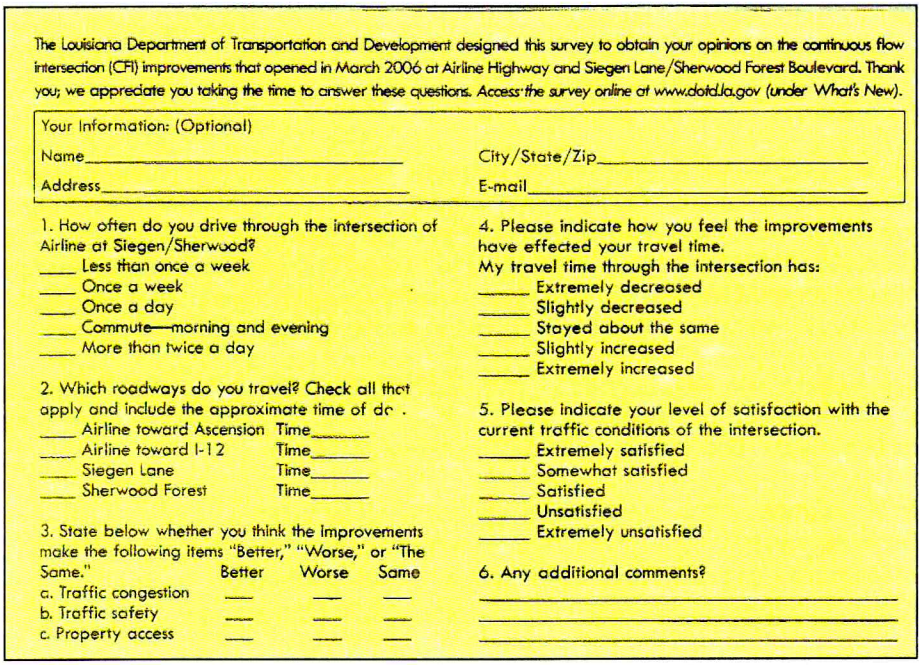
The purpose of roadway improvements is to efficiently and effectively use available funds to improve streets, reduce congestion and increase safety. Critical to the success of any project is approval from the driving public. For the Continuous Flow Intersection (CFI) implementation at Airline and Siegen/Sherwood, public opinion was considered especially important since the concept is relatively untested in the United States, and considered by many in the engineering community to be unconventional.

The Louisiana Department of Transportation and Development (LADOTD) conducted a large-scale public outreach effort for the project prior to construction. A series of public meetings, neighborhood association meetings, stakeholders meetings and adjacent business owners meetings were held to acquire the opinions, concerns and suggestions of those most affected by the project. Several viable ideas resulted from these meetings and were included in the project including a frontage road servicing southbound vehicles on Airline Highway and a median u-turn along Airline prior to the intersection.

Since the opening of the CFI on March 21, 2006, there has been wide-spread media attention, and word-of-mouth comments on the traffic operations of the new design. A Task Force was assembled to report on operations of the CFI, and as part of that effort, an official survey was designed and conducted to quantify user opinion of the CFI. The survey was conducted in two parts: 1.) a driver survey 2.) an adjacent business owner survey.

Driver survey

The driver survey consisted of 5 questions, and an option for additional comments. The questions were designed to determine how the driver perceived the operation of the CFI, as well as determine statistical data such as frequency of use and direction traveled, to uncover patterns. The survey questions were printed on postcards with prepaid postage, allowing the recipient to return the survey at no cost. Figure 1 shows the survey card.



The Louisiana Department of Transportation and Development designed this survey to obtain your opinions on the continuous flow intersection (CFI) improvements that opened in March 2006 at Airline Highway and Siegen Lane/Sherwood Forest Boulevard. Thank you; we appreciate you taking the time to answer these questions. Access the survey online at www.dotd.la.gov (under What's New).

Your Information: (Optional)

Name_____ City/State/Zip_____

Address_____ E-mail_____

1. How often do you drive through the intersection of Airline at Siegen/Sherwood?
____ Less than once a week
____ Once a week
____ Once a day
____ Commute—morning and evening
____ More than twice a day

2. Which roadways do you travel? Check all that apply and include the approximate time of dc .
____ Airline toward Ascension Time_____
____ Airline toward I-12 Time_____
____ Siegen Lane Time_____
____ Sherwood Forest Time_____

3. State below whether you think the improvements make the following items "Better," "Worse," or "The Same."

	Better	Worse	Same
a. Traffic congestion	___	___	___
b. Traffic safety	___	___	___
c. Property access	___	___	___

4. Please indicate how you feel the improvements have effected your travel time.
My travel time through the intersection has:
_____ Extremely decreased
_____ Slightly decreased
_____ Stayed about the same
_____ Slightly increased
_____ Extremely increased

5. Please indicate your level of satisfaction with the current traffic conditions of the intersection.
_____ Extremely satisfied
_____ Somewhat satisfied
_____ Satisfied
_____ Unsatisfied
_____ Extremely unsatisfied

6. Any additional comments?
_____
_____
_____

Figure 1, Driver Survey Card

Driver surveys were distributed in the a.m. and p.m. peak hours of commuter traffic on Airline Highway on March 21 and 22, 2007. Surveys were handed out randomly to vehicles stopped at the intersection when the traffic signal was red. Approximately 3,300 surveys were distributed over a two day period. Remaining surveys were given to adjacent businesses to be distributed to employees and customers. In addition, the survey directed drivers to the LADOTD website where the same questions could be answered online. To date, over 400 driver survey cards (approximately 12% of what was distributed) have been received in the mail, and 89 surveys were completed on the website. Results of the survey were complied, and representative data is shown below. A complete list of survey results are found in the appendix.

Table 1, Question 3a: State below whether you think the improvements make TRAFFIC CONGESTION Better, Worse, or the Same

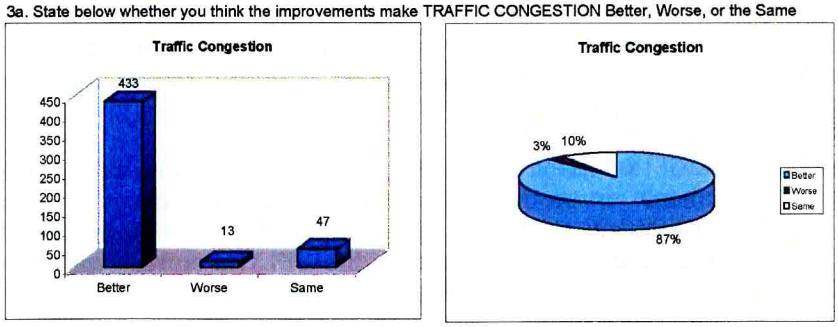
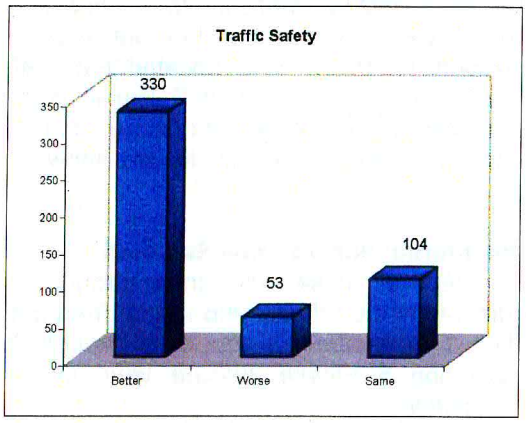


Table 2, Question 3b: State below whether you think the improvements make TRAFFIC SAFETY Better, Worse, or the Same

3b. State below whether you think the improvements make TRAFFIC SAFETY Better, Worse, or the Same



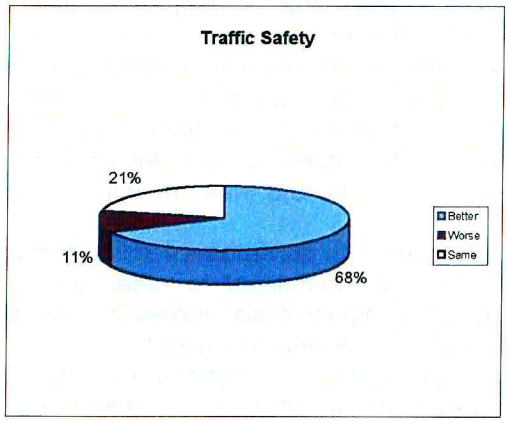


Table 3, Question 4. Please indicate how you feel the improvements have effected your travel time. My travel time through the intersection has:

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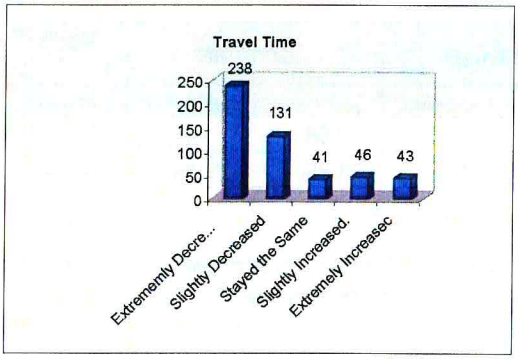


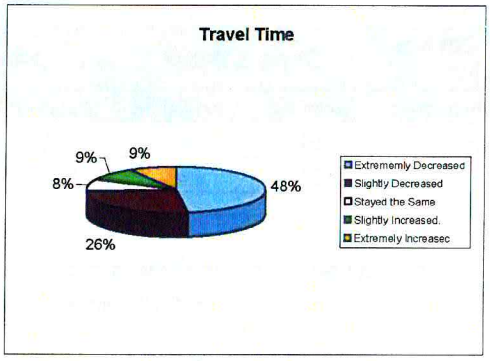
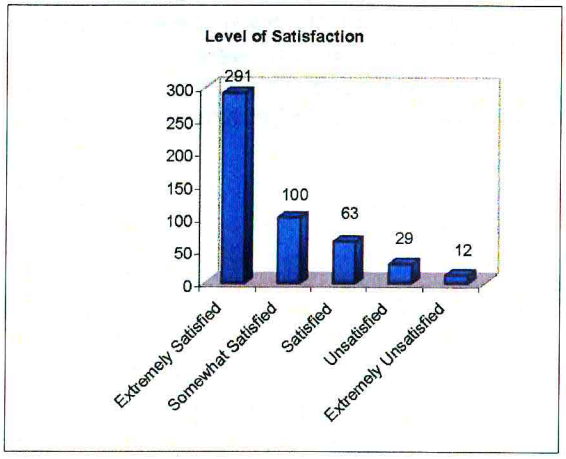
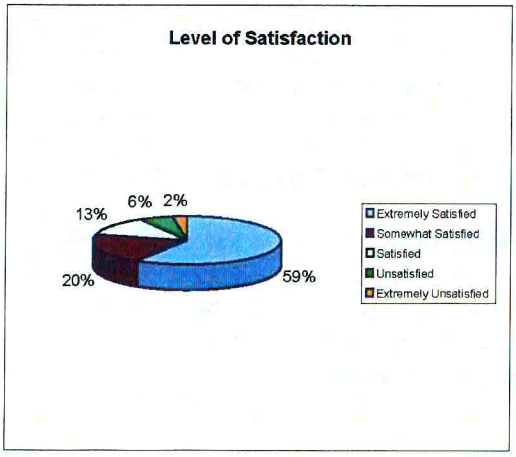


Table 4, Question 5. Please indicate your level of satisfaction with the current traffic conditions of the intersection.

5. Please indicate your level of satisfaction with the current traffic conditions of the intersection.





The results overall indicated that the public views the CFI project positively. Other analyses were conducted testing the following criteria.

1. **Anomalies** (This comparison was completed for mailed cards only and does not included website results)

There was a concern that wording in question 4 may have mislead participants to choose an answer which they did not intend. Of the 37 participants who indicated that they believed that their travel time had "Extremely Increased," 29 of those participants (or 78%) indicated that Traffic Congestion was "Better" (question 3a) as well as "Extremely Satisfied" (question 5). Based on this analysis, there is reason to assume that the data is misrepresentative, and some of these participants did not intend to mark the conflicting answer. However, data results are shown as they were on the cards, and were not adjusted.

2. How often the participants drive through the intersection vs. How Satisfied

This analysis was completed to determine if commuters or those who drive through the intersection on a regular basis viewed the operation differently than those who do not frequently travel through it. This analysis was based on Question 1 *How often do you drive through the intersection of Airline at Siegen/Sherwood?* and Question 5 *Please indicate your level of satisfaction with the current traffic conditions of the intersection.*

The results are show below. A "Satisfied" driver is a participant who indicated that they were either "Extremely Satisfied," "Somewhat Satisfied", or "Satisfied" with the operation.

Table 5, How Often Driven Vs. Satisfied

Less than Once a Week		Once a Week		Once a Day		Commute		More Than Twice a Day	
Satisfied	Unsatisfied	Satisfied	Unsatisfied	Satisfied	Unsatisfied	Satisfied	Unsatisfied	Satisfied	Unsatisfied
21	0	54	4	71	1	158	19	72	11
100%	0%	93%	7%	99%	1%	89%	11%	87%	13%

The results of this analyses did not show a significant trend, but seem to somewhat indicate that the participants who drove the intersection less frequently were more satisfied.

3. Direction Traveled vs. Travel Time

This analysis tested how drivers on particular approaches perceived the change in their travel time since the opening of the CFI. This analysis measured Question 2 *Which roadways do you travel. Check all that apply and include approximate time of day* and Question 4. *Please indicate how you feel the improvements have effected your travel time. My travel time through the intersection has.* Question 2 often had more than one answer, and all were included in the analysis. Answers to Question 4 were assigned a value and averaged: 1= Extremely Decreased; 2= Slightly Decreased; 3=Stayed the Same; 4=Slightly Increased and 5=Extremely Increased.

Table 6, Direction Traveled vs. Travel Time

Approach	Weighted Score
Airline Northbound	2.12
Airline Southbound	1.96
Siegen Eastbound	1.94
Sherwood Westbound	2.09

The results did not show a significant pattern among the approaches.

The 5 multiple choice questions on the driver survey where followed by a question 6, which was the option for additional comments. Of the cards received, over 50% gave additional comments. All survey comments are found in the appendix. In general, the ratio of positive comments to negative generally mirrored the responses to the direct questions.

Business survey

Approximately 60 adjacent businesses owners/managers from all quadrants of the intersection were invited to participate in the business survey. Representatives for the companies were given the option of a face-to-face interview, phone interview, or a faxed copy of the questions for them to fill out. The survey contained 31 questions and the purpose was to determine how the representatives viewed the CFI, and if they had perceived any changes in their business operations (either positive or negative) as a result of the CFI implementation. To date, 11 companies have participated in the survey, representing approximately 20% of the businesses that were invited. Copy of Business Survey is in the appendix. A summary of the results is presented below.

Survey results are shown below.

Table 7: Question 1. What is your overall view of the Continuous Flow Intersection operations at Airline and Siegen / Sherwood?

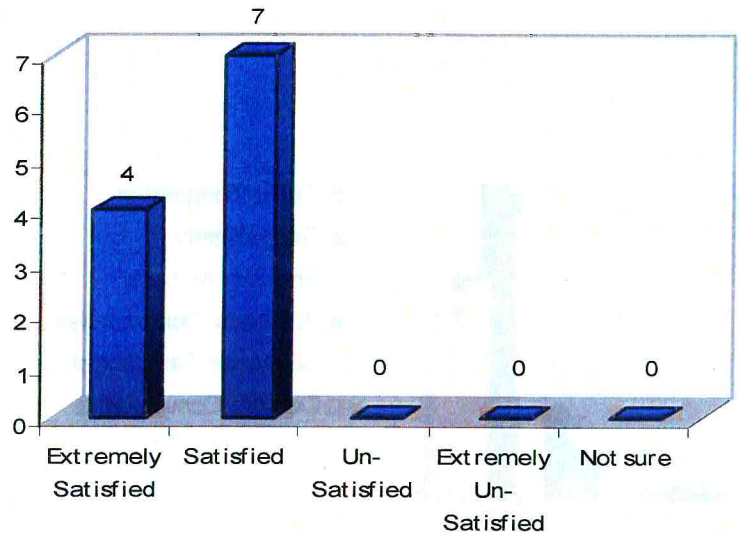


Table 8: Question 18. How has the CFI construction affected regular and non-regular customers? Have their patronizing patterns remained about the same, are more likely, or have been less likely to visit your business?

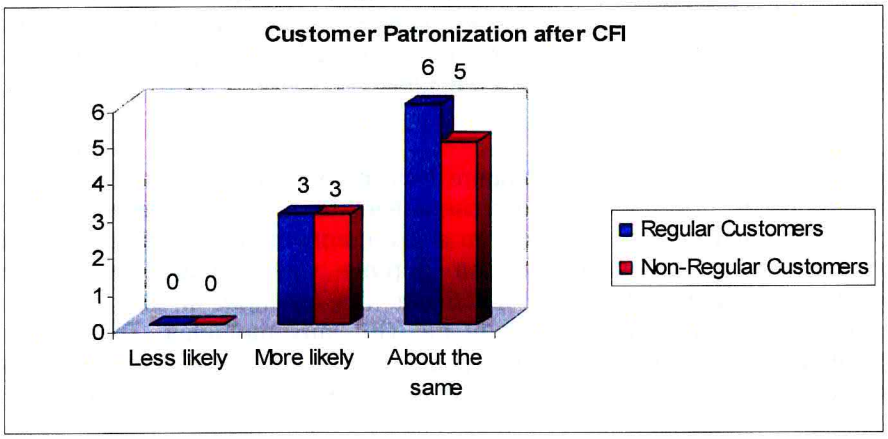
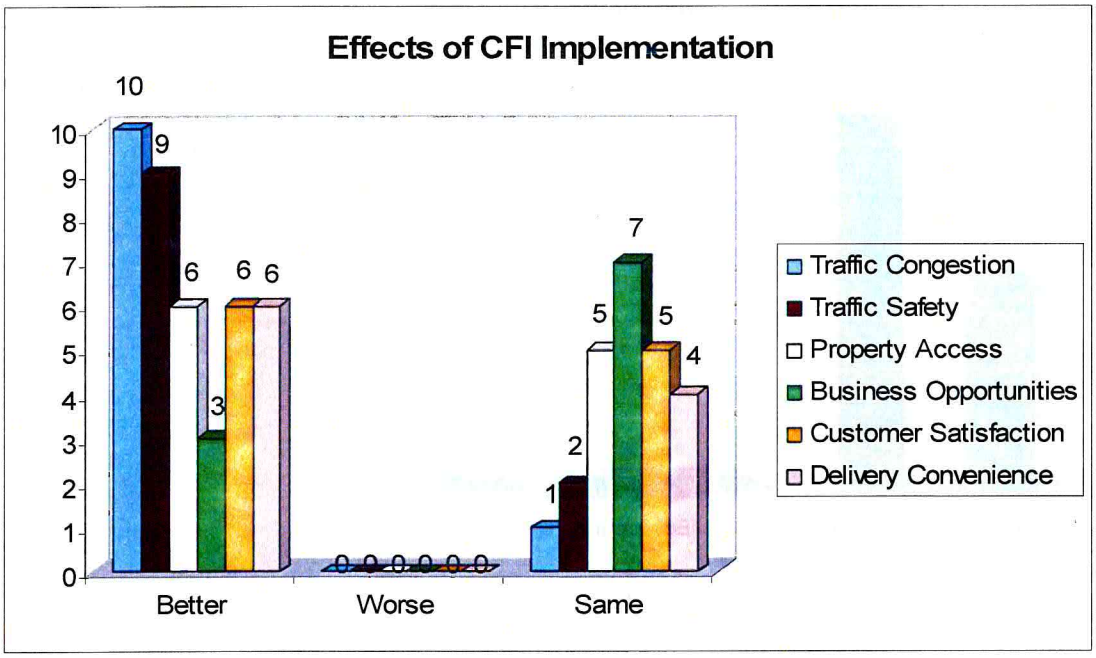


Table 9: Question 28. Please indicate whether you believe the CFI implementation has made the following items "Better," "Worse," or about "The Same."



The results of the survey indicate that for the most part, business owners/managers did not feel that the CFI significantly impacted their business. Those who did report an effect generally thought that the changes were positive.

Conclusions

Based on the results of the surveys, the majority of drivers and adjacent business owners view the CFI as a positive change. The majority of drivers are pleased with the operation and feels that their travel time has improved. The majority business owners who chose to participate in the survey were pleased with the operation of the CFI, but did not feel that the changes had a significant impact on their business operations. Most business owners that did perceive a change in business thought that the change was positive.

Location and CFI Design Development

The Louisiana Department of Transportation and Development opened its first continuous flow intersection (CFI) in the city of Baton Rouge on March 21, 2006. It is located at the US 61 (Airline Highway) and Siegen Lane / Sherwood Forest Boulevard intersection. The two legged CFI was constructed along US 61 where there was 200 feet of existing right of way. The CFI design was approached on the basis that new right of way would not be acquired.

Prior to construction of the CFI, US 61 in this area was a divided four lane roadway with continuous 10-foot outside shoulders and continuous two-way frontage roads on both sides of US 61 north of the Siegen Lane / Sherwood Forest Boulevard intersection. The two-way frontage road on the east side of US 61 continued south of the intersection for a short distance.

During the development of the conceptual layout, it became apparent that certain concessions would have to be made to ensure that both the CFI intersection and a new two way frontage road, needed for business access, could be successfully fit within existing right of way. It was decided that concessions would be made on the new lower speed frontage road instead of on the higher speed 50 mph US highway.

These concessions involved limited outer separation distance for the new frontage road, inability to U-turn larger trucks onto the new frontage road, reducing the new two-way frontage road to one-way at the Siegen Lane intersection, reducing the distance between the main CFI intersection and new frontage road intersection along Siegen Lane, and several revisions to existing frontage roads.

Design elements for the main CFI intersection were not reduced. A 43-foot wide median width was used so a fairly consistent median width would be maintained throughout the project area. Eight foot wide shoulders were also provided along US 61 through the CFI intersection to maintain shoulder continuity and to provide refuge for stalled vehicles.

The wide median permitted displaced left turning vehicles to be offset approximately 20 feet from approaching through vehicles. The wider median also greatly improved the angle of crossing for displaced left turn vehicles thus resulting in a smaller median opening, a decreased possibility that through drivers would enter the displaced left turn lanes the wrong way, and a reduced crossing time.

A reverse curve alignment (with tangent between horizontal curves) was used to transition displaced left turning traffic across the opposing US 61 through lanes. The 400-foot radii curves used in the transition did not require 12-foot lanes to be widened.

Once displaced left turning vehicles crossed the through lanes, they were separated from the US 61 edge of travel lane by an 8-foot paved outside shoulder along US 61 and a 12 foot paved divider, thus providing a clear zone distance between opposing moves of 20 feet, which met the AASHTO Roadside Design Guide recommended distance.

The wide median also permitted guardrail, for protecting large sign and lighting supports, to be offset a good distance from high speed through traffic.

AutoTurn software was used to check all truck turning movements. For the double left turn from Siegen Lane (LA 3246) to US 61, a single unit design vehicle was used in the inner lane and a WB-50 design vehicle in the outer lane. The turning path for the outer vehicle was allowed to turn onto the outer shoulder which helped reduce the size of the median opening at the main intersection.

All lane widths used in the CFI design were 12 feet except for those on the frontage roads. The attached plan sheets show the plan layout, dimensions, signing and striping.

Design changes since construction

When the CFI was constructed, it was necessary to remove several hundred feet of the existing US 61 east frontage road from Sherwood Forest Boulevard northward. After construction, westbound Sherwood Forrest drivers began turning right at various places within the CFI intersection looking for the frontage road. To prevent this, it was decided to add a right turn lane on Sherwood Forest Boulevard in advance of the CFI intersection. A project to accomplish this is currently being developed.

Before determining to implement a CFI, it is important to carefully consider the following planning and design considerations.

Important planning considerations for future CFI designs

1. Traffic flow will obviously improve with any new intersection improvement project and the CFI is no exception. However, the capacity of a CFI is limited, especially if only two legs are constructed, CFI capacity should be compared to the capacity provided by conventional intersection improvements, such as providing additional through lanes / turn lanes at the intersection, or by denying lefts at the main intersection and providing U-turns beyond the intersection (i.e. the Michigan U-turn design).

2. Adding future through lanes to CFI legs can be difficult if the lanes are not planned for as part of the initial design. Planning for these lanes initially will ensure that future lanes can be added economically.

3. The cost of a CFI can be more expensive than other conventional designs, such as those mentioned above. The two-legged Louisiana CFI that was let to construction in 2005 cost 4.5 million, which included 1 million for a new frontage road. The advantages, disadvantages, and cost of alternative designs should be carefully compared and evaluated before determining which design to implement.

Important design considerations for future CFI designs

1. The angle of crossing for displaced left turning vehicles should be as great as possible to help reduce wrong way entry and reduce the crossing time at the signalized intersection.

2. Right turn lanes should be provided on intersection legs approaching displaced left turning roadways. These turn lanes channel traffic to the correct roadway and discourage drivers from entering the displaced left turning roadway the wrong way.

3. Two-way frontage roads may be essential in some quadrants of the CFI in order to provide property owners with sufficient access. If a two-way frontage road is not provided, and access cannot be provided via another intersection approach, then access will be limited to right turns in and out on a one-way right turn roadway that can be accessed only from one direction on one intersection leg.

CRITICAL CFI DESIGN ELEMENTS

The CFI configuration introduces several critical elements that must be considered to produce a safe, efficient and acceptable design. Several key features are inter-related within a CFI and many of these may be mutually competitive. In order to achieve the most efficient and best-fit design, several iterations may be required to optimize these competing interests as the project moves from initial traffic models to final design. Traffic models should be re-tested as the geometry is refined to ensure the intended traffic operations will be provided.

GEOMETRY

Proper geometry is the backbone to a well-designed CFI. Poor geometry compromises safety, leads to driver confusion, and decreases operational efficiency. In addition to the traditional design elements inherent within a CFI, there are several design controls and criteria that must be determined early in the design process to ensure a proper design and cross section will be provided, as listed below:

I. Design Controls and Criteria

1. **Design Vehicle:** The design vehicle plays an important role in determining turning radii, stop bar location, lane widths and other criteria. At some locations where the truck percentage is low, the intersection footprint could be compressed.

2. **Roadway Classification:** As with traditional designs, roadway classification will dictate the geometric design criteria to be applied to CFI locations. At the outset, it should be confirmed to ensure consistency and contextual-fit with the surrounding development and roadway corridor.

3. **Pedestrian and Bicycle Considerations:** Pedestrian and/or bicycle accommodations will greatly affect roadway cross section elements. Multiple stops will likely be required to completely cross each intersection leg. Adequate island widths within crosswalks must be provided to safely harbor pedestrians and bicycles between crossing stages. Signal phasing, timing, and clearance intervals will need to be properly designed to accommodate these movements.

II. Design and Cross Section Elements

1. **CFI Cross-over intersection:** Creating a safe crossing at the CFI left-turn lane and the main lanes is imperative. Proper cross-over location, length, angle, reverse curvature, signage and signal placement are all critical design elements that must be addressed. Poor design will encourage wrong-way entry and diminish traffic operations. Graphical grades may be required to provide a smooth transition for vehicles as they cross from left-turn lanes over the main lanes. These grades must also allow for proper drainage.

   a. ***Crossover Location:*** The location of the CFI crossover is the component that most directly affects the overall effectiveness of the intersection. The location is a based on many factors, such as cycle length, traffic demand, and site conditions. Proper placement of the crossover allows opposing traffic to run simultaneously, creating the efficiency of the CFI design. The distance a left-turning vehicle must travel from the stop bar at the CFI crossover to the stop bar at the main intersection is typically between 400 to 500 feet. This distance is comprised of two segments, the crossover length and the remaining CFI-leg length.

   b. ***Crossover Length:*** The crossover length is determined by the crossover angle and the reverse curvature that is used. This length is typically 175 to 225 feet. The remaining length for the CFI-leg would be between 225 to 325 feet. The length of the CFI-leg is not a function of storage requirements but the residual length that remains after the crossover is properly placed and the crossover length set.

   c. ***Crossover Angle:*** The crossover angle of the CFI left-turn lanes to the main lanes is critical in order to prevent wrong-way entry. The angle is usually 10 to 15 degrees and is influenced by the median width and the alignment of the main lanes (tangent or reverse curve) through the crossover.

   d. ***Crossover Reverse Curves:*** Depending on the median width between the main lanes, the crossover reverse curve radii typically range between 300 to 400 feet. Superelevation is normally not provided and the reverse curves are connected by an adequate tangent length to meet the desired crossover angle. Turning roadway lane width requirements in the AASHTO Green Book need to be met to ensure vehicles do not encroach on adjacent lanes.

e. ***Alignment of Main Lanes through Crossover:*** A tangent alignment is desirable as the main lanes approach the crossover. However, reverse curves can be provided along the main lanes through the crossover if, for instance, the overall footprint at the core intersection needs to be reduced. Reverse curve radii must meet design speed requirements.

2. **CFI Right Turn Lane:** A right turn roadway is required adjacent to the displaced left roadway on the CFI-leg to remove right-turning vehicles from the core intersection. Design elements critical to the right turn roadway include overall width, separation from the CFI-leg, and its connection to the main lanes.

   a. ***Right Turn Roadway Width:*** Depending on the type of curb provided (mountable or barrier), the overall width of the right turn roadway should be set by the width required to pass a stalled vehicle.

   b. ***Right Turn Roadway Separation from Displaced left on CFI-leg:*** The separation between the right turn roadway and the displaced left will be influenced by the required shoulder widths, type of curb and gutter, and desired raised separator width. The raised separator should be wide enough to house any sign or signal supports required and act as a positive separation between the opposing traffic directions. In addition, if a shoulder is not provided along the main lanes, the separator should be wide enough to shelter disabled vehicles and curb adjacent to the outer through lane should have a flat slope.

   c. ***Right Turn Roadway Connection at Main Lanes:*** The connection of the CFI right turn roadway to the main lanes can occur in one of two ways. Either it can tie directly into the main lanes and be controlled by a signal, or an acceleration lane can be provided to allow the right turn traffic to adequately merge into the main lanes. Stop or yield control between the right turn lane and the main lanes should be not allowed unless the angle of approach for right turning vehicles can be increased to 60 degrees.

3. **Cross Section Elements**

   a. ***Medians and Islands:*** Within the core intersection area, raised medians and islands are typically preferred to provide positive channelization and separation. Median and island widths should be sufficient to allow for placement of signs and signal poles where appropriate. Clear zone requirements will need to be considered in positioning signal poles and sign supports. Guardrail or other measures may be required to satisfy clear zone requirements, particularly at the crossover intersections. Median and island widths will be influenced by maintenance needs (paved vs. grassed, snow storage, etc.), pedestrian and bicycle refuge areas (typically 8-10 feet) and other factors.

   b. ***Drainage:*** Due to the increased use of raised islands and channelization, particularly within the core intersection area, special attention to grades and cross slopes will be required to adequately drain the roadway pavement.

   c. ***Right Turn Lane across from displaced left roadway:*** Within a 2-leg CFI, the right turn lane opposite the displaced left roadway should desirably be separated from the outside through lane near the main intersection core. This can be accomplished by using a sweeping right turn lane or creating a striped gore between the turn lane and through lane. Since these two movements will likely be signalized and phased differently, separation of the lanes will reduce the tendency of right turners to proceed with the through lanes.

OPERATION

I. Signal Placement

The CFI design creates several signal placement issues. The CFI crossover should be signalized (not STOP controlled) to ensure safe and positive operation along the CFI left turn lanes and main lanes. Because of the increased intersection footprint, adequate signal head to stop bar distances must be investigated and maintained. Signal heads controlling movements outboard of the CFI-leg / side street intersection should be placed as close as possible to the stop bar on the side street. At these locations, supports for the signal heads can be placed within the separator between the displaced left on the CFI-leg and opposing traffic or between the displaced left and right turn roadway in lieu of the median between the mainline lanes.

II. Signing Considerations

Due to the unique configuration of the CFI, additional signing in advance of and within the intersection may be warranted. Overhead guide signs are very effective at the CFI crossover locations to provide positive guidance for left-turning vehicles maneuvering through the intersection. Additional guide, warning, and regulatory signs will also be required to provide safe and efficient operations.

III. Access Control

Full access will likely be eliminated, or at least limited, within the quadrants housing CFI legs. Certain situations may allow side roads to tie to the main lanes at or near the CFI crossover, but these should be thoroughly investigated. Right-in right-out driveways are typically allowed to tie along the CFI right turn roadways. Side road and driveway tie-ins should be placed to discourage wrong-way entry and crossover maneuvers (i.e. crossing multiple lanes to reach a turn lane) that would create unsafe operations. Frontage roads adjacent to the intersection core were used in the Louisiana design and are a viable option to provide access relief to adjacent development.

IV. Maintenance of Traffic

Existing left turn lanes on CFI legs at the main intersection must eventually be removed. If shoulders are provided, traffic can be shifted outward to create temporary left turn lanes. Temporary signals will likely be required to maintain traffic control during construction. Providing a smooth switchover from temporary control to the permanent signal equipment must be carefully coordinated and well planned. It is critical that permanent signal equipment is field-tested prior to the switchover to verify that timing, phasing, and offsets are properly set.

V. Roadway Lighting

In order to provide safe and efficient nighttime operations, adequate lighting within the intersection core is critical. High-mast lighting has been found to be very effective in providing the required illumination. Placement of the lighting supports should be considered during initial development of the concept.

SIGNAL TIMING

I. Signal Timing / Coordination

Signals must be coordinated properly to ensure traffic moves continuously through the CFI signalized intersections. This involves two steps as follows:

1. When left turning vehicles receive a green indication (i.e. at point A in Figure 1) they cross over opposing through travel lanes and proceed towards the main intersection. Before they reach the signal at point B in Figure 1, the green indication is received, thus resulting in no delay. The same thing occurs at point C. Successful signal timing is crucial to this effort. With a four-leg configuration, there are two signals (Points B and C); with a two leg, there is one signal (Point B, Figure 2).

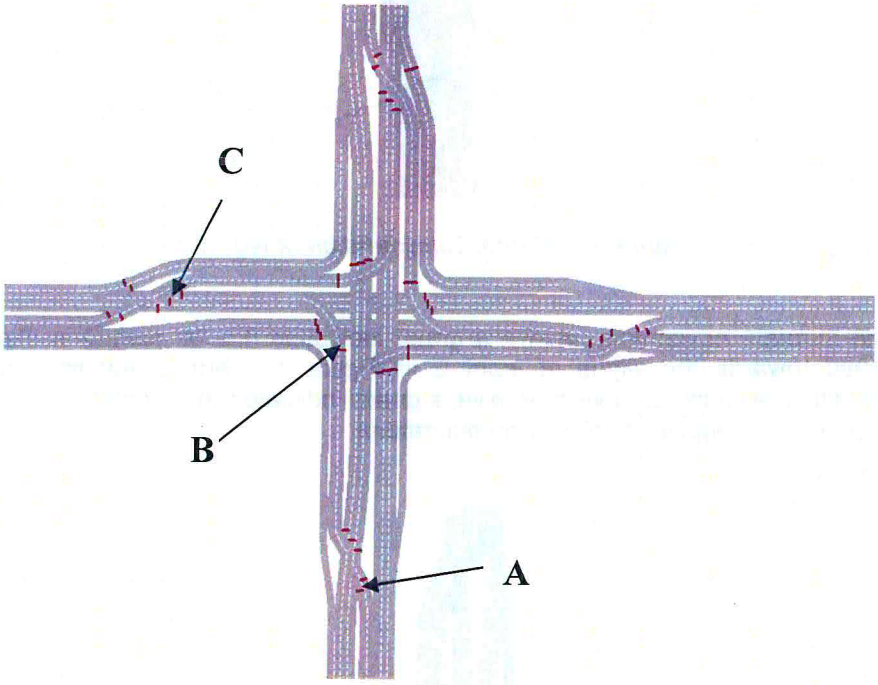


Figure 1, Left turn Consideration, 4-leg CFI

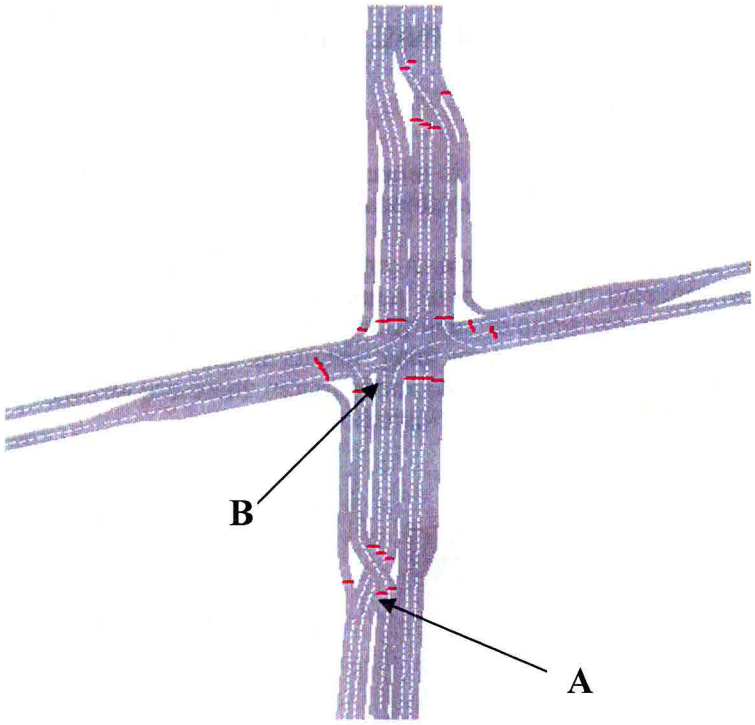


Figure 2, Left turn Consideration, 2-leg CFI

2. When through movements receive a green indication (i.e. at point D in Figure 3), they proceed towards the signal at point E in Figure 1. Before reaching the crossover intersection at point E, drivers receive a green indication and continue to move without any delay. This applies to all CFI configurations.

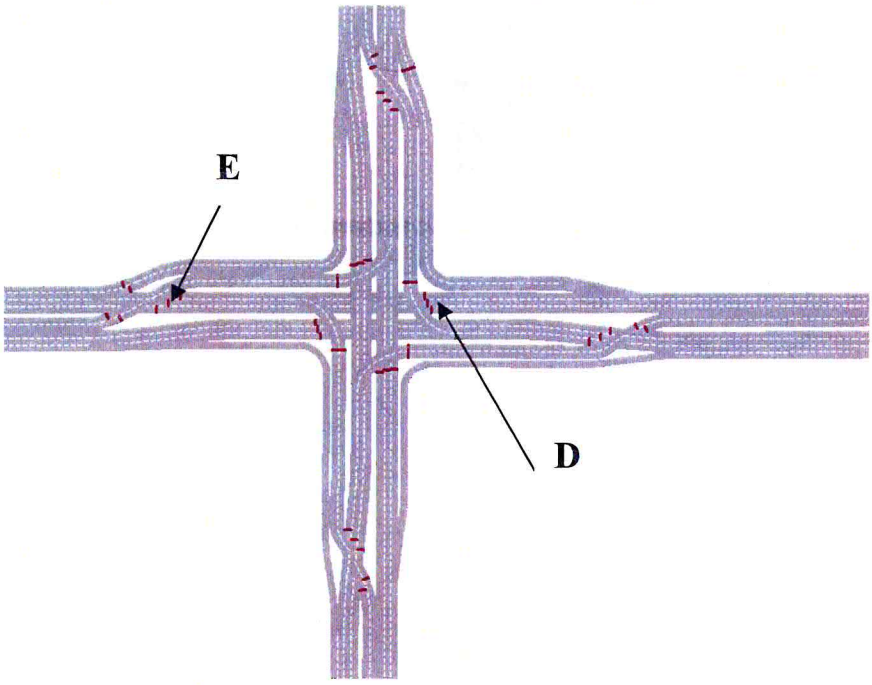


Figure 3, Through Movement Consideration

Simulated traffic models are essential to test the CFI configuration. All calculations and output from non-simulated programs should be verified using simulation. VISSIM software was used to simulate the Louisiana CFI but other software could be used. Cycle lengths, splits, and geometry may need to be adjusted accordingly to accommodate these movements.

Adequate clearance times need to be provided due to the increased distance across the intersection. For more information on phasing, cycle lengths, splits and other signal timing issues, please consult the following TRB paper authored by Joe G. Bared and Ramanujan Jagannathan, Design and Operational Performance of Crossover Displaced Left-turn (XDL) Intersections (also called Continuous Flow Intersection (CFI)), 2004.

II. Controller Coordination

Using a single controller, either sequential or NEMA phasing may be used at the CFI.

Using sequential phasing, the timing and wiring is less complex; however, there is less flexibility in the timings that can be utilized.

With NEMA phasing, the timing is more flexible to adjustments; however, the phasing, wiring and ring barriers become more complex.

More than one controller can be used; however, it is not recommended due to the potential timing complexities as well as equipment failures that multiple controllers introduce. Coordination issues also arise using multiple controllers.

STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION & DEVELOPMENT

PLANS OF PROPOSED

STATE HIGHWAY

F.A.P. NO. 1703(534)
STATE PROJECT NO. 007-08-0032

AIRLINE HIGHWAY AT SIEGEN LANE
(CFI IMPROVEMENTS) U.S. 61
EAST BATON ROUGE PARISH

STATE PROJECT
NO. 007-08-0032

VICINITY MAP

STATE OF LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT OFFICE OF PLANNING REVISED PLANS

INDEX TO SHEETS

TOTAL SHEETS WITHOUT CROSS SECTIONS = 188 [1] [4]
TOTAL SHEEETS WITH CROSS SECTIONS = 200

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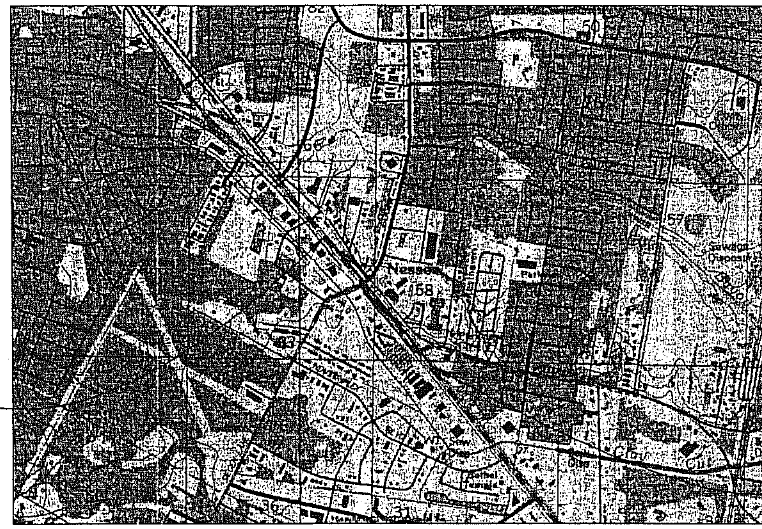
END F.A.P. NO. 1703(534)



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BEGIN F.A.P. NO. 1703(534)

LAYOUT MAP

1000 0 1000 2000
SCALE: 1 INCH = 1000 FEET

PREPARED AND RECOMMENDED FOR APPROVAL
[signature] ABMB ENGINEERS, INC. DATE 6-11-04

APPROVED
[signature] D.O.T.D. CHIEF ENGINEER DATE 7-15-04

APPROVED
FEDERAL HIGHWAY ADMINISTRATION DATE

STATE OF LOUISIANA — MICHAEL G. BRUCE REG. No. 20397 REGISTERED PROFESSIONAL ENGINEER IN CIVIL ENGINEERING

TRAFFIC DATA:
AIRLINE HIGHWAY (U.S. 61)
2004 ADT = 46950
2024 ADT = 65150
D = 55.0%
K = 10.0%
T = 5.9%
DESIGN SPEED = 50 m.p.h.
UA-3

	DATE	REVISION	DATE	RECOMMENDED	DATE	APPROVED
4	9-29-04	SHTS. 1, 2b, 2e, 3, 3a-4, 3h, 31, 3-8, 12-15, 17-20, 23-26, 51, 217-219, 224, 228, 229	10-2-04	[signature]	[illegible]	[signature]
3	8-27-04	SHTS. 1, 3h, 31	8-27-04	[signature]	[illegible]	[signature]
2	8-11-04	SHTS. 1, 217, 228, 229, 228	8-12-04	[signature]	[illegible]	[signature]
1	7/21/04	SHTS. 1, 3h, 31, 217-229	8-3-04	[signature]	[illegible]	[signature]

SCHEDULE OF REVISIONS

TYPE OF CONSTRUCTION:
PORTLAND CEMENT CONCRETE PAVEMENT, ASPHALTIC CONCRETE WIDENING, BASE COURSE, CONCRETE CURB, CURB & GUTTER, ASPHALTIC CONCRETE OVERLAY, DRAINAGE STRUCTURES, AND TRAFFIC SIGNALIZATION.

DATUM: NAD 83 (1992)
BM: NESSFR 1970
EL. 33.54 NAVD 88

SCALES
PLAN : 1" = 20'
PROFILE : HOR. 1" = 20'
VERT. 1" = 2'

NOTE:
THE 2000 EDITION OF THE LOUISIANA DOTD STANDARD SPECIFICATIONS FOR ROADS AND BRIDGES, AS AMENDED BY THE PROJECT SPECIFICATIONS, SHALL GOVERN ON THIS PROJECT

LENGTH OF PROJECT

DESCRIPTION	ALGEBRAIC SUM OF ALL EQUATIONS	GROSS LENGTH	EXCEPTION	BRIDGE LENGTH		ROADWAY LENGTH	
STATION TO STATION	FEET	FEET	FEET	FEET	MILES	FEET	MILES
AIRLINE HWY.							
97+50 - 129+50		3200.00				3200.00	0.606
TOTAL LENGTH OF BRIDGES							
TOTAL LENGTH OF ROADWAY						3200.00	0.606
TOTAL MILES				0.606			

DATE	REVISION DESCRIPTION	BY
10-4-04	DELETED SHEETS 51, 308-310	
7-21-04	Added sheets	WHI

PARISH: EAST BATON ROUGE
FEDERAL PROJECT: 1703(534)
STATE PROJECT: 007-08-0032
SHEET NUMBER: 1

TITLE SHEET
AIRLINE HWY. AT SIEGEN LANE CFI

PROJECT ENGINEER [signature] 1/12/07

ABMB

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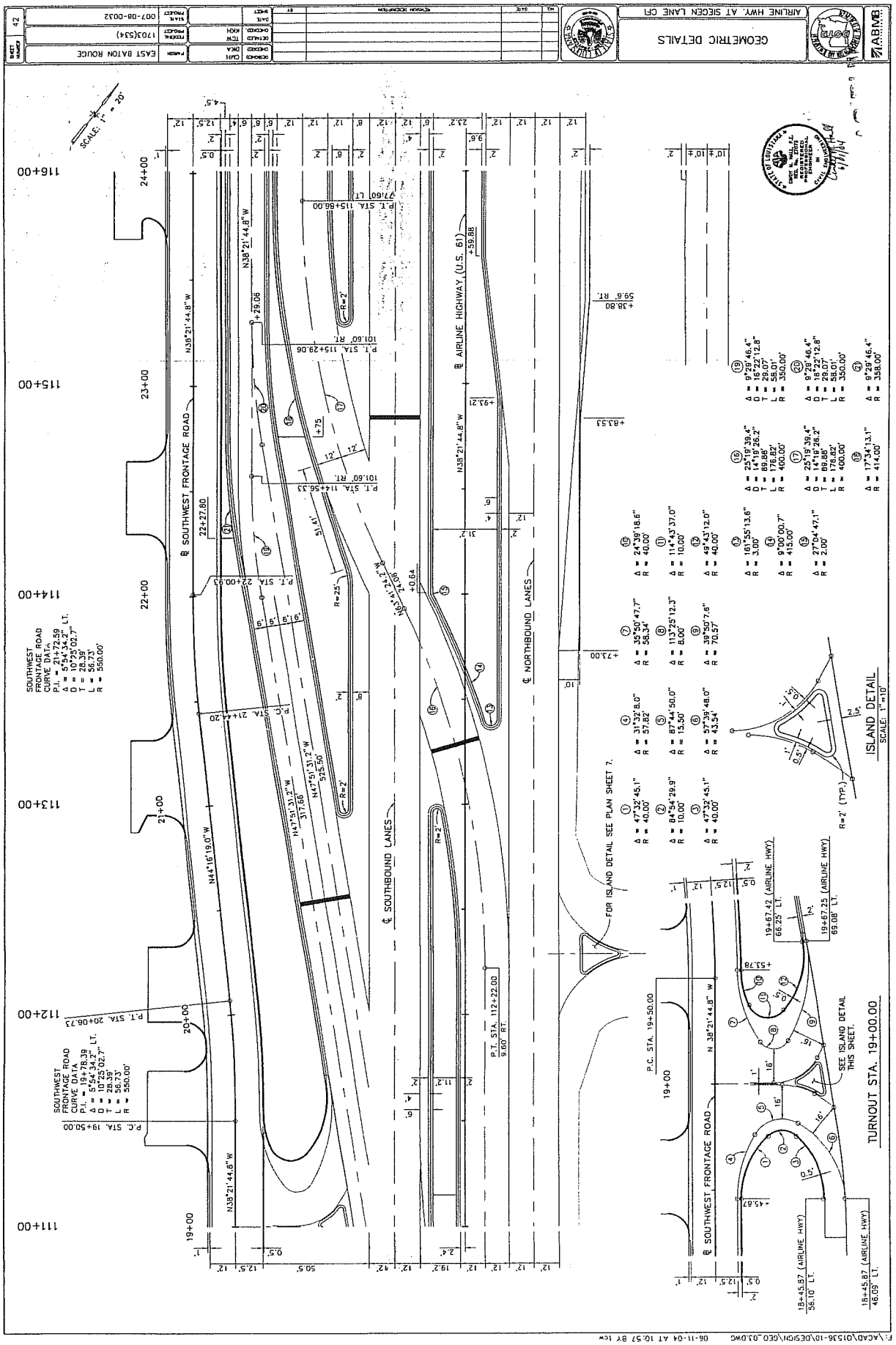
GEOMETRIC DETAILS
AIRLINE HWY. AT SIEGEN LANE CFI
EAST BATON ROUGE
007-08-0032
1703(334)
SOUTHWEST FRONTAGE ROAD
AIRLINE HIGHWAY (U.S. 61)
NORTHBOUND LANES
SOUTHBOUND LANES
ISLAND DETAIL
SCALE: 1" = 10'
TURNOUT STA. 19+00.00
SEE ISLAND DETAIL THIS SHEET.
FOR ISLAND DETAIL SEE PLAN SHEET 7.
P.C. STA. 19+50.00
P.T. STA. 20+06.73
P.C. STA. 21+72.20
P.T. STA. 22+00.93
P.T. STA. 22+27.80
P.T. STA. 114+56.33
P.T. STA. 115+29.06
P.T. STA. 115+86.00
P.T. STA. 112+22.00
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T = 28.39'
L = 56.73'
R = 550.00'
SOUTHWEST FRONTAGE ROAD CURVE DATA
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D = 10°25'02.7"
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L = 56.73'
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N44°16'19.0"W
N47°51'31.2"W
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525.50'
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R=25'
R=40'
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101.60' LT.
59.6' RT.
59.6' LT.
+38.80
+93.21
+83.53
+73.00
+59.88
+29.06
+0.64
+53.78
+45.87
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66.25' LT.
+67.25 (AIRLINE HWY)
69.08' LT.
+45.87 (AIRLINE HWY)
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+45.87 (AIRLINE HWY)
46.09' LT.
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112+00
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114+00
115+00
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21+00
22+00
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24+00
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Δ = 9°29'46.4" D = 16°22'12.8" T = 29.07' L = 58.01' R = 350.00'
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CIVIL
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PROJECT ENGINEER
11/10/04
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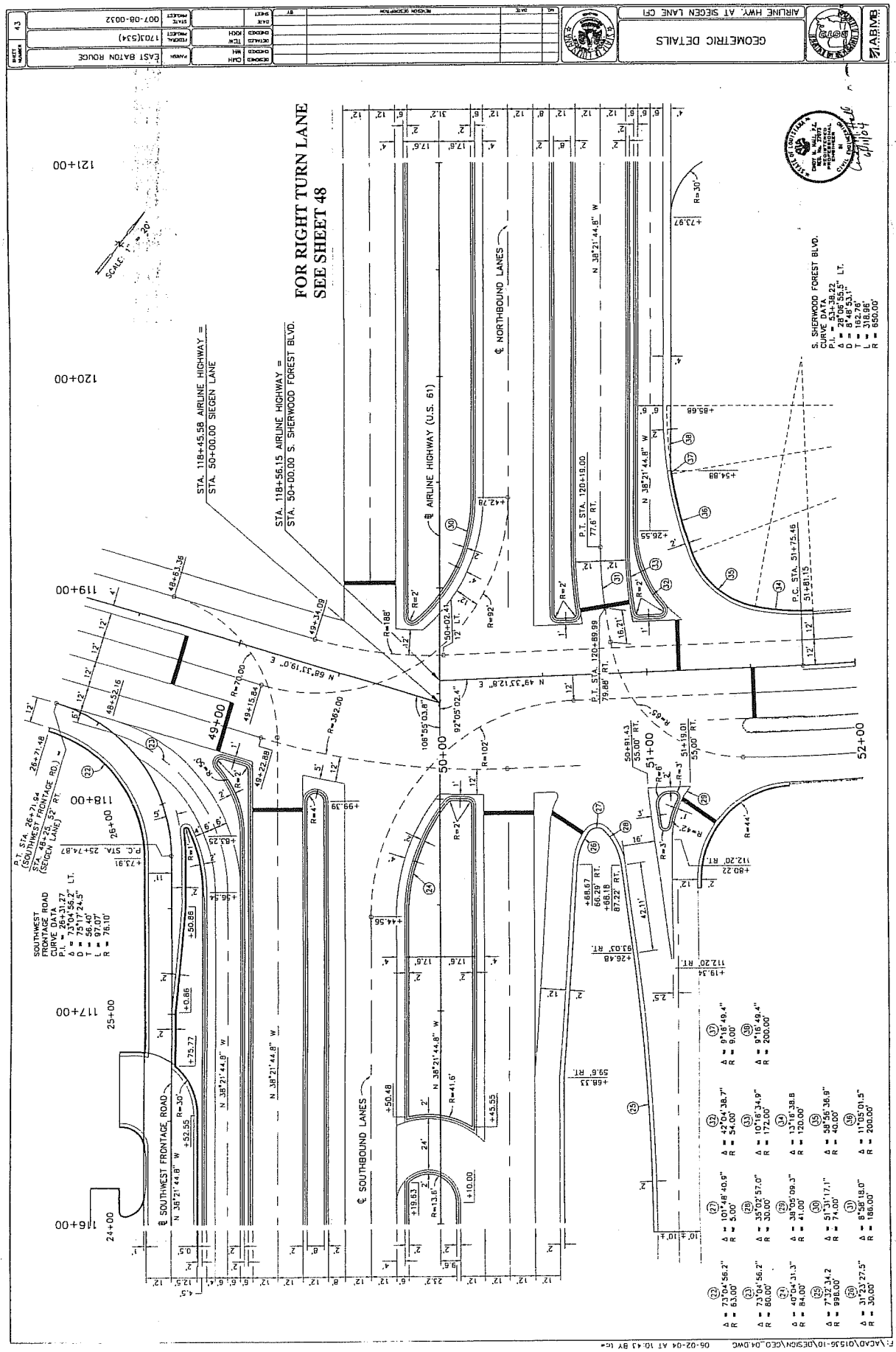
GEOMETRIC DETAILS
AIRLINE HWY. AT SIEGEN LANE CR1
EAST BATON ROUGE
007-08-0032
FOR RIGHT TURN LANE
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STA. 50+00.00 SIEGEN LANE
STA. 118+56.15 AIRLINE HIGHWAY =
STA. 50+00.00 S. SHERWOOD FOREST BLVD.
AIRLINE HIGHWAY (U.S. 61)
NORTHBOUND LANES
SOUTHBOUND LANES
SOUTHWEST FRONTAGE ROAD
SOUTHWEST FRONTAGE ROAD
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(SIEGEN LANE)
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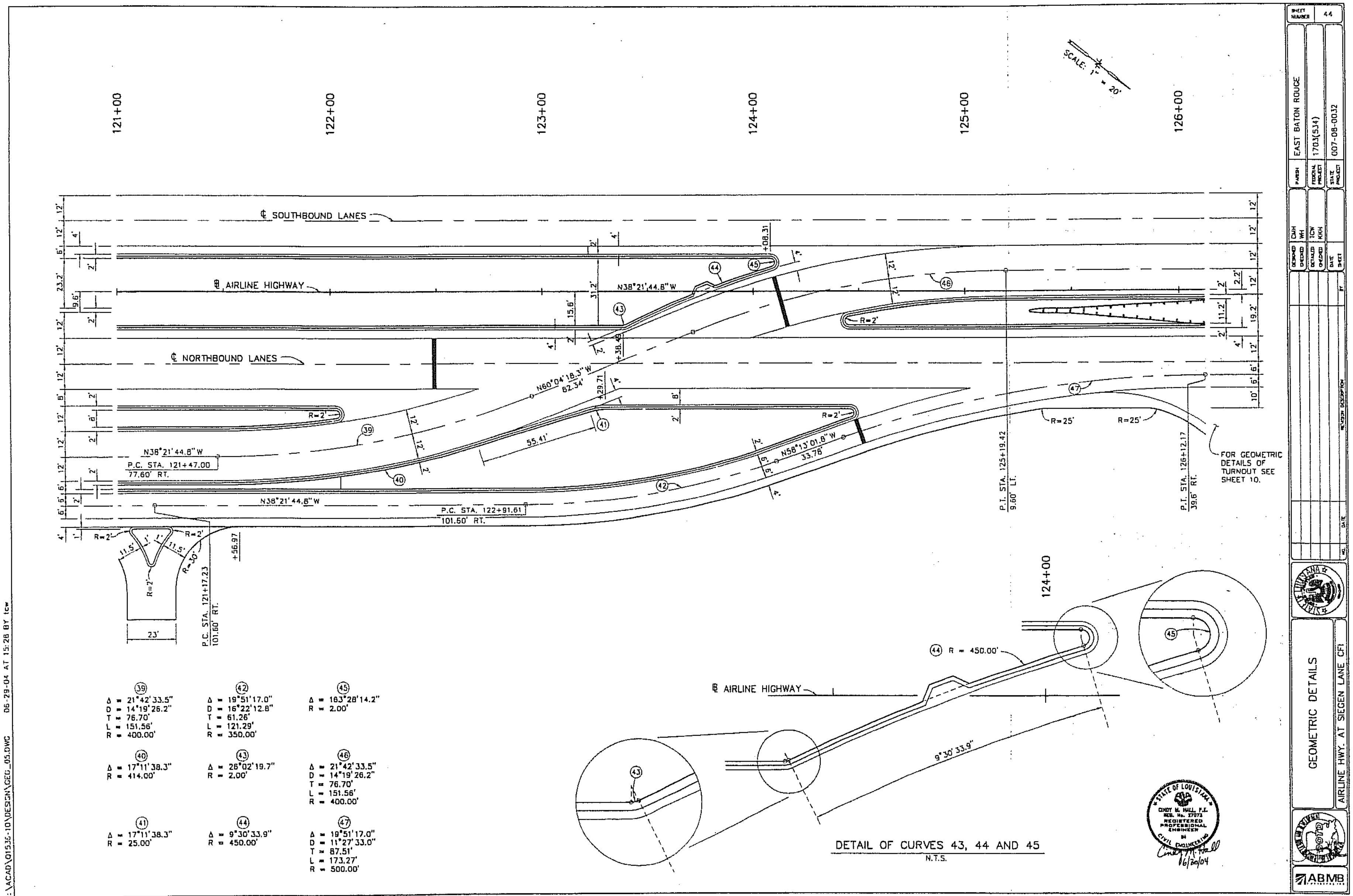
GEOMETRIC DETAILS
AIRLINE HWY. AT SIEGEN LANE CFI
PARISH EAST BATON ROUGE
FEDERAL PROJECT 1703(534)
STATE PROJECT 007-08-0032
SHEET NUMBER 44
DESIGNED CMH
CHECKED WH
DETAILED TCW
CHECKED KKH
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122+00
123+00
124+00
125+00
126+00
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℄ AIRLINE HIGHWAY
℄ NORTHBOUND LANES
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N60°04'18.3"W
62.34'
N58°13'01.8"W
33.76'
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77.60' RT.
P.C. STA. 122+91.61
101.60' RT.
P.C. STA. 121+17.23
101.60' RT.
P.I. STA. 125+19.42
9.60' LT.
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+29.71
+56.97
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R=30'
23'
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T = 76.70'
L = 151.56'
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Δ = 17°11'38.3"
R = 414.00'
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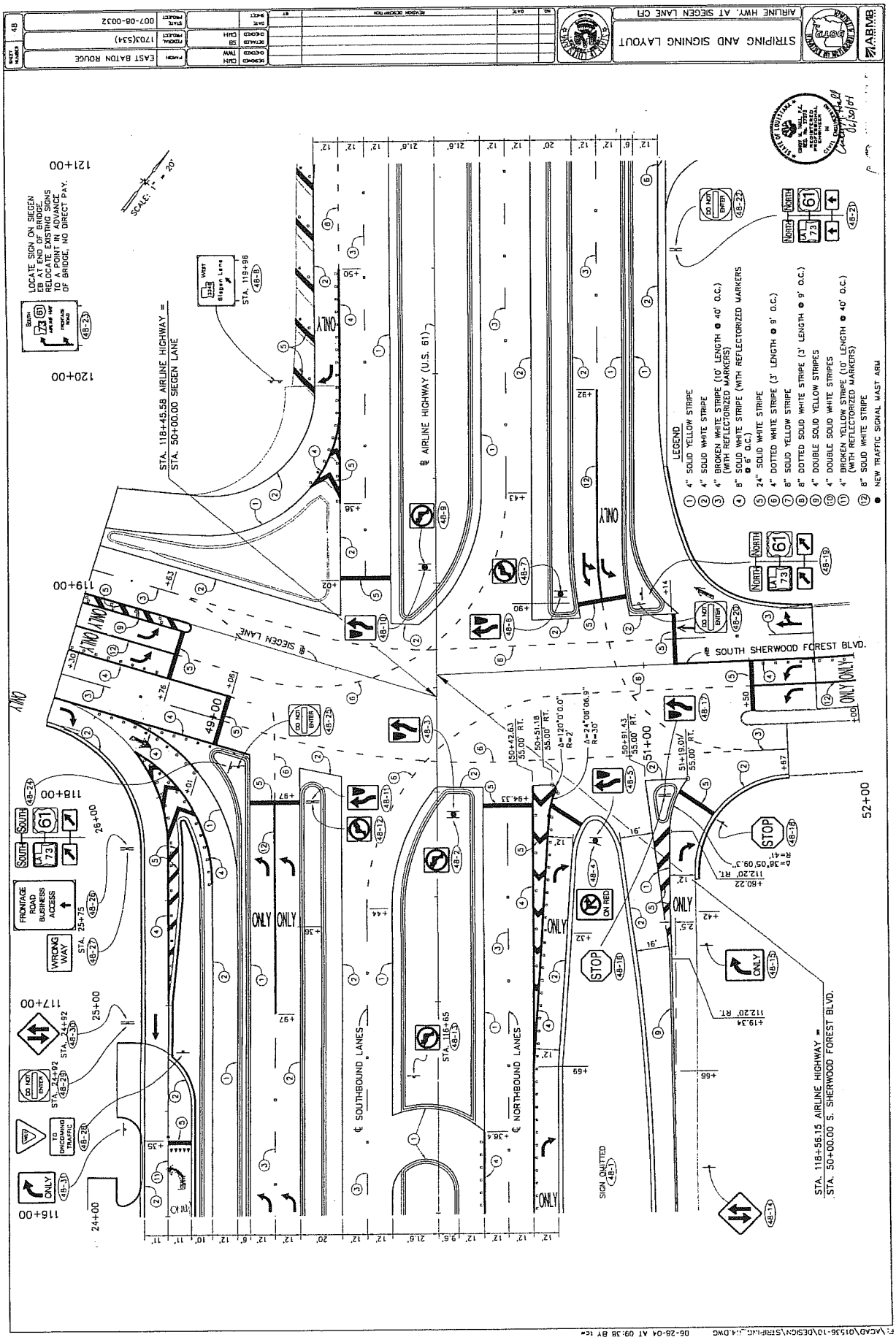
42
Δ = 19°51'17.0"
D = 16°22'12.8"
T = 61.26'
L = 121.29'
R = 350.00'
43
Δ = 26°02'19.7"
R = 2.00'
44
Δ = 9°30'33.9"
R = 450.00'
45
Δ = 163°28'14.2"
R = 2.00'
46
Δ = 21°42'33.5"
D = 14°19'26.2"
T = 76.70'
L = 151.56'
R = 400.00'
47
Δ = 19°51'17.0"
D = 11°27'33.0"
T = 87.51'
L = 173.27'
R = 500.00'
44 R = 450.00'
9°30'33.9"
DETAIL OF CURVES 43, 44 AND 45
N.T.S.
STATE OF LOUISIANA
CINDY M. HALL, P.E.
REG. No. 27073
REGISTERED PROFESSIONAL ENGINEER
IN CIVIL ENGINEERING
6/20/04
PROJECT ENGINEER
ABMB
F:\ACAD\01535-10\DESIGN\GEO_05.DWG 06-29-04 AT 15:28 BY tcw

STRIPING AND SIGNING LAYOUT
AIRLINE HWY. AT SIEGEN LANE CR
EAST BATON ROUGE
007-08-0032
1703(514)
SCALE: 1" = 20'
SOUTHWEST FRONTAGE ROAD
SOUTHBOUND LANES
NORTHBOUND LANES
AIRLINE HIGHWAY (U.S. 61)
JEFFERSON HWY.
STA. 103+24.20 AIRLINE HIGHWAY =
STA. 10+25.05 SOUTHWEST FRONTAGE ROAD
STA. 103+44.49 AIRLINE HIGHWAY =
STA. 50+00.00 JEFFERSON HIGHWAY
TO West
3246
Siegen Lane
LOCATE CANTILEVER ON JEFFERSON HWY. NB AT STA. 52+65. CENTER SIGN OVER LEFT RIGHT TURN LANE.
FRONTAGE ROAD BUSINESS ACCESS
STOP
ONLY
1 4" SOLID YELLOW STRIPE
2 4" SOLID WHITE STRIPE
3 4" BROKEN WHITE STRIPE (10' LENGTH @ 40' O.C.) (WITH REFLECTORIZED MARKERS)
4 8" SOLID WHITE STRIPE (WITH REFLECTORIZED MARKERS @ 6' O.C.)
5 24" SOLID WHITE STRIPE
6 4" DOTTED WHITE STRIPE (3' LENGTH @ 9' O.C.)
7 8" SOLID YELLOW STRIPE
8 8" DOTTED SOLID WHITE STRIPE (3' LENGTH @ 9' O.C.)
9 4" DOUBLE SOLID YELLOW STRIPES
10 4" DOUBLE SOLID WHITE STRIPES
11 4" BROKEN YELLOW STRIPE (10' LENGTH @ 40' O.C.) (WITH REFLECTORIZED MARKERS)
12 8" SOLID WHITE STRIPE
● NEW TRAFFIC SIGNAL MAST ARM
F:\ACAD\01536-10\DESIGN\STRIPING_01.DWG 06-02-04 AT 10:5


STRIPING AND SIGNING LAYOUT
AIRLINE HWY. AT SIEGEN LANE CR
EAST BATON ROUGE
007-08-0032
1703(534)
LEGEND
4" SOLID YELLOW STRIPE
4" SOLID WHITE STRIPE
4" BROKEN WHITE STRIPE (10' LENGTH @ 40' O.C.) (WITH REFLECTORIZED MARKERS)
8" SOLID WHITE STRIPE (WITH REFLECTORIZED MARKERS @ 6' O.C.)
24" SOLID WHITE STRIPE
4" DOTTED WHITE STRIPE (3' LENGTH @ 9' O.C.)
8" SOLID YELLOW STRIPE
8" DOTTED SOLID WHITE STRIPE (3' LENGTH @ 9' O.C.)
4" DOUBLE SOLID YELLOW STRIPES
4" DOUBLE SOLID WHITE STRIPES
4" BROKEN YELLOW STRIPE (10' LENGTH @ 40' O.C.) (WITH REFLECTORIZED MARKERS)
8" SOLID WHITE STRIPE
NEW TRAFFIC SIGNAL MAST ARM
LOCATE SIGN ON SIEGEN LANE AT END OF BRIDGE. RELOCATE EXISTING SIGNS TO A POINT IN ADVANCE OF BRIDGE, NO DIRECT PAY.
STA. 118+45.58 AIRLINE HIGHWAY = STA. 50+00.00 SIEGEN LANE
STA. 118+56.15 AIRLINE HIGHWAY = STA. 50+00.00 S. SHERWOOD FOREST BLVD.
℄ AIRLINE HIGHWAY (U.S. 61)
℄ SIEGEN LANE
℄ SOUTH SHERWOOD FOREST BLVD.
℄ SOUTHBOUND LANES
℄ NORTHBOUND LANES
SIGN OMITTED
ONLY
STOP
ON RED
DO NOT ENTER
WRONG WAY
FRONTAGE ROAD BUSINESS ACCESS
TO ONCOMING TRAFFIC
NORTH
SOUTH
61
73
118+00
119+00
120+00
121+00
117+00
116+00
24+00
25+00
26+00
49+00
51+00
52+00

CFI Traffic Report

The District 61 Traffic Operations office has evaluated the CFI intersection which is the intersection of US 61 (Airline Highway) @ La 3246 (Siegen Lane) / Sherwood Forest Boulevard for over a year (March 2006 to present). This report documents our findings as to the CFI intersection's performance in reducing congestion.

Concept: The concept of the CFI intersection is very creative, and its primary advantage is that it relocates the left-turning movements upstream of the main intersection and allows those movements departing the main highway to occur simultaneously with the side street through movements, then funnels the stored left-turning traffic in an auxiliary lane which allows the actual intersection left-turns to occur simultaneously with the mainline through and right-turn movements.

Alternatives: Since there were already double left-turn lanes on all approaches, options for improving the intersection included a six-lane intersection, the CFI concept, or some type of far side U-Turn design. This report, in addition to evaluating the level of capacity improvement created by the CFI will also compare its efficiency with that of a six-lane design. Although this report will not evaluate the far-side U-Turn concept, it is the author's opinion that a far-side U-Turn design would be less efficient than the CFI design in terms of actual capacity improvement if the U-Turns were not protected by downstream signalization. This is because queuing of the opposing through movements during peak hours would make the U-Turns very inefficient and also less safe. Additionally, the far side U-Turn concept would require a more circuitous route for the left-turning traffic than the more direct flow of the CFI. However, it is noted that the far-side U-Turn design would not have the access problems of the CFI concept, and it would have a smaller footprint, which would allow more room for future widening to a six-lane roadway.

Observed Improvements of the CFI Intersection: After the CFI intersection was opened to traffic on March 21, 2006, timing runs were made for comparison with timing runs made previously with the conventional intersection. Several runs were made during each peak period, before with the conventional intersection, and after with the CFI intersection. The results of the average times are summarized below:

Time Period	Run	Time from previous signal *	Corridor Time **
a.m. peak	Before CFI	NB 44 sec, SB 50 sec	NB 223 sec, SB 252 sec
a.m. peak	After CFI	NB 92 sec, SB 78 sec	NB 318 sec, SB 270 sec
p.m. peak	Before CFI	SB 195 sec, NB 43 sec	SB 441 sec, NB 221 sec
(before adjustment)	After CFI	SB 150 sec, NB 42 sec	SB 450 sec, NB 270 sec
(after adjustment)	After CFI	SB 102 sec, NB 42 sec	SB 265 sec, NB 306 sec

* note: Sherwood Common – Siegen (southbound) Jefferson – Siegen (northbound)
** note: Nesser O'Pass – Industriplex (southbound) Industriplex – Nesser O'pass (northbnd)

NB = northbound, SB = southbound

See Tables A-1 – A-5

It is noted that significant improvement was made in the p.m. peak period after adjustment of the signal timing for the CFI. Since the a.m. period congestion was not as bad, and some of that congestion has been due to traffic control for Parkview school, located on La 73 (Jefferson Highway) near the US 61 (Airline Highway) @ La 73 (Jefferson Highway) intersection just south of the CFI intersection, only minor adjustments were made during the a.m. peak period, so no follow-up timing runs were made for the a.m. period.

Increased Traffic after the CFI: Additional information was gathered to determine whether or not the traffic had increased between design volumes and the CFI opening, including the very significant effects Hurricane Katrina discussed later in this report. Below are the percentage growths in volumes for the p.m. peak hour from February 2004 to August 2006. This growth, particularly for the Siegen / Sherwood Forest corridor and southbound Airline is extraordinary growth that could not have been accounted for in the design.

	Airline		Siegen	Sherwood
Southbound		Northbound	Eastbound	Westbound
+ 12.4 %		- 1.8 %	+ 14.6%	+ 15.7 %
	+ 6.0 %		+ 15.0 %	
Total Intersection		+ 9.6%		

See Table A-6

In summary, the CFI intersection made significant improvement in traffic flow at the intersection for the p.m. peak period, which is the worst congestion period. It is noted that the improved flow in the p.m. peak from 195 seconds to 102 seconds (from Sherwood Common to Siegen, 0.47 miles), and from 441 seconds to 265 seconds (from the Nesser Overpass to Industriplex, 2.02 miles). This equates to an average speed change from 16 mph to 27 mph through the 2.02-mile corridor during the p.m. peak hour, before and after the CFI, respectively, even with the additional traffic.

General Observation: Since the completion of the six-laning of Airline Highway north of the CFI Intersection, in the fall of 2006, the opportunity for comparing the 4-lane CFI intersection's performance to a 6-lane conventional intersection's performance has been afforded. Indications, particularly in the p.m. peak hour, are that the 6-lane intersections are outperforming the four-lane CFI intersection to a considerable degree. Most notably, the nearest 6-lane major intersection (Airline @ Bluebonnet / Coursey) is handling a greater volume of traffic than the CFI intersection in the p.m. peak period, and it is operating at a much better level of service with queues clearing most cycles, whereas the CFI intersection is failing with queue lengths averaging about a mile during the peak hour. However, it is noted that the volumes at Airline @ Bluebonnet / Coursey could be regarded as inflated since they include a very high right-turn volume from Coursey to Airline of 705 vph. Right-turn volumes are not nearly as taxing to intersection capacity as left-turn and through volumes, especially considering that this volume is handled with double right-turn lanes, and that the right-turn movement overlaps very nicely with the left-turn phase which services a comparable left-turn volume of 807 vph.

Advantages / Disadvantages of 4-Lane CFI vs 6-Lane Conventional Intersection: Below are some of the advantages and disadvantages of a 4-Lane CFI versus a 6-Lane Conventional Intersection from a traffic-handling standpoint.

	4-Lane CFI	6-Lane Conventional
Advantage	better allocation of green time	
	reduced number of phases	
	facilitates WB Jefferson to Siegen move	
		greater lane geometry for thru vehicles
		greater redundancy (for passing slower-moving trucks, and for incidents)
		more flexibility to handle directional flows

	4-Lane CFI	6-Lane Conventional
Disadvantage	cannot favor the heavy direction of traffic *(although the main intersection operates essentially like a 3-phase intersection, there are actually 7 phases which are interwoven – this significantly inhibits flexibility for timing changes)*	
	friction from the peripheral signals	
	poor LOS for side street right turns	
	higher costs at the intersection	
		increased number of phases at main intersection
		greater costs over a corridor because the improvement is continuous rather than simply intersection improvements

Timing Adjustments: While the CFI intersection was under construction, Hurricane Katrina struck the Gulf Coast. The damage and destruction caused by the storm created a shift in traffic patterns in the greater Baton Rouge area. There were both short and long term changes in traffic patterns due to evacuation, population shifts from temporarily and permanently displaced residents, and reparation caravans in and out of New Orleans with Baton Rouge serving as a

transportation hub. Storm damage, including mass flooding, produced not only residential displacements, but commercial displacements as well. These factors have combined to produce a large net growth in population, which has produced increased congestion on the entire transportation network in the Baton Rouge area, including the intersection where the CFI intersection was constructed. This increased population noted previously was in place prior to the opening of the CFI intersection.

After the CFI intersection opened initially, our traffic operations staff along with ABMB's staff spent a good bit of time trying to fine tune the operation, since the CFI time-of-day plans were based on pre-Katrina volumes. When the CFI initially opened, it seemed to function exceptionally well during off-peak traffic periods, and the p.m. peak failure period of about 30 minutes, was considerably shorter than the 2-hour plus failure period previously observed. After a period of time, however, traffic increased through the intersection, probably due to the initial increased capacity. The resulting increased traffic prolonged the failure period from 30 minutes to 60 minutes. One of the observations by our staff was that there was a phase in the CFI signal timing that was like an auxiliary phase to help Siegen traffic. We found that as long as that phase was utilized, Siegen traffic was serviced very well, but Sherwood Forest traffic had a very poor level of service. On the other hand, if that phase was omitted, Sherwood Forest traffic was well served, but Siegen traffic had a poor level of service. Ms. Sarah Edel of our staff came up with the innovative idea of having two timing plans (one with and one without the auxiliary phase), and alternating back and forth between the two plans to flush the queued traffic periodically on each side street. This seemed to better equalize the side street traffic, but we have determined that there is no way to reasonably handle the Airline traffic in the p.m. peak hour. Long queues are observed daily on both southbound Airline and eastbound Jefferson which merges into Airline just upstream of the Airline @ Sherwood Common signal (the closest signal north of the CFI intersection).

Consideration of Adjacent Intersection: At one point it was questioned whether some of the queuing was attributable to the Sherwood Common intersection, noting that the queue for the Sherwood Common intersection was very close to the length between the Sherwood Common and CFI intersection. That is, the queue for the CFI intersection has been running approximately a mile in length with about half of it extending between the two intersections and the other half approaching the Sherwood Common intersection. On several timing runs that were made on southbound Airline in the p.m. peak period, it was noticed that the delay for the first half of the queue (approaching the Sherwood Common intersection) was about twice as long as that for the second half of the queue (that portion between the Sherwood Common and CFI intersections). This raised the question of whether the Sherwood Common intersection was causing some of the queuing. In an effort to answer this question, a test was conducted at the Sherwood Common intersection. During the test period of a few days, the cycle length for the Sherwood Common intersection was doubled with virtually all of the additional time given to the Airline Highway southbound movement. During this period there was no observable difference in the queuing or delays after that timing change, which is indicative that the queuing is attributable to the CFI intersection and not the Sherwood Common intersection.

Comparison Calculations: Several comparison analyses were undertaken to assess the theoretical effectiveness of a CFI intersection versus a conventional six-lane intersection with dual left-turn lanes assuming double-left turn lanes on the main street for each. Below is a listing of various comparisons analyzed, followed by the results of each comparison analysis.

1. Intersection: Airline @ Siegen (analyze both intersection types)
   Analysis: simulated 4-lane CFI intersection vs conventional 6-lane intersection

2. Intersection: Airline @ Siegen (as CFI intersection)
   Analysis: Airline @ Siegen traffic vs Airline @ Coursey traffic superimposed on CFI

3. Intersection: Airline @ Bluebonnet/Coursey (as conventional 6-lane intersection)
   Analysis: comparing LOS with Airline @ Coursey traffic vs Airline @ Siegen traffic superimposed

The results of these comparisons are as follows (see attached comparison tables)

1. Intersection: Airline @ Siegen (analyze both intersection types)
   Analysis: simulated 4-lane CFI intersection vs conventional 6-lane Intersection

   The analysis results showed intersection levels of service (LOS) very similar between a 4-lane CFI intersection and a 6-lane conventional intersection, noting that the idealized CFI LOS is artificially low because the main street left turns are not considered, therefore, the left-turn delays are falsely assigned a value of "0". (see table p A–7)

2. Intersection: Airline @ Siegen (as CFI intersection)
   Analysis: Airline @ Siegen traffic vs Airline @ Coursey traffic

   The analysis results showed intersection levels of service (LOS) much higher for the case with the Airline @ Coursey intersection traffic superimposed than for the base case where the actual CFI traffic was analyzed. (see table p A–8)

3. Intersection: Airline @ Coursey (as conventional 6-lane intersection)
   Analysis: comparing LOS with Airline @ Coursey traffic
   vs Airline @ Siegen traffic

   The analysis results showed intersection levels of service (LOS) very similar with the Coursey traffic versus the Siegen traffic (see table p A-9)

Given these analysis results, the conclusions are somewhat confusing. However, the field observations definitely show much better performance of the conventional intersection at the intersection of Airline @ Bluebonnet / Coursey over that of the CFI intersection at Airline @ Sherwood / Siegen.

Traffic Volume Comparison: It was noted that when the total intersection traffic volume of the Airline @ Bluebonnet / Coursey intersection was compared to the total volume of the Airline @ Sherwood / Siegen intersection, the former was significantly higher. As noted previously, however, the Airline @ Bluebonnet / Coursey intersection volume was somewhat inflated by the large right-turn volume from Coursey to Airline. (see table p A-10).

Photographs of Traffic Queueing: Several pictures were taken at approximately the same times of each intersection during the p.m. peak period. The persons taking the pictures communicated by cell phone to assure that they were taking pictures at each intersection, at the end of green for southbound Airline at each signal, at nearly the same time. The pictures are included herein. (see pictures, p A-11 – A-14)

Cost Comparison CFI vs Six-Lane Intersection: The cost of the CFI intersection was around $4.4 million. It is noted that this cost included over $1 million for a frontage road that was required to mitigate lost access due to the CFI intersection. The Airline six-laning project cost $17,183,158 for a length of 3.68 miles, for a cost of $4.67 million / mile. I have an estimate from the District 61 Design Section that would indicate that the cost of six-laning a section of Airline at the CFI would be around $2.86 million (Sherwood / Siegen to Jefferson + 500' on each end and a transition). To construct a six-lane section from Sherwood Common to Jefferson + 500' on each end and a transition would be around $5.0 million.

Another cost factor with the CFI intersection is that due to its complexity and the concerns about the intersection's performance during a power failure with no signal operation, an emergency generator was installed at a cost of approximately $10,000. There is also an annual cost of approximately $1000 / year for the contractor who periodically tests, maintains, and monitors the generator. Although the Department has taken the position that this additional cost is a requirement for this intersection, it is also being considered for conventional intersections both to minimize risks from routine power failures as well as to guarantee intersection performance during hurricane evacuations.

CFI Selection Criteria: One very key criterion in considering a CFI intersection is the left-turn volumes. Obviously, the higher the left-turn volumes are as a percentage of the total approach volumes, the more advantageous a CFI intersection is likely to be, because the green time for the left-turn signal phases at the intersection that are being eliminated would, therefore, be higher, thereby allowing the redistribution of a larger eliminated green time to the other signal phases. The left-turn percentages at this intersection range from 7.1% to 16.5%, which were the southbound and northbound percentages, respectively, in the p.m. peak period. The greater the left-turn percentage is, the greater the ability of the CFI is to compete with an alternative geometric improvement that would add an additional through lane.

The other criterion is the existing right-of-way envelope and access to corner developments. CFI intersections have a larger footprint than conventional intersections and require a significant amount of right-of-way. The access to corner developments can be limited, and even cut off, as was the case with this project which required the costly mitigation of an access frontage road, which was over 25% of the project cost.

Conclusion: After a lengthy study including many manhours of signal timing in the field, computations, and observations, it can be concluded that the CFI intersection has significantly improved traffic flow through the Airline @ Sherwood / Siegen intersection. However, traffic volume increase due to Hurricane Katrina has offset much of that improvement. It is noted that traffic flows during most of the day are greatly improved over the former conventional intersection. The CFI intersection is an innovative design concept that should be considered in the future. However, from the lessons learned from this project, it is clear that the next time a CFI intersection is being considered, more evaluation of critical factors should be done to assure a more successful project. These factors would include:

1. Access issues and the potential for additional mitigation improvements
2. Mainline left-turn volumes as a percent of the total mainline volumes
3. Mainline total volumes versus side street total volumes
4. Mainline left-turn volumes versus side street left-turn volumes
5. Comparison of the most desirable traffic legs for CFI implementation versus the most desirable right-of-way legs

The data herein indicates that for this location the CFI design was less efficient than a six-lane design. However, this may not be the case at other intersections where the two design types may be compared in the future. While the CFI intersection concept has proven its worth at this intersection, a more careful consideration of the above five factors would increase the likelihood of a more successful CFI project in the future.

Ronald D. Carter
09/18/07

Appendix

Airline Corridor Times Before CFI (a.m. peak)

(Seconds Between Intersections)

5/3/2005

		Nesser	Sherwood Common	Sherwood / Seigen	Jefferson	Industriplex / Pecue	
distance (mi)		0.340	0.465	0.285	0.930		
distance (ft)		1795	2455	1505	4910		
start / end time							
southbound	Run						Corridor
7:07:51 a.m.	1	63	34	22	129		248
	2	26	43	65	85		219
	3	57	51	25	127		260
	4	26	111	122	90		349
	5	57	39	60	74		230
	6	57	46	60	84		247
	7	53	42	25	108		228
8:27:14 a.m.	8	29	35	26	143		233
Ave		46	50	51	105		252
northbound	Run						
7:18:08 a.m.	1	20	40	57	101		218
	2	23	74	46	128		271
	3	20	47	62	116		245
	4	19	34	44	106		203
	5	20	38	31	116		205
	6	25	35	31	109		200
8:22:46 a.m.	7	17	45	35	123		220
Ave		21	45	44	114		223

Airline Corridor Times After CFI (a.m. peak)

(Seconds Between Intersections)

6/7/2006

		Nesser	Sherwood Common	Sherwood / Seigen	Jefferson	Industriplex / Pecue	
distance (mi)		0.340	0.465	0.285	0.930		
distance (ft)		1795	2455	1505	4910		
start / end time							
southbound	Run						Corridor
6:59:14 a.m.	1	35	65	46	145		291
	2	29	73	53	70		225
	3	24	71	38	80		213
	4	30	80	75	106		291
	5	66	93	73	102		334
	6	57	89	69	68		283
8:21:18 a.m.	7	25	74	30	124		253
Ave		38	78	55	99		270
northbound	Run						
7:09:44 a.m.	1	22	41	94	75		232
	2	17	38	113	147		315
	3	20	47	112	173		352
	4	23	63	108	207		401
	5	23	58	79	136		296
	6	23	85	53	128		289
8:23:43 a.m.	7	22	107	84	129		342
Ave		21	63	92	142		318

Airline Corridor Times Before CFI (p.m. peak)

5/3/2005

		Nesser	Sherwood Common	Sherwood / Seigen	Jefferson	Industriplex / Pecue	Total
distance (mi)		0.340	0.465	0.285	0.930		2.02
distance (ft)		1795	2455	1505	4910		10,666
start / end time		(Seconds Between Intersections)					
southbound	Run						Corridor
3:44:30 p.m.	1	26	123	30	134		313
	2	28	60	21	120		229
	3	50	133	27	138		348
	4	51	301	29	133		514
	5	77	261	27	150		515
	6	111	203	31	142		487
	7	155	208	27	169		559
	8	165	218	28	137		548
	9	63	272	24	144		503
5:57:26 p.m.	10	84	173	26	113		396
Ave		81	195	27	138		441
northbound	Run						
3:55:19 p.m.	1	24	36	30	122		212
	2	19	35	27	118		199
	3	18	34	28	128		208
	4	19	35	28	125		207
	5	19	35	27	138		219
	6	19	36	25	117		197
	7	21	43	101	109		274
	8	20	32	24	124		200
	9	18	34	26	125		203
6:00:00 p.m.	10	20	35	117	114		286
Ave		20	36	43	122		221

Airline Corridor Times After CFI (p.m. peak)

6/6/2006

		Nesser	Sherwood Common	Sherwood / Seigen	Jefferson	Industriplex / Pecue	
distance (mi)		0.340	0.465	0.285	0.930		
distance (ft)		1795	2455	1505	4910		
start / end time		(Seconds Between Intersections)					
southbound	Run						Corridor
3:44:36 p.m.	1	31	55	26	135		247
	2	27	99	34	145		305
	3	28	107	29	92		256
	4	71	156	31	163		421
	5	60	133	32	192		417
	6	62	186	33	203		484
	7	95	156	32	302		585
	8	183	222	40	243		688
6:00:00 p.m.	9	169	232	32	217		650
Ave		81	150	32	188		450
northbound	Run						
3:56:00 p.m.	1	22	46	75	124		267
	2	27	74	34	145		280
	3	23	78	31	110		242
	4	24	79	38	106		247
	5	22	83	41	96		242
	6	23	88	31	226		368
	7	24	80	33	207		344
	8	24	73	46	108		251
6:03:19 p.m.	9	20	40	45	87		192
Ave		23	71	42	134		270

Airline Corridor Times After CFI Timing Plan Adjustments (p.m. peak)

8/8/2006

		Nesser	Sherwood Common	Sherwood / Seigen	Jefferson	Industriplex / Pecue	
distance (mi)		0.340	0.465	0.285	0.930		
distance (ft)		1795	2455	1505	4910		
start / end time		(Seconds Between Intersections)					
southbound	Run						Corridor
3:41:30 p.m	1	28	56	36	80		200
	2	50	43	23	131		247
	3	42	99	27	121		289
	4	51	50	27	111		239
	5	45	75	26	100		246
	6	26	106	30	99		261
	7	44	139	26	71		280
	8	53	201	29	79		362
	9	94	143	28	64		329
	10	28	129	30	112		299
	11	34	62	26	66		188
6:00:14 p.m.	12	24	116	27	67		234
Ave		43	102	28	92		265
northbound	Run						
3:48:22 p.m.	1	24	73	39	176		312
	2	25	57	46	108		236
	3	24	69	39	215		347
	4	23	70	42	239		374
	5	21	74	42	168		305
	6	24	79	37	173		313
	7	19	34	35	180		268
	8	23	74	47	288		432
	9	21	74	44	99		238
	10	18	76	44	115		253
5:53:39 p.m.	11	28	72	42	146		288
Ave		23	68	42	173		306

PM Volume Comparison of CFI Intersection (before/after CFI)

Feb 2004

Airline						Side Street					
SB Airline			NB Airline			Siegen			Sherwood Forest		
L	T	R	L	T	R	L	T	R	L	T	R
128	1638	217	327	1022	285	592	575	432	361	428	57
1983			1634			1599			846		
3617						2445					
6062											

Oct 2005

Airline						Side Street					
SB Airline			NB Airline			Siegen			Sherwood Forest		
L	T	R	L	T	R	L	T	R	L	T	R
121	1622	246	216	1174	255	549	622	314	368	528	83
1989			1645			1485			979		
3634						2464					
6098											

08/08/06

Airline						Side Street					
SB Airline			NB Airline			Siegen			Sherwood Forest		
L	T	R	L	T	R	L	T	R	L	T	R
141	1719	369	336	1126	142	557	737	539	319	584	75
2229			1604			1833			978		
3833						2811					
6644											

Percentage Increases

Airline						Side Street					
SB Airline			NB Airline			Siegen			Sherwood Forest		
L	T	R	L	T	R	L	T	R	L	T	R
-5.5%	-1.0%	13.4%	-33.9%	14.9%	-10.5%	-7.3%	8.2%	-27.3%	1.9%	23.4%	45.6%
0.3%			0.7%			-7.1%			15.7%		
1.0%						8.6%					
0.6%											

Airline						Side Street					
SB Airline			NB Airline			Siegen			Sherwood Forest		
L	T	R	L	T	R	L	T	R	L	T	R
10.2%	4.9%	70.0%	2.8%	10.2%	-50.2%	-5.9%	28.2%	24.8%	-11.6%	36.4%	31.6%
12.4%			-1.8%			14.6%			15.6%		
6.0%						15.0%					
9.6%											

Analysis Comparisons — Volumes, Levels of Service & Delay

Airline @ Sherwood / Siegen

Case 1 — **Simulated CFI Analysis (not considering mainline left turns or peripheral intersection effects)**

AM Peak

	SB Airline			NB Airline			EB Siegen			WB Sherwood Forest			Intersection
	L	T	R	L	T	R	L	T	R	L	T	R	
volume	214	1275	300	355	1817	371	258	589	135	265	570	99	
LOS	A	C	B	A	E	B	F	F	D	F	F	F	
delay	0	22	15.4	0	62.1	16.7	83.7	92.9	46.4	87.9	146	146	
LOS		C			E			F			F		E
delay		20.8			55			84.6			130		63

PM Peak

SB Airline			NB Airline			EB Siegen			WB Sherwood Forest			Intersection
L	T	R	L	T	R	L	T	R	L	T	R	
156	1732	300	289	1196	271	478	704	306	176	533	337	
A	F	B	A	C	B	F	F	F	D	F	F	
0	81.1	16.1	0	25.6	18.1	251	101	80.8	51.4	214	214	
	E			C			F			F		F
	76.3			24.3			146			185		100

Case 2 — **6-lane Configuration with dual left turn lanes on Airline**

AM Peak

SB Airline			NB Airline			EB Siegen			WB Sherwood Forest			Intersection
L	T	R	L	T	R	L	T	R	L	T	R	
214	1275	300	355	1817	371	258	589	135	265	570	99	
F	D	D	F	E	E	F	F	C	F	F	F	
171	45.7	45.7	85.5	62.2	62.2	127	81.8	33.1	134	117	117	
	E			E			F			F		E
	60.9			65.5			87.8			122		76.1

PM Peak

SB Airline			NB Airline			EB Siegen			WB Sherwood Forest			Intersection
L	T	R	L	T	R	L	T	R	L	T	R	
156	1732	300	289	1196	271	478	704	306	176	533	337	
F	F	F	F	D	D	F	F	D	E	F	F	
83.9	103	103	235	43.3	43.3	250	82.4	43.8	67.3	167	167	
	F			E			F			F		F
	102			75.4			130			150		109

Analysis Comparisons — Volumes, Levels of Service & Delay

Airline @ Sherwood / Siegen

Case 1 — Simulated CFI Analysis with Airline @ Sherwood / Siegen Traffic

AM Peak

	SB Airline			NB Airline			EB Siegen			WB Sherwood Forest			Intersection
	L	T	R	L	T	R	L	T	R	L	T	R	
volume	214	1275	300	355	1817	371	258	589	135	265	570	99	
LOS	A	C	B	A	E	B	F	F	D	F	F	F	
delay	0	22	15.4	0	62.1	16.7	83.7	92.9	46.4	87.9	146	146	
LOS		C			E			F			F		E
delay		20.8			55			84.6			130		63

PM Peak

	SB Airline			NB Airline			EB Siegen			WB Sherwood Forest			Intersection
	L	T	R	L	T	R	L	T	R	L	T	R	
	156	1732	300	289	1196	271	478	704	306	176	533	337	
	A	F	B	A	C	B	F	F	F	D	F	F	
	0	81.1	16.1	0	25.6	18.1	251	101	80.8	51.4	214	214	
		E			C			F			F		F
		76.3			24.3			146			185		100

Case 2 — Simulated CFI Analysis with Airline @ Bluebonnet / Coursey Traffic Superimposed

AM Peak

	SB Airline			NB Airline			EB Siegen			WB Sherwood Forest			Intersection
	L	T	R	L	T	R	L	T	R	L	T	R	
	580	1654	458	26	1422	9	313	346	40	27	620	1042	
	A	F	B	A	E	B	F	C	C	D	F	F	
	0	142	18.1	0	72.2	11.3	350	28.9	26	50.1	336	336	
		F			E			F			F		F
		117			71.9			174			331		172

PM Peak

	SB Airline			NB Airline			EB Siegen			WB Sherwood Forest			Intersection
	L	T	R	L	T	R	L	T	R	L	T	R	
	807	1987	234	24	1358	18	515	1018	67	32	477	705	
	A	F	B	A	E	A	F	F	C	D	F	F	
	83.9	103	103	235	43.3	43.3	250	82.4	43.8	67.3	167	167	
		F			E			F			F		F
		226			56			190			222		180

Analysis Comparisons — Volumes, Levels of Service & Delay

Airline @ Bluebonnet / Coursey

Case 1 — **Airline @ Bluebonnet / Coursey (6-Lane) Intersection with its own traffic**

AM Peak

	SB Airline			NB Airline			EB Bluebonnet			WB Coursey			Intersection
	L	T	R	L	T	R	L	T	R	L	T	R	
volume	580	1654	458	26	1422	9	313	346	40	27	620	1042	
LOS	F	D	C	E	F	C	E	D	D	E	F	D	
delay	92.1	50.8	25	65.2	182	24.3	61.4	38.4	38.4	61.4	89.9	44.2	
LOS		E			F			D			E		F
delay		55.4			179			48.8			61.8		84.1

PM Peak

SB Airline			NB Airline			EB Bluebonnet			WB Coursey			Intersection
L	T	R	L	T	R	L	T	R	L	T	R	
807	1987	234	24	1358	18	515	1018	67	32	477	705	
F	F	B	E	F	C	E	F	F	E	F	C	
224	128	14.6	64.1	198	26.5	62.1	146	146	69.2	110	32.8	
	F			F			F			E		F
	146			194			119			66		136

Case 2 — **Airline @ Bluebonnet / Coursey (6-Lane) Intersection with Airline @ Sherwood / Siegen traffic superimposed**

AM Peak

SB Airline			NB Airline			EB Bluebonnet			WB Coursey			Intersection
L	T	R	L	T	R	L	T	R	L	T	R	
214	1275	300	355	1817	371	258	589	135	265	570	99	
F	E	C	F	E	C	E	F	F	F	E	D	
147	59.8	23.4	209	57.6	21.6	69.6	170	170	343	77.4	35.7	
	E			E			F			F		F
	64.8			74.2			144			150		93.7

PM Peak

SB Airline			NB Airline			EB Bluebonnet			WB Coursey			Intersection
L	T	R	L	T	R	L	T	R	L	T	R	
156	1732	300	289	1196	271	478	704	306	176	533	337	
E	F	B	F	D	C	F	F	F	F	E	D	
75.9	140	19.7	501	38.6	20.9	126	327	327	303	57.4	35.2	
	F			F			F			F		F
	117			113			261			134		152

Volume Comparison on US 61 (Airline Hwy) Intersections

a.m. peak hour

Bluebonnet / Coursey

Airline						Side Street					
SB Airline			NB Airline			Bluebonnet			Coursey		
L	T	R	L	T	R	L	T	R	L	T	R
580	1654	458	26	1422	9	313	346	40	27	620	1042
2692			1457			699			1689		
4149						2388					
6537											

Sherwood Common

Airline						Side Street					
SB Airline			NB Airline			Service Rd			Sherwood Common		
L	T	R	L	T	R	L	T	R	L	T	R
50	2003	17	43	2052	43	48	48	100	84	58	261
2070			2138			196			403		
4208						599					
4807											

Sherwood / Siegen CFI

Airline						Side Street					
SB Airline			NB Airline			Siegen			Sherwood Forest		
L	T	R	L	T	R	L	T	R	L	T	R
214	1275	300	355	1817	371	258	589	135	265	570	99
1789			2543			982			934		
4332						1916					
6248											

p.m. peak hour

Bluebonnet / Coursey

Airline						Side Street					
SB Airline			NB Airline			Bluebonnet			Coursey		
L	T	R	L	T	R	L	T	R	L	T	R
807	1987	234	24	1358	18	515	1018	67	32	477	705
3028			1400			1600			1214		
4428						2814					
7242											

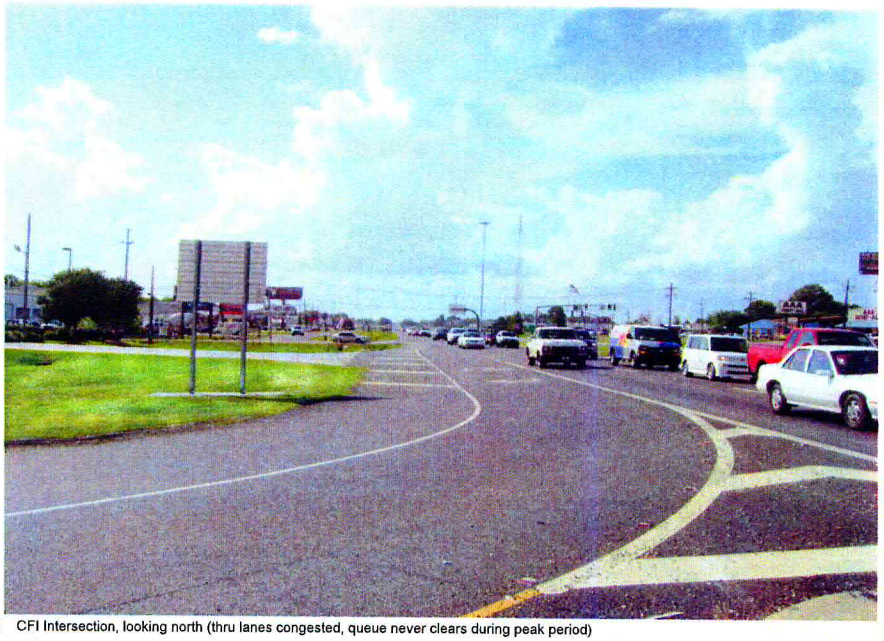
Sherwood Common

Airline						Side Street					
SB Airline			NB Airline			Service Rd			Sherwood Common		
L	T	R	L	T	R	L	T	R	L	T	R
40	2182	13	41	1828	106	48	47	60	70	52	113
2235			1975			155			235		
4210						390					
4600											

Sherwood / Siegen CFI

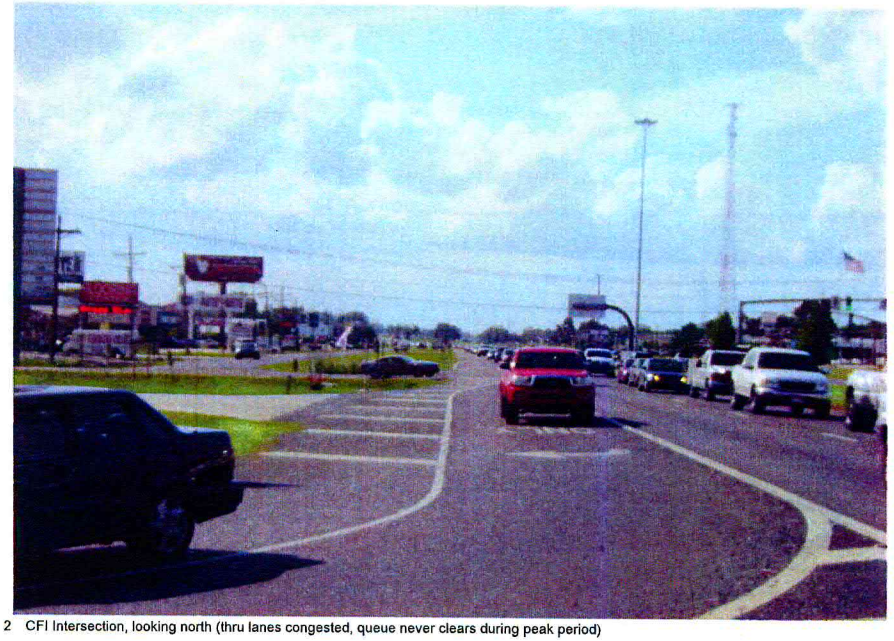
Airline						Side Street					
SB Airline			NB Airline			Siegen			Sherwood Forest		
L	T	R	L	T	R	L	T	R	L	T	R
156	1732	300	289	1196	271	478	704	306	176	533	337
2188			1756			1488			1046		
3944						2534					
6478											

1 Bluebonnet / Coursey Intersection, looking north (thru lanes clear)



1 CFI Intersection, looking north (thru lanes congested, queue never clears during peak period)

2 Bluebonnet / Coursey Intersection, looking north (right thru lane clear, some vehicles stranded in left thru lane)



2 CFI Intersection, looking north (thru lanes congested, queue never clears during peak period)

3 Bluebonnet / Coursey Intersection, looking north (right thru lane clear, some vehicles stranded in left thru lane)

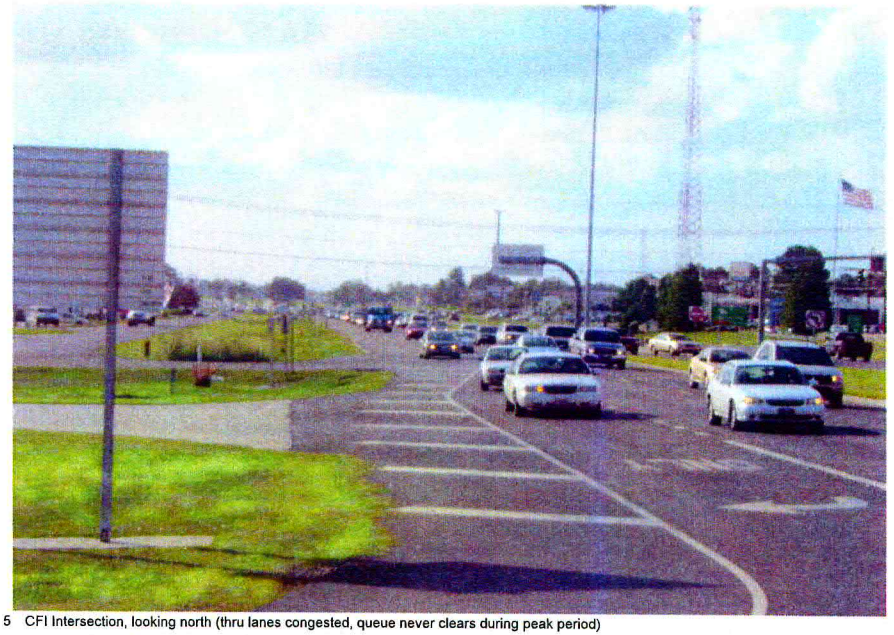
3 CFI Intersection, looking north (thru lanes congested, queue never clears during peak period)

4 Bluebonnet / Coursey Intersection, looking north (some congestion, right thru lane clear)

4 CFI Intersection, looking north (thru lanes congested, queue never clears during peak period)

5 Bluebonnet / Coursey Intersection, looking north (thru lanes clear, late arrivals shown)

6 Bluebonnet / Coursey Intersection, looking north (some cars stranded)



5 CFI Intersection, looking north (thru lanes congested, queue never clears during peak period)

6 CFI Intersection, looking north (thru lanes congested, queue never clears during peak period)

7 Bluebonnet / Coursey Intersection, looking north (few cars stranded, large open space behind them)

7 CFI Intersection, looking north (thru lanes congested, queue never clears during peak period)