OBSERVATION AND MODELING OF TRAFFIC OPERATIONS AT INTERSECTIONS IN MALFUNCTION FLASH MODE

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OBSERVATION AND MODELING OF TRAFFIC OPERATIONS AT INTERSECTIONS IN MALFUNCTION FLASH MODE

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SUMMARY

When a traffic signal's malfunction monitoring unit detects a problem with a traffic signal such as the simultaneous display of green indications to conflicting movements or loss of power to some signal heads, the signal is automatically placed into flash mode as a safety precaution. Signals can have either red/red malfunction flash, where all vehicles facing a flashing red signal and are required to stop before entering the intersection, or they can have yellow/red malfunction flash, where only vehicles on the minor street facing a flashing red signal and are required to stop. At an individual intersection, only one of these modes of flashing can be used during malfunctions; the mode cannot change by time of day or day of week.

In addition to malfunction flash mode, signals can intentionally be placed into flash for a variety of reasons. One common and well-studied use of flashing operation is during low-volume, nighttime conditions when signal warrants are not being met. The results of studies of these conditions, though, have limited applicability to malfunction flash. Malfunction flash can occur during peak periods when volumes are much higher than overnight conditions, and malfunction flash cannot be eliminated (many studies of programmed nighttime flash have recommended when it is and is not appropriate to use).

A review of traffic engineering manuals and a survey of agencies responsible for the maintenance and operation of traffic signals revealed that little formal guidance with regard to flash mode choice during malfunctions exists. In most agencies, the choice is made based solely on engineering judgment. Throughout Georgia and most of the US, yellow/red flash is favored because it is believed to be more operationally efficient.

This study analyzed traffic operation at 34 instances of yellow/red malfunction flash and 9 instances of red/red malfunction flash in the Atlanta, Georgia area. A high level of driver confusion exists at such intersections. The rate at which through major street drivers (i.e. those facing a flashing yellow signal) stopped exceeded 75 percent at some yellow/red flash intersections. This creates a safety hazard for other major street drivers who are not expecting vehicles to stop, and for minor street drivers who cannot tell what type of control is being presented to cross traffic or do not understand that vehicles are not required to stop when approaching a flashing yellow indication. Furthermore, high stopping rates at a flashing yellow signal eliminate many of the operational benefits that yellow/red flash is assumed to have over red/red flash.

Based on the findings of this study, the use of red/red flash should be the primary flash mode and possibly used exclusively. Requiring all vehicles to stop will improve safety conditions and not have large operational impacts at intersections where a majority of major street vehicles are already stopping at a flashing yellow signal. There may be some situations where yellow/red flash is an acceptable malfunction flash mode however additional measures would be required at those intersections to address potential driver confusion. There is no ideal flash mode and neither flash mode is preferred in comparison to normal signal operation, but the nature of malfunction flash makes it impossible to completely eliminate. However, the best strategy to reduce the safety and operation impacts of malfunction flash mode is the reduction in its occurrence and minimizing its time frame when it does occur.

CHAPTER 1

INTRODUCTION

The United States has more than 260,000 traffic signals controlling vehicular activity at roadway intersections [1]. Significant resources have been invested in operational and safety improvements at signalized intersections. Technologies such as actuated traffic signals and coordinated traffic signals have been developed to reduce delay and increase capacity. Yellow and all-red clearance intervals are designed to reduce the number of drivers that will pass through the intersection on a steady red indication. These innovations, as well as many others, are dependent upon a traffic signal operating in normal, green/yellow/red mode.

The alternative to normal operation of traffic signals is flashing operation. There are four primary categories of flashing operation [2]:

- Programmed – scheduled, usually during periods of low volume,
- Police panel – manually initiated at a controller cabinet, usually so an officer can direct traffic by hand,
- Technician – manually initiated at a controller cabinet, usually so a technician can perform maintenance on signal equipment,
- Malfunction – automatically initiated by the signal's malfunction monitoring unit.

Under any of these scenarios, there are two sets of signal indications that can be displayed to drivers. One option is to have signal heads for all approaches flash red (red/red flash), and the other is to have signal heads for the major road flash yellow and signal heads for the minor road flash red (yellow/red flash). The meaning of flashing yellow and flashing red signals is regulated by the legal code of each state, but state to state differences are minor. Georgia law, stated in Section 40-6-23 of the Unannotated Georgia Code [3], is typical of most state laws:

> "When a red lens is illuminated with rapid intermittent flashes, drivers of vehicles shall stop at a clearly marked stop sign… …When a yellow lens is illuminated with rapid intermittent flashes, drivers of vehicles may proceed through the intersection or past such signal only with caution."

Little guidance is available with regard to the selection of flash mode. The 2003 Manual of Uniform Traffic Control Devices (MUTCD) [4] essentially avoids the issue by allowing both. In Section 4D.11, guidance states:

> "When a traffic control signal is operated in the flashing mode, a flashing yellow signal indication should be used for the major street and a flashing red signal indication should be used for the other approaches unless flashing red signal indications are used on all approaches."

In practice, yellow/red is the default flash mode selection in most states, including Georgia. Red/red is generally used under special circumstances, such as the intersection of two large roads, unusual geometry, or a lack of sight distance. These decisions are made with engineering judgment on a case-by-case basis.

1.1 Study Need

Previous studies of flashing traffic signal operation have largely focused on program flash. This type of flashing operation is used almost exclusively during late night and early morning hours when traffic volumes are very low. Using a variety of techniques, primarily accident data and simulation models, many of these studies have recommended the conditions under which program flash is appropriate. Malfunction flash can occur at any time of day, under any demand conditions that exists at the intersection. Thus, driver response, as well as traffic operations, may be fundamentally different than under program flash. Malfunction flash can also not be eliminated as it is a failsafe mode, so the recommendations of many previous studies (i.e. when to use program flash and when to not use it) are not applicable.

Previous studies generally assumed that all drivers would stop when facing a flashing red indication and no drivers would stop when facing a flashing yellow indication. Few studies attempted to validate these assumptions by observing driver behavior at flashing signals, and driver surveys have indicated that many drivers are not aware of the meaning of flashing yellow and flashing red indications. If a significant percentage of drivers do not stop at flashing red signals or stop at flashing yellow signals, traffic operations may be quite different than previous studies have suggested. This confusion would also create safety risks at intersections operating under malfunction flash.

This thesis is the second part of larger, three part project. The first part, Bansen's *Evaluation of Traffic Operations at Intersections in Malfunction Flash Mode* [2], developed measures of effectiveness for traffic operations at intersections operating under malfunction flash control and a computer program to track vehicle movements at such intersections. This was done with a small field dataset collected at malfunction flash controlled intersections in the Atlanta area. This portion of the project uses Bansen's computer program to analyze a much larger dataset and propose a policy stating which flash mode (yellow/red or red/red) should be used at intersections under various conditions based on both Bansen's measures of effectiveness (MOEs) and additional

MOEs. A model of the stopping rate of vehicles facing a flashing yellow signal is also developed in this part of the project. A third part of the project will simulate traffic operation at malfunction-flash controlled intersections using the stopping rate model as a means of comparing yellow/red and red/red flashing operation.

1.2 Study Objective

The purpose of this study is to propose a policy for flash mode choice during traffic signal malfunction events. There are three possible policies: exclusive use of yellow/red flash, exclusive use of red/red flash, or use of both modes with the selection at a particular intersection based upon criteria identified in this study.

1.3 Study Overview

The primary focus of this study was the collection and analysis of field data. Traffic operations at malfunctioning traffic signals were recorded with a video camera at intersections in the Atlanta, Georgia area. Flashing signals were located by members of the research team in their everyday travels and colleagues and friends notified team members via cellular telephone of any flashing traffic signals they encountered. The video footage was then returned to the lab, processed with a computer program developed in previous portion of this study, and analyzed. Signals were never intentionally placed into flash due to the safety risks associated with flashing operation.

As the ultimate goal of this project was to propose a policy for flash mode choice during malfunction events, it was important to see what policies may already exist with regard to flashing operation in general. A review of all readily accessible state documentation related to flashing operation was conducted, as well as a survey of agencies responsible for the maintenance and operation of traffic signals. A summary of each section of the report is included below.

1.3.1 Literature Review

The literature review discussed in Chapter 2 of this report has two main sections. The first is a review of previous studies of flashing operation of traffic signals. Most of these studies were of late night and early morning program flash, which is used under low volume conditions. No studies of traffic operations under malfunction flash were found. The second portion of the literature review is a summary of flashing signal regulation and guidance found in state MUTCDs and state traffic engineering manuals. Much of this material is also focused on program flash.

1.3.2 State of Practice Survey

A survey was sent to every agency in Georgia that maintains traffic signals, as well as select agencies across the country. The purpose of the survey was to identify current practices for several issues related to flashing operation including the frequency of malfunction flash, causes of malfunction flash, agency notification of and response to malfunction flash, and flash mode (yellow/red or red/red) selection criteria. The results of the survey are summarized in Chapter 3 and presented in more detail in Appendices A and B.

1.3.3 Field Data Collection and Processing

Chapter 4 presents an overview of the field data collection process and the analysis program developed by Bansen. A summary of the dataset itself is included, with more information provided in Appendices C and D. The chapter also includes the details of a quality control program used to ensure accurate processing of field data by the various members of the project team.

1.3.4 Field Data Analysis

The heart of this thesis is the analysis described in Chapter 5. The emphasis of the analysis is the rate at which drivers choose to stop at flashing yellow and flashing red signals. The stopping rate at flashing yellow signals varied widely from intersection to intersection, and a number of variables were studied to identify the characteristics of an intersection that best predict major street (that is, facing a flashing yellow signal) stopping rate. Stopping rates on the minor street and at red/red intersections were also studied.

1.3.5 Modeling

One of the primary findings of the operational analysis was that a large number of drivers facing a flashing yellow signal chose to stop. The rate at which stopping occurred varied greatly from one study location to another, and a logit model was developed to predict the probability of a major street driver stopping at a yellow/red intersection based on the presence or absence of a minor street vehicle and the volume ratio between the two streets. The model is presented in Chapter 6.

CHAPTER 2

LITERATURE REVIEW

Since the invention of the traffic signal in the early part of the 20^{th} century, research has been conducted to analyze driver behavior and traffic operation at signalized intersections. This research has been used as the basis for traffic signal policies and standards, such as those found in the Manual of Uniform Traffic Control Devices (MUTCD) and various state-level documents. Much of this research has been focused on normal, green/yellow/red operation of signals. It has always been recognized, though, that traffic signals can also be operated in flash mode. Some flash mode-related research has been conducted, primarily with a focus on program flash. Program flash is scheduled to occur by time of day, usually during overnight hours when traffic volume is low.

The purpose of most program flash studies has been to determine when the use of program flash is appropriate [5-11]. This has been done by analyzing accidents rates at signalized intersections operating under program flash and comparing them to accident rates at signalized intersections operating under normal signal control. Some studies have also used models to compare various signal operation modes, such as pre-timed, actuated, yellow/red flash, and red/red flash [5,6]. In the models, it has always been assumed that all vehicles stop at a flashing red signal and no vehicles stop at a flashing yellow signal. These studies have found that either flash mode usually results in less delay and less fuel consumption than pre-timed or actuated control. Since the simulations have been based on low-volume conditions that do not meet signal warrants, these results are not surprising.

Although program flash studies represent most of the knowledge base of flashing operation, the ability to apply these findings to malfunction flash situations is somewhat limited. Malfunction flash cannot be eliminated, so safety-based studies recommending the elimination of program flash in specific situations cannot be generalized to recommend the elimination of malfunction flash in specific situations. Safety-based studies examining differences between the two modes of flash (yellow/red and red/red) would be useful, but little research has been done in this area. The results of simulation-based studies should be applied to malfunction flash situations with caution as the simulations are based on low volume conditions and the driver behavior assumptions have not been verified with field observations.

A handful of states have state specific MUTCDs or other traffic engineering manuals that address flashing operation. As most flashing operation research has focused on program flash, so has most flashing operation policy and guidance. Much of this documentation provides little or no guidance with regard to the mode of flash.

2.1 Previous Studies of Flashing Operation

Summaries of previous studies of flashing operation and major findings of those studies are presented in this section. Many of these studies were also summarized by Bansen in the first phase of this project, so readers are referred to his work, *Evaluation of Traffic Operations at Intersections in Malfunction Flash Mode*, [2] for a more thorough discussion of some previous studies. Included below are summaries of the two major studies of flashing operation that have been conducted, as well as several smaller studies.

2.1.1 Federal Highway Administration (1980)

In the late 1970's, the Federal Highway Administration sponsored several studies of traffic signal operations collectively entitled *A Study of Clearance Intervals, Flashing Operation, and Left-Turn Phasing at Traffic Signals*. Volume three of this study [5], which was conducted by the San Francisco-area firm TJKM, covers flashing operation. The objectives of the study were to answer the following two questions:

- "Under what circumstances should traffic signals be operated in a flashing mode?
- Where flashing operation is used, when should it have a yellow/red pattern and when should it have a red/red pattern?" [5]

In order to answer these questions, the following techniques were used:

- "A literature review of standards and past research studies
- A review of applicable state laws
- A questionnaire to state and local traffic engineers regarding their practice and personal experiences
- A questionnaire to drivers regarding their understanding of flashing operation
- Field studies of operations and safety
- An analysis of the effects of flashing operation on fuel consumption, vehicle emissions and signal costs
- An analysis of analytical models that can be used to predict the effects of flashing and regular signal operation" [5]

The literature review summarizes documents dating back to the 1934 MUTCD. Early literature recommended the use of flash at off-peak hours as a means of reducing delay. Beginning in the 1960's, though, studies began to find that converting signals from flashing to normal operation reduced accident rates during the periods in which flash mode had been used. Literature discussing flash mode choice was also reviewed. The vast majority of guidance documents (such as current and previous editions of the MUTCD and traffic engineering handbooks) favor the use of yellow/red flash. The authors of the FHWA study acknowledge that yellow/red is a more efficient means of traffic control than red/red, but they also feel that safety is “probably the most important consideration in choosing the type of flashing operation” [5]. Unfortunately, no studies comparing safety at yellow/red and red/red flash controlled intersections had been conducted at the time the FHWA was written.

The survey of agencies that maintain traffic signals received 250 responses. These agencies represented states, large and small cities, and counties. A majority of agencies reported the use of program flash. A majority also reported having no warrants for the use of flashing operation and having conducted no studies within their jurisdiction of the effects of flash on traffic operation or accident rates. One hundred forty seven agencies reported the use of yellow/red flash exclusively, 20 reported the use of red/red flash exclusively, and 37 reported the use of a combination. Red/red and combination were most common in the far west. This was also the region where late night program flash was the least common.

The survey of drivers received 352 responses at four different locations across the US. Participants were shown a five foot tall traffic signal that was manually placed into different modes of operation. Although the meanings of flashing yellow and flashing red indications were clear to a majority of drivers, the actions of cross-street traffic were not. This creates the potential for a dangerous scenario in which a driver enters an intersection while cross traffic is approaching but the cross traffic does not stop because it is facing a flashing yellow signal. The responses to questions related to flashing operation are shown in Figure 2.1. Numbers shown are percentages, arrows indicate the correct response.

PART 2. FLASHING TRAFFIC SIGNALS

3. In front of you is a traffic signal. Pretend that it is at an intersection. As you approach this flashing yellow signal, what must you do?

C3

→ 1. [90] Slow down and proceed through the intersection with caution.

2. [10] Stop before entering the intersection and yield to crossing traffic before proceeding.

4. At this same signal, what do you expect traffic on the cross-street to do?

C4

1. [23] Slow down and proceed through the intersection with caution.

→ 2. [53] Stop before entering the intersection and yield to me and other crossing traffic before proceeding.

3. [24] I cannot tell from looking at the traffic signal what they will do.

5. Here is another way a traffic signal may operate at an intersection. As you approach this flashing red signal, what must you do?

C5

1. [3] Slow down and proceed through the intersection with caution.

→ 2. [97] Stop before entering the intersection and yield to crossing traffic before proceeding.

6. At this same signal, what do you expect traffic on the cross-street to do?

C6

1. [39] Slow down and proceed through the intersection with caution.

2. [28] Stop before entering the intersection and yield to me and other crossing traffic before proceeding.

→ 3. [33] I cannot tell from looking at the traffic signal what they will do.

Figure 2.1 Responses to FHWA Driver Survey [5]

Field studies of accidents, conflicts, violations, spot speed, and stopped time delay were made at 94 locations. The majority were in Northern California, but some were in other parts of the county. The study was conducted in a before-and-after format; data under normal and flashing modes was captured at each intersection. Flashing yellow/red operation was found to "significantly increase the hazard of driving at night." [5] Exceptions to this were intersections where the major street to minor street volume ratio was 3 to 1 or more, and intersections where the major street volume was less than 200 vehicles per hour during flash. Accidents rates at intersections that flashed red/red were no higher than accident rates under normal operation. The violation study was less conclusive because it is impossible to violate a flashing yellow signal. Speed studies found average approach speed changes of less than one mile per hour when signals were converted from normal to either flashing yellow or flashing red operation. Under the low night time volumes studied, yellow/red flash produced less delay than any type of regular operation and red/red produced less delay than pretimed control but more delay than fully or semi-actuated control.

The conclusions identified by the authors based on the results of the study are:

- Yellow/red flash is acceptable when the major street volume is less than 200 vehicles per hour
- Above 200 vehicles per hour, yellow/red flash is only acceptable if the major street to minor street volume ratio is 3:1 or more.
- Accident rates should be monitored at locations where flash is used and if certain thresholds are exceeded flashing operation should be eliminated.
- Red/red flash should not be programmed as an alternative to normal operation

Additionally, the authors made several recommendations based on past studies and engineering judgment:

- Yellow/red flash should not be used at intersections where minor street drivers have a restricted view of major street traffic
- Yellow/red flash may be used at any intersection where stopping for an extended period of time (at a steady red signal) would make drivers subject to assault
- Red/red flashing operation is reasonable for emergency signal operation (such as a controller malfunction), emergency vehicle or railroad preemption, or transitional period prior to normal operation of a newly installed signal at an intersection previously controlled with a four-way stop.

2.1.2 Texas Transportation Institute (1993)

The second major study of flashing operation that has been conducted thus far was performed by the Texas Transportation Institute (TTI) for the Texas Department of Transportation and the Federal Highway Administration [6]. The findings of this report were subsequently summarized in ITE Journal [7] and Transportation Research Record 1421 [8]. The objectives of the study were the same as the objectives of the FHWA study [5] - to determine when flashing operation should be used and, when it is used, what mode should the flash be.

The study begins by listing common applications of flashing operation [6]:

- Low-volume periods
- As part of signal installation
- Prior to signal removal

- Emergencies (this encompasses controller malfunctions and technician flash)
- Adverse weather
- Railroad preemption
- School areas

Following this is a literature review of previous studies of flashing operation, of which the FHWA study [5] is acknowledged as the most comprehensive. Most previous studies have examined accident rates at signals programmed to flash during low volume overnight hours. Based on volume, volume ratio, time of night, and other factors, studies have created guidelines for when and where the use of flashing operation is appropriate. Most studies have not considered the mode of flash.

Two surveys were conducted – one of flashing practices in Texas, and the other of flashing practices during inclement winter weather. Twenty eight agencies in northern portions of the US responded to the winter flashing signal survey. Five of these agencies reported that they put some of their signals into flash when snow or ice is present. The purpose of doing so is to reduce the number of vehicles that have to start and stop on icy pavement. Overall, winter weather flash does not appear to be common and may create additional safety hazards. Intersections with steep grades that would make braking difficult seem to benefit the most from winter weather flashing operation.

Operation analysis of intersections operating in flash mode was conducted using two microscopic simulation models: TEXAS and TRAF-NETSIM. The scenarios modeled are shown in Table 2.1, and the capabilities of the models themselves are shown in Table 2.2. As the study was designed with program flash in mind, high volumes representative of peak or other daytime periods were not simulated and the results may not be applicable to these situations.

Table 2.1 Scenarios Used in TTI Simulation Models [6]

Type of Signal Control	Geometrics (Major St. × Minor St.)	Type of Intersection Control	Volume Categories(vph)	
			Major St.	Minor St.
Red/red flashing Yellow/red flashing Pretimed Actuated	5 lanes × 4 lanes 5 lanes × 2 lanes 4 lanes × 2 lanes 2 lanes × 2 lanes	Isolated System Diamond	0-125 126-250 251-500	0-125 126-250 251-500

Table 2.2 Capabilities of Software Used in TTI Simulation Models [6]

Capabilities	NETSIM Model	TEXAS Model
Stochastic	✓	✓
Yellow/Red Flashing	✓	✓
Red/Red Flashing		✓
Pretimed	✓	✓
Fully Actuated	✓	
Semi-Actuated	✓	✓
Isolated Intersection	✓	✓
Signal System	✓	

The simulations were not calibrated with any field data collected at flashing signals, and complete compliance with control devices was assumed. The authors feel that this may overestimate delay (as real drivers may choose to not stop at a flashing red signal on the minor road, or the major road in the case of red/red flash). Although not discussed in the report, it is also possible that delay at yellow/red flash intersections may be underestimated if real drivers choose to stop at flashing yellow signals. Red/red flash (in comparison to normal operation) was found to reduce delay only at large (5 lane by 4 lane or 5 lane by 2 lane) intersections with pretimed signals where volumes were less than 50 percent of the MUTCD volume warrant. Yellow/red flash was found to reduce delay at all pretimed signals and at actuated signals when the intersection was large (5 lane by 4 lane or 5 lane by 2 lane), the major street to minor street volume ratio was greater than three, and volumes were less than 50 percent of MUTCD warrants.

In conclusion, the authors feel there are no "particular circumstances where it is clearly advantageous to use flashing operation instead of normal operation." [6] Based on the results of their study and previous studies, though, circumstances where flashing operation *may* be more advantageous than normal operation are:

- Railroad preemption
- As part of signal installation
- Prior to signal removal
- Controller malfunction
- During maintenance or construction
- Certain low-volume scenarios

Regarding the mode of flash, yellow/red should be considered if the major street to minor street volume ratio is greater than three and adequate sight distance is available. Red/red should be considered if the major street to minor street volume ratio is less than three or if adequate sight distance is not available.

2.1.3 Portland, Oregon (1986)

Akbar and Layton [9] conducted a study of accident rates at 30 intersections in Portland, Oregon that utilized flash during low volume periods. The study was conducted in “before and after” fashion, where accident rates under normal and flashing operation at the same intersections were compared. Flash had been implemented at these intersections “in accordance with accepted guidelines.” The study suggests that the intersections were all flashed yellow/red, however this is never explicitly stated. Intersections were compared based on volume ratios, street classification, types of approaches, approach speed limits, and parking conditions. Flashing operation was found to be unsafe at major street to minor street volume ratios of 2.0 to 4.0, but safe above and below this range. Arterial/local intersections were found to be safer under flash control, while arterial/collector, collector/local, and local/local all had higher accident rates under flash. At collector/collector intersections, the accident rate was virtually unchanged. Two-way/one-way street intersections had lower accident rates under flash control, while two-way/two way and one-way/one-way had higher accident rates. Speed limit and parking condition results were inconclusive. Overall, the study found an increase in the rate of accidents and the severity of accidents under flashing operation. The study does not call for an end to program flash, but it does recommend that it only be used under circumstances that did not greatly increase accident rates.

2.1.4 Oakland County, Michigan (1987)

Oakland County, Michigan conducted a before-and-after accident rate study at flashing traffic signals, the findings of which were published in two ITE articles [10, 11]. The “before” period, when flashing operation was used, ran from 1980 to 1983, and the “after” period, when normal operation was used, ran from 1984 to 1985. Neither article states which mode of flash was used. The study found that right angle accidents were "significantly overrepresented" when flash mode was used at four leg intersections of two arterials. The authors propose warrants for the use of flashing operation based on right-angle accident frequencies, but also provide surrogate warrants that could be used in lieu of accident data. According to these surrogate warrants, the elimination of flashing operation should be considered at four legged intersections of two arterials, at intersections where the major street to minor street volume ratio is 4:1 or less, and at all intersections until one hour past the closing time of bars. Drunk drivers were significantly overrepresented in right-angle accidents at flashing signals, and the right angle accident rate declined dramatically at flashing signals after 3:00 AM, which was one hour after bars in Michigan closed.

2.1.5 Parsonson and Walker (1992)

The only prior traffic engineering research focused on the subject of malfunction flash was an ITE Journal article by Parsonson and Walker [12] summarizing a previous Georgia Institute of Technology study. The study identified ten intersections in the Atlanta, Georgia area that lacked intersection sight distance as defined by AASHTO. It was determined through interviews with transportation agencies that these ten signals were configured to flash yellow/red during malfunction events, even though the AASHTO Green Book specifically cautions that yellow/red flash is not appropriate at signalized intersections lacking sight distance. Only one of eight agencies interviewed reported the use of red/red flash at intersections with sight distance problems; the other agencies did not use red/red flash or felt that none of the signalized intersections in their jurisdiction had sight distance problems. Many agencies felt that the MUTCD intends for yellow/red to be the "default" flash mode and for red/red to only be used in special circumstances. Many agencies also feared excessive delay that would be induced by red/red flash. The authors feel that the MUTCD should be reworded to remove language suggesting that yellow/red flash is favored. Red/red seems to be primarily used at the intersection of two major streets, but the authors feel that it is appropriate for other situations.

2.2 Flashing Signal Law and Guidance in Georgia

In the State of Georgia, the meaning of flashing traffic signals is regulated by Section 40-6-23 of the Unannotated Georgia Code [3]:

> "Flashing signal indications shall have the following meanings:
> (1) FLASHING RED (Stop Signal) – When a red lens is illuminated with rapid intermittent flashes, drivers of vehicles shall stop at a clearly marked stop line or, if there is no stop line, before entering the crosswalk on the near side of the intersection or, if there is no crosswalk, at the point nearest the intersecting roadways where the driver has a view of approaching traffic on the intersecting roadway before entering the intersection, and the right to proceed shall be subject to the rules applicable after making a stop at a stop sign.
> (2) FLASHING YELLOW (Caution Sign) – When a yellow lens is illuminated with rapid intermittent flashes, drivers of vehicles may proceed through the intersection or past such signal only with caution."

Section 40-6-70, which regulates right of way at intersections, also mentions flashing traffic signals. The difference between inoperative (dark) and flashing traffic signals is explained [3]:

> "…When two vehicles approach or enter an intersection with an inoperative traffic light, the driver of each vehicle shall be required to stop in the same manner as if a stop sign were facing in each direction at the intersection. When a flashing indication is given, the driver shall stop for the flashing red signal and exhibit caution while passing through a flashing yellow indication."

Georgia does not have a MUTCD or traffic engineering manual that further clarifies these instructions. The Georgia Department of Transportation and the City of Atlanta have issued have issued public bulletins on the topic of flashing signals in the past, and a summary of these can be found in Bansen's thesis [2]. Additionally, no Georgia policies regarding flash mode choice were identified in the literature search conducted for this project. The choice between yellow/red flash and red/red flash seems to be left to the judgment of local traffic engineers.

2.3 Traffic Engineering Manuals and MUTCDs in Other States

The Manual of Uniform Traffic Control Devices (MUTCD), published by the Federal Highway Administration (FHWA), addresses flashing traffic signal operation in Sections 4D.11 and 4D.12. In Section 4D.11, the manual states [4]:

> "When a traffic control signal is operated in the flashing mode, a flashing yellow signal indication should be used for the major street and a flashing red signal indication should be used for the other approaches unless flashing red signal indications are used on all approaches."

No guidance as to *when* flashing operation should be used is provided.

Although FHWA's MUTCD is intended for nationwide use, some states publish their own MUTCDs or have supplements to the federal version. These state documents are not intended to conflict with the federal version but rather to provide additional guidance. Many states also have traffic engineering manuals, some of which address flashing operation.

All state MUTCDs, MUTCD supplements, and traffic engineering manuals that are readily available on state DOT websites were reviewed as part of this project. Those that address flashing operation are detailed below. Omitted are states that use the FHWA version of sections 4D.11 and 4D.12 in their MUTCD and states whose only change to sections 4D.11 and 4D.12 is the removal of references to yellow and red arrow lenses, presumably because these states do not use such lenses.

- Arizona – Section 625 of *ADOT Traffic Engineering Policies, Guidelines, and Procedures* [13] lists four conditions under which flashing operation may be used: railroad preemption, repair or maintenance of the a signal, emergency conditions including snowplow operation, and the results of traffic engineering study. The mode of flashing is not addressed.
- Connecticut – The Connecticut Department of Transportation's *Traffic Control Signal Design Manual* [14] states that program flash may be used to conserve energy and fuel when volume warrants are not met so long as the following conditions are met:
  - The artery normally displays a flashing yellow during flash
  - There are no sight line restrictions from the side street
  - No special feature of the signal requires continuous operation

  The manual goes on to state that signals that flash all red should not be placed into program flash as it does not conserve fuel. The *State Traffic Commission Regulations* [15] of Connecticut reaffirms that yellow/red flash should 'normally" be used.
- Florida – The Florida Department of Transportation's *Traffic Engineering Manual* [16] encourages the use of programmed yellow/red flash for fuel and electrical conservation purposes with the following conditions:

- Two-way traffic volumes on the main street are less than 200 veh/hour
- Two-way main street traffic volumes are greater than 200 veh/hour but MUTCD Signal Warrants 1 and 2 are not met and the main street to side street volume ratio is greater than 4:1
- Flashing operation should be discontinued if there is a change in crash pattern, an increase in crash severity, or an increase in conflicts
- A "speedway effect" is avoided by maintaining regular operation at some signals
- Flash should not be used if adequate sight distance is not available, unusual geometry exists, or railroad preemption is used.
- Flash should not be used for more than three separate periods within a 24 hour time period

The manual also states that the main street shall receive flashing yellow during malfunction flash, and the side street and any protected left turns should receive flashing red.

- Idaho – Section 305 of the Idaho Transportation Department's *Traffic Manual* [17] states that the two reasons for flashing a traffic signal are low volumes at night and emergencies caused by an "inoperative" signal. The following factors are to be considered before implementing nighttime flash:
  - The availability of gaps during which cross street traffic can enter the intersection
  - Intersection crash history

- The reason the signal was initially installed and the major street to minor street volume ratio
- Visibility for side street traffic
- The distraction and glare of the flashing signal

For emergency flash, the manual recommends the yellow/red flash unless the major street volume is so heavy that minor street vehicles will rarely have an adequate gap or there is a sight distance problem.

- North Carolina – The North Carolina Department of Transportation's [NCDOT] supplement to the MUTCD [18] allows the use of program flash during off-peak hours, typically midnight to 5:00 AM based on the following considerations:
    - Sight distance
    - Night-time volume ratio
    - Operation of adjacent signals
    - Pedestrians
    - Original intent of signal
    - Crash history of adjacent signals
    - Type of signal
    - Adjacent land uses
    - Days and times signal will flash

  Flash is prohibited at signals with railroad preemption. The mode of flash is not addressed. Additionally, a NCDOT memo [19] outlines which officials in the department are responsible for deciding when to use program flash and approving the decision.

- Ohio – The Ohio Department of Transportation's *Traffic Engineering Manual* [20] allows the use of program flash under guidelines set forth in Section 403-3. The following considerations govern the use of off-peak flash:
    - Flash may be appropriate at "simple, four-legged or three-legged intersections" without sight distance restrictions.
    - Flash should be not used when the major street volume exceeds 200 veh/hour unless the major street to minor street volume ratio is more than 3:1.
    - In the vicinity of "night establishments", flash should not be used until one hour after the closing time of these establishments.
    - Signal progression can be maintained and a "speedway" effect can be avoided by keeping some signals in normal operation
    - In flash mode, "a yellow indication is normally used for the major street and red indications are used for all other approaches". Ohio has its own MUTCD, but it does not further address this issue.
    - The signal should be changed back to normal operation if certain accident thresholds are exceeded.
- Tennessee – The Tennessee Department of Transportation's *Traffic Design Manual* [21] discusses four types of flashing operation in Section 4.16: emergency flash, maintenance flash, railroad preemption flash, and scheduled (nighttime) flash. Different flash modes are recommended for these different situations, although the manual also cautions that "mixing the types of flash can confuse drivers if they are accustomed to the all-red flash".

For emergency flash, all-red should be used "exclusively". For maintenance flash, yellow/red "can" be used if the main street has significantly more traffic than the minor street. For railroad preemption, either mode can be used. For scheduled flash, yellow/red flash is "typically" used. Nighttime flash is not encouraged at fully actuated signals unless there are other signalized intersections in the area and flash is used at them.

The manual states that, in general, yellow-red flashing operation is the most common but red-red may be used at intersections with sight distance problems, excessive minor street delay due to high main street volume, or nearly equal traffic volumes on the main and minor streets.

- Texas – The Texas MUTCD [22] adds as statement to Section 4D.12 allowing the use of program flash based on engineering judgment. FHWA's MUTCD does not mention program flash.
- West Virginia – Traffic Engineering Directive 405 [23] allows the use of both red/red and yellow/red flash for situations such as police control or signal maintenance. Program flash and malfunction flash are not addressed. For the unusual case of the major approaches to an intersection meeting at right angles, "one [major approach] may display flashing yellow but the other must flash red <u>or</u> both major approaches, as well as the minor approaches shall flash red."

A number of states have traffic engineering manuals or MUTCDs that address flashing operation of traffic signals. Most do not address the mode of flashing operation or allow both yellow/red and red/red without providing substantial guidance as to when to use each mode. Connecticut policy favors yellow/red unless there are sight distance problems. Florida policy never mentions red/red flash and seems to only allow yellow/red flash to be used. Idaho policy favors yellow/red unless there are sight distance problems or major street volumes are high enough that crossing traffic will rarely have an adequate gap. Ohio policy mentions flash mode but essentially provides no guidance. Tennessee policy calls for red/red flash during malfunctions but allows both modes for other flash scenarios. West Virginia policy favors yellow/red unless traffic volumes are similar on all approaches, in which case red/red can be used.

Most states with flashing traffic signal policies tend to favor yellow/red flash unless special circumstances exist. These circumstances differ from state to state. The issue of flash mode choice among transportation agencies is further discussed in Chapter 3.

2.4 Literature Review Summary

The vast majority of research related to flashing traffic signal operation has focused on program flash. More specifically, emphasis has been placed on determining when program flash should and should not be used by analyzing accident rates. These studies have generally found that operating a signalized intersection in flash mode increases the accident rate, although this is not necessarily true with very low volumes or high major street to minor street volume ratios.

Studies that have considered the mode of flash have generally favored yellow/red flash in most circumstances because of the operation benefits that are assumed to be associated with it. Traffic engineering manuals generally favor the use of yellow/red for this same reason. Common uses of red/red flash include intersections of two major streets with similar volumes and intersections lacking adequate sight distance, although many agencies do not use red/red flash at all.

There have been few attempts to verify the common assumption that all vehicles facing a flashing red signal stop and all vehicles facing a flashing yellow signal do not stop. Some studies have hinted that this is not the case, but a formal analysis has never been conducted.

There has been very little research focused on flash due to controller malfunction. This type of flash differs from programmed and other types of flash in that it must be used (i.e. normal operation is not available) and it can occur during high volume time periods.

CHAPTER 3

SURVEY

As part of the study of malfunction flash, it is important to consider policies currently in place and procedures currently in use with regard to flashing operation and malfunction prevention. Agency policies with regard to flash may be a reflection of formal documents such as state traffic engineering handbooks, or they may be more informal and practice-based. To capture this information, then, a survey of officials responsible for traffic signals was necessary. Agencies that maintain traffic signals in Georgia and throughout the United States were surveyed to identify:

- The frequency of malfunction flash
- Methods for notifying agencies that a signal is operating in malfunction flash
- Equipment standards
- Maintenance procedures and programs

3.1 Survey Distribution

A list of all local agencies that maintain traffic signals in Georgia was provided by consultants of the Georgia Department of Transportation (GDOT). Agency websites and the online membership directory of the Institute of Transportation Engineers (ITE) were used to help identify the appropriate person to contact in each agency. The survey was sent to the fifty three local agencies in Georgia that maintain traffic signals, the district signal engineer at each of GDOT's seven district offices, and the state signal engineer.

A list of agencies outside of Georgia that received the nationwide survey was selected by the project team. The team was careful to include the five states bordering Georgia as drivers near the state border are likely to experience the policies of Georgia and the neighboring state. State level and regional (district or division) level officials within each state's department of transportation (DOT) received a copy of the survey, as well as officials in major cities in the five bordering states. Selected large cities and state DOTs in other regions of the country also received a copy of the survey.

The survey was conducted electronically. One person in each agency was selected and sent an e-mail message notifying them of the survey and providing a link to the web page that contained the survey. The web page was interactive, so recipients could fill in responses and electronically submit them to the research team. A copy of the original email text requesting the survey, the survey introduction, and survey forms may be found in Appendices A and B.

Two similar survey documents were used – one for agencies within Georgia and one for agencies outside of Georgia. Both versions of the questionnaire had twenty nine questions. The only difference between the two survey versions is found in question 20, which specifically references the GDOT signal maintenance specifications in the Georgia survey while the national survey asks for a link to any maintenance specification that the agency may be following.

The survey document was first sent to GDOT staff for approval. After this, it was sent to the state signal engineer and signal engineer in each GDOT district. Responses from all of these individuals were then reviewed to ensure that questions were being properly understood and the e-mail and website systems were working correctly. The survey was then sent to all of the cities and counties in Georgia that maintain signals. Agencies that did not respond after several weeks were sent a reminder e-mail. After the completion of the state survey, the selected national agencies were contacted. A sample of the Georgia Survey (with web formatting removed for simplicity) is given in Figure 3.1.

Malfunctioning Flashing Signal Operation Questionnaire

General Information

1) Name of Respondent:
2) Title:
3) Associated Jurisdiction/Organization:
4) Address:
5) City:
6) State:
7) Zip Code:
8) Contact Phone Number:
9) Fax Number:

Background

10) Number of signals in your jurisdiction:

11) Are records maintained for occurrences of malfunction flash?

    Yes No

12) If possible, approximate the percentage of flashing signal occurrences that are likely attributed to the following sources

    Power Interruption %
    Lightning %
    Equipment Malfunction %
    Other (explain below) %

    Percentages based on: Record Review Expert Judgment

13) Approximately how many malfunction flash signal trouble calls are received per month?

14) What methods are used to identify when a signal goes into malfunction flash?

    Citizen notification
    Inspection of signals by agency crews
    Automatic notification (please describe)
    Other

15) In your jurisdiction, who would a citizen call to report a malfunctioning signal? Describe the chain of notification that would occur, starting with the citizen and ending with the person that would make the necessary repairs.

16) Once the agency is notified, what are the typical response and repair times?

17) Does the response time vary by time of day or time of year? If so, describe.

    Yes No

18) Does a policy exist for the provision of traffic control by police officers at malfunctioning signals?

    Yes No
    If "Yes", describe

19) Are police officers used to temporarily provide traffic control while technicians conduct regular maintenance?

Figure 3.1 Sample Georgia Survey

Signal Equipment

20) Do you use the current GDOT specifications for Surge Protection and Grounding and Bonding or a different specification?
(GDOT Specifications are provided at Section 925.2.02-A-14, Surge Protection and Section 647.3.05 – Z & AA, Grounding)
For Surge Protection, specifications match those recommended by GDOT
For Grounding, specifications match those recommended by GDOT
Alternate specifications utilized. (If possible, please provide below a web link or contact information for obtaining a copy of the specifications)

21) Are uninterruptible power supplies (UPS) utilized for any signals within your jurisdiction?
Yes No

22) What percentage of signals within the jurisdiction have communications capabilities either via a closed loop or direct connect system?

Flashing Signal Operations

23) Indicate which types of flashing operation are currently utilized within your jurisdiction:
Red / Red
Yellow / Red
A combination of Red / Red and Yellow / Red

24) Describe the policy within your jurisdiction for utilizing either red/red or yellow/red signal displays under malfunction or technician flash.

25) Is program flash (regularly scheduled flashing intersection control) utilized within your jurisdiction?
Yes No

Maintenance Programs

26) As a part of your regular signal maintenance program, is the grounding/bonding within the signal cabinet tested?
Yes If yes, what is the average duration between testing?
No

27) Have you implemented any programs or measures to reduce the instances of malfunction flash within your jurisdiction?
Yes No
If yes, please briefly describe these measures in the space below and indicate whether or not they were successful in meeting their intended outcomes:

Additional Comments

28) Please provide any additional comments that you may have regarding signal operations during malfunction or technician flash (i.e. hardware issues, equipment configurations, mitigation strategies, or any other lessons learned).

Survey Follow-Up

29) Please indicate below if you are willing to participate in follow up correspondence, which may be via e-mail or telephone.
Yes No

Figure 3.1 continued

3.2 Survey Response

All GDOT officials that were contacted responded to the survey, as well as eighteen of the fifty three local agencies in Georgia that maintain traffic signals. The nationwide portion of the survey had twenty one responses, including ten from major cities near Georgia and states bordering Georgia. The response is summarized in Table 3.1. It is important to note that many of the agencies that responded to the Georgia survey were small cities and counties, and many of the agencies responding to the national survey were state DOTs or major cities that maintain hundreds or thousands of signals.

Table 3.1 Agency Response to Survey

	GDOT	Georgia Local	Nationwide (state and local)
Surveys Sent	8	53	56
Surveys Returned	8	18	21

3.3 Survey Findings

The aggregated results of both surveys can be found in Appendices A and B. Included below is a discussion of some important questions.

Question 12: If possible, approximate the percentage of flashing signal occurrences that are likely attributed to the following sources

Response to this question varied greatly from agency to agency. Table 3.2 shows an average of the percentage values provided by the agencies. The responses were primarily based on engineering judgment and not agency records.

Table 3.2 Causes of Malfunction Flash – Agency Averages

	Georgia	Nationwide
Power Interruption	51 %	29 %
Lightning	20 %	29 %
Equipment Malfunction	24 %	33 %
Other	5 %	11 %

Damage to signal equipment or wiring due to traffic accidents or construction was the most frequently cited "other" cause of malfunction flash.

Question 13: Approximately how many malfunction flash signal trouble calls are received per month?

Response to this question is obviously a function of how many signals are in a particular jurisdiction, so responses from multiple agencies are best described in terms of the number of monthly calls per signal. Georgia agencies reported a median of 0.05 phone calls per signal per month, and the agencies in other states reported a median of 0.03 phone calls per month. For this analysis the median is taken as the preferred measure of central tendency due to sample size; for example an extremely high phone call rate reported by one small Georgia agency dramatically impacts the mean value.

Question 14: What methods are used to identify when a signal goes into malfunction flash?

Four choices were provided: citizen notification, inspection of signals by agency crews, automatic notification, and other. Almost all agencies selected citizen notification, and about half of the agencies selected the agency crew option. Two agencies in metropolitan Atlanta and seven agencies in other states (primarily very large cities) reported automatic notification systems. Most automatic notification systems utilize closed loop communications between traffic signal controllers in the field and a central computer that monitors the system. About three quarters of the agencies selected the "other" option, and most cited notification by police.

Question 15: In your jurisdiction, who would a citizen call to report a malfunctioning signal? Describe the chain of events that would occur…

Most responses to this question can be grouped into two categories. Some agencies reported that the process begins by citizens calling 911, and other agencies reported that the process begins by citizens calling the agency responsible for maintaining traffic signals. Some large cities reported that public agencies share a phone number such as 311 that citizens can use to reach them. In many other cases, though, it is not apparent how a citizen would know how to directly contact the agency responsible for maintaining traffic signals.

Question 16: Once the agency is notified, what are the typical response and repair times?

Almost all agencies reported that crews can arrive at a malfunctioning signal and repair it in two hours or less. It is important to note that this time does not include the amount of time it takes for an agency to become aware that a signal is malfunctioning. Notification time could be many more hours, or even days at lower volume intersections. Also, this value is based typically based on the survey respondent judgment, not a review of maintenance records.

Question 17: Does the response time vary by time of day or time of year? If so, describe.

More than half of the agencies reported that response time does vary. Variation was usually due to time of day (business hours versus non-business hours), the location of signal in relation to the location of the technician, and weather (storms that cause many signals to enter into flash, or snow and ice in northern parts of the country)

Question 18: Does a policy exist for the provision of traffic control by police officers at malfunctioning signals?

Most agencies did not report having such a policy.

Question 19: Are police officers used to temporarily provide traffic control while technicians conduct regular maintenance?

Only a few of the agencies in Georgia reported using police officers control traffic during technician flash, but a majority of the nationwide agencies did.

Question 20

This question dealt with Surge Protection, Grounding, and Bonding specifications. Different versions of this question were used in the Georgia and the national surveys, and the Georgia version of the question referenced GDOT specifications. All agencies in Georgia reported the use of GDOT's grounding specification, and all but one reported the use of GDOT's surge protection specification. Nine agencies outside of Georgia provided internet links to the specifications they use, all of which were agency-specific.

Question 21: Are uninterruptible power supplies (UPS) utilized for any signals within your jurisdiction?

Five of the twenty six responding Georgia local agencies and GDOT districts reported the use of UPS devices. Eight of the twenty one agencies outside of Georgia reported the use of UPS devices. Many of the same agencies not using UPS devices also report that power interruption is responsible for the majority of malfunction flash occurrences. Installation UPS devices could dramatically reduce the occurrence of malfunction flash. It should be noted that the Georgia signal specifications were updated in 2006 to include a UPS in all new signal installations.

Question 22: What percentage of signals within the jurisdiction have communication capabilities either via a closed loop or direct connect system?

Agencies in Georgia reported that an average of forty two percent of the signals in their jurisdiction have communication capabilities; agencies in other states reported an average of forty nine percent. The total percentage of signals in all surveyed jurisdictions having communication capabilities is higher than either of these numbers, because agencies that maintain a large number of signals generally have a larger percentage of them configured for communication capability.

Overall, forty one agencies reported that some or all of their signals have communication capability, but only eleven reported the use of automatic notification to alert officials that a signal is in malfunction flash mode. This is clearly one area that warrants further exploration. It is possible that a majority of agencies could significantly optimize their response to malfunctioning traffic signals by implementing automatic notification with hardware and, in some cases, software that is either already in place or would represent minimal additional costs.

Questions 23 and 24: Indicate which types of flashing operation are currently utilized within your jurisdiction (23). Describe the policy within your jurisdiction for utilizing either red/red or yellow/red signal displays under malfunction or technician flash (24).

Three choices were provided:

- Red/Red
- Yellow/Red
- A combination of Red/Red and Yellow/Red

All agencies in Georgia stated that they used yellow/red or a combination. All agencies that used a combination and provided further explanation stated that they use yellow/red for most of their signals and red/red is used for special circumstances only. For most agencies, the special circumstance is an intersection where both roadways have fairly similar traffic volumes, such as an intersection of two arterials. One Georgia agency uses red/red at intersections that previously were all-way stops, another agency identified using red/red at "newer, high volume" intersections only.

Nationally, there is a strong relationship between geographic location and flash mode selection. Agencies in the southeast, as well as two large northeastern cities and one suburban county in the Great Lakes region, all reported the use of yellow/red or a combination. Agencies that use a combination state that red/red is used only for special situations (such as an intersection of two major roads) and that yellow/red is the primary mode. Five agencies on the west coast and one major city in Texas reported that they only use red/red. Another major city in Texas reported that "98 percent" of its signals are red/red.

This geographic pattern has existed for at least several decades, and was documented in the 1980 FHWA study [5]. The authors of this study distributed a survey to 360 state, city, and county agencies across the county, and received 232 responses in time to use in the report. The nation was broken down into five regions, including a western region consisting of Alaska, Arizona, California, Hawaii, Nevada, Oregon, and Washington. Table 3.3 shows the use of flash mode by region.

Table 3.3 Agency Flash Mode Choice by Region, as Reported in 1980 FHWA Study [5]

	Yellow/Red	Red/Red	Combination
Northeast	40	1	2
South	40	3	8
Midwest	31	2	10
Mountain	11	0	2
West	25	14	15

The literature review in Chapter 2 also contains the current guidelines found for specific states through the US.

The FHWA study also sorted survey results by type of jurisdiction and by number of signals maintained by the agency. Tables 3.4 and 3.5 show these results. Such an analysis was not performed with data gathered for this survey because the number of responses was much lower and the results would likely not be statistically significant.

Table 3.4 Agency Flash Mode Choice by Jurisdiction Type, as Reported in 1980 FHWA Study [5]

	Yellow/Red	Red/Red	Combination
City	86	15	26
County	30	5	4
State	31	0	7

Table 3.5 Agency Flash Mode Choice by Number of Signals, as Reported in 1980 FHWA Study [5]

	Yellow/Red	Red/Red	Combination
Less than 21	10	1	2
21-50	17	8	3
51-100	37	5	11
101-300	46	3	8
More than 300	37	3	13

Question 25: Is *program* flash (regularly scheduled flashing intersection control) utilized within your jurisdiction?

No GDOT districts reported use of program flash, however four local agencies in Georgia did report the use of program flash. Nine agencies outside of Georgia reported the use of program flash. With one exception, these were agencies that used primarily yellow/red flash mode.

Question 26: As part of your regular signal maintenance program, is the grounding/bonding within the signal cabinet tested?

More than half of the agencies answered yes to this question, and all of these agencies reported testing their cabinet equipment either once or twice a year. Analysis was performed with data from question thirteen to see if agencies that regularly test their equipment report fewer trouble phone calls per month per signal, but the results are inconclusive. Agencies outside of Georgia that regularly tested their equipment reported at phone call rate that was twenty seven percent lower than agencies that did not regularly test equipment. Within Georgia, though, there was virtually no difference in the phone call rate.

Question 27: Have you implemented any programs or measures to reduce the instances of malfunction flash within your jurisdiction?

Within Georgia, about half of the agencies answer yes. Outside of Georgia, fourteen answered yes and seven answered no. Once again, analysis was performed with data from question thirteen to see if agencies that implemented programs also reported fewer trouble phone calls per month per signal. Agencies in Georgia that had implemented malfunction flash reduction programs reported twenty five percent fewer phone calls than agencies that had not, and agencies outside of Georgia that had implemented such programs received thirty four percent fewer phone calls than agencies that had not. Agencies were also asked about the specifics of their programs, and a wide variety of answers were provided. Preventative maintenance programs involving cabinet inspections and tests were most commonly cited. The specifics of these programs can be found in Appendices A and B.

3.4 Conclusion

The results of the survey of agencies within Georgia and throughout the US show widespread differences within flashing traffic signal policy. Most agencies do not use automatic notification technology to identify when a signal has gone into flash. Once the agency is aware of a flashing traffic signal, response time was reported to be less than two hours in almost all cases. Agencies that reported the use of preventative maintenance programs also reported fewer trouble calls per month.

Regarding flash mode, all agencies in Georgia used exclusively yellow/red or yellow/red for most intersections and red/red for special circumstances. Nationally, the flash mode selection was similar to this except in Texas and on the west coast, where red/red flash seems to be the standard. The basis flash mode selection varied widely.

CHAPTER 4

FIELD DATA COLLECTION AND PROCESSING

As mentioned in Chapter 1, the field data portion of this project is a continuation of Justin Bansen's *Evaluation of Traffic Operations at Intersections in Malfunction Flash Mode* [2]. Bansen conducted the only known field study of traffic operations at intersections operating under *malfunction* flash control. Traffic operations at these intersections were filmed with a video camera and analyzed in the lab. Bansen used a data set consisting of only eleven instances of yellow/red malfunction flash, two instances of red/red malfunction flash, and two instances of new signals operating in yellow/red flash mode. This study used more than three times the amount of field data, and developed new data analysis procedures described in Chapter 5. Due to the difficultly of gathering field data and the time-intensive nature of processing it, data gathered and processed for Bansen's work was reused for this project, as well as additional data collected by members of the project team. Two permanently flashing yellow/red beacons were also included in the analysis for comparative purposes.

4.1 Data Collection

Malfunction flash mode is, by definition, an unplanned and unscheduled occurrence. Malfunction flash mode also has safety risks associated with it, especially when traffic volumes are high, so no signals were intentionally placed into flash for this study. As a result, data collection could not be scheduled for specific times or days and several tactics were continuously used by the project team to discover and film malfunctioning traffic signals. Team members carried video recording equipment in their vehicles so any malfunctioning signals observed in everyday travel could be filmed. News channel traffic websites were monitored, and friends and colleagues of the team members notified them via telephone of any malfunctioning signals that they observed so that team members could travel to the intersection and gather data. Locations were filmed for one hour, except when maintenance crews arrived and restored normal signal operation before an hour had passed. Data collection began in May 2005 and ended in December 2006. A complete description of the data collection procedure can be found in Chapter 3 of Bansen's *Evaluation of Traffic Operations at Intersections in Malfunction Flash Mode* [2].

A total of fifty one instances of flashing operation in the Atlanta region were captured, including the original thirteen instances from Bansen's work. Some intersections were filmed under malfunction flash control on two separate occasions, so only forty three unique locations were captured. Due to the travel patterns of those involved with the study, most of the intersections are within a few miles of the Georgia Tech campus. The resulting data set consists primarily of intersections located in highly urbanized areas. Tables 4.1 through 4.5 list all instances of flashing operation used in this study. Instances of flash are grouped into five categories: malfunctioning yellow/red signals, malfunctioning red/red signals, new yellow/red signals, new red/red signals, and permanent yellow/red beacons. Aerial photos of each intersection as well as lane configurations and conditions at the time of data collection can be found in Appendix C.

Table 4.1 Malfunctioning Yellow/Red Signals in Study

Intersection	City	County	Date	Start Time
Northside Dr. at Peachtree Battle Ave.*	Atlanta	Fulton	5/11/2005	9:00 AM
Monroe Dr. at 10th St.*	Atlanta	Fulton	8/17/2005	4:50 PM
Candler Dr. at Rainbow Dr.*	-	DeKalb	8/12/2005	3:05 PM
N. Highland Ave. at University Dr.*	Atlanta	Fulton	9/21/2005	8:25 AM
Lenox Rd. at Phipps Dr.*	Atlanta	Fulton	9/30/2005	9:25 PM
Spring St. at 17th St.*	Atlanta	Fulton	10/15/2005	10:55 AM
W. Peachtree St. at 11th St.*	Atlanta	Fulton	10/15/2005	1:05 PM
14th St. at Williams St.*	Atlanta	Fulton	10/22/2005	1:20 PM
W Peachtree St. at 16th St.*	Atlanta	Fulton	10/22/2005	3:30 PM
Techwood Dr. at Merritts Ave.	Atlanta	Fulton	3/7/2006	10:00 PM
Techwood Dr. at Merritts Ave.	Atlanta	Fulton	3/9/2006	5:20 PM
E. Rock Springs Rd. at Barclay Pl.	Atlanta	Fulton	3/12/2006	5:30 PM
Ashford Dunwoody Rd at Harts Mill Rd.	-	DeKalb	3/14/2006	9:20 AM
10th St. at Hemphill Ave.	Atlanta	Fulton	4/4/2006	8:45 PM
10th St. at Hemphill Ave.	Atlanta	Fulton	4/5/2006	7:40 AM
17th St. at I-75/85 SB off ramp	Atlanta	Fulton	4/5/2006	4:00 PM
Paces Ferry Rd. at Paces Mill Rd.	-	Cobb	4/9/2006	6:10 PM
Peachtree Rd. at Sheridan Dr.	Atlanta	Fulton	4/22/2006	1:10 PM
Roxboro Rd. at Pritchard Dr.	Atlanta	Fulton	4/22/2006	3:00 PM
W Peachtree St. at Peachtree Pl.	Atlanta	Fulton	4/22/2006	5:00 PM
Spring St. at Abercrombie Pl.	Atlanta	Fulton	4/22/2006	6:15 PM
10th St. at Holly St.	Atlanta	Fulton	5/4/2006	12:30 PM
Juniper St. at 12th St.	Atlanta	Fulton	5/7/2006	12:15 PM
Charles Allen Dr. at 8th St.	Atlanta	Fulton	5/7/2006	7:30 PM
Charles Allen Dr. at 8th St.	Atlanta	Fulton	5/8/2006	7:40 AM
W. Peachtree St. at 16th St.	Atlanta	Fulton	5/8/2006	6:15 PM
10th St. at Holly St.	Atlanta	Fulton	5/20/2006	1:20 PM
10th St. at I-75/85 SB ramps	Atlanta	Fulton	6/12/2006	3:10 PM
Peachtree St. at Pine St.	Atlanta	Fulton	6/12/2006	4:35 PM
Collier Rd. at Post Collier Hills Apts.	Atlanta	Fulton	6/22/2006	4:45 PM
Howell Mill Rd. at I-75 SB ramp	Atlanta	Fulton	6/26/2006	7:05 AM
Howell Mill Rd. at I-75 NB ramp	Atlanta	Fulton	6/26/2006	7:05 AM
Ponce de Leon Ave. at Fairview Rd./Lullwater Rd.	Atlanta	DeKalb	6/26/2006	11:15 AM
Ponce de Leon Ave. at Frederica St.	Atlanta	Fulton	7/30/2006	2:15 PM

* These intersections are included in Bansen's original analysis

Table 4.2 Malfunctioning Red/Red Signals in Study

Intersection	City	County	Date	Start Time
Piedmont Ave at The Prado*	Atlanta	Fulton	11/15/2005	5:35 PM
Roswell Rd at W. Wieuca Rd.*	Atlanta	Fulton	1/14/2006	11:20 AM
Roswell Rd at W. Wieuca Rd.	Atlanta	Fulton	3/5/2006	10:30 AM
17th St. at Market St.	Atlanta	Fulton	3/9/2006	3:50 PM
North Ave. at Piedmont Ave.	Atlanta	Fulton	3/10/2006	8:00 AM
10th St. at Peachtree St.	Atlanta	Fulton	6/28/2006	10:00 AM
Northside Dr. at 14th St.	Atlanta	Fulton	8/22/06	10:20 AM
14th St. at State St.	Atlanta	Fulton	11/18/2006	9:30 AM
5th St. at Fowler St.	Atlanta	Fulton	12/1/2006	12:20 PM

* These intersections are included in Bansen's original analysis

Table 4.3 Newly Installed Yellow/Red Signals in Study

Intersection	City	County	Date	Start Time
17th St. at Bishop St.*	Atlanta	Fulton	9/26/2005	4:45 PM
Market St. at 18th ½ Street*	Atlanta	Fulton	10/26/2005	2:30 PM
Peachtree St at 8th St.	Atlanta	Fulton	3/1/2006	5:10 PM
Spring St. at 8th St.	Atlanta	Fulton	3/15/2006	8:00 AM

* These intersections are included in Bansen's original analysis

Table 4.4 Newly Installed Red/Red Signals in Study

Intersection	City	County	Date	Start Time
Market St. at 18th ½ Street	Atlanta	Fulton	4/5/2006	5:20 PM

Table 4.5 Permanent Yellow/Red Beacons in Study

Intersection	City	County	Date	Start Time
Lindbergh Dr. at Parkdale Pl	Atlanta	Fulton	10/9/2005	5:00 PM
Lindbergh Dr. at Parkdale Pl	Atlanta	Fulton	2/15/2006	7:45 AM
Lindbergh Dr. at Acorn Ave.	Atlanta	Fulton	2/17/2006	7:00 AM

4.2 Data Reduction

In order to obtain quantitative data from the videos recorded in the field, it was necessary to make a record of all vehicle movements at each intersection. This process is referred to as reducing a video, and was done with a Visual Basic computer program operated in a Microsoft Excel interface developed by Bansen. The data reduction portion of the Microsoft Excel interface contains four worksheets – one for each leg on an intersection. Each approach was reduced separately, so every video was watched multiple times in order to reduce all approaches. *Evaluation of Traffic Operations at Intersections in Malfunction Flash Mode* [2] contains a complete discussion of the development of the program, as well as a description of how a person reducing a video interacts with the program. A brief overview of the reduction process and quality control measures follows.

Step 1: A laptop computer was placed beside a desktop computer's monitor. The video file from the intersection being reduced was opened on the laptop, and the Excel program was opened on the desktop and the worksheet for the approach being reduced was selected. The play button for the video and a start button in the Excel program were pressed at the same time; the person reducing the data used both hands to accomplish this.

Step 2: As vehicles on the selected approach traveled through the intersection, specific keys were pressed on the keyboard of the desktop computer to record vehicle movements. The keystrokes recorded which lane a vehicle was in, the time it stopped at the stop bar (only if a stop was made), the time it departed the stop bar, and the movement (right, through, or left) that the vehicle made. A different set of keys were used for each lane. If the person watching the video made a mistake, such as accidentally pressing the wrong key, they noted it on a piece of paper. Except for very low volume approaches, only two lanes could accurately be reduced at once. Approaches with more than two lanes, then, had to be watched twice and the reduction for each group of lanes was later combined into a single worksheet.

Step 3: If the person reducing the video needed to stop at any point, they could pause the video and the Excel program at the same time and then simultaneously restart them. Due to the possibility of the video and Excel program getting out of sync, pausing was done as infrequently as possible.

Step 4: After the entire video had been watched, the Excel program was stopped. Any mistakes that the person watching the video had written down were now manually corrected by entering the correct information into the proper cell on the spreadsheet.

Step 5: Steps one through four were repeated for each approach.

Step 6: The Excel file of reduced data was given to a second member of the project team to be spot-checked using the procedure described in Section 4.3

Step 7: The team leader looked at the results of the spot checking and determined what corrections, if any, needed to be made to the reduced data.

Step 8: Corrections were made if necessary, the data was processed with the Excel program, and the aggregated statistics were incorporated into the project's analysis phase described in Chapter 5.

4.3 Quality Control

The vast majority of mistakes that occurred when a video was being reduced can be classified into three categories: an incorrect key accidentally being pressed, vehicle movements *not* being recorded or nonexistent vehicle movements *being* recorded, and vehicle movements being recorded at the wrong time. Incorrect keystrokes, which were relatively rare, could easily be fixed by the person who originally reduced the data because they usually knew when they had pressed the incorrect key. The other errors were identified by a second person who spot checked the spreadsheets of reduced data.

To spot check a video, several minutes of data were selected. Typical times might be minutes 5 to 7, 30 to 32, and 55 to 57 for a one hour video. The same times were always used for all approaches. The person doing the checking then printed out all vehicle activity that had been recorded during those times. The video was played back, and by frequently pausing it the original reduction could be audited. If a specific vehicle action (a stop or a departure) had been accurately recorded, a check mark was written next to record on the printout of the vehicle activity. If it had been recorded at the wrong time, this was also indicated. For example, if a vehicle actually stopped two seconds before the "stop" key was pressed, then "-2" was written on the vehicle activity printout. If a vehicle was not counted, counted twice, or placed in the wrong lane, it was noted on the activity printout. Missed stops were also noted.

Vehicles were recorded at the wrong time for several reasons. If the video and the Excel program were not started at exactly the same time, times recorded would not correspond with the actual times from the video. Occasionally, the computer playing the video or the computer running the Excel program would begin to lag, and over the course of an hour the two would be out of sync by several seconds. Finally, camera angles sometimes made it difficult to see which lane a vehicle was in until the vehicle actually entered the intersection, and the person watching the video could not properly identify the vehicle movement until several seconds after it occurred.

After spot checking each intersection approach, the marked up vehicle activity printouts were shown to the project team leader, who decided what adjustments needed to made. If times were consistently inaccurate by the same number of seconds, then a uniform adjustment was applied to all of the times recorded for the approach. In a few cases, adjustments were only made to a portion of an approach's data, such as when a computer began to lag only towards the end of the video. Overall, less than half of the approaches needed time adjustments of some kind. The adjustments were usually one or two seconds and never more than four seconds. Several approaches had significant time errors that were not uniform – some vehicles were recorded at the correct time and others were recorded several seconds early or late. These approaches were reduced a second time, and the second reduction was verified and used further analysis.

A more serious error occurred when vehicles or stops were not counted. If more than or two or three missed vehicle stops or departures were discovered during spot checking, additional portions of the reduced data were spot checked. If additional stops or departures were missed, the approach was reduced again. Usually departures or stops were missed because the person reducing the video had attempted to watch more than two lanes at once. In these cases, which were rare, the video was re-watched twice for the approach in question and not all lanes of the approach were reduced at once.

Finally, some approaches that could not be clearly seen from the camera had lane placement problems. The reduction process required the lane of a vehicle to be entered whenever the vehicle's movements were entered. In order to accurately record the time of the vehicle, a lane had to be selected without certainty. This usually occurred on minor approaches, since the camera was usually positioned to have a better view of the major approaches. Tracking vehicles by lane is needed for stopping analysis, but on a low volume approach where there are usually zero or one vehicles present at any given time, stopping analysis can still be accurately conducted with lane records that are sometimes incorrect. For this reason, and the fact the re-watching the video would likely not result in a more accurate reduction, lane errors were generally not corrected.

CHAPTER 5

FIELD DATA ANALYSIS

This chapter presents the results of the analysis of traffic operation at 51 instances of flashing operation captured on video in the Atlanta area. As detailed in Chapter 4, the dataset consists of 34 instances of yellow/red malfunction flash, 4 instances of programmed yellow/red flash at newly installed signals, 9 instances of red/red malfunction flash, 1 instance of programmed red/red flash at a newly installed signal, and 3 yellow/red beacons. For analysis purposes, the signals were grouped into three categories: yellow/red traffic signals, red/red traffic signals, and yellow/red beacons.

5.1 Analysis Background

A primary source of guidance on the evaluation and analysis of transportation facilities is the Highway Capacity Manual (HCM). The HCM provides guidance on the evaluation of signalized intersection operations under normal conditions, i.e. pre-timed, semi-actuated, or actuated control. However, the HCM offers no guidance on the analysis and evaluation of signalized intersections under any mode of flashing operation (e.g. malfunction, police, or planned). To utilize the HCM to analyze intersections operating in flash mode it must be assumed the intersection functions in a manner similar to a two-way (TWSC) or an all-way (AWSC) stop controlled intersection. However, the application of these procedures at flash controlled intersections, particularly intersections in malfunction flash, is not appropriate. The HCM analysis for TWSC and AWSC are calibrated for relatively low volumes. As volumes increase the signals begin to satisfy signal warrants, resulting in the eventual conversion from stop control to signal control. Malfunction flash may occur under significantly higher traffic demands than those considered for TWSC and AWSC conditions. Also, most drivers do not encounter flash on a regular basis, so there is potentially a much higher level of confusion and control device noncompliance than would exist at a stop sign.

Under normal operating conditions the HCM utilizes control delay to determine signalized and unsignalized intersection Level of Service (LOS), as control delay offers a reasonable means to assess the quality of service perceived by drivers using the intersection. The field measurement of intersection delay, though, requires the queue length to be known for all approaches. Unfortunately the method of data collection used in this malfunction flash study – videotaping of intersections operating in flash mode – did not allow for consistent back-of-queue measurements. Vehicles on some approaches could not be seen on the video until they were at the stop bar, thus the back of the queue could not be observed, making it impossible to field measure queue length or delay. In addition to field measurement problems it is also reasonable to question if control delay is a reasonable means to gauge an intersection's operations under malfunction conditions. For instance, given that the intersection is operating in a temporary mode due to an intersection control malfunction it may be more reasonable to select a performance metric more closely tied to safety.

As a result, measures of effectiveness other than control delay had to be chosen by the research team. Based on field observations, a considerable number of drivers choose to stop at flashing yellow signals or choose to not stop at flashing red signals. The first scenario is a departure from an assumption made in all major previous studies of driver behavior at flashing signals, and the second scenario is a violation of Georgia law [3]. For these reasons, the percentage of vehicles choosing to stop (on various intersections approaches or before making certain movements) was the primary focus of flashing signal analysis.

5.2 Analysis of Yellow/Red Flash

At a signalized intersection operating in yellow/red flash control in Georgia, drivers on the minor street (facing a flashing red signal) are required by law to stop, and drivers on the major street (facing a flashing yellow indication) may cautiously proceed through the intersection without stopping [3]. This study, though, found that many major street drivers choose to stop at flash-controlled intersections even when there are no conflicts necessitating a stop. The percentage of through vehicles on the major street at a given intersection that stop – referred to as "percent major through stopping" was chosen as the primary measure of effectiveness for intersections being controlled by yellow/red flash. This percentage is an important statistic because it represents both driver confusion and potential safety risks. It is also important as an operational statistic because it represents the degradation of major street flow that theoretically should be uninterrupted by yellow/red flash.

In the following sections the relationship between vehicle stopping and a number of potential explanatory variables is analyzed. First, percent major through stopping is analyzed as a function of two variables – minor street volume and the minor street to major street volume ratio, as studied by Bansen [2]. This was done to evaluate trends that had been identified with Bansen's more limited data set. Additionally, percent major through stopping was analyzed as a function of major street volume, roadway functional classification, average daily traffic (ADT), intersection geometry, presence of vehicles on the minor approaches, and the number of lanes on the major and minor streets. Chapter 6 will model stopping relative to those variables deemed to potentially significantly influence stopping in these analyzes.

5.2.1 Definition of a Stop

For the purposes of the analysis conducted for this project, stops could only occur at the stop bar. Thus, a vehicle that stopped when reaching the back of a queue but proceeded through the intersection without stopping when it reached the front of the queue was not counted as stopping. Every vehicle was classified as either stopping or not stopping. In addition, turning vehicles were excluded from most of the major street stopping analysis. At a signalized intersection with permitted left turns operating under normal conditions or at an unsignalized intersection, vehicles turning left routinely stop because of conflicts with vehicles traveling the other direction on the major street. This same scenario can exist at a flashing signal and does not necessarily represent driver confusion with regard to the meaning of a flashing yellow indication. Vehicles turning right were found to stop much less frequently than vehicles going through the intersection. Since the percentage of vehicles turning right or left varies from intersection to intersection, the complexity of comparisons of different intersections would have been further increased by the inclusion of turning vehicles. Future research will attempt to capture the influence of flashing operations on turning movements.

5.2.2 The Yellow/Red Dataset

Table 5.1 lists traffic volumes and stopping rates at all thirty eight instances of yellow/red flash included in the study. The major street, defined as the street receiving a flashing yellow indication, is always the first street listed in the intersection name column. Information about when the data was collected can be found in Chapter 4, and complete volume and stopping rate information can be found in Appendix C.

5.2.2.1 Volume Computation

The volumes listed in Table 5.1 are representative of one hour at the time that each video was filmed. The video cassette tapes on which the footage was recorded were generally 62 minutes long, so volume data was simply truncated at the 60 minute mark if the entire tape was used. For video recordings that were shorter (due to the signal being repaired by maintenance crews before one hour of footage was gathered), volumes were scaled up to an equivalent hourly flow, assuming uniform demand throughout the hour.

5.2.2.2 New Signal Installations

Four of the yellow/red signals were not operating under malfunction flash but rather newly installed signals that were being flashed as part of a transitional period before regular green/yellow/red operation was implemented. These signals are denoted as "new" throughout the remainder of the chapter because driver behavior is potentially different under this circumstance. One of these new signals, Market Street and 18th and a Half Street in Atlanta's new Atlantic Station development, merits special discussion. This signal was initially placed into yellow/red flash following installation, and later changed to red/red flash. Data was gathered during both flash mode operations (the red/red data can be found in Section 5.3). The location also makes it unique – pedestrian volumes were much higher than any other intersection studied, and many drivers, especially at the time of the yellow/red filming, were likely entering the development for the first time and may have stopped at the intersection because they were unsure of how to get to their destination or were simply exploring the area.

Table 5.1 Traffic Conditions at Yellow/Red Signals in Study

Intersection *(Major Street at Minor Street)*	**Equivalent Hourly Volume**			**Percent Major Thru Stopping**
	Major Total	**Major Thru**	**Minor Total**	
Northside Dr. at Peachtree Battle Ave.	989	812	428	58.6
Monroe Dr. at 10th St.	1481	1129	715	57.8
Candler Dr. at Rainbow Dr.	1857	1290	771	57.9
N. Highland Ave. at University Dr.	902	830	224	9.8
17th St. at Bishop St. (new signal)	790	638	278	2.9
Lenox Rd. at Phipps Dr.	1897	1586	513	32.9
Spring St. at 17th St.	535	428	764	45.4
W. Peachtree St. at 11th St.	843	785	58	0.7
14th St. at Williams St.	1516	1212	884	59.7
W Peachtree St. at 16th St. #1	1487	1397	210	8.5
Market St. at 18th ½ St. (new signal)	445	414	14	16.5
Peachtree St. at 8th St. (new signal)	1695	1603	140	6.6
Techwood Dr. at Merritts Ave. #1	191	162	23	4.8
Techwood Dr. at Merritts Ave. #2	432	387	66	5.7
E. Rock Springs Rd. at Barclay Pl.	507	502	2	0.0
Ashford Dunwoody Rd at Harts Mill Rd.	1030	921	201	6.5
Spring St. at 8th St. (new signal)	1854	1785	73	1.3
10th St. at Hemphill Ave. #1	606	359	364	45.6
10th St. at Hemphill Ave. #2	884	639	381	62.8
17th St. at I-75/85 SB off ramp	1258	1258	355	3.9
Paces Ferry Rd. at Paces Mill Rd.	672	474	234	39.2
Peachtree Rd. at Sheridan Dr.	2715	2612	129	4.3
Roxboro Rd. at Pritchard Dr.	1296	970	364	35.4
W Peachtree St. at Peachtree Pl.	842	755	147	3.22
Spring St. at Abercrombie Pl.	868	836	17	0.5
10th St. at Holly St. #1	1548	1533	46	1.4
Juniper St. at 12th St.	533	477	137	13.5
Charles Allen Dr. at 8th St. #1	121	74	115	21.8
Charles Allen Dr. at 8th St. #2	417	280	279	51.7
W. Peachtree St. at 16th St. #2	1853	1690	290	14.2
10th St. at Holly St. #2	989	961	46	2.3
10th St. at I-75/85 SB ramps	1715	1101	944	61.1
Peachtree St. at Pine St.	1376	1291	452	51.1
Collier Rd. at Post Collier Hills Apts.	1326	1234	50	4.8
Howell Mill Rd. at I-75 SB ramps	1817	829	697	76.4
Howell Mill Rd. at I-75 NB ramps	1170	918	745	69.9
Ponce de Leon Ave. at Fairview Rd./Lullwater Rd.	1668	1627	142	20.4
Ponce de Leon Ave. at Frederica St.	2274	2173	91	3.9

5.2.3 Major Street Stopping

This section explores the relationship between percent major through stopping at intersections operating under yellow/red flash and various characteristics of the study intersections: minor street volume, major street volume, minor street to major street volume ratio, roadway functional classification, average daily traffic (ADT), intersection geometry, presence of vehicles on the minor approaches, and the number of lanes on the major and minor streets. For volume-related variables, the hourly rates in Table 5.1 were always used. Mathematical models presented in Chapter 6 were developed based on relationships observed between some of these variables and percent major through stopping.

5.2.3.1 Minor Street Volume

A correlation between minor street volume and percent major through stopping was observed. The minor street volumes studied are the same as those in Table 5.1 – they are the volumes captured from the videos and adjusted to hourly flow rates. At low minor street volumes, the percentage of major street through vehicles stopping was always less than 25 percent, and usually less than ten percent. At high volume minor streets, the percentage of major street vehicles stopping was generally around 60 percent, ranging between 45 and 80 percent. In between is a transitional range, where stop percentages can range from less than five percent to more than sixty percent. As seen in Figure 5.1, the transitional range begins to occur at a flow rate of 200 vehicles per hour on the minor street, and ends at a flow rate of approximately 500 vehicles per hour. The high minor street flow rate is considered to begin near 700 vehicles per hour. The exact boundary between the transitional and high range is difficult to clearly define as there was only one data point collected with a minor street flow between 500 and 700 veh/hr.

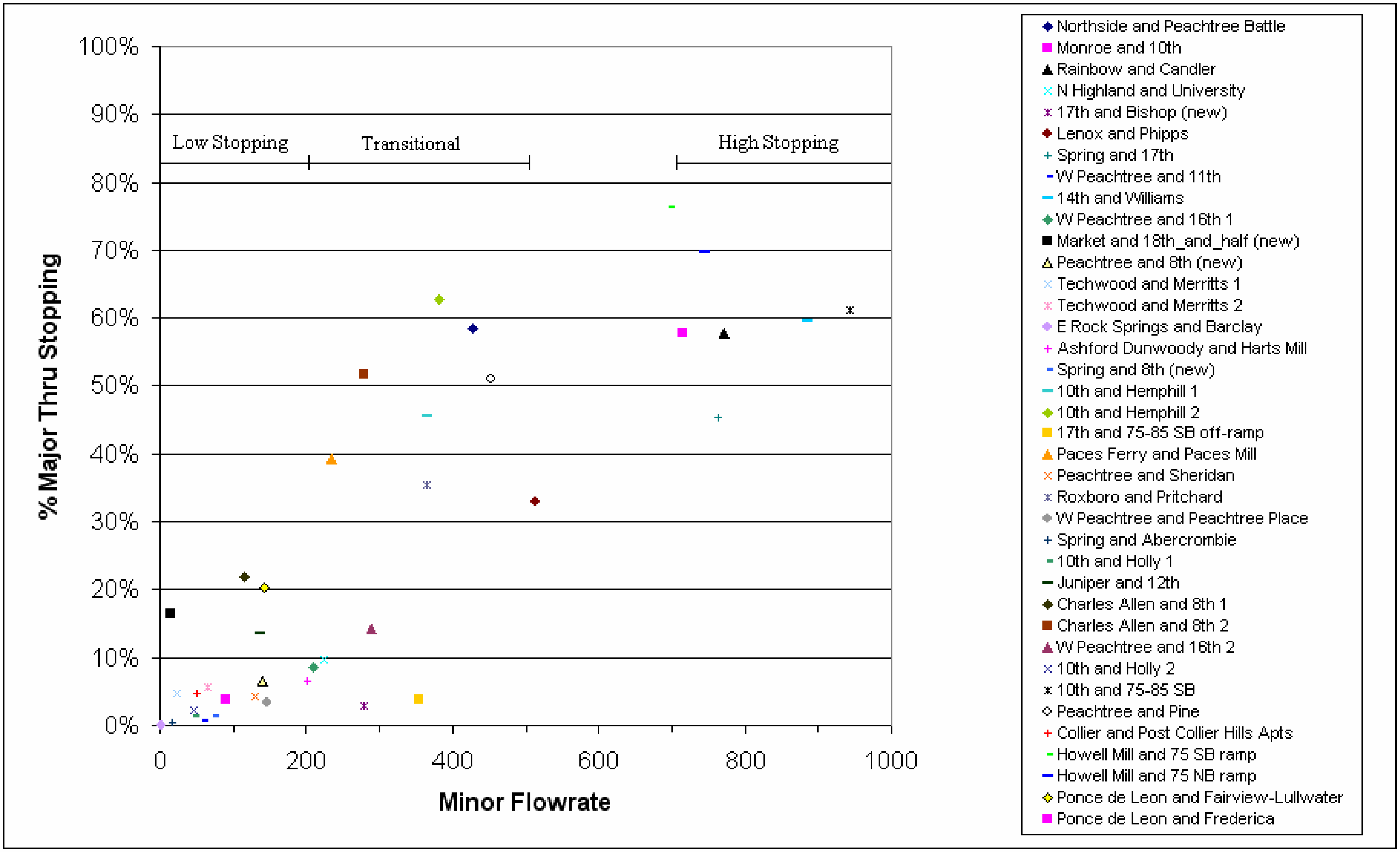

Figure 5.1 Major Street Stops (Through Vehicles) vs. Minor Street Volume Yellow/Red Flashing

At minor street volumes less than 200 vehicles per hour, yellow/red flash operates closer to expectation. The vast majority of vehicles on the major street proceed through the intersection without stopping. At minor street volumes of more than 500 vehicles per hour, yellow/red flash operating characteristics are more similar to red/red flash, with a majority of the vehicles stopping at the flashing yellow indication. Bansen observed the same phenomenon, although he identified a smaller transitional range of 300 to 500 vehicles per hour [2]. This is likely due to the smaller data set that lacked intersections within portions of the transitional volume range.

In the transitional range, where stopping percentages vary widely, factors other than minor street volume may be better predictors of percent major through stopping. This may be due to the fact that minor street volume only captures conditions on one set of approaches and not the relationship between the minor and major street approaches. A minor street with a volume of 400 vehicles per hour will presumably have a different affect on a six lane arterial with a volume of 1000 vehicles per hour than it would on a two lane collector with a volume of 400 vehicles per hour. To explore the relationship between the roads, volume ratio, ADT ratio, functional classification, the number of lanes on each approach, and the lane ratio were all studied and presented in later portions of the chapter.

5.2.3.2 Platoon Considerations

Another operational change at higher volumes is the development of platoons. When a stopped vehicle departs the stop bar and proceeds through the intersection, other vehicles behind it or next to it on a multilane approach will "piggyback" with the lead vehicle and form a platoon that travels through the intersection. Bansen [2] first explored this phenomenon by conducting a separate analysis of platoon-leading vehicles only. Vehicles that proceeded through an intersection without stopping within three seconds of a vehicle that stopped and then departed were considered to be following vehicles and therefore excluded from the platoon-specific analysis. Figure 5.2 shows a graphical representation of this scenario.

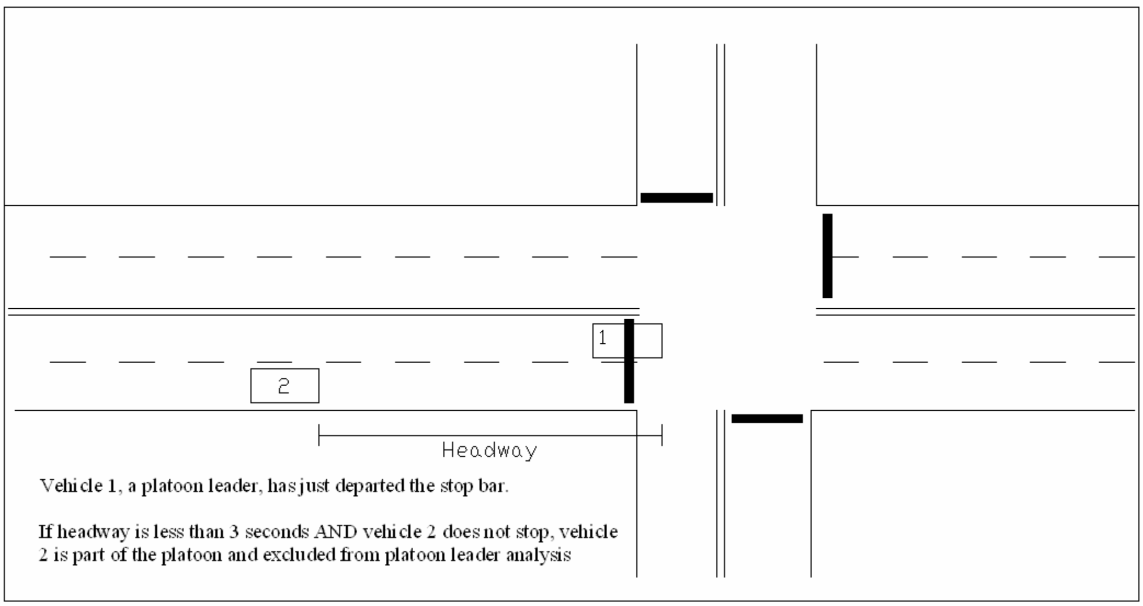

Figure 5.2 Definition of Platoon

The platoon analysis found that the exclusion of following vehicles did increase the stopping percentage and further illustrated the behavior of high minor volume yellow/red intersections to behave similar to red/red intersections. The stopping percentage increases averaged eight percent, but were as high as twenty three percent at one high volume intersection. Platoon analysis did not alter the overall trend of low volume, transitional volume, and high volume cases, and as such it was not conducted for percent major through stopping rates for yellow/red intersections for the expanded set of

38 intersections. Later sections of this chapter do include platoon analysis as an explanation of why some drivers do not stop at flashing red indications.

5.2.3.3 Major Street Volume

Before proceeding to volume ratio analysis, the second component of volume ratio – major street volume – was analyzed independently to examine what relationship exists between it and percent major through stopping. The results of this analysis can be seen in Figure 5.3. Major street volume does not appear to have much of an effect on percent major through stopping, as stopping percentages vary greatly at all volume levels. Stopping rates of less than ten percent are found over the entire range of data. Stopping rates of over fifty percent are found for all but the highest and lowest of major volumes. At these extremes, there is limited data and the possibility of high stopping rates existing is not necessarily excluded.

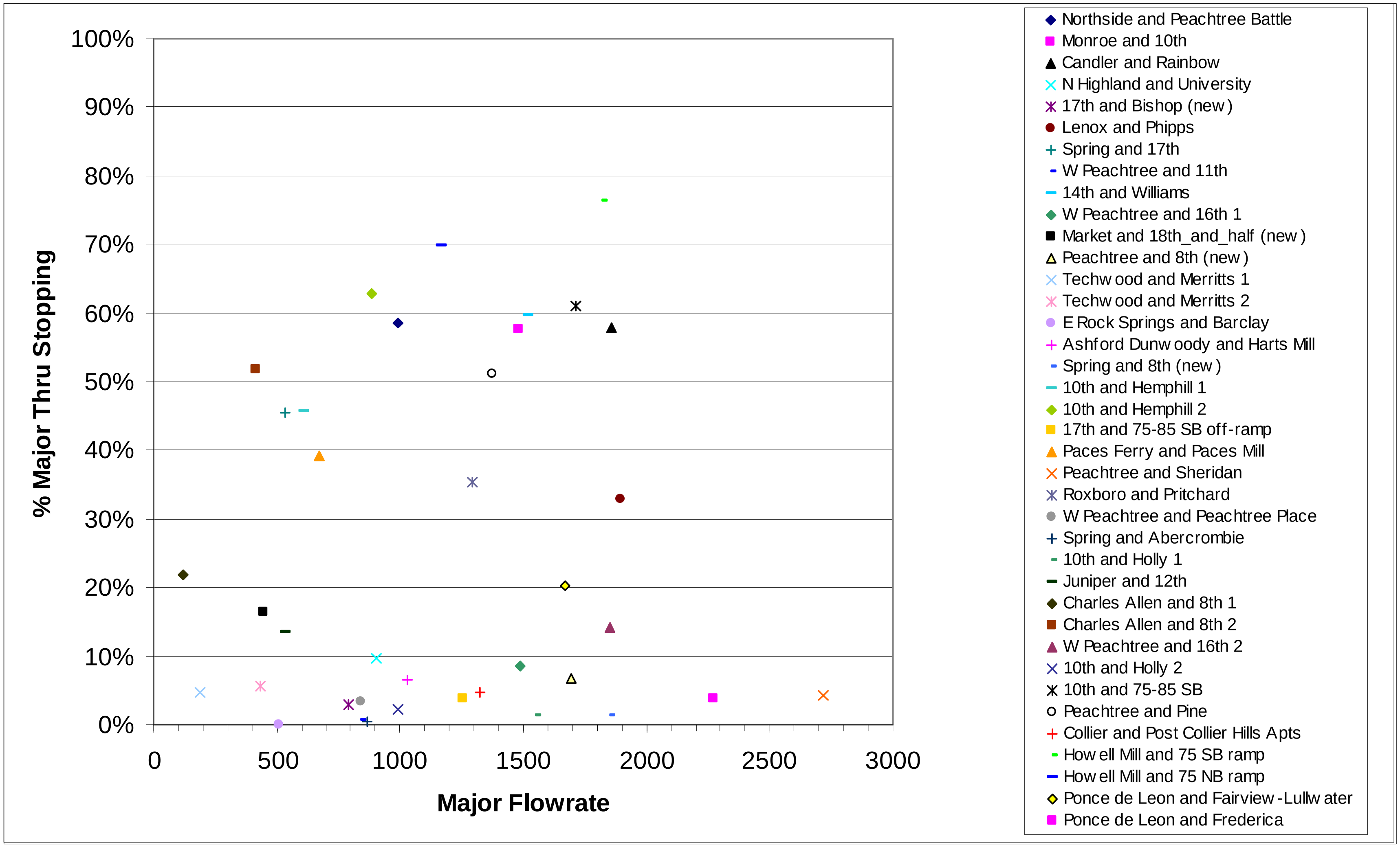

Figure 5.3 Major Street Stops (Through Vehicles) vs. Major Street Volume Yellow/Red Flashing

5.2.3.4 Volume Ratio

Analysis of the volume ratio between the two streets at an intersection allows for a study of percent major through stopping as a function of characteristics of both streets relative to one another. For most of the analysis conducted in this study, the volume ratio is defined as minor street volume to major street volume. This definition bounds the volume ratio to values between zero and one (except for one intersection that had a higher volume on the minor street), whereas, a major to minor volume ratio creates outlying data points at intersections with major volumes that are an order of magnitude larger than minor volumes, creating significant difficulties in interpretation. Utilizing the ratio minor to major is also preferable because it results in one dependent and one independent variable. Specifically, the dependent variable has been set as the number of minor street vehicles divided by the number of major street vehicles, and the independent variable has been set as the number of major street vehicles stopping divided by the number of major street vehicles. The number of major street vehicles is found in the denominator of both terms. With its elimination, the dependent variable reduces to be the number of minor street vehicles, and the independent variable reduces to be the number of major street stops. This is not completely accurate as the dependent variable is actually based on major street through vehicles (as opposed to all major street vehicles like the independent vehicle is), but it is still a simpler relationship than would result from the use of *major:minor* volume ratio.

Previous studies such as the FHWA study [5], the TTI study [6], Akbar and Layton's work in Portland [9], and Gaberty and Barbaresso's work in Oakland County, Michigan [10, 11]have chosen to define volume ratio as major street volume to minor street volume. To allow comparisons to these studies, a second volume ratio analysis using the ratio in this form is conducted.

5.2.3.4.1 Findings

The relationship between percent major through stopping and volume ratio is shown in Figure 5.4. Figures 5.5 and 5.6 also show this relationship but use the major to minor ratio that previous studies used. Figure 5.6 is a subset of Figure 5.5, with several outlying data points removed to enlarge the lower ratio portion of the graph where most of the data points lie.

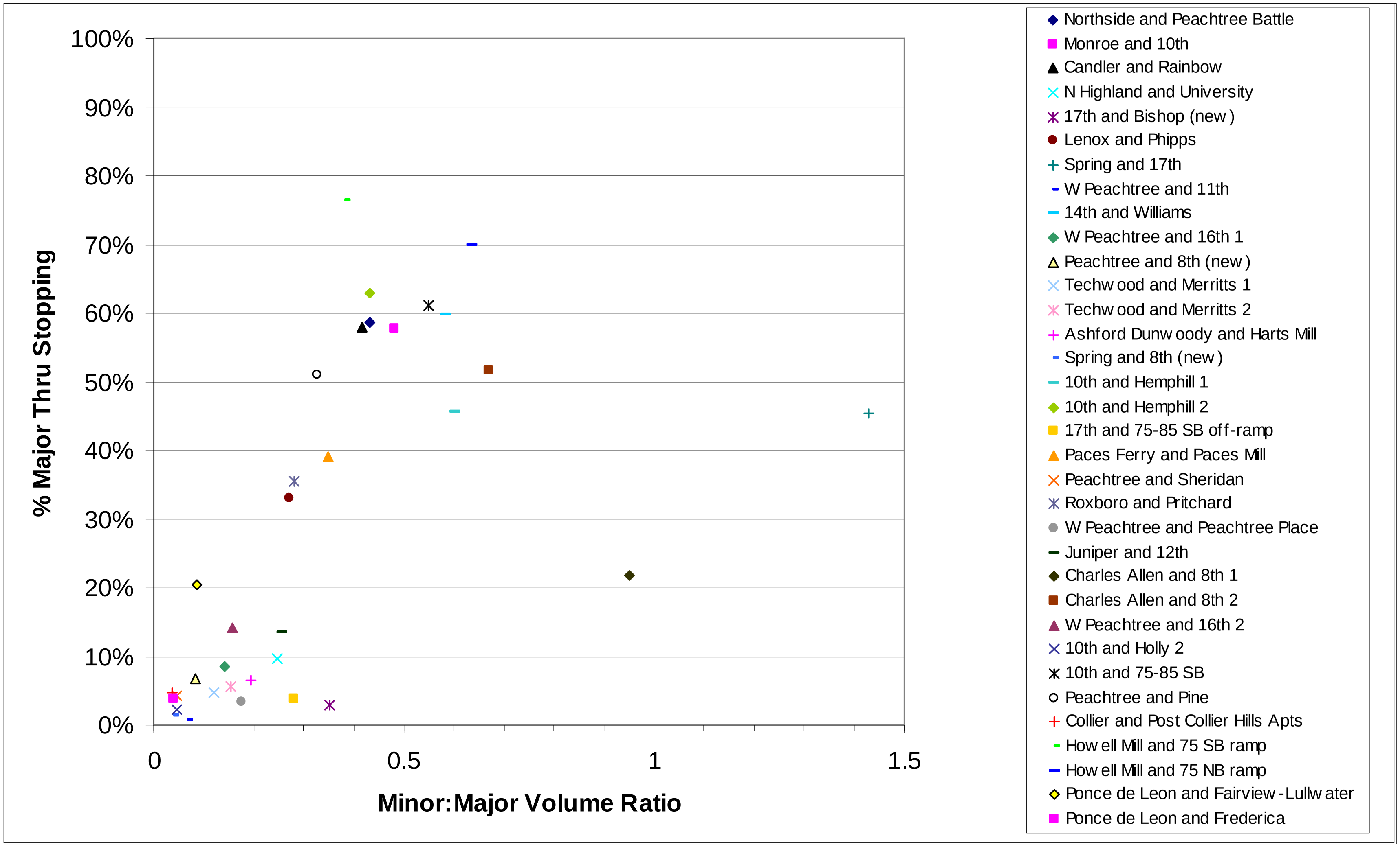

Figure 5.4 Major Street Stops (Through Vehicles) vs. Minor:Major Volume Ratio Yellow/Red Flashing

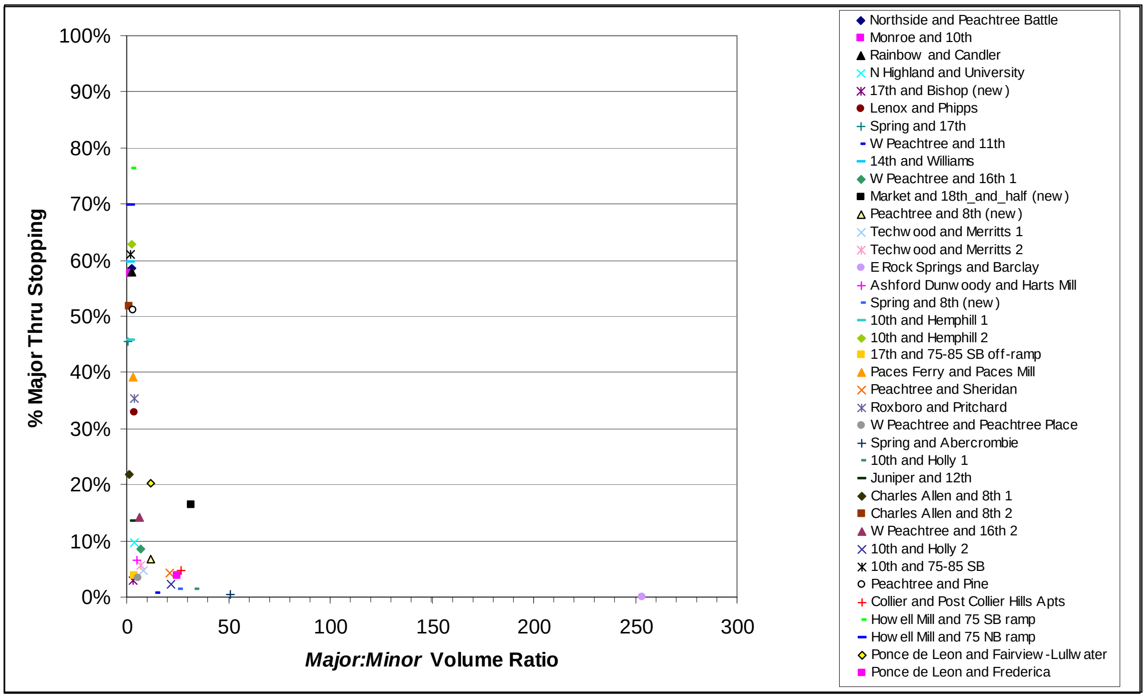

Figure 5.5 Major Street Stops (Through Vehicles) vs. *Major:Minor* Volume Ratio All Yellow/Red Flashing Intersections

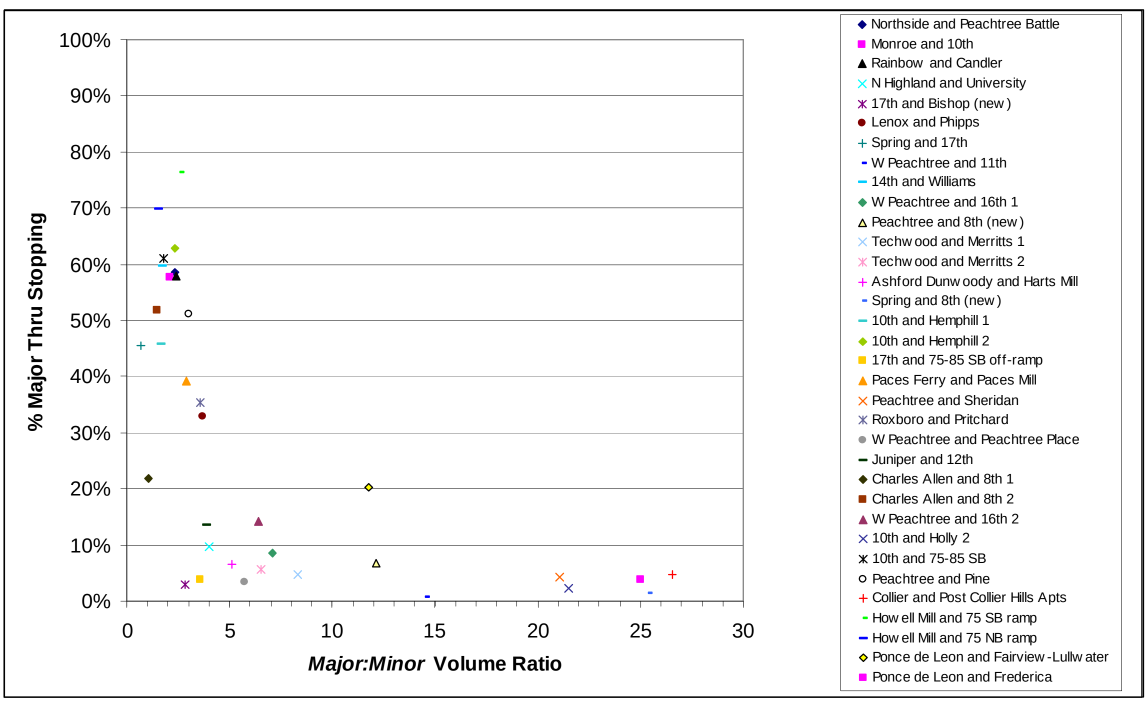

Figure 5.6 Major Street Stops (Through Vehicles) vs. *Major:Minor* Volume Ratio Low Ratio Yellow/Red Flashing Intersections

Examination of Figure 5.4 reveals a relationship between minor to major volume ratio and percent major through stopping. At volume ratios below 0.25, the percentage of through vehicles on the major street choosing to stop is usually less than fifteen. Above a 0.25 ratio, the percentage choosing to stop is usually above thirty and often nearly sixty. There are some exceptions to this general trend. Ponce de Leon and Fairview/Lullwater, and Market and 18th and a half (a newly installed signal) have volume ratios of less than 0.1 but a stopping percentages around twenty percent. On Ponce de Leon this may be due to a lack of traffic signal sight distance as described in Section 4D.15 of the MUTCD, and on Market it may be due to high pedestrian volumes and driver confusion that exists at a new development. 17th and Bishop (a newly installed signal), and 17th and the Interstate 75/85 off ramp both have stopping percentages of less than five percent and volume ratios greater than 0.25. There are several possible explanations for this. Both intersections are located in a large development that was under construction at the time of data collection and roads within it still had very low traffic volumes. Also, 17th is much wider in terms of the number of lanes than either Bishop or the I-75/85 off ramp, a fact further explored with functional classification and lane ratio analysis in later sections of this chapter. Finally, there may exist a transitional volume ratio range in which these intersections lie; the transitional range would be similar to the one that was discovered in minor flow rate analysis.

Two data points in Figure 5.4 – Charles Allen and 8th #1 and Techwood and Merritts #1 – have traffic volumes that are considerably lower than all others and are therefore the most similar to typical program flash conditions. Techwood and Merritts #1 also has a low volume ratio, but Charles Allen and 8th #1 has a ratio of nearly one. The stopping rate at Charles Allen and 8th #1 – just over twenty percent – is much lower than what would be expected based on the volume ratio. This may be an illustration of how traffic operations are fundamentally different during periods of very low volume and why conclusions drawn from studies of program flash – which is used for low volume periods – may not be transferable to malfunction flash.

5.2.3.4.2 Potential Limitations

Under certain situations the volume ratio analysis must be interpreted with caution. The volumes used in the analysis are counts of the number of vehicles that passed through the intersection during the first sixty minutes of filming (for videos less than an hour in the length, the counts were scaled up to the equivalent hourly volume). At lower volume levels, these counts are representative of the demand at the intersection. Queues may form, but they clear out throughout the hour and all vehicles attempting to pass through the intersection are able to do so. However, at higher volume levels queues may form and continue to build throughout the hour on one or both streets. If a queue builds on the minor approaches, the volume ratio will be artificially high; if it is the major road that fails to process the actual demand the volume ratio is artificially low. If constant queues are observed on all approaches the intersection volume ratio is representative of the major to minor lane capacity ratio not the actual demand volumes. To examine the extent of the effect queuing may have had on the volume ratio analysis, Table 5.2 was constructed and videos were examined to see what queuing may have existed. If a vehicle was present on the minor approach for nearly 100 percent of the video, the volume ratio analysis should be used with some caution. A similar check could have been performed with major street vehicle presence, but was deemed unnecessary as major street queues were never observed at yellow/red flash intersections for more than several minutes without the presence of minor street queues.

Table 5.2 Percent of Time Minor Street Vehicles are Present

Intersection	**Percent of Time a Minor Street Vehicle is Present**
Northside Dr. at Peachtree Battle Ave.	78.5
Monroe Dr. at 10th St.	92.0
Candler Dr. at Rainbow Dr.	* (nearly 100)
N. Highland Ave. at University Dr.	47.4
17th St. at Bishop St. (new signal)	44.2
Lenox Rd. at Phipps Dr.	81.2
Spring St. at 17th St.	85.7
W. Peachtree St. at 11th St.	16.4
14th St. at Williams St.	98.9
W Peachtree St. at 16th St. #1	71.4
Market St. at 18th ½ St. (new signal)	3.1
Peachtree St. at 8th St. (new signal)	54.4
Techwood Dr. at Merritts Ave. #1	4.7
Techwood Dr. at Merritts Ave. #2	15.8
E. Rock Springs Rd. at Barclay Pl.	0.6
Ashford Dunwoody Rd at Harts Mill Rd.	49.1
Spring St. at 8th St. (new signal)	31.8
10th St. at Hemphill Ave. #1	75.4
10th St. at Hemphill Ave. #2	79.5
17th St. at I-75/85 SB off ramp	68.0
Paces Ferry Rd. at Paces Mill Rd.	57.6
Peachtree Rd. at Sheridan Dr.	61.7
Roxboro Rd. at Pritchard Dr.	75.3
W Peachtree St. at Peachtree Pl.	42.4
Spring St. at Abercrombie Pl.	4.7
10th St. at Holly St. #1	22.1
Juniper St. at 12th St.	40.4
Charles Allen Dr. at 8th St. #1	21.2
Charles Allen Dr. at 8th St. #2	55.0
W. Peachtree St. at 16th St. #2	85.0
10th St. at Holly St. #2	16.4
10th St. at I-75/85 SB ramps	100.0
Peachtree St. at Pine St.	84.6
Collier Rd. at Post Collier Hills Apts.	23.0
Howell Mill Rd. at I-75 SB ramps	97.4
Howell Mill Rd. at I-75 NB ramps	*
Ponce de Leon Ave. at Fairview Rd./Lullwater Rd.	38.1
Ponce de Leon Ave. at Frederica St.	39.8

***** Camera angle prevented complete presence analysis for these intersections.

Several intersections have a volume ratio that is likely more representative of capacity than demand. Candler Drive at Rainbow Drive and 10th Street at I-75/85 southbound ramps are almost certainly in this category, and Howell Mill Road at I-75 southbound ramp may be as well due to traffic volumes that increase during the latter part of the video. Fourteenth Street at Williams Street and other intersections with minor street vehicles being present for a high percentage of time do have queues clear at times throughout the video so the volume ratio is representative of demand.

Another potential pitfall of volume ratio analysis is that absolute volume on either approach is no longer an independent variable. Certain ranges of volume ratio data may consist of only high or low absolute volumes due to dataset size limitations. Stopping rates could be correlated with the high or low volume condition experienced, and would not necessarily be a predictor of stopping rates at the same volume ratio but dramatically different absolute volumes. To see if this situation existed with the data collected for this study, Figure 5.7 was created. This figure shows the major and minor hourly volumes for each intersection in the study, and the volume ratio can be seen from the slopes plotted onto the figure.

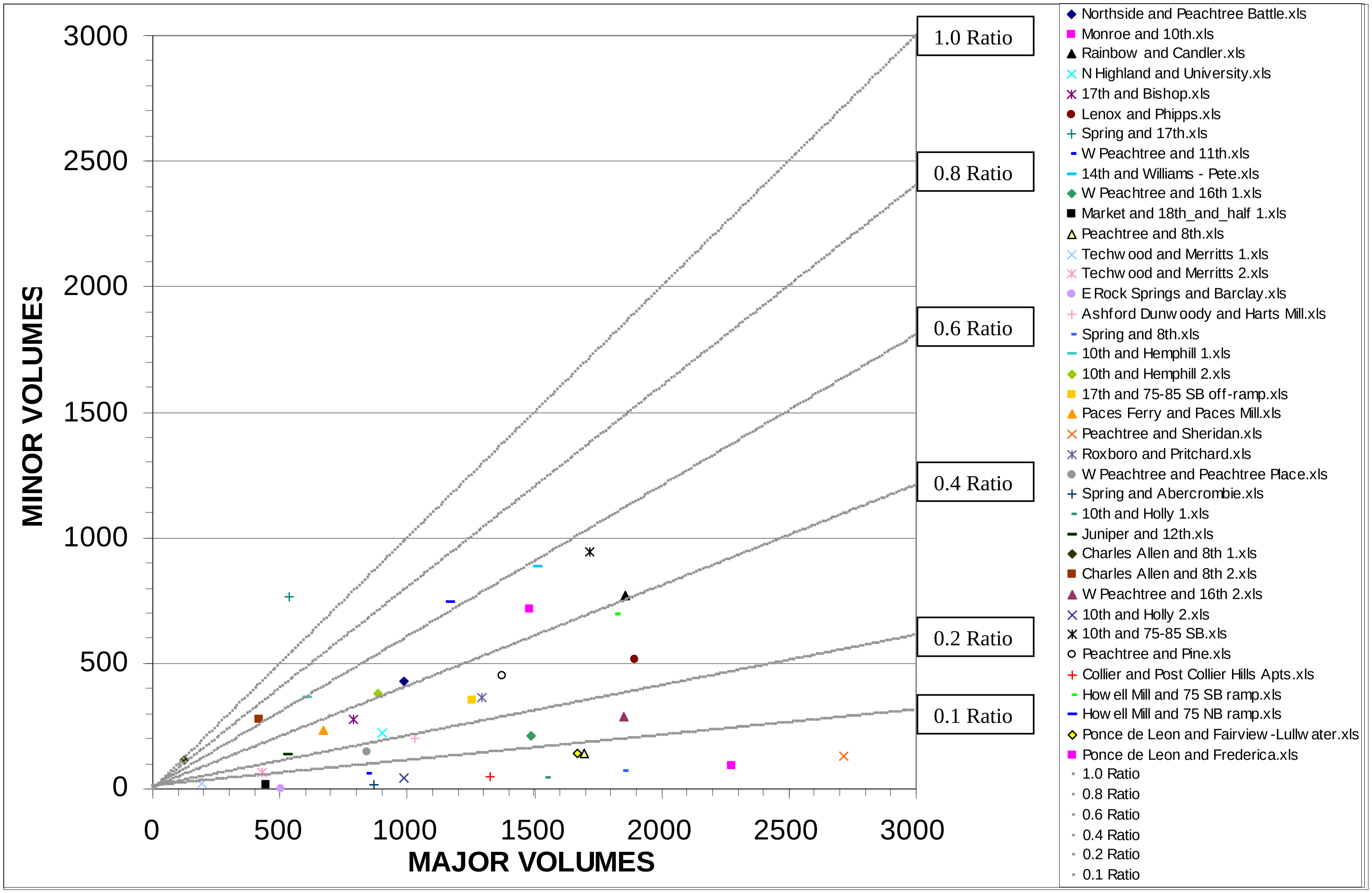

Figure 5.7 Hourly Volumes and Minor:Major Volume Ratio for Yellow/Red Flashing Intersections

Figure 5.7 shows that this study did not capture any instances of major street volumes of more than 2000 vehicles per hour with a ratio of more than 0.1. One possible reason is that most intersections lack the capacity required to process this many vehicles without normal (green/yellow/red) signalized control. Candler Dr. at Rainbow Dr. and 10^{th} St. at the I-75/85 southbound ramps may have had demands corresponding to major street volumes of more than 2000 and ratios above 0.1, but queues formed during flashing operation and volumes were constrained. Also, many agencies indicated in the survey that they configure intersections of two arterials or two “large” roads to flash red/red. Several intersections filmed in red/red malfunction flash and discussed later in this chapter have absolute volumes and volume ratios lying in regions where Figure 5.7 lacks data points. Thus, the results of the volume ratio analysis conducted for this study should be used with caution, not extending the results for each volume ratio beyond the bounds of the absolute volumes for which the volumes ratios were measured. For example, the operations at intersections with minor/major volume ratios above 0.1 and high major street demand (i.e. 2000 + veh/hr) cannot be extrapolated from the given data. In addition, the extrapolation of any operations for a minor/major volume ration above 0.6 must be used with caution.

5.2.3.4.3 Comparisons to Previous Studies

Many previous studies of flashing operation conducted analysis based on volume ratio [5-11], but comparisons are difficult to draw for several major reasons. First, previous studies were of program flash, which is used during nighttime periods with very low volume. Although the volume ratios during these times may be similar to daytime ratios, the absolute volumes are significantly lower such that traffic operations at an intersection may be fundamentally different for similar ratios. Previous operational studies [5, 6] assumed that vehicles facing a flashing yellow indication never stop, but this study has shown that more than half of the vehicles facing a flashing yellow indication stop at some intersections. Although delay was not measured in this study, the field data collected suggests that delay-based operational conclusions drawn by past studies may not be valid. A future study will explore this hypothesis using a simulation model with vehicle stopping rates based on the rates observed in this study.

Studies that examined accident rates as a function of volume ratio [5, 9-11] are the most useful for comparative potential. Stopping at a flashing yellow signal is potentially hazardous, as a following vehicle may not expect its lead vehicle to stop, resulting in a rear-end collision. Stopping at a flashing yellow signal may also result in potential hazards by creating false expectancies in the minor street drivers. The minor street drivers may be led to believe that all major street drivers will be stopping and they can safely enter the intersection even when major street vehicles are approaching. Percent major through stopping, then, may be correlated with accident experience, and it would be expected that higher stopping percentages correspond to higher accident rates. However, comparative potential between this study and previous studies may again be limited due to absolute volume differences. Also, previous studies had the ability to recommend the elimination of program flash when accident rates were high, whereas this study can only recommend conditions under which each type of flash should be considered.

Table 5.3 shows accident rates as a function of *major to minor* volume ratio for a set of intersections outside of the San Francisco area that were part of the FHWA program flash study [5]. The mode of flash was yellow/red for all of the intersections. The top number in each cell is the accident rate before program flash was implemented, and the bottom number is the accident rate after program flash was implemented. Arrows indicate a significant difference at a level of 0.05. Although there does appear to be a relationship of increasing accidents rates as major to minor volume rate decreases, it appears to exist for both regular operation and program flash.

Table 5.3 Accident Rates by Volume Ratio, FHWA Report

GROUP				ACCIDENT CATEGORY								
CRITERIA	CATEGORY	Intersections for Statistics	Intersections for Rates	Property Damage Only	Personal Injury	Fatality	Rear End	Right Angle	Approach Turn	Pedestrian/ Bicycle	Other	Total
Main Street to Side Street Volume Ratio: For Volume During Flashing Hours	< 1.0	5	5	4.20/3.35	.91/3.10	0/0	1.46/.91	.91/2.79	0/0	0/.30	2.74/2.44	5.11/6.45
	> 1.0 and ≤ 2.0	10	10	1.14/4.55 ↑	2.18/.84	0/0	.77/.49	1.45/4.06	.13/.66	0/0	1.28/.77	3.62/5.99
	> 2.0 and ≤ 3.0	12	12	.57/1.66	0/1.20 ↑	0/0	.12/.34	0/2.17 ↑	0/0	.12/.04	.33/.30	.57/2.86
	> 3.0 and ≤ 4.0	4	4	1.27/1.48	.63/.21	0/0	1.27/0	.63/.85	0/.42	0/0	0/.42	1.90/1.69
	> 4.0 and ≤ 5.0	5	5	1.36/2.55	0/1.64	0/0	.39/0	0/2.51	0/.16	0/.31	.97/1.22	1.36/4.20
	> 5.0 and ≤ 10.0	8	8	1.10/.81	1.15/.27	0/0	.96/0	.33/.23	.83/.35	0/0	.08/.35	2.20/.94
	> 10.0	9	9	.21/1.43	.19/.69	0/0	.19/1.55	.21/.27	0/0	0/.31	0/0	.40/2.12
All Intersections:	Rate/Million Vehicles	58	55	1.58/3.37	.99/.99	0/0	.77/.68	.64/2.34 ↑	.23/.34	0/.10	1.03/.98	2.66/4.44 ↑
	Total Number of Accidents	58	58	37/104	13/34	0/0	21/31	15/59	8/13	1/6	27/49	72/158

A study of program flash in Oakland County, Michigan [10, 11] found that intersections of two arterials with a *major to minor* volume ratio of 2:1 or less (minor to major volume ratio of .5 or more) had significantly greater accident rates than those with ratios of major to minor of 4:1 or more (minor to major ration of .25 or less) when program flash mode was in use. As a result, Oakland County stopped using program flash at four leg intersections of two arterial roads, many of which had ratios of 2:1 or less. The study suggests but does not directly state that yellow/red was the flash mode used for all signal.

A study of program flash in Portland, Oregon [9] grouped intersections into *major to minor* volume ratios of less than two, between two and four, and greater than four. The results can be seen in Table 5.4. Accident rates were lower at intersections with ratios of more than four than at intersections with ratios between two and four, as would be expected. Also, there is a significant difference in accident rates under full color and flashing operation in the two to four volume ratio range. Surprisingly, flashing operation with volume ratios less than two resulted in the lowest accident rate of the three volume ratio ranges and a lower accident rates than full-color operation for the same ratios [9]. This may be due to the small sample size used for the study. Also, it is not stated that all signals were operated with the same flash mode, so it is possible that low volume ratios were flashed red/red and other intersections were flashed yellow/red.

Table 5.4 Accident Rates by Volume Ratio, Portland Study [9]

	Mean Accident Rate		Standard Deviation		
Classification of Accident	Full Color	Flashing	Full Color	Flashing	t-Statistic
Volume Ratios Between 0.0 and 2.0 (N = 4)					
All	3.29	1.06	6.58	2.12	0.645
PDO	0.00	1.06	0.00	2.12	−1.000
Injury	3.29	0.00	6.58	0.00	0.999
Volume Ratios Between 2.0 and 4.0 (N = 14)					
All	1.20	5.44	2.32	5.39	−2.704[a]
PDO	0.64	0.92	1.34	2.76	−0.340
Injury	0.56	4.52	2.09	4.92	−2.769[a]
Angle	0.00	3.30	0.00	4.03	−3.060[a]
Rear end	0.47	1.60	1.41	3.53	−1.111
Volume Ratios Greater Than 4.0 (N = 12)					
All	1.89	2.76	2.20	3.79	−0.688
PDO	1.02	1.84	1.58	2.41	−0.985
Injury	0.87	0.92	1.49	1.70	−0.076
Angle	0.43	2.21	1.15	2.87	−1.990[b]
Rear end	0.41	0.00	1.09	0.00	1.296

Note: Results are given as accident rate per million entering vehicles. PDO = property damage only.

[a] Significant at 95 percent level of confidence.
[b] Significant at 90 percent level of confidence.

Collectively, the results of the FHWA study, the Oakland County study, and the Portland study are inconclusive. Accident rates overall generally increased after the initiation of flashing operation, but when only certain volume ratios are examined the study results begin to conflict.

5.2.3.5 Functional Classification

Analysis based on functional classification is another way of studying percent major through stopping as a function of the relationship between both streets at an intersection. Unlike volume ratio, which could vary based on time of day or day of week, functional classification is a constant. Since malfunction flash can occur at any time, analysis based on variables not subject to fluctuation is potentially more applicable.

The Georgia Department of Transportation (GDOT) assigns a functional classification to all roadways in the state [24]. Separate classification systems are used for urban and rural areas, but all intersections included in this study were in urban areas. The classifications for urban areas are, in decreasing order of mobility: interstate principal arterial, freeway and expressway, principal arterial, minor arterial, collector, and local. Interstate ramps were treated as a separate functional classification in this study because GDOT does not appear to include them in the listed functional classes. Analysis was conducted based on the combination of functional classifications at a given intersection. For example, the intersection of a collector and a local street would be in one category, and the intersection of two collectors would be in another. Figure 5.8 presents stopping rates at all yellow/red flash intersections sorted by functional classification combination. One intersection, Market Street at 18th ½ Street, is excluded because both streets are too new to appear on GDOT's maps and thus their classification is unknown.

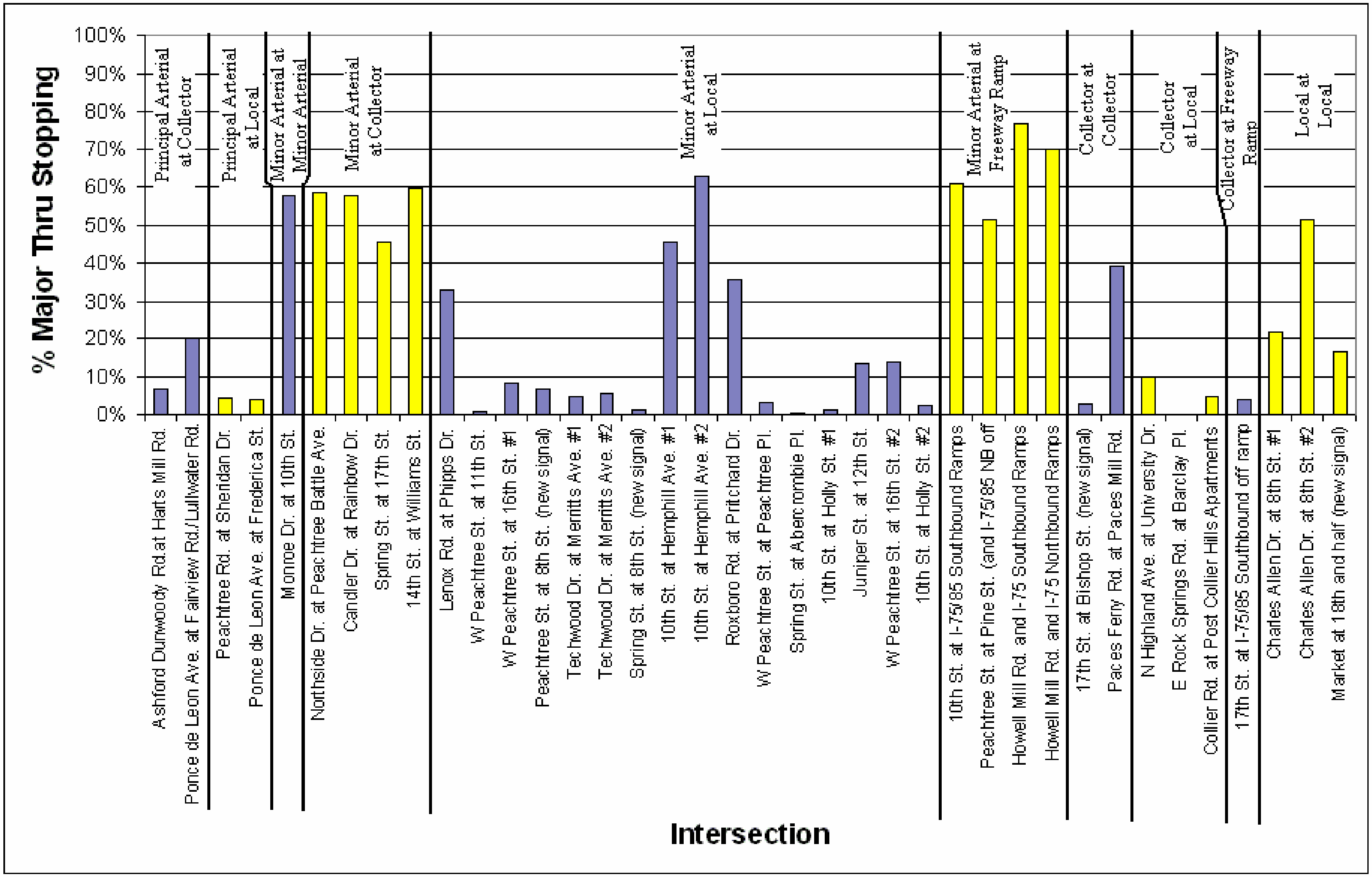

Figure 5.8 Major Street Stops (Through Vehicles) by Functional Classification Combination

Functional classification combinations seem to be a good predictor of percent major through stopping. When the flashing red street is a local street, very few drivers on the flashing yellow street usually chose to stop (except when the flashing yellow street is another local street). Intersections of two roads with the same functional classification usually have high stopping rates. Minor arterials (yellow flash) at collectors (red flash) have high stopping rates, as do minor arterials (yellow flash) at freeway ramps (red flash). The one instance of a collector (yellow flash) at a freeway ramp (red flash) has a very low stopping rate. However, the intersection is located in a new development and all approaches had very low traffic volumes relative to their size. Also, many signals in this development had recently been in flashing operation prior to the beginning of standard operation, so drivers at this location may have been more accustomed to flashing operation.

Figure 5.8 also has some notable exceptions to the trends identified above. In many cases, this may be due to roads that are carrying higher traffic volumes or serving more important roles in the transportation network than their classification implies. The high stopping rates at some minor arterial (yellow flash)/local (red flash) intersections are likely due to roads that are classified as local or collector but provide a higher level of mobility than this classification would normally indicate. For example, 17^{th} Street is classified as a collector yet has six lanes, a nontraversable median, bicycle lanes, HOV lanes, and links Midtown Atlanta to Northside Drive, a principal arterial. It was also under construction at the time the functional classification map was created. Phipps Drive, Hemphill Ave., and Pritchard Drive are all categorized as local streets, although Phipps Drive is seven lanes wide, Hemphill Avenue is a four lane cut-through route between a minor arterial and principal arterial, and Pritchard Drive was relocated and improved between the publication of GDOT's functional classification data and the recording of malfunction flash operations data.

Figure 5.8 was reconstructed as a means of exploring the fact that some roads are serving roles not usually associated with their functional classification. Phipps Drive (at the Lenox and Phipps intersection), Hemphill Avenue (at the 10th and Hemphill intersection), and Pritchard Drive (at the Roxboro and Pritchard intersection) were all reclassified as collectors. 17th Street (at the 17th and Bishop intersection and the 17th and I-75/85 southbound off ramp intersection) was reclassified as a minor arterial. These were the only roads within the yellow/red malfunction flash dataset that were clearly serving a different level of mobility than is usually associated with their GDOT-assigned functional classification. Figure 5.9 shows the result of this reclassification, with reclassified intersections shown in black.

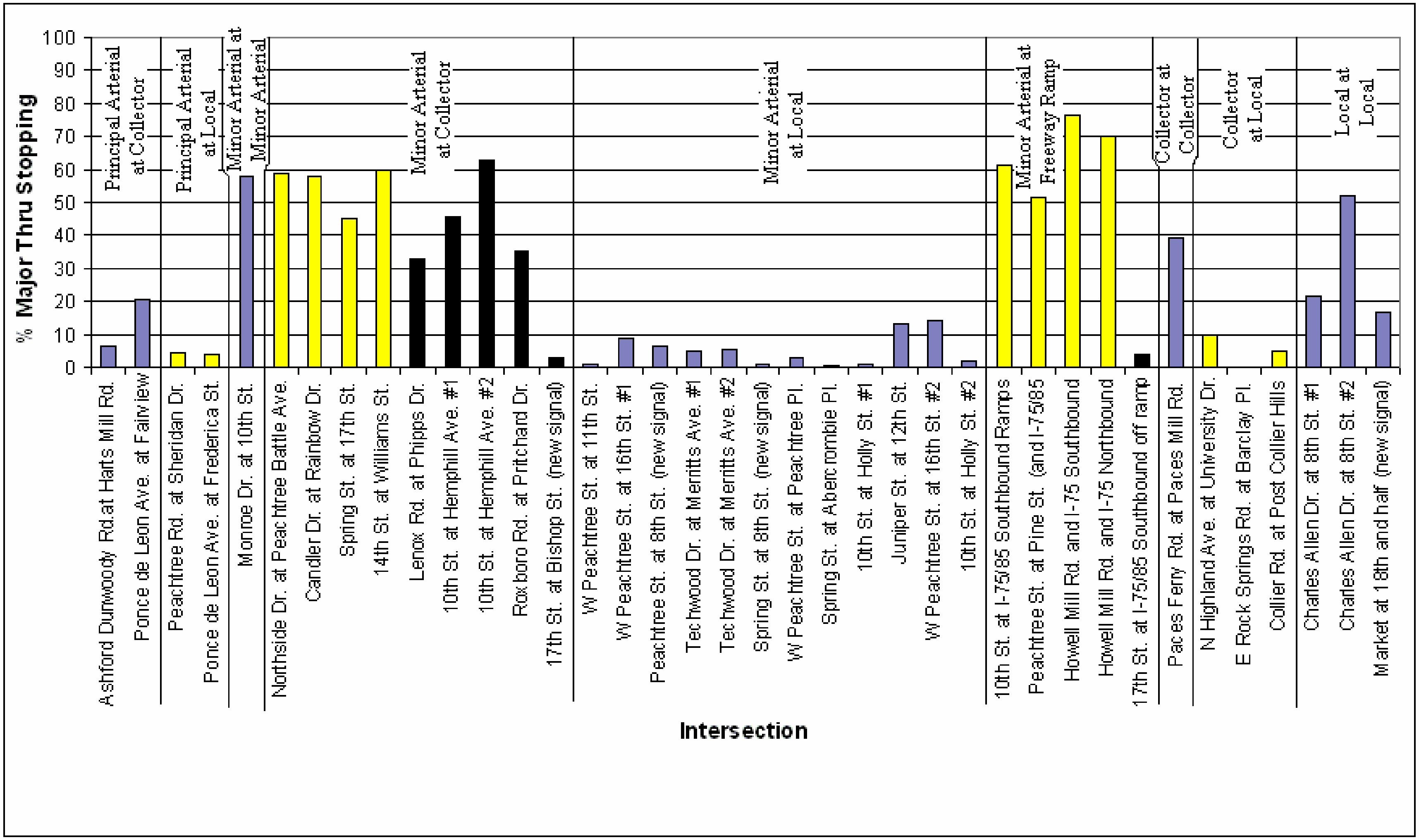

Figure 5.9 Major Street Stops (Through Vehicles) by Functional Classification Combination, with Select Roadways Reclassified

The classification reassignments shown in Figure 5.9 removed some of the outliers in Figure 5.8. Reassignment of large, high volume local roads as collectors removed all of the intersections with high stopping rates from the minor arterial at local category and placed them into the minor arterial at collector category, where all intersections already had high stopping rates. Reassignment of 17th Street as a minor arterial, though, still placed the intersections of 17th at Bishop and 17th at Interstate 75/85 southbound off ramp in categories where stopping rates for all other intersections are much higher. It is possible that 17th Street should actually be classified as a principal arterial (which would eliminate the remaining outliers), although there is insufficient data to make comparisons with principal arterial intersections.

Other studies have considered the importance of functional class. For example, the Portland study [9] examined accident rates for different functional classifications. The classifications were arterial, collector, and local; intersections consisted of all combinations of these except arterial/arterial. As described in Section 5.2.3.4.3, stopping rate at a flashing yellow indication may be related to intersection accident rate. Under this assumption, there are similarities between the results of this study and the results of the Portland study, shown in Table 5.5

Table 5.5 Accident Rates for Functional Classification Combinations, Portland Study [9]

Classification of Accident	Mean Accident Rate: Full Color	Mean Accident Rate: Flashing	Standard Deviation: Full Color	Standard Deviation: Flashing	t-Statistic
Arterial/Collector (N = 2)					
All	1.02	12.02	1.43	0.26	-10.688[a]
PDO	1.01	9.03	1.43	1.62	-5.243[a]
Injury	0.00	2.99	0.00	1.36	-3.117[b]
Angle	0.00	7.00	0.00	1.26	-7.875[a]
Arterial/Local (N = 4)					
All	4.63	3.78	5.91	4.37	0.231
PDO	0.97	0.73	1.95	1.46	0.197
Injury	3.65	3.05	6.38	3.79	0.161
Angle	4.27	3.78	6.21	4.37	0.128
Collector/Local (N = 11)					
All	0.55	2.14	1.30	3.81	-1.309
PDO	0.19	0.80	0.62	1.19	-1.499
Injury	0.36	1.35	1.20	3.65	-0.852
Angle	0.00	1.35	0.00	2.10	-2.129[a]
Rear end	0.00	0.55	0.00	1.82	-1.001
Collector/Collector (N = 6)					
All	4.34	4.14	2.93	5.56	0.078
PDO	2.21	0.46	1.80	1.13	2.225[b]
Injury	2.14	3.68	3.14	5.10	-0.629
Angle	0.22	3.24	0.53	5.32	-1.383
Rear end	1.93	0.67	2.10	1.10	1,301
Local/Local (N = 7)					
All	0.00	3.71	0.00	4.19	-2.343[a]
PDO	0.00	0.36	0.00	0.96	-0.047
Injury	0.00	3.35	0.00	4.41	-2.010[b]
Angle	0.00	1.95	0.00	1.93	-2.675[a]
Rear end	0.00	1.77	0.00	4.67	-1.001

Note: Results are given as accident rate per million entering vehicles. PDO = property damage only.

[a]Significant at 95 percent level of confidence.
[b]Significant at 90 percent level of confidence.

Arterial/collector and local/local intersections had high stopping rates in this study, and they had high accident rate increases when flashing was implemented in Portland. Arterial/local intersections had a decrease in accident rate when flashing was implemented, and generally had low stopping rates in this study. There were some differences. Collector/local intersections had high accident rates, but this study did not identify high stopping rates at such intersections. Collector/collector intersections had a decrease in accidents when flashing was implemented, but accident type changed from primarily rear end to primarily angle, and the severity increased dramatically. Collector/collector stopping rate data in this study was inconclusive.

5.2.3.6 Average Daily Traffic (ADT)

Average daily traffic (ADT) could be another characteristic correlated with percent major through stopping. ADT-based analysis could be conducted with the absolute daily volumes of the major or the minor roadways, or with an ADT ratio to capture the relative difference between the intersecting roads. Unlike the observed volume ratios it would not be subject to capacity constrains and it would not vary by time and day. ADT analysis might also eliminate irregularities that arise in functional classification analysis by directly reflecting a road's relative function through actual aggregate traffic flows.

In order to use ADT for comparative analysis, ADT is needed for both roads at an intersection. The 38 instances of yellow/red flashing operation included in this study were captures at 33 unique intersections. Of these 33 intersections, only five had ADT values available for both roadways. ADT could not be measured by the project team due to time limitations, so no analysis could be conducted using ADT.

5.2.3.7 Lane Ratio

Lane ratio analysis was the final analysis undertaken to examine the impact of the relative difference between the roadways on percent major through stopping. There are different possible methods for defining the number of lanes on either the major or minor roadway, which is a potential weakness of this analysis method. The definition chosen for this analysis was the total number of entering lanes on both approaches. Left and right turn bays were included in the lane count. The ratio was defined as the number of minor street lanes to the number of major street lanes, as shown in Figure 5.10. Three leg intersections (at which the minor road comes to an end) have relatively low volume ratios because there is only one minor street approach to contribute to the minor street lane total. One way major roads do not necessarily result in relatively high volume ratios because the entering approach often had more entering lanes than one approach of a two way street.

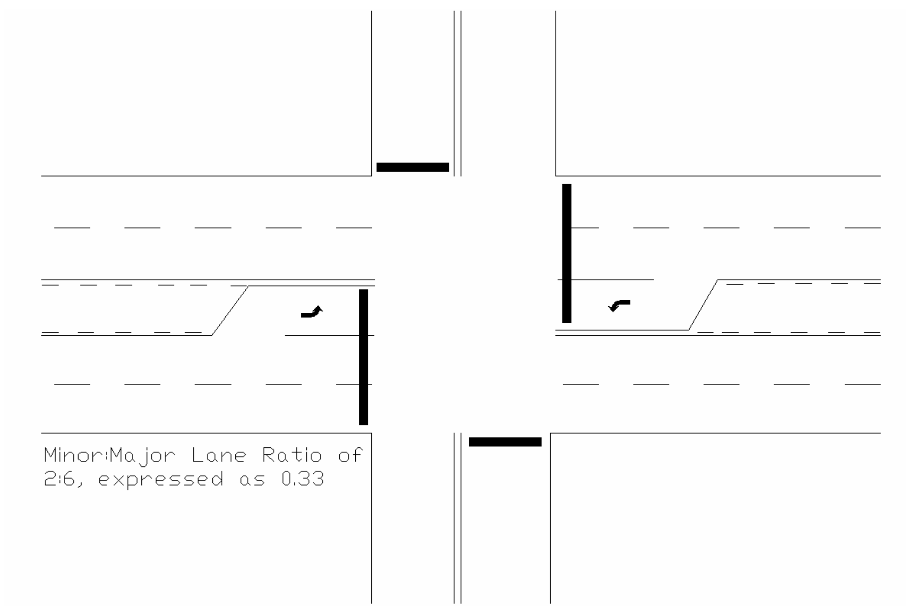

Figure 5.10 Example Lane Ratio Definition

Figure 5.11 shows the results of lane ratio analysis. There does not appear to be a notable relationship between percent major thru stopping and lane ratio. The lowest lane ratios have relatively low stopping rates, but they also have volume ratios and functional class combinations that are associated with low stopping rates, resulting in little new insight gained by using the lane ratio.

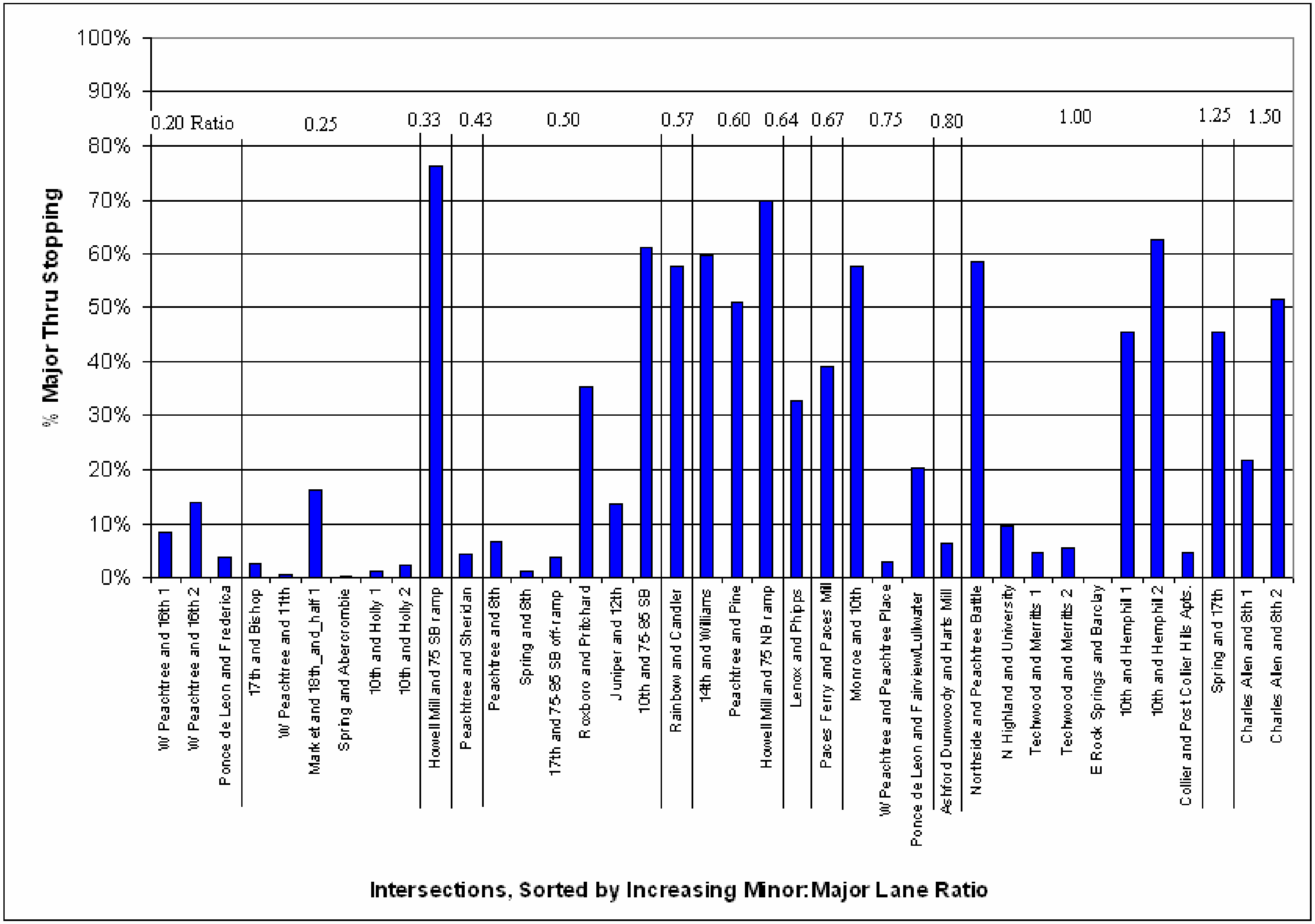

Figure 5.11 Major Street Stops (Through Vehicles) by Minor:Major Lane Ratio

5.2.3.8 Intersection Geometry and Approach Type

Intersection geometry and approach type were the next variables to be analyzed in relation to percent major through stopping. Two geometric configurations were included in the study – three leg intersections and four leg intersections. For each geometric configuration, there were three combinations of approaches: two two-way streets, major two-way street and minor one-way street, and major one-way street and minor two-way street. There were no intersections where both streets were one-way. At three leg intersections, the road with one leg always received the flashing red indication. Freeway ramps were considered one-way streets. Figure 5.12 shows intersections grouped into these categories.

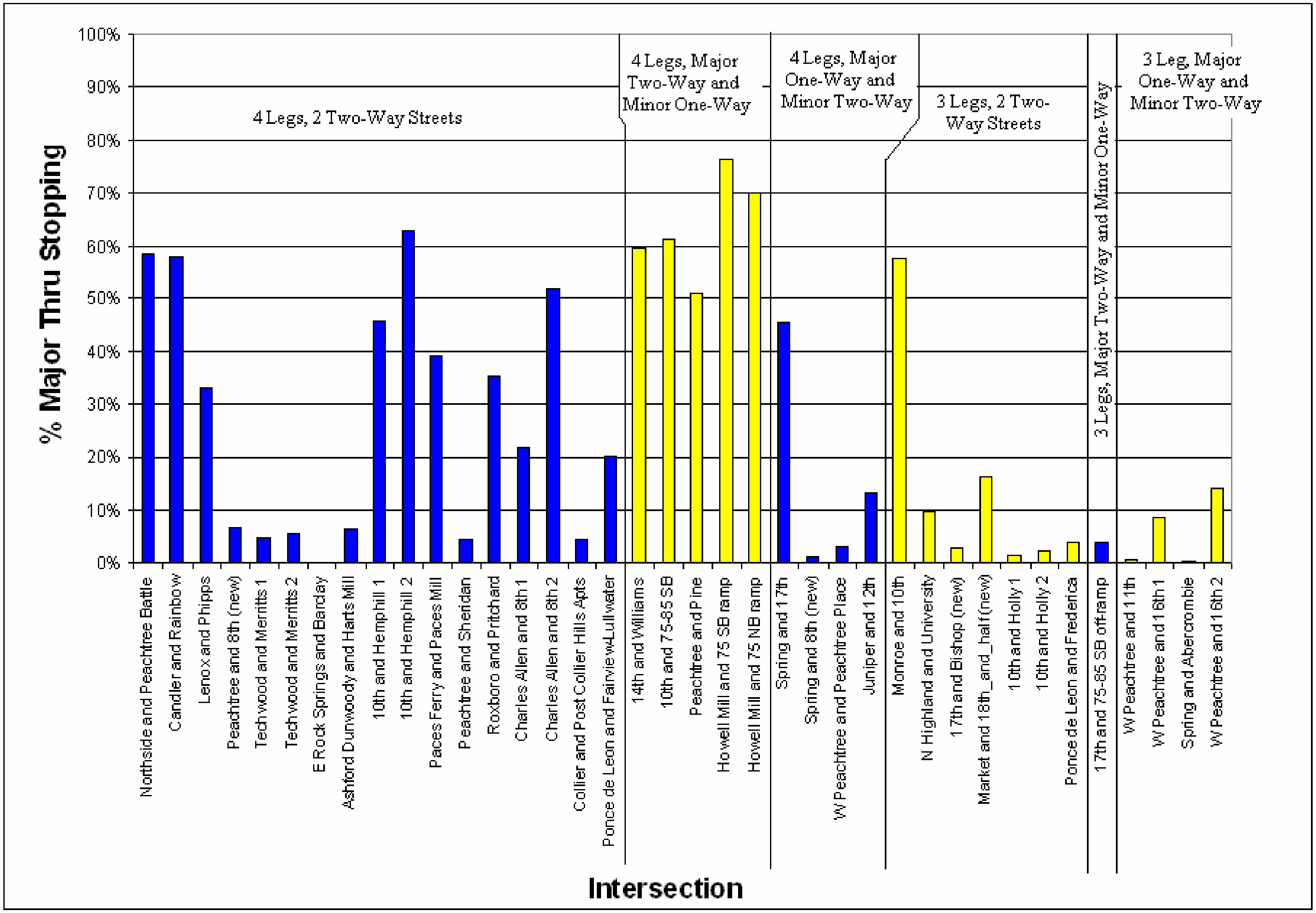

Figure 5.12 Major Street Stops (Through Vehicles) by Geometry and Approach Type

5.2.3.8.1 Geometry Findings

The results suggest that far more drivers choose to stop at four leg intersections than at three leg intersections, although this may partially be a reflection of other variables. All but one of the three leg intersections has a fairly low stopping rate, most of the minor roads at the three leg intersections in the study are small roads that have a much lower traffic volume than the major road. Also, while most of the intersections with high stopping rates have four legs, there are also four leg intersections with very low stopping rates. One possible explanation is that the decision to stop or not stop at a flashing yellow indication is driven by multiple factors including geometry. For example, at an intersection with a volume ratio of 0.3 (which was found to be in the transitional range for stopping rates as a function of volume ratio), geometry may become the factor that influences a driver's stopping decision. The FHWA study [5] performed analysis based on intersection geometry but included such a small number of three leg intersections that no meaningful results could be obtained.

5.2.3.8.2 Approach Type Findings

The results of approach type analysis are inconclusive. Intersections with two two-way streets contain the complete range of stopping percentages. All but one of the intersections with a one-way minor street are freeway ramps, so the results may not be applicable to other intersections. The intersections with a one-way major street generally have low stopping rates, but most of these intersections have a large, high volume major street and a small, low volume minor street, so again these results may be a reflection of other factors.

The Portland study [9] analyzed the differences between one-way and two-way streets. Intersections were classified as two-way/two-way, two-way/one-way, or one-way/one-way. Two-way/two-way intersections were found to have an accident rate under flashing operation that was more than three times as high as the accident rate under normal operation. Two-way/one-way intersections showed a decrease in accidents when flashing was implemented and one-way/one-way intersections showed an increase; however, these results were not statistically significant. As a result, the Portland study cautions that "use of a flashing signal on a two-way/two-way intersection could significantly reduce safety." However, it must once again be recalled that this conclusion is entirely based upon program flash conditions, which typically have much lower volumes than malfunction flash.

5.2.3.9 Minor Street Vehicle Presence

During field data collection and data reduction, it became apparent that the presence of vehicles on the minor street potentially influenced the major street vehicle's stopping decision. Stops related to minor vehicle presence appeared to occur for a variety of reasons. Some drivers stopped as a courtesy to let minor street vehicles through the intersection, and others stopped as a necessity because minor street vehicles had crept into the intersection. Also, some drivers simply seemed confused about which vehicles had the right-of-way.

Analysis of the correlation of the main street vehicle's stopping rate with vehicles being present on the minor street was conducted in two different ways. First, major street vehicle activity was segregated into two groups. One group consisted of activity that occurred while a vehicle was present on the minor street, and the other group consisted of activity that occurred while vehicles were not present on the minor street. Differences in percent major through stopping rates for each group were then compared. The second analysis procedure created a new independent variable referred to percent time present. This variable was defined as the percent of time throughout an entire video that a vehicle was present on the minor street.

5.2.3.9.1 Present Versus Absent Analysis

Before major vehicle activity could be segregated into the two cases of minor street vehicles being present and absent, precise definitions of presence were needed. A minor street vehicle is first considered to be present when it stopped at the stop bar. Presence continues until three seconds after the minor street vehicle departs the stop bar. Figure 5.13 shows the conditions that marked the beginning and end of the presence period. Based on observation of the videos, three seconds was the amount of time was usually required for a minor street vehicle to clear the intersection. For minor street vehicles that did not stop, presence began when they crossed the stop bar and ended three seconds later. When a *major* street vehicle arrived at the stop bar (and either stopped or proceeded through the intersection) minor street vehicle presence was checked and the major street vehicle was assigned to either the minor vehicle present category or the minor vehicle absent category.

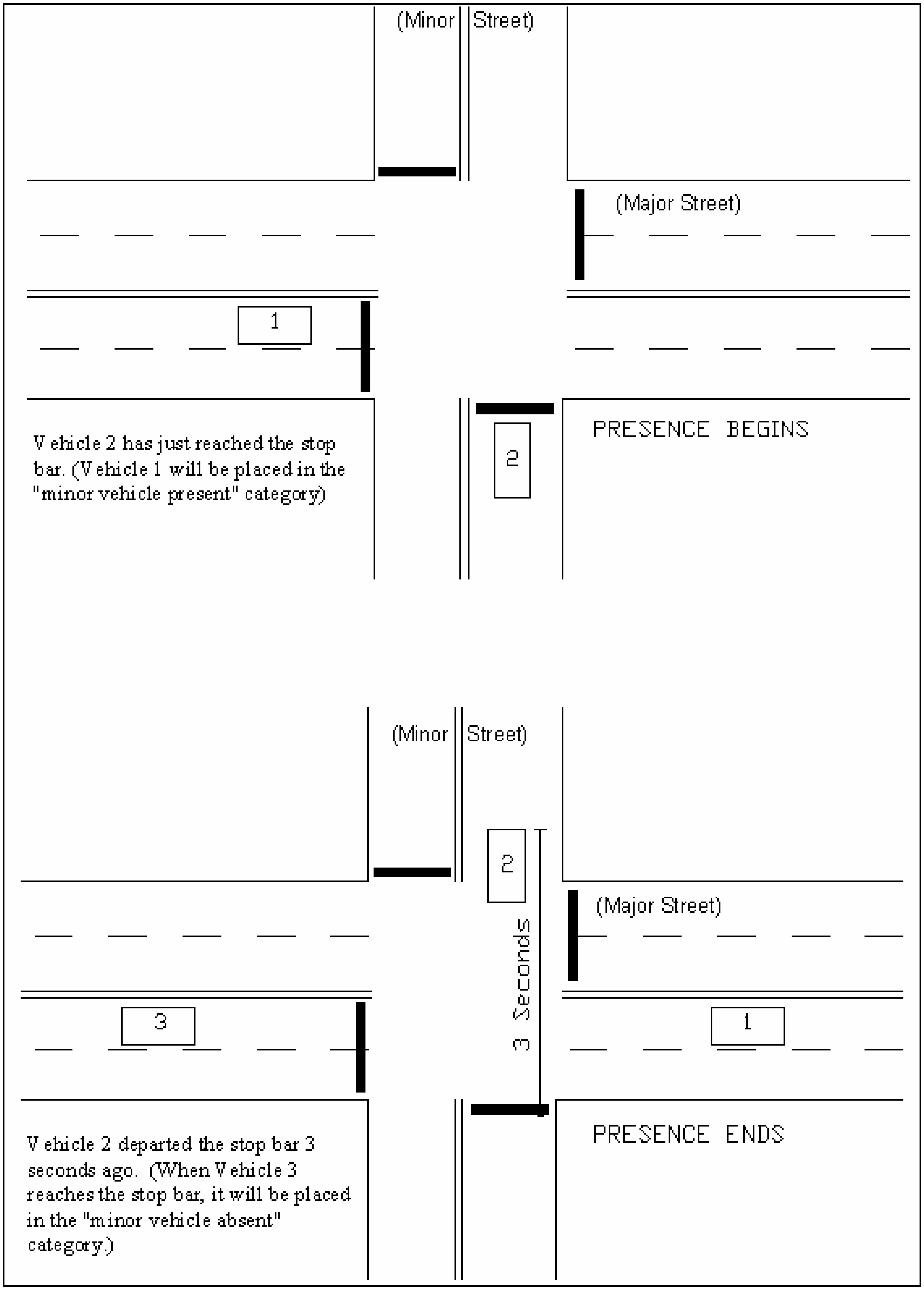

Figure 5.13 Beginning and End of Minor Street Vehicle Presence

Intersections with very low or very high minor street volumes can produce misleading results because nearly all major street vehicles get classified into one category. For example, only three percent of major street through vehicles at the intersection of Spring Street and Abercrombie Place arrived when a minor street vehicle was present. As a result, stopping rates for the case of a minor street vehicle being present are based on only a handful of vehicles. Table 5.6 includes the percent of major through vehicles that passed through the intersection when a minor street vehicle was present, as well as the percent major through stopping rates for both cases.

Table 5.6 Effects of Minor Street Vehicle Presence on Percent Major Through Stopping

Intersection	Percent of Through Vehicles Entering When Minor Vehicle Present	Percent Major Through Stopping	
		Minor Vehicle Present	Minor Vehicle Absent
Northside Dr. at Peachtree Battle Ave.	72.8	67.7	34.1
Monroe Dr. at 10th St.	90.1	59.5	42.2
Candler Dr. at Rainbow Dr.	Likely 100.0*	60.1	-
N. Highland Ave. at University Dr.	43.7	12.0	8.1
17th St. at Bishop St. (new signal)	45.2	4.1	1.9
Lenox Rd. at Phipps Dr.	81.1	34.8	24.9
Spring St. at 17th St.	88.9	47.9	25.6
W. Peachtree St. at 11th St.	15.9	1.1	0.7
14th St. at Williams St.	98.3	60.2	~~28.6~~
W Peachtree St. at 16th St. #1	77.1	10.0	3.7
Market St. at 18th ½ St. (new signal)	3.1	~~38.5~~	15.8
Peachtree St. at 8th St. (new signal)	54.3	8.2	4.8
Techwood Dr. at Merritts Ave. #1	4.2	~~0.0~~	5.0
Techwood Dr. at Merritts Ave. #2	20.1	8.5	4.9
E. Rock Springs Rd. at Barclay Pl.	0.6	~~0.0~~	0.0
Ashford Dunwoody Rd at Harts Mill Rd.	54.0	9.5	2.9
Spring St. at 8th St. (new signal)	37.4	2.4	0.6
10th St. at Hemphill Ave. #1	72.7	54.0	23.3
10th St. at Hemphill Ave. #2	75.8	65.9	53.1
17th St. at I-75/85 SB off ramp	71.7	4.7	1.6
Paces Ferry Rd. at Paces Mill Rd.	49.8	53.3	25.2
Peachtree Rd. at Sheridan Dr.	46.3	6.1	2.8
Roxboro Rd. at Pritchard Dr.	73.2	41.9	17.9
W Peachtree St. at Peachtree Pl.	44.4	4.5	2.0
Spring St. at Abercrombie Pl.	3.0	~~5.3~~	0.3
10th St. at Holly St. #1	21.5	2.0	1.2
Juniper St. at 12th St.	40.0	17.3	10.9
Charles Allen Dr. at 8th St. #1	19.2	53.3	14.3
Charles Allen Dr. at 8th St. #2	55.6	66.9	32.8
W. Peachtree St. at 16th St. #2	85.6	15.5	6.4
10th St. at Holly St. #2	19.9	2.5	2.2
10th St. at I-75/85 SB ramps	100.0	61.1	-
Peachtree St. at Pine St.	78.5	55.7	34.5
Collier Rd. at Post Collier Hills Apts.	22.8	9.4	3.4
Howell Mill Rd. at I-75 SB ramps	98.0	77.0	~~47.1~~
Howell Mill Rd. at I-75 NB ramps	*	-	-

Table 5.6 continued

Intersection	Percent of Through Vehicles Entering When Minor Vehicle Present	Percent Major Through Stopping	
		Minor Vehicle Present	Minor Vehicle Absent
Ponce de Leon Ave. at Fairview Rd./Lullwater Rd.	32.2	33.8	14.0
Ponce de Leon Ave. at Frederica St.	41.4	6.0	2.4

* Camera angle did not allow for presence analysis

Presence of a minor street vehicle clearly increased the probability that a driver going through an intersection on the major street would choose to stop. A stopping rate increase occurred at all but three of the intersections. One of these three had no major street vehicles arrive when there was not a minor street vehicle present, and another had no vehicles stop for either case.

Table 5.6 also reveals several intersections where minor street vehicles were nearly always present or nearly always absent. At intersections where a minor street vehicle was present less than five percent of the time (Market and 18th ½, Techwood and Merritts #1, East Rock Springs and Barclay, Spring and Abercrombie), stopping rates from the "minor street vehicle present" category are excluded from further analysis. At intersections where a minor street vehicle was present more than ninety five percent of the time (14th and Williams, 10th and I-75/85 SB ramps, Howell Mill and I-75 SB ramps), stopping rates from the "minor street vehicle absent" category are excluded from further analysis. All of these excluded stopping rates are struck out in Table 5.6

5.2.3.9.2 Analysis of Other Variables Using Presence and Absence

Using the separated stopping rates for present and absent conditions shown in Table 5.6, it is possible to conduct further analysis of variables that had previously been studied using the combined (present + absent) stopping rate data. Minor flow rate, discussed in Section 5.2.3.1, and minor:major volume ratio, discussed in Section 5.2.3.4, were selected for presence/absence analysis because the initial analysis had revealed a correlation between these variables and percent major through stopping.

Figures 5.14 and 5.15 are subsets of the data presented in Figure 5.1. The data represented by each point in Figure 5.1 is collectively represented by a point in Figure 5.14 and point in Figure 5.15, except for the handful of intersections described in Section 5.2.3.9.1 that lacked sufficient presence or absence data. Stopping rates when a minor street vehicle is present, shown in Figure 5.14, are noticeably higher than stopping rates when a minor vehicle is absent, shown in Figure 5.15. This increase occurs throughout the entire range of minor flow rates used in the study, although the highest of minor flow rates are omitted from Figure 5.15 because there are few or no instances of minor street vehicles being absent at these intersections.

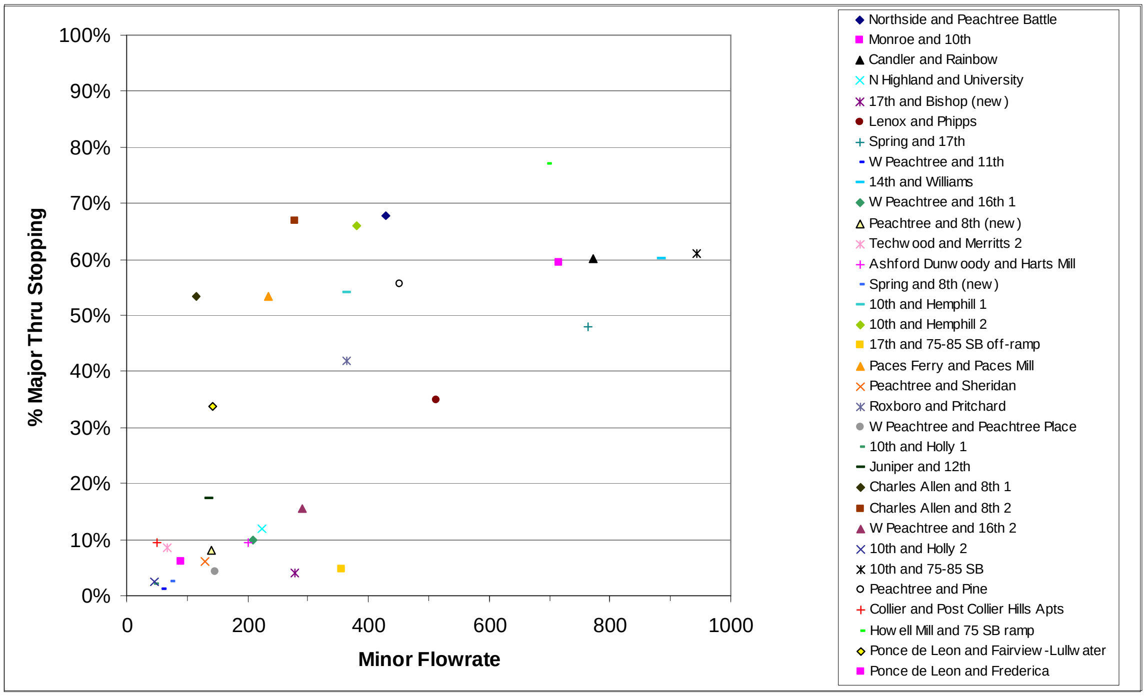

Figure 5.14 Major Street Stops (Through Vehicles) vs. Minor Street Volume Yellow/Red Flashing, when a Minor Street Vehicle is Present

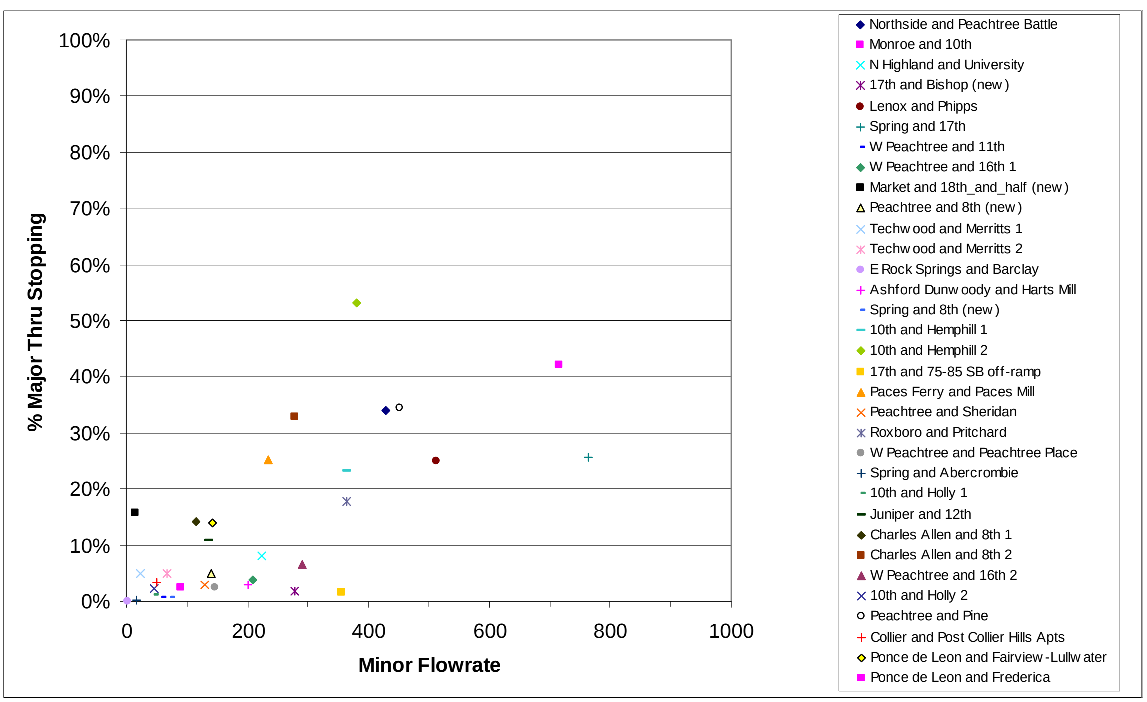

Figure 5.15 Major Street Stops (Through Vehicles) vs. Minor Street Volume Yellow/Red Flashing, when a Minor Street Vehicle is Absent

Figures 5.16 and 5.17 are both use subsets of the data presented in Figure 5.3. As previously demonstrated, stopping rates are higher when a minor street vehicle is present. In both figures, there appears to exist a well-defined relationship between volume ratio and percent major through stopping. Stopping increases as the ratio increases for both the presence and absence cases, but the increase is not as great for the absence case. The relationships presented in Figures 5.16 and 5.17 were chosen as the relationships on which to base the model of percent major through stopping. This is discussed at length in Chapter 6.

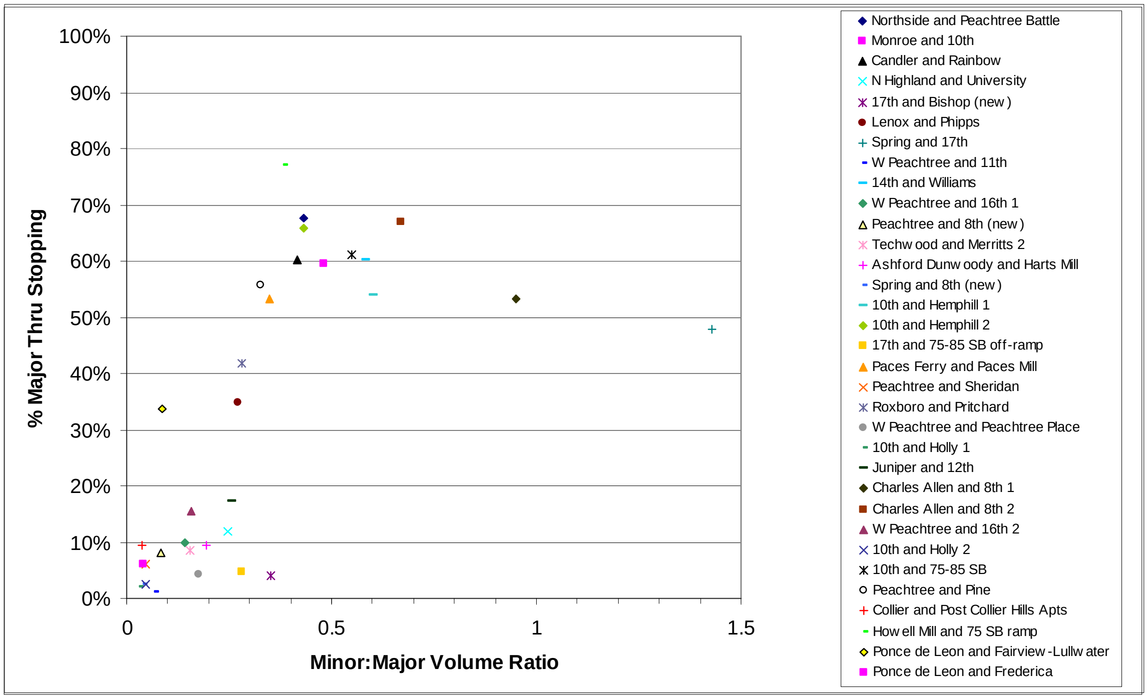

Figure 5.16 Major Street Stops (Through Vehicles) vs. Minor:Major Volume Ratio Yellow/Red Flashing, when a Minor Street Vehicle is Present

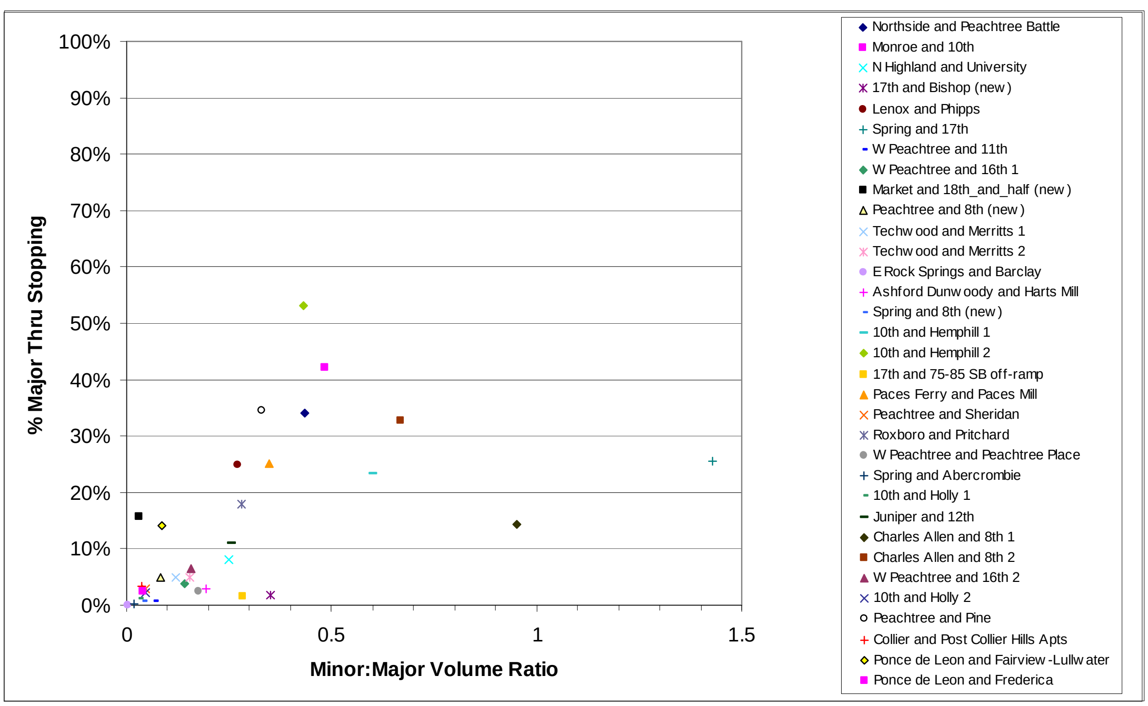

Figure 5.17 Major Street Stops (Through Vehicles) vs. Minor:Major Volume Ratio Yellow/Red Flashing, when a Minor Street Vehicle is Absent

5.2.3.9.3 Percent Time Present Analysis

Percent time present analysis avoids the segregation of major street through vehicles into different categories by instead examined major through stopping rates as a function of a continuous variable, percent time present. Minor street vehicle presence is still defined as the period of time beginning when a minor street vehicle reached the stop bar and ending three seconds after its departure. These time periods were then summed over the duration of the video and the percentage of the total video length during which a minor street vehicle was present was calculated. The results are shown below in Figure 5.18.

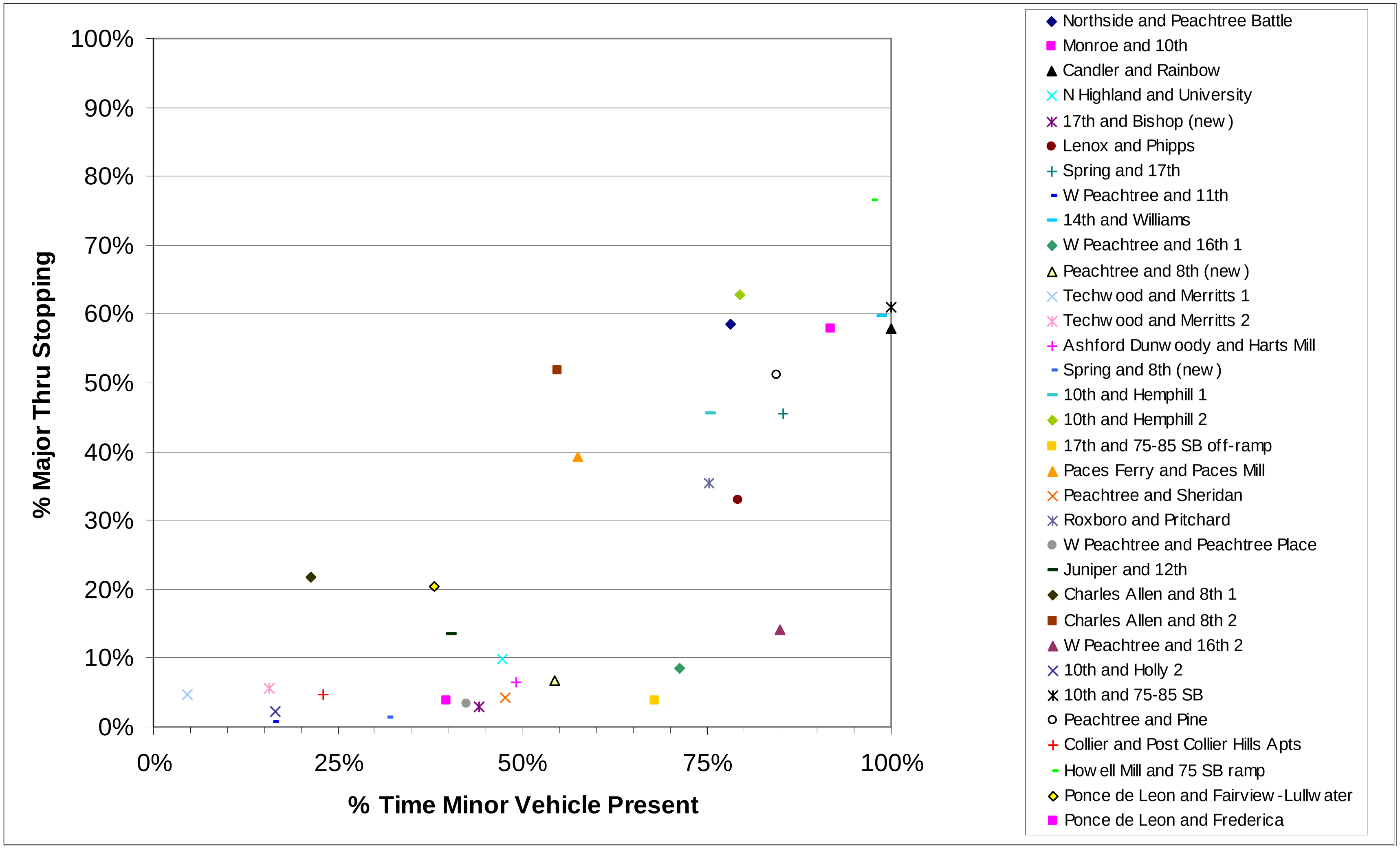

Figure 5.18 Major Street Stops (Through Vehicles) vs. Percent Time Minor Vehicles Present Yellow/Red Flashing

Figure 5.18 illustrates the relationship of percent major through stopping and the percent of time a minor street vehicle is present at an intersection. A transition appears to take place when minor street vehicles are present over 50% of the time. Below this breakpoint, stopping percentages usually do not exceed ten percent and never exceed twenty five percent. Above this breakpoint, stopping percentages are usually at least thirty percent, although they under 10% in a few cases. From these results it is seen that when minor street vehicles are present more than 50% of the time at an intersection operating under yellow/red malfunction flash, the intersection will likely begin to function similar to a four-way stop. There are three data points in the range of more than 50% vehicle presence that do not fit into this relationship. They are both of the West Peachtree and 16th malfunction flash instances as well as programmed flash at the newly installed 17th and Bishop signal. West Peachtree is a 5 lane one way street, and 17th Street is a 6 lane street with HOV and bicycle lanes and a nontraversable median. 16th Street and Bishop Street both have one lane in each direction. This may be evidence that if the size difference between roads is sufficiently large (i.e. a significant difference in functional classification), that this difference dominates the vehicle's stopping decision process and stopping rates will always be low regardless of the presence or absence of minor street vehicles.

5.2.4 Minor Street Stopping

The previous sections of this chapter have demonstrated that the widely used assumption that no vehicles stop at a flashing yellow indication is incorrect. In this section, the assumption that all vehicles stop at a flashing red indication is examined. Only yellow/red intersections are analyzed here, as red/red intersections are analyzed in Section 5.3.

For analysis of major street stopping, only through vehicles are analyzed. For minor street stopping, all vehicles (through and turning) are included in the analysis. Turning movements are included on the minor street for two reasons. First, through movements are much less common on minor streets than they are on major streets. At three leg intersections there can be no minor through movements, and at many four leg intersections, especially freeway ramps, a high percentage of minor street vehicles turn onto the major street. Second, minor street vehicles face a flashing red indication, so failure to stop, even by a vehicle turning right, is a violation and a potential safety hazard to major street drivers who are expecting all minor street vehicles to stop.

Violation of a flashing red indication (i.e. failure to stop) by minor street drivers was found to be a much rarer event than an unnecessary stop (i.e. any stop) at a flashing yellow indication. The assumption that all vehicles stop at a flashing red indication is more realistic than the assumption that no vehicles stop at a flashing yellow indication. Still, stopping rates at many intersections do not reach ninety or even eighty percent.

One possible explanation for this is the formation of platoons. When the vehicle at a minor street stop bar departs and enters the intersection, vehicles behind it or next to it will sometimes immediately proceed through the intersection without stopping. Bansen developed a procedure to account for this behavior that only analyzes the stopping rate of the lead vehicle in a platoon and excludes following vehicles, if any exist [2]. Vehicles making different movements (such as a through and a left turn) could be part of the same platoon. Bansen used his platoon analysis only for the major street, but in this study it was used to analyze minor street vehicle activity. Figure 5.19 shows minor street stopping rates for all vehicles and platoon leaders only. Two intersections, Candler Drive at Rainbow Drive and Howell Mill Road and I-75 northbound ramps, had to be excluded from the analysis because the camera angle did not allow for consistent observation of minor street vehicles at the stop bar.

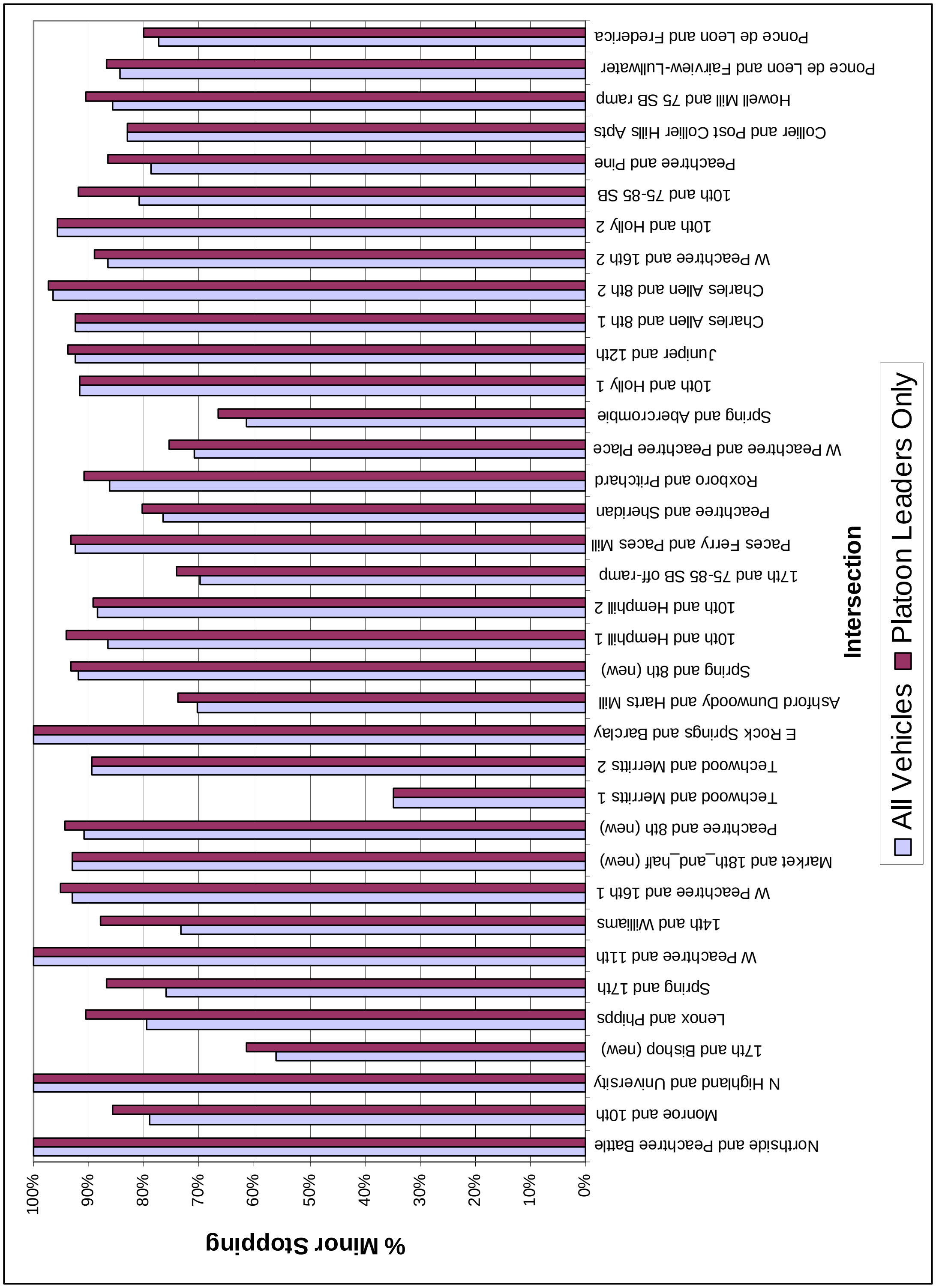

Figure 5.19 Minor Street Stopping Rates at Yellow/Red Intersections

Some intersections still have very low stopping rates even when only platoon leaders are analyzed. These intersections tend to have low traffic volumes, good visibility, and a high percentage of minor street vehicles making right turns (or left turns onto one-way streets). Instead of treating these intersections as stop-controlled, drivers may be treating them more similar to yield controlled intersections. As they approach the intersection, observe that the signal is not operating normally and that there are no vehicles making conflicting movements, minor street drivers may choose to proceed with caution as they would at a yield controlled neighborhood or rural intersection.

Even if the handful of intersections with very low stopping rates are overlooked, a large number of minor street drivers at other intersections who are also *not* following other vehicles in a platoon are still violating the flashing red indication. The rate of this violation is much lower than the rate at which major street vehicles choose to stop at flashing yellow, but it still shows that both major assumptions about stopping at malfunctioning signals (i.e. no vehicles stop at a flashing yellow and all vehicles stop at a flashing red) are not representative of actual driver behavior.

The violations of flashing red, though, may be a reflection of typical driver compliance with control devices. A 1989 FHWA study by Pietrucha et al [25] found that only 19% of drivers voluntarily came to a full stop at a stop sign. Also, less than 50% of drivers fully stopped before making a right turn at a red signal. In Pietrucha's study, rolling stops were not considered to be stops. In this study, rolling stops often were considered stops. Due to camera angles and resolution limitations, wheels were not observed. If a vehicle slowed to the extent that, from a distance, it appeared to stop, then it was considered to be stopped. This may partially explain what Pietrucha's stopping rates were much lower than those observed in this study. Flashing traffic signal operation is also a more unfamiliar situation to drivers than a stop sign and is used at intersections that warrant a traffic signal. These conditions may make drivers more cautious at flashing signals and thus more likely to stop than at a stop sign.

5.2.5 Summary of Yellow/Red Flash Analysis

Analysis of yellow/red flash primarily examined the percentage of through vehicles on the major street choosing to stop. This is useful as a measure of effectiveness because it represents driver confusion, potential risks, and the degradation of major street flow. The stopping rate was studied as a function of minor street volume, major street volume, minor street to major street volume ratio, roadway functional classification, intersection geometry, lane ratio, intersection geometry and approach type (one-way or two-way street), and the presence or absence of a minor street vehicle.

The minor street volume and the volume ratio were seen to have some correlation with the stopping rate of major street through vehicles. Functional classification was also a reasonably good predictor, but with notable exceptions. Analysis that considered both the presence or absence of a minor street vehicle and other independent variables was also conducted. By dividing major street stopping rate data from each intersection into either a "minor street vehicle present" or a "minor street vehicle absent" category and then analyzing each as a function of volume ratio, a relationship suitable for modeling (discussed in Chapter 6) was discovered.

Minor street stopping rates were also analyzed, and it was discovered that red flash violation rates of ten percent at yellow/red intersection are not uncommon.

5.3 Analysis of Red/Red Flash

In Atlanta, the configuration of an intersection to flash red/red under malfunction conditions seems to be rarer than the configuration of an intersection to flash yellow/red. When used, red/red flash tends to be limited to the intersection of two major roadways. During the field data collection for this project, it was also found that intersections flashing red/red seem to be reported and/or repaired more quickly than intersections flashing yellow/red. Only 5 of the 34 instances of yellow/red malfunction flash were reset into normal operation during the one hour data collection period, but 5 of 9 instances of red/red malfunction flash were reset during the one hour data collection period and at least two others were reset as team members were setting up their video equipment. The red/red dataset shown in Table 5.7 is considerably smaller than the yellow/red dataset.

Table 5.7 Traffic Conditions at Red/Red Signals in Study

Intersection	**Equivalent Hourly Volume**			**Percent Major *Through* Stopping**	**Percent Minor Stopping**
	Major Total	**Major Through**	**Minor Total**		
Piedmont Ave at The Prado	2167	2041	310	85.3	97.8
Roswell Rd at W. Wieuca Rd. #1	1810	1530	713	83.6	82.9
Roswell Rd at W. Wieuca Rd. #2	1503	1273	369	86.0	90.1
17th St. at Market St.	1173	837	381	85.5	89.4
North Ave. at Piedmont Ave.	1638	1388	1183	77.9	82.1
Market St. at 18th ½ St. (new signal)	451	430	5	60.0	100.0
10th St. at Peachtree St.	917	616	900	87.1	81.1
Northside Dr. at 14th St.	1227	993	631	90.6	86.7
14th St. at State St.	690	578	84	84.4	93.1
Fowler St. at Ferst Dr./5th St.	518	323	443	93.1	95.4

For red/red intersections, the major road is defined as the road with a higher traffic volume during the period of time in which video footage was captured. In Table 5.12, this road is always listed first in the "Intersection" column. It is possible that at a different time or on a different day, the road defined as the major road could change. Also, equivalent hourly volumes like those used in Table 5.1 are used in Table 5.12 so that all traffic volumes listed are representative of exactly one full hour of time.

Quantitative analysis of red/red intersections was based on both major and minor street stopping rates. For the major street, analysis focused on only through vehicles. Although the failure to stop at a flashing red indication is a violation regardless of the movement being made by the driver, the likelihood of a violation occurring varies from movement to movement. For comparative purposes described in Section 5.2, through vehicle stopping rates are the focus of major street analysis at red/red intersections. For minor street analysis, the stopping rates of all vehicles are used. While this impacts the ability to compare major street and minor street stopping rates, it is a necessity as some minor streets have very few through vehicles (or none at a 3 leg intersection).

Major street stopping rates with red/red flash are predictably much higher than with yellow/red flash. They are, however, usually less than ninety percent. At all but two of the red/red intersections, more than ten percent of major street through drivers did not stop. Minor street stopping rates tended to be higher, but were still below ninety percent at some intersections. There is no apparent relationship between major street stopping rates at red/red intersections and any of the variables found to influence major street stopping rates at yellow/red intersections. With a larger sample size, though, it is possible that trends might emerge.

The formation of platoons partially explains the low stopping rate. On high volume approaches, a vehicle that is in the second position in a queue will sometimes closely follow the lead vehicle in the queue through the intersection when the lead vehicle departs. The second vehicle will not stop at the stop bar before following the lead vehicle, so it is not recorded as a stopped vehicle. By calculating the stopping rate of lead vehicles only, the effect of platoons on stopping rates can be analyzed. Table 5.8 presents a comparison of overall stopping rates and platoon stopping rates.

Table 5.8 Effect of Platoons on Vehicle Stopping Rates

Intersection	**Percent Major Through Stopping**		**Percent Minor Stopping**	
	All Vehicles	**Platoon Leaders Only**	**All Vehicles**	**Platoon Leaders Only**
Piedmont Ave at The Prado	85.3	92.1	97.8	98.5
Roswell Rd at W. Wieuca Rd. #1	83.6	90.0	82.9	83.3
Roswell Rd at W. Wieuca Rd. #2	86.0	90.4	90.1	91.9
17th St. at Market St.	85.5	85.6	89.4	92.0
North Ave. at Piedmont Ave.	77.9	92.6	82.1	90.2
Market St. at 18th ½ St. (new signal)	60.0	61.6	100.0	100.0
10th St. at Peachtree St.	87.1	93.0	81.1	85.2
Northside Dr. at 14th St.	90.6	94.0	86.7	90.5
14th St. at State St.	84.4	84.9	93.1	93.1
Fowler St. at Ferst Dr./5th St.	93.1	95.3	95.4	95.9

Although the platoon stopping rates are higher then the overall stopping rates, they are still low enough to indicate that noncompliance with a flashing red indication is a fairly common occurrence. Unfortunately, the rates cannot illustrate the type of non-compliance that is occurring. A vehicle that does not stop and is not part of a platoon could slow and creep through the intersection, or it could proceed without slowing. This latter scenario tends to occur at intersections of a relatively large road and a relatively small road operating in red/red flash, such as Piedmont Avenue at The Prado, 14th Street at State Street, and 17th Street at Market Street. The first two are intersections of minor arterials and local roads. Seventeenth at Market is the intersection of a collector and local road, although the importance of 17th Street to the transportation network in its vicinity has increased since the most recent functional classification map was created. High speed violations of a red/red intersection by major street drivers create the potential for severe accidents. Minor street drivers who observe that an intersection is operating as a four-way stop may enter the intersection even if a major street vehicle is approaching because they believe it will stop. If the major street vehicle does not stop, there is the potential for a high speed right angle accident to occur.

5.4 Analysis of Permanent Beacons

Two permanently flashing yellow/red beacons were observed as part of this study. Yellow/red beacons and yellow/red malfunctioning traffic signals should produce the same driver response, but the limited amount of beacon data collected in this indicates that this is not the case.

The two beacons studied were both located on Lindbergh Drive, a two-lane minor arterial located in residential area within the City of Atlanta. A beacon at Parkdale Place was filmed on a Sunday afternoon and during the morning peak, and a beacon at Acorn Avenue was filmed during the morning peak. Since beacons permanently flash, one hour of footage was always able to be captured. Both of these streets are classified as local roads and are two lanes each. Both intersections have only three legs. Table 5.14 contains traffic volume and stopping rate information for these intersections. The volumes are for a one hour time period.

Table 5.9 Traffic Volumes and Stopping Rates at Yellow/Red Beacons

Intersection	Day and Start Time	Major Street Volume	Minor Street Volume	Major Street Through Volume	Percent Major Through Stopping
Lindbergh Dr. at Parkdale Pl.	Sunday 5:00 PM	731	5	728	0.0
Lindbergh Dr. at Parkdale Pl.	Wednesday 7:45 AM	1111	4	1107	0.0
Lindbergh Dr. at Acorn Ave.	Friday 7:00 AM	748	42	699	0.0

During the study period, more than 2500 vehicles passed through the intersections where the beacons were located, and none of them stopped. Drivers also did not appear to slow for the beacons, as is often the case at malfunctioning yellow/red signals. The driver confusion that exists at malfunctioning signals does not seem to exist at beacons.

Due to the small dataset, beacon analysis results should be used with caution. Both intersections are comprised of a minor arterial and a local street, and this combination generally had very low stopping rates under malfunction flash control. The intersections have only three legs, which usually resulted in a low stopping rate under malfunction flash control. Minor street to major street volume ratios range from 0.004 to 0.06, and few stops at a malfunctioning signal would be expected for such ratios. Finally, the intersection captured under malfunction flash control that is most similar to the beacon intersections is East Rock Springs Road and Barclay Place, and this intersection was the only malfunction flash intersection to record no stops by major street through vehicles.

5.5 Analysis of Intersections Filmed Twice

Eight intersections were filmed on two separate occasions. Five of the intersections were yellow/red malfunctions, one was a red/red malfunction, one was a yellow/red beacon, and one was a newly installed signal that was first flashed yellow/red and then changed to red/red. In some cases, the first and second filming of an intersection occurred during separate malfunction events that were months apart, and in other cases filming was done under different volume conditions during the same malfunction flash event.

Table 5.15 contains traffic data from intersections that were filmed twice. Traffic volumes and stopping rates are equivalent hourly flows. In the scenario column, “Y/R” refers to yellow/red flashing and “R/R” refers to red/red flashing. Equivalent hourly flows, as discussed in Section 5.1, are actual traffic counts for a one hour period of time (if a full hour of data could be gathered) or the traffic counts from a shorter time period scaled up to be representative of an hourly volume (if a signal was repaired before a full hour of data could be collected). Volumes ratios and stopping percentages in this table may differ slightly from values in other tables. Other tables, such as Table 5.5, use the stopping rate from an entire video worth of data, typically 62 minutes. Since hourly volumes are listed in this table, stopping rates and volume ratios for videos more than one hour in length are only based on the first 60 minutes for consistency.

Table 5.10 Intersections Filmed Twice

Intersection	Scenario	Day and Date	Start Time	Equivalent Hourly Volumes			Percent of Minor Vehicles Stopping	Major Through	
				Major	Minor	Minor:Major Ratio		Equivalent Hourly Volume	Percent Stopping
Lindbergh Dr. at Parkdale Pl.	Y/R Beacon	Sun. 10/9/2005	5:00 PM	731	5	0.01	100.0	728	0.0
	Y/R Beacon	Wed. 2/15/2006	7:45 AM	1111	4	0.00	100.0	1107	0.0
W Peachtree St. at 16th St.	Y/R Malfunction	Sat. 10/22/2005	3:30 PM	1487	210	0.14	92.9	1397	8.5
	Y/R Malfunction	Mon. 5/8/2006	6:15 PM	1853	290	0.18	86.6	1690	14.3
Market St. at 18th ½ St.	Y/R New	Wed. 10/26/2005	2:30 PM	445	14	0.03	92.9	414	16.4
	R/R New	Wed. 4/5/2006	5:20 PM	451	5	0.01	100.0	430	60.2
Roswell Rd. at W Wieuca Rd.	R/R Malfunction	Sat. 1/14/2006	11:20 AM	1810	713	0.39	80.2	1530	83.7
	R/R Malfunction	Sun. 3/5/2006	10:30 AM	1503	369	0.25	90.0	1273	86.0
Techwood Dr. at Merritts Ave.	Y/R Malfunction	Tue. 3/7/2006	10:00 PM	191	23	0.12	34.8	162	4.9
	Y/R Malfunction	Thurs. 3/9/2006	5:20 PM	432	66	0.15	89.4	387	5.7
10th St. at Hemphill Ave.	Y/R Malfunction	Tue. 4/4/2006	8:45 PM	606	364	0.60	86.3	359	45.4
	Y/R Malfunction	Wed. 4/5/2006	7:40 AM	884	381	0.45	88.2	639	63.2
10th St. at Holly.	Y/R Malfunction	Thurs. 5/4/2006	12:30 PM	1548	46	0.03	93.5	1533	1.4
	Y/R Malfunction	Sat. 5/20/2006	1:20 PM	989	46	0.05	95.7	961	2.3
Charles Allen Dr. at 8th St.	Y/R Malfunction	Sun. 5/7/2006	7:30 PM	121	115	0.77	92.2	74	21.6
	Y/R Malfunction	Mon. 5/8/2006	7:40 AM	417	279	0.69	97.5	280	51.8

Behavior at malfunctioning signals does vary with traffic volume and by time and day of week, however the observed variations in volume ratios is relatively limited. West Peachtree Street at 16th Street, Techwood Drive at Merritts Avenue, and 10th Street at Holly Street all had relatively low stopping rates during both observation periods. 10th Street at Hemphill Avenue had a relatively high stopping rate and began to function similar to a four way stop during both observation periods. Operation at Charles Allen Drive at 8th Street changed substantially. On Sunday evening, only 21.6 percent of major street through drivers stopped. On Monday morning, when classes were beginning at a high school located at one corner of the intersection and traffic volumes were nearly three times as high, 51.8 percent of major street drivers chose to stop. One possible explanation for this is that drivers begin to ignore control devices at an intersection if traffic volumes are very low, even under similar volume ratios. It is also possible that nighttime conditions are a factor, however few of the other intersections were observed during dark conditions making it impossible at this time to test this hypothesis. This would explain the minor street stopping rate of only 34.8 percent during the nighttime observation at Techwood Drive at Merritts Ave.

The beacon at Lindbergh Drive and Parkdale Place and the red/red signal at Roswell Road and West Wieuca Street had similar effects on drivers for both observation periods, although traffic volumes were also similar. The conversion of Market Street and 18th ½ Street from a yellow/red signal to a red/red signal nearly quadrupled the stopping rate, although drivers were also more familiar with the intersection when the red/red video was recorded because the intersection had been open for more than half a year by this point.

Volume ratio was relatively similar during both observation periods at all intersections, which suggests that it may be an appropriate variable on which to base flash mode selection. Since only one flash mode can be selected for a given intersection, the basis of the selection should be a variable that does not vary greatly between different times of the day and days of the week.

5.6 Field Analysis Findings

Analysis of field data collected at flashing traffic signals was conducted. The dataset consisted to 41 video recordings of yellow/red flashing operation (34 instances of malfunction flash, 4 instances of program flash at new signals, and 3 beacons) and 10 recordings of red/red flashing operation (9 instances of malfunction flash and 1 instance of program flash at a new signal). The percentage of vehicles choosing to stop was chosen as the primary performance measure. Failure to stop at a flashing red signal is a violation of Georgia law, and stopping at a flashing yellow signal violates the expectancy of many drivers (since it is not required by law) and it reduces the major street operational benefits that yellow/red flash provides over red/red flash.

The percentage of through vehicles stopping at an intersection when facing a flashing yellow indication ranged from 0 to 76. This is a major departure from previous operation studies, which assumed that no vehicles would stop when facing a flashing yellow indication. The minor street to major street volume ratio, minor street volume, and functional classifications of the roads at the intersection were all found to be correlated with percent major through stopping. Further analysis combining the volume ratio and the presence or absence of a vehicle on the minor street also proved to be a good predictor of the major street through vehicle stopping rate. In Chapter 6, this relationship is used to model stopping at flashing yellow signals

The percentage of major street through vehicles choosing to stop at an intersection operating in red/red malfunction flash control ranged from 78 to 93 percent. This is also a departure from previous studies, which assumed that all drivers would stop at a flashing red indication. No variable studied was a good predictor of this stopping rate.

CHAPTER 6

MODELING

When a signalized intersection is configured to flash yellow/red during a malfunction event, signals for the major street flash yellow (drivers may proceed with caution) and signals for the minor street flash red (drivers are required by law to stop). One of the major findings of the field data collection portion of this project was that a large number of drivers choose to stop when facing a flashing yellow signal, even though they are not required to do so. At the 38 instances of yellow/red flashing operation included in this study, the percentage of major street through vehicles choosing to stop (referred to in this report as “percent major through stopping”) ranged from 0.0 to 76.4. Through vehicles have been chosen as the focus of the initial analysis. The behavior of left and right turning vehicles is different from that of through vehicles. Left turning vehicles have a higher likelihood of stopping as they must yield to opposing through vehicles and right turning vehicles tend to have lower stopping rates as they treat the intersection similar to a green light or right on red. Future study will consider improvements in the model given the inclusion of turning movements.

Modeling of stopping rates will allow for the data collected from this study to be applied to other intersections and it will enable the creation of a simulation of yellow/red flashing operation under various traffic volumes. Based on the analysis conducted in Chapter 5, two variables were selected as good predictors of percent major through stopping. One is the presence or absence of a vehicle on the minor street, and the other is the volume ratio between the two streets. To study both of these independent variables simultaneously, major street vehicles at each intersection were segregated into two categories – those that arrived when a minor street vehicle was present, and those that arrived when a minor street vehicle was absent. Within each category, drivers are then faced with a binary choice – they can stop, or then can not stop. A logit model was selected as the functional form as it models binary choice. Plots of the stopping rate data as a function of minor street to major street volume ratio, shown in Figures 6.1 and 6.2, also reveal a relationship that resembles a logistical growth function.

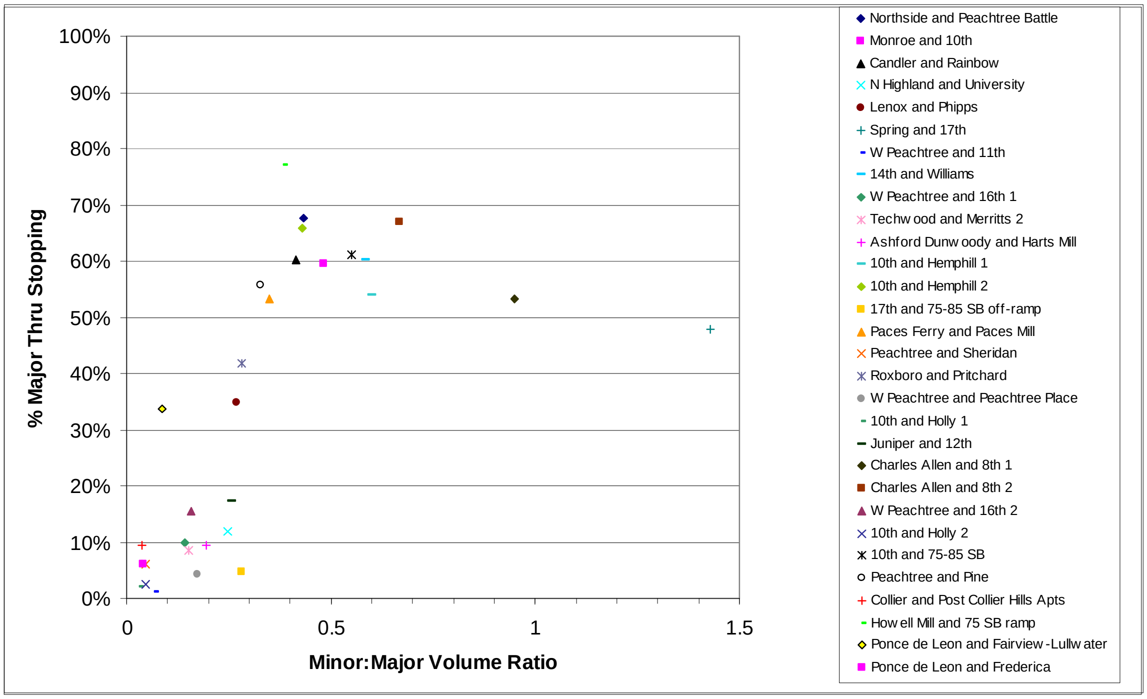

Figure 6.1 Major Street Stops (Through Vehicles) vs. Minor:Major Volume Ratio Yellow/Red Flashing, when a Minor Street Vehicle is Present

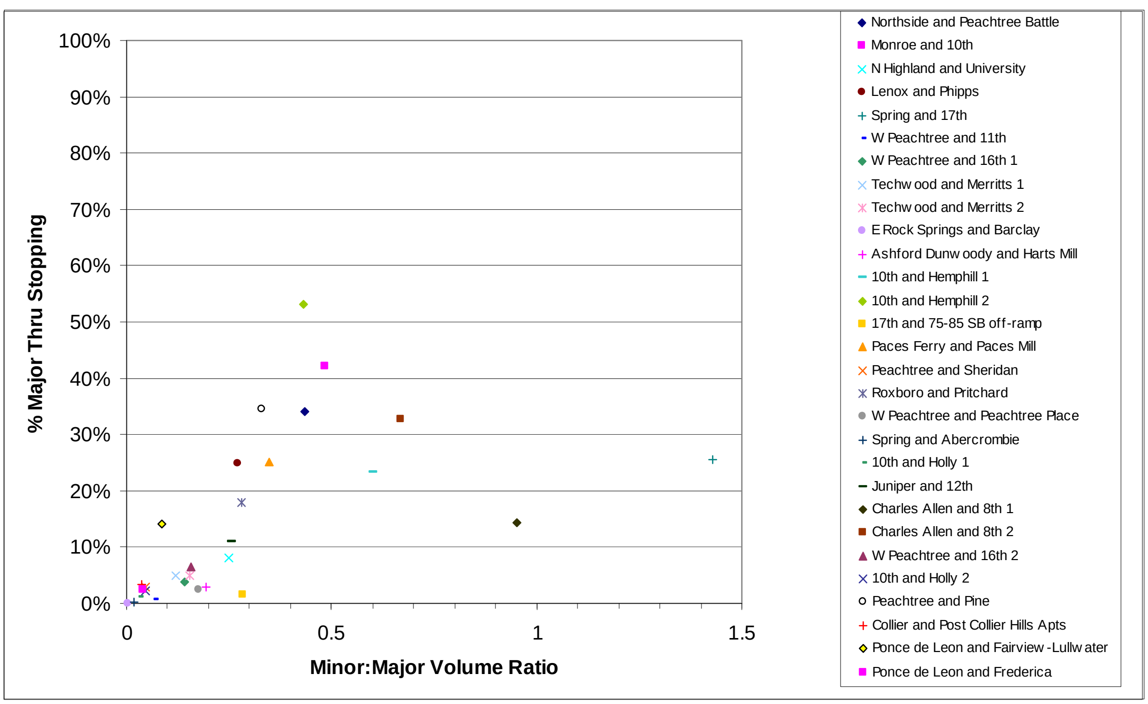

Figure 6.2 Major Street Stops (Through Vehicles) vs. Minor:Major Volume Ratio Yellow/Red Flashing, when a Minor Street Vehicle is Absent

6.1 The Logit Model

Logit models are used to predict the probability (say P_i) of an individual or a population to select one alternative (say alternative i) out of a group of many alternatives (say the set J_n). The form of the model is

$$P_i = \frac{\exp(U_i)}{\sum_{j=1}^{J_n} \exp(U_{J_n})}$$

where U_i is the utility function associated with alternative i, U_{Jn} is the set of all utility functions, and all other variables are those described above [26]. The shape of a logit model is shown in the generic model depicted in Figure 6.3.

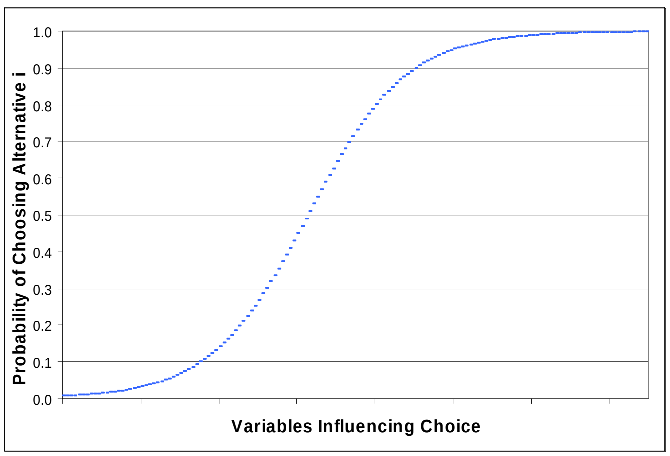

Figure 6.3 Logit Model Form

A utility function is a measure of the satisfaction (or in an economic sense, the utility) experienced by an individual when they choose alternative i. Each utility function contains all variables that are said to have an influence on the choice being modeled, a coefficient associated with each variable, and a constant term. The coefficients and the constant are the terms that are optimized to fit the data that is being modeled.

Suppose it is determined that three variables x, y, and z influence an individual's decision to choose alternative A or alternative B. The utility of choosing A would be expressed as

$$U_A = \alpha_A + \beta_{1A}x + \beta_{2A}y + \beta_{3A}z$$

and the utility of choosing B would be expressed as

$$U_B = \alpha_B + \beta_{1B}x + \beta_{2B}y + \beta_{3B}z\,.$$

The probability of choosing A, then, would be expressed as

$$P_A = \exp(U_A) \big/ \exp(U_A) + \exp(U_B) + \text{constant}$$

In transportation engineering, the logit model is typically used in the four step travel demand modeling process. The logit model has the ability to accommodate multiple independent variables, which is useful since many factors drive trip-making decisions. The alternatives being modeled must be discreet, which is a good representation of the choices available in a travel context. For example, there are a fixed number of modes (walk, drive, bus, etc.) available to an individual, and there are a fixed number of routes (roads, bus lines, etc.) available within each mode.

6.1.1 Logit Model Range

The logit model is used to model probabilities. As a result, values of the basic form of the model vary from zero to one. In some situations, though, the probability of the selection of a certain alternative may never approach one. In these situations, a scaling factor can be applied to the model as a means of creating an upper boundary. For example, the equation

$$P_A = \left[\exp(U_A) \Big/ \sum_{j=1}^{J_n} \exp(U_{J_n}) \right] * 0.7$$

would have an upper boundary of 0.7, indicating that alternative A will never be chosen more than seventy percent of the time. It should be noted that if a scaling factor is applied to a previously optimized model, it is necessary to re-optimize the model. In other words, the coefficients and constant terms will need to be changed.

6.1.2 Goodness of Fit Tests

The coefficient of determination R^2 can be used as a measure of the goodness of fit of a logit model to a set of data. An R^2 value is a measure of how much of the variation of the dependent variable being studied can be explained with the variation of the independent variable(s) chosen. The value of R^2 ranges from zero to one, with one indicating a curve that fully explains the variation of the dependent variable and passes through every data point in the set, and zero indicating a curve that does not explain any of the variation in a particular data set.

The coefficient of determination can be calculated as

$$R^2 = 1 - \frac{SSE}{SST}$$

where SSE is the sum of squares for error and SST is the total sum of squares. SSE is the sum of all the squares of the vertical distance between the fitted curve and each data point in the dataset. The value of SSE is minimized with the curve that best fits the dataset. SST is the sum of all of the squares of the vertical distance between the average value of the dependent variable and each data point in the dataset [27].

6.2 Modeling of Stopping at Yellow Flash

Major street through vehicle stopping rate at yellow/red flash intersections was modeled based on the presence or absence of a minor street vehicle and the minor street to major street volume ratio. Two logit models were created in which volume ratio was an independent variable. One model was for percent major through stopping when a minor street vehicle was present (the data shown in Figure 6.1) and the other was percent major through stopping when a minor street vehicle was absent (the data shown in Figure 6.2). The scenarios are depicted in Figure 6.4. The models had different scaling factors applied to them as the upper boundary of stopping rates for the presence and absence cases differs greatly.

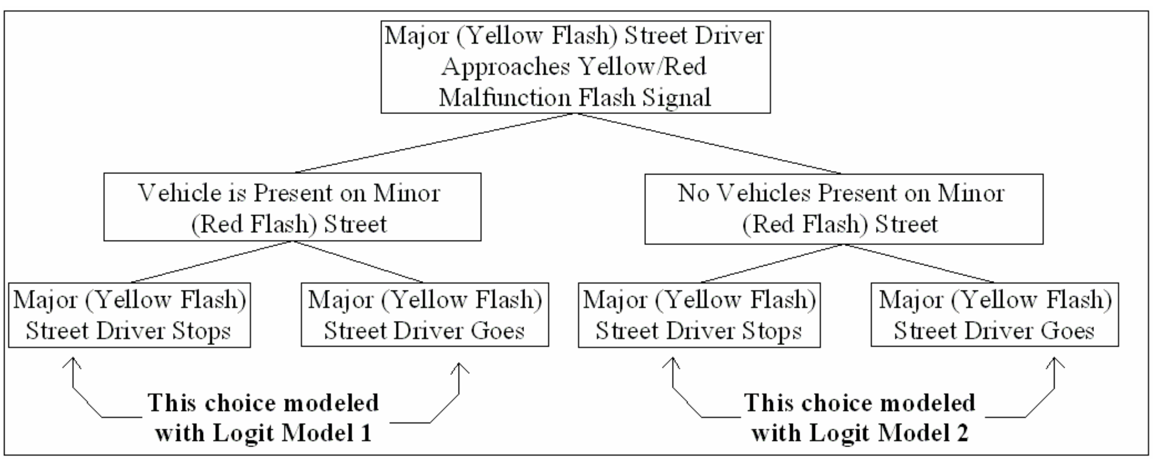

Figure 6.4 Modeling Scenarios

6.2.1 The Models

Logit Model 1, created for through vehicle stopping rate at a flashing yellow traffic signal with a vehicle present on the minor street, is

$$P_{Stopping} = \left[\exp(-7 + 25 * VR) \big/ \exp(-7 + 25 * VR) + 1 \right] * 0.62$$

where VR is the minor street to major street volume ratio. The scaling factor is 0.62, meaning that the model will never predict a stopping rate of more than 62 percent. This model can be seen in Figure 6.5. The utility equation is based only one independent variable – volume ratio. Preliminary versions of the model also included some of the other variables explored in Section 5.1, but inclusion of these variables had only a minimal effect on the goodness of fit of the model.

The scaling factor of 0.62 should not be interpreted to mean that the remaining 38 percent of drivers choose not to stop based on the fact they are facing a flashing yellow signal. Major street through vehicle stopping rates at red/red flash intersections averaged only 86 percent, suggesting that approximately 14 percent of through drivers do not stop at any type of flashing signal.

For the case of a minor street vehicle *not* being present, different constant and coefficient values for the utility function were considered. The optimal values, though, were nearly the same as those used in the presence model. A scaling factor of 0.31 was used because it was close to the optimal value and is half of the magnitude of the scaling factor for the presence model. This creates a relationship where the presence of a minor street vehicle doubles the probability of stopping. Using a constant of -7 and a coefficient of 25 and an upper boundary of 0.31 resulted in an R^2 value that was less than 0.01 lower than the optimized value. Logit Model 2, created for through vehicle stopping rate a at flashing yellow traffic signal without a vehicle present on the minor street, is

$$P_{Stopping} = \left[\exp(-7 + 25 * VR) \Big/ \exp(-7 + 25 * VR) + 1 \right] * 0.31 .$$

This model can be seen in Figure 6.6. The parameters of both models are shown in Table 6.1.

Table 6.1 Logit Model Parameters

	Model 1	**Model 2**
Application	When minor street vehicles present	When minor street vehicles absent
α	-7	-7
β_1	25	25
x_1 (independent variable)	Volume Ratio	Volume Ratio
Constant	1	1
Scaling Factor	0.62	0.31

By only changing the scaling factor and not the utility equations, the probability of stopping has been modeled as a function of two independent variables such that P(Stopping) = f(Volume Ratio)*f(Presence). The effect of volume ratio on stopping rate is the same whether a minor street vehicle is present or absent.

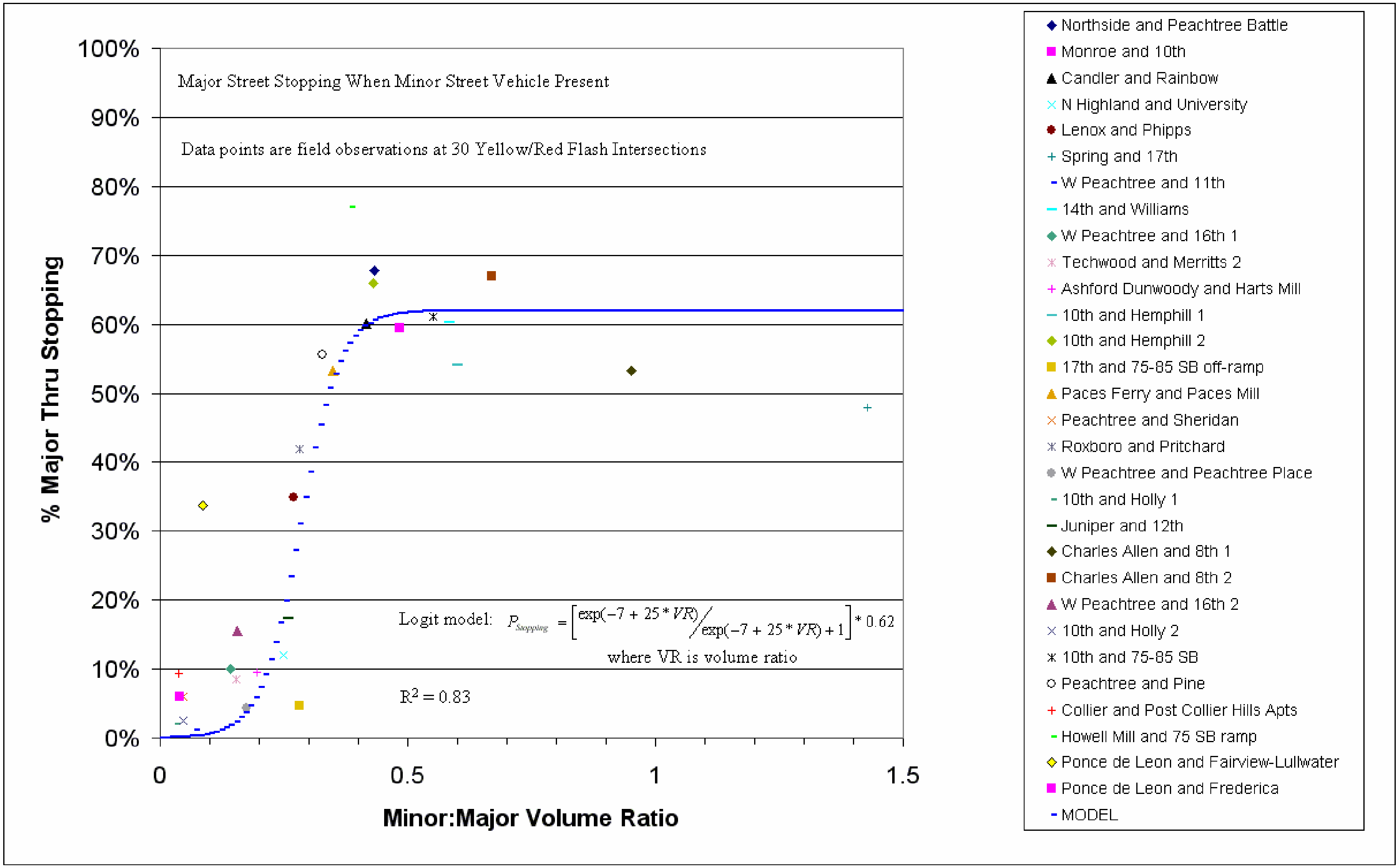

Figure 6.5 Logit Model 1 - Percent Major Through Stopping During Yellow/Red Malfunction Flash with Minor Street Vehicles Present

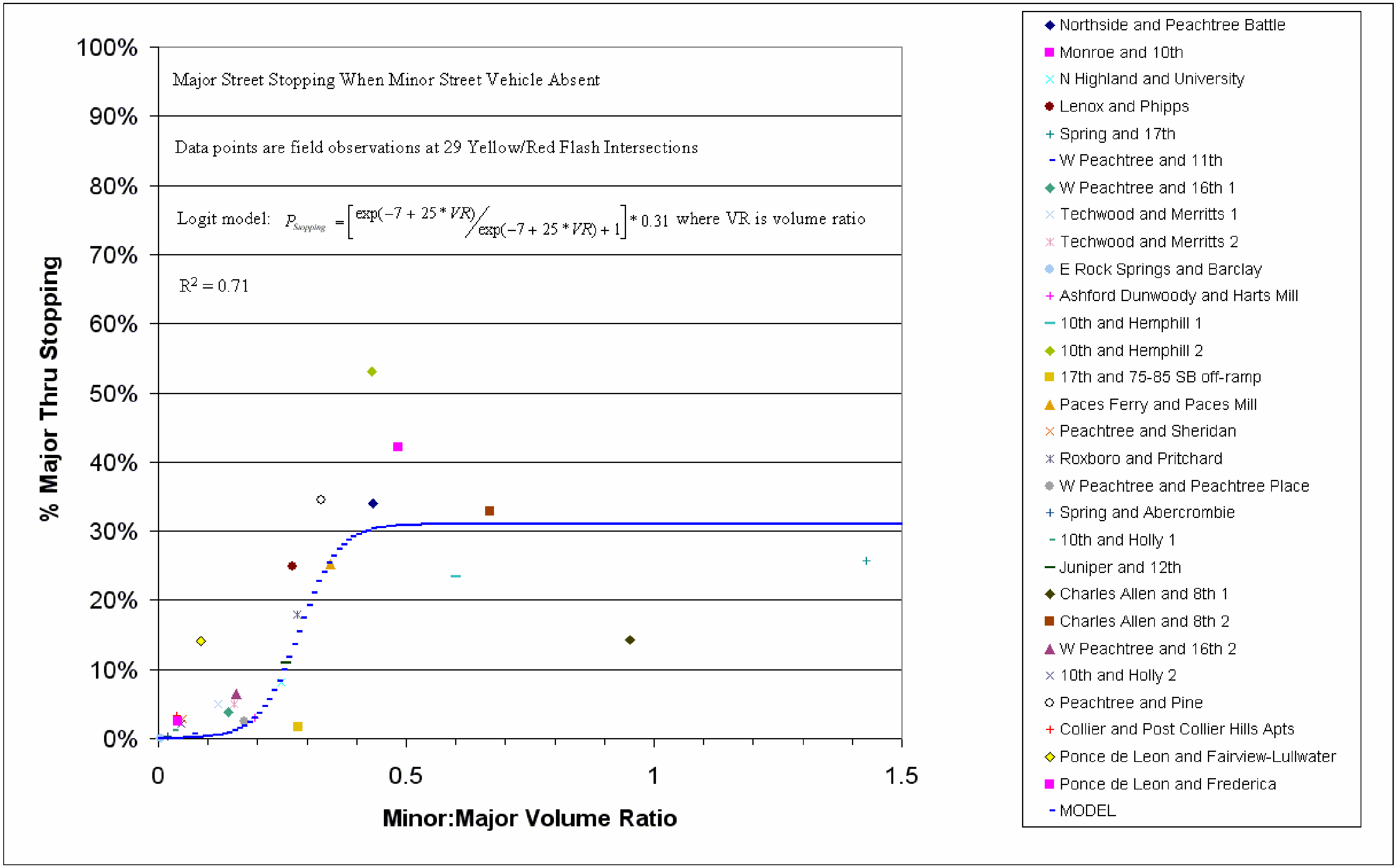

Figure 6.6 Logit Model 2 - Percent Major Through Stopping During Yellow/Red Malfunction Flash with Minor Street Vehicles Absent

6.2.2 Excluded Intersections

Some yellow/red flash intersections excluded from the data set used to create the model. The four newly installed signals that had not yet been placed into normal operation and were flashing as part of an intersection transition from unsignalized to signalized control were excluded because driver response to this situation may differ from driver response to a malfunctioning signal. Howell Mill and the I-75 Northbound ramps were excluded because presence and absence of minor street vehicles could not be accurately determined from the video.

As discussed in Section 5.2.3.9.1, intersections at which minor street vehicles were present less than five percent of the time or more than ninety-five percent of the time were only used in one model. Two intersections with minor street presence less than five percent of the time were not used in the model for the "minor vehicle present" case. Four other intersections with minor street presence more than ninety-five percent of the time were not used in the mode for the "minor vehicle absent" category.

Consideration was given to the exclusion of several other intersections. Charles Allen and 8th is an intersection of two roads functionally classified as local. This intersection was filmed twice and these two instances of flash comprise the entire local/local malfunction dataset. It is possible that under malfunction flash driver behavior at a local/local intersection differs from driver behavior at any other type of intersection., as it is common for local/local intersections to be unsignalized and occasionally uncontrolled.. Ponce de Leon and Fairview-Lullwater lacks the traffic signal sight distance described in Section 4D.15 of the MUTCD (there are signs along Ponce de Leon notifying drivers that there is a signal ahead as required by the MUTCD when signal sight distance is not available). Since flash is a rare event, drivers do not expect to encounter it and may require more time to fully comprehend and respond to it than they would normal signal operation. There was, however, insufficient evidence to validate either of these assumptions and data from these three instances of flash was used in the creation of the model.

6.3 Summary

Logit models were used to predict the probability of a driver stopping at a flashing yellow traffic signal during a malfunction flash event. The probability is based on the minor (red flash) street to major (yellow flash) street volume ratio and the presence (or absence) of vehicles on the minor street when the major street driver arrives at the intersection. Two models were created – one for the case of vehicles being present on the minor street, and the other for the case of no vehicles being present on the minor street. Volume ratio was then used as the independent variable in each model. The models fit the data well – the R^2 values are 0.83 and 0.71 for the cases of minor street vehicles present and absent, respectively.

These stopping rate models will later be used in another portion of this project that will develop a microscopic simulation of malfunction flash. This model will enable comparisons of yellow/red and red/red flash at identical intersections with identical demands, as well as the study of variables such as delay that were not directly measured from the field data.

CHAPTER 7

CONCLUSION

Beginning in the 1960's, studies of traffic signals in flash mode during low volume, nighttime hours have documented safety risks that do not exist at normally operating traffic signals. Little research, though, has been conducted with regard flashing operation during higher volumes, such as those that may be experienced when a malfunction monitoring unit initiates flashing operation. Malfunction flash cannot be eliminated as it is used for emergency purposes, but the mode of flash can be configured as yellow/red or red/red. The key findings of this thesis, which investigated malfunction flash mode choice, are presented below.

7.1 State of Practice

The state of practice with regard to malfunction flash issues was investigated by reviewing traffic engineering manuals and guidebooks and surveying public agencies responsible for the maintenance and operation of traffic signals.

7.1.1 Guidance Documents

The MUTCD allows both yellow/red and red/red flash, but provides no guidance for when each mode is to be used. Nine states with additional flash mode policy or guidance were identified. Most of these documents address flash mode choice for flash scenarios in general (programmed, malfunction, technician, etc.), and several acknowledge that malfunctions are one of the reasons flash is used. Only documents from Idaho and Tennessee explicitly address flash mode choice for malfunction scenarios (it is possible to use one mode for under malfunction flash and another under programmed flash). Idaho recommends yellow/red malfunction flash unless there is inadequate sight distance or major street traffic could be too heavy to provide sufficient gaps for minor street traffic. Tennessee states that red/red malfunction flash should be used exclusively.

7.2.2 Survey

With little guidance available with regard to flash mode selection, the choice between yellow/red and red/red flash is usually made with engineering judgment on a case-by-case or jurisdiction-to-jurisdiction basis. A survey was sent to every agency in Georgia responsible for the maintenance and operation of traffic signals, as well as a sample of agencies across the US. All Georgia agencies that responded to the survey reported using yellow/red flash exclusively or a combination of yellow/red and red/red. Georgia agencies that use a combination of flash modes generally have a majority of yellow/red flashing signals and use red/red flash at intersections with similar traffic volumes, especially similar and high volumes. The nationwide survey revealed a relationship between flash mode choice and geography. All 13 responding agencies in the southeast and on the east coast favor yellow/red flash. Most use it exclusively, but some use red/red for special circumstances. All five responding agencies on the west coast reported the exclusive use of red/red flash. The survey response rate in the central portion of the country was not high enough to draw conclusions.

7.2 Field Data Analysis

Thirty-eight instances of yellow/red flash and 10 instances of red/red flash were recorded on video. In a few cases, some of the instances of flash were captured at the same intersection on different days. Videos were generally recorded for one hour, but were sometimes shorter due to the signal being reset into normal operation before one hour had passed. Signals were never intentionally placed into flash as part of this study.

The percentage of vehicles stopping at a flashing signal was selected as the basis of analysis based on initial, qualitative observation. High stopping rates were observed at some flashing yellow signals, and some vehicles did not stop at flashing red signals. Stopping rates capture both quality of service (the capacity and efficiency of a flashing yellow signal is diminished as stopping rates increase) and safety (a control device at which some drivers choose to stop and others do not creates the potential for crashes). Field measurement of delay, a typical quality of service measure, was not possible as the video camera could not capture queues on all approaches. Accident rates, a typical safety measure, were not available in Georgia because the state's accident database does not identify the state of the signal control (i.e flashing) at the time of an incident. Also, exposure-based data would require knowledge of the frequency and duration of malfunction flash.

At yellow/red malfunction flash controlled intersections, major street through vehicle stopping rates observed in the field ranged from 0.0 % to 76.4 %. A variety of variables were studied, and minor street to major street volume ratio, the presence or absence of a minor street vehicle, and the functional class combination (with some adjustments for roads seeming to serve a higher level of mobility than their GDOT-assigned class indicated) of the two roadways were found to have the strongest relationship with major street through vehicle stopping rate.

At red/red malfunction flash controlled intersections, major street through vehicle stopping rates observed in the field ranged from 77.9 % to 93.1 %. No variables explaining the intersection-to-intersection variation within this range were identified. This low compliance rate is partially explained by the formation of platoons, in which one vehicle will “piggyback” behind another to pass through the intersection, and by the tendency of some drivers to creep through intersections without stopping. There were also instances, though, of drivers passing through a red/red controlled intersection without slowing. The limited data collected at intersections of an arterial (principal or minor) and a local street controlled by red/red flash suggests that these high speed violations are more common at such intersections, even if the overall violation rate is not.

7.3 Modeling

Logit models were used to capture the relationship between major street through vehicle stopping rate and the two selected independent variables – volume ratio and the presence of a minor street vehicle. Two models were created – one for the case of vehicles being present on the minor street and the other for the case of no vehicles being present on the minor street. In each case, the percent of major street through vehicles stopping was modeled as a function of the minor street to major street volume ratio. The utility functions in each model are the same; only the scaling factor that sets the upper boundary of stopping rate changes. The scaling factor for minor street vehicle present model is twice the scaling factor for the minor street vehicle absent model. The interpretation of these models is that a driver is twice as likely to stop at flashing yellow signal when a vehicle is present on the minor street compared to when a minor street vehicle is not present, with the absolute probably of stopping being determined by the ratio of minor street to major street volume at the intersection. A future portion of this study will use these logit models as the basis of a simulation of flashing operation in which some vehicles will stop at flashing yellow signals.

7.4 Malfunction Flash Mode Recommendations

The results of this study have demonstrated that malfunction flash mode is not a desirable state of operation for traffic signals and efforts should be made to reduce its occurrence and duration. Malfunction flash mode cannot be entirely eliminated, though, so traffic engineers must choose which mode – yellow/red or red/red – has fewer undesirable outcomes. Based on the results of this study, it is recommended that red/red flash be primary mode of malfunction flash.

Engineers often select yellow/red flash mode on the basis that it will produce less delay than red/red flash, though for several reasons this can be a poor selection:

- As many as three-quarters of the drivers approaching some flashing yellow signals choose to stop. This produces much of the same delay that would exist if the signal were flashed red/red
- Malfunction flash is used as a safety precaution to avoid conflicting movements and dark signal heads. It is also a temporary means of control that is only used until maintenance personnel can arrive on-site. Flash mode selection, then, should be based primarily on safety criteria and not operational criteria.

- The tendency of some drivers to stop at a flashing yellow signal, some to proceed slowly through the intersection, and others to pass through the intersection without slowing creates safety risks and the potential for rear-end accidents.
- If a driver is facing a flashing red signal head, there is no way to know from the signal head itself whether the cross traffic is receiving a flashing yellow or flashing red indication. The fact that some drivers stop at flashing yellow signals, especially with a minor street vehicle present, adds to risk that is already present at such a scenario. A minor street driver at an intersection flashing yellow/red may observe several major street vehicles stopping, assume the major street is receiving a red flash and all vehicles will stop, and pull into the intersection with major street traffic that may not stop approaching. This creates the potential for right angle accidents.

If one flash mode to be used at all intersections had to be selected, that mode should be red/red for the reasons stated above. However, it should be recognized that if red/red were to become the standard mode of malfunction flash, there may exist a scenario in which yellow/red flash would still arguably be the preferred flash mode. At the intersection of a sufficiently large, high volume road and a sufficiently small, low volume road, few drivers choose to stop at a flashing yellow signal. Little data was collected at red/red flash controlled intersections where one road had a significantly higher volume than the other, but the data that was collected seemed to indicate that major street drivers are more likely to violate a flashing red signal at a high rate of speed under such circumstances. If yellow/red flash is to be used at all, the most appropriate location would be at intersections of local and arterial roads where the minor street to major street volume ratio is approximately 0.20 or less (during all time periods as malfunction flash may occur any time of day) and AASHTO intersection sight distance requirements are met.

However, in a system dominated with red/red flash intersections, an occasional yellow/red flash intersection could be hazardous as minor street drivers might assume they were at a red/red flash intersection and the cross traffic (i.e. major street traffic) would stop. One methods of addressing this would be the installation of a sign such as those proposed by TTI [6] or Parsonson and Walker [12] informing minor street drivers that that cross traffic does not stop during flash mode or that the minor street traffic must turn right if the signal is in flash. Currently the recommended default position is to utilize red/red malfunction flash at all intersections, however, future studies should investigate the possibility of utilizing signage or some other means to address driver expectancy issues and allow for yellow/red malfunction flash at the intersection of an arterial and a local road.

7.5 Recommendations for Future Study

A follow-up project that will use microscopic simulation and the stopping rates modeled in this thesis to evaluate yellow/red and red/red flash is planned. This will allow for each flash mode to be implemented under identical demands at an intersection, and for variables such as delay to be analyzed.

In addition, there are other aspects of malfunction flash control that should be further investigated:

- Effects of opposing left turns on major street through vehicle stopping rate
- Factors that affect major street turning vehicle stopping rate
- Additional field analysis of red/red flash, especially at intersections with uneven volumes that most agencies would configure for yellow/red flash.
- Accident rates at signalized intersections in malfunction flash mode. Accident rates under malfunction flash are almost certainly higher than under normal operation, but a comparison of accident rates at yellow/red flash intersections and accident rates at red/red flash intersections would be useful.
- The history of flash mode selection. Agencies on the West Coast have historically used red/red, even though most of the country uses yellow/red for operational reasons. What has led to that decision?
- Field studies of malfunction flash in suburban and rural areas, as the field data in this study is overwhelmingly urban.
- Development of signage or other means to allow for safe implementation of yellow/red flash at the intersection of an arterial and local road.

APPENDIX A

STATE SURVEY

Initial e-mail message requesting survey response

Dear [recipient's name],

The Georgia Institute of Technology in cooperation with the Georgia Department of Transportation is conducting a survey as part of a study of intersection operations under malfunction flash control. The intent of this survey is to gather Georgia-specific information related to the frequency of malfunction flash, methods of notification that a signal is in malfunction flash, equipment standards, and maintenance. This information will provide a knowledge base of the current practices within the state of Georgia. The primary outcome of this survey and subsequent study efforts will be the development of policy recommendations for the use of red/red and yellow/red malfunction flash operation.

Your response to this survey will greatly assist in addressing this critical safety issue. If you choose to respond to this survey please be assured that no agency identifying information will be released as part of any report. Survey responses will be aggregated to allow for a general picture of malfunction flash signal operation practices within the state of Georgia, not within any particular jurisdiction. If you feel that someone else at your agency is more appropriate to complete this survey, or to approve of the survey completion, please reply to this e-mail with their name and contact information (including e-mail) so that we may seek their input on this important safety issue.

The survey can be accessed here:
http://www.ce.gatech.edu/research/malfunctionflash/

Username: signal
Password: flash

If you have any questions or comments regarding this survey please do not hesitate to contact us at malfunction.flash@ce.gatech.edu. Also, please feel free to contact me directly at michael.hunter@ce.gatech.edu or (404)385-1243, or to contact David Jared, P.E., GDOT research contact, at David.Jared@dot.state.ga.us or (404)363-7569.

Best regards,

Michael P. Hunter, Ph.D.
Assistant Professor
Georgia Institute of Technology
School of Civil and Environmental Engineering
Atlanta, Georgia 30332
michael.hunter@ce.gatech.edu
Phone: (404)385-1243 Fax: (404)894-2278

Follow-up e-mail message requesting survey response

Dear [recipient's name],

Several weeks ago I contacted you regarding a survey of agencies in Georgia that maintain traffic signals. The intent of the survey is to gather Georgia-specific information related to the frequency of malfunction flash, methods of notification that a signal is in malfunction flash, equipment standards, and maintenance.

The survey can be accessed at:
http://www.ce.gatech.edu/research/malfunctionflash/

Username: signal
Password: flash

If you have any questions or comments regarding this survey please do not hesitate to contact us at malfunction.flash@ce.gatech.edu. Also, please feel free to contact me directly at michael.hunter@ce.gatech.edu or (404) 385-1243, or David Jared, P.E., GDOT research contact, at David.Jared@dot.state.ga.us or (404) 363-7569. If you believe you are not the appropriate person to complete this survey it would be greatly appreciated if you could reply to this email with the name of the correct contact.

I would like to thank you in advance for taking the time to complete this survey. I greatly appreciate your efforts in helping address this critical safety issue.

Best regards,

Michael P. Hunter, Ph.D.
Assistant Professor
Georgia Institute of Technology
School of Civil and Environmental Engineering
Atlanta, Georgia 30332
michael.hunter@ce.gatech.edu
Phone: (404)385-1243 Fax: (404)894-2278

Introductory webpage presented to respondents before the survey itself

Enter the survey here (requires userid and password sent in e-mail request)

Survey Background

Evaluation Study of Intersection Operations under Flashing Signal Control

The Georgia Institute of Technology in cooperation with the Georgia Department of Transportation is conducting a survey as part of a study of intersection operations under malfunction flash control. The intent of this survey is to gather Georgia-specific information related to the frequency of malfunction flash, methods of notification that a signal is in malfunction flash, equipment standards, and maintenance. This information will provide a knowledge base of the current practices within the state of Georgia. The primary outcome of this survey and subsequent study efforts will be the development of policy recommendations for the use of red/red and yellow/red malfunction flash operation.

Your response to this survey will greatly assist in addressing this critical safety issue. If you choose to respond to this survey please be assured that no agency identifying information will be released as part of any report. Survey responses will be aggregated to allow for a general picture of malfunction flash signal operation practices within the state of Georgia, not within any particular jurisdiction.

If you have any questions or comments regarding this survey please do not hesitate to contact us at malfunction.flash@ce.gatech.edu. Also, please feel free to contact me directly at michael.hunter@ce.gatech.edu or (404)385-1243, or to contact David M. Jared, P.E., GDOT research project technical contact, at David.Jared@dot.state.ga.us or (404) 363-7569.

We greatly appreciate your time in completing this survey.

Michael P. Hunter, Ph.D.
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Phone: (404)385-1243 Fax: (404)894-2278

Respondents

GDOT State Signal Engineer, 7 GDOT District Signal Engineers, 18 city and county agencies (26 total responses)

Response

General Information

Questions 1 through 9 ask for contact information about the person filling out the survey and the agency with which they are associated.

Background

10) Number of signals in your jurisdiction:

Ranges from 5 to 2500. Average is 275

11) Are records maintained for occurrences of malfunction flash?

Yes-17 No-9

12) If possible, approximate the percentage of flashing signal occurrences that are likely attributed to the following sources (averages listed)

Power Interruption	51%
Lightning	20%
Equipment Malfunction	24%
Other (explain below)	5%

Signal damage by contractors. construction and vehicle accidents.

Auto Accidents

shorts. opens. bulbs. etc.
Note: Percentages given are rough estimates!

Traffic Accidents

Our Central Business District signals flash remotely after midnight.

Lightning causes loss of power and damage to equipment. some equipment want start back up.

Bulb outage. signal head damage. wire/cable shorts or breaks

Signals will trip to flash during accidents at the intersections that knock down the Pedestrian Poles etc... We average 4 to 5 a week ...

Construction

Percentages based on: Record Review-2 Expert Judgment-24

13) Approximately how many malfunction flash signal trouble calls are received per month?

Varies by number of signals. Median of 0.05 calls per signal

14) What methods are used to identify when a signal goes into malfunction flash?

Citizen notification- 22 of 26

Inspection of signals by agency crews- 11 of 26

Automatic notification (please describe) - 4 of 26

Police Dept. /TMC

ACTRA system monitoring,

Page to Engineer on call from Sheriff's Office

traffic management system via e-mail text messages.

Other- 17 of 26

advised by local government(police. sherrif. ect....

Local Governments. Law Enforcement Agents

911.TMC

Notification by local law enforcement

Police as they ride their routes.

Sheriffs Dept

Sheriff Dept.

County's Traffic Control Center

County crews are notified after hours through the 911 center

Calls from jurisdictional Police

Notification via Public Safety Agency (911 call center from police reports)

Some notifications come via GDOT. vast majority of notifications come from 911 dispatch.

911 Dispatch

police.fire

Police-911

Identified by Police or other City employee

15) In your jurisdiction, who would a citizen call to report a malfunctioning signal? Describe the chain of notification that would occur, starting with the citizen and ending with the person that would make the necessary repairs

Citizen calls in to report malfunctions to the Traffic Signal Technician Supervisor, who gathers information and dispatches personnel. 2. Citizen calls law enforcement or 911 who then contact Signal Technician Supervisor.

Citizen calls main DOT number and message is forwarded to the traffic operations manager

Citizen calls Sheriff's Dept.

Dept. of Engineering or other county office

DOT Service Request Center

Citizen contacts Public Works

Citizen calls 911 or police dept. and the dispatcher forwards the call to 24 on call unit

Public Works secretary

Traffic signal maintenance shop (traffic signal technician after hours)

City Engineering Dept.

Traffic Engineering Receptionist

PWD

On call signal technician (after hours)

On call signal technician (after hours)

On call personnel

On call personnel

On call personnel

City Clerk

16) Once the agency is notified, what are the typical response and repair times?

1-24 hours

15-30 minutes

15-30 minutes

15-30 minutes

20 minute response, 15 minute repair

25-40 minutes

30-45 minutes

0.5 hours response

0.5 hours response

0.5 hours response

0.5 hours response

1 hour

1 hour

1 hour

1 hour response, 1-3 hours repair

1-3 hours response, 2 hours repair

1.5 hours

1.5 hours

2 hours

2 hours

2-3 hours

Immediate response

Immediate response

Immediate response

17) Does the response time vary by time of day or time of year? If so, describe.

Yes-14 No-11 Did Not Respond-1

response time may take a little longer after normal work hours.

Time of Day: Responding technician may receive call in the middle of the night. which requires time to get dressed. warm vehicle engine. drive slower at night; Technician may be a considerable distance from on call vehicle when he/she is notified;
Time of Year: Driving in inclement (winter) weather slows the response time.

After hours response could be grater than work hours due to weather conditions.

Atlanta Traffic. Seasonal Traffic

By time of day: Due to technicians being in the various areas during the day on routine work. they will catch trouble calls in the area mimimzing the response time. Otherwise they will be on call and respond from their home or wherever they may be.

Daytime a tech may be in the area.

varies by location of indiviual responding to trouble call.

Not really. but during the spring/summer months we have more lightning storms that can cause numerous signals to flash at the same time which may slow down response time

As described above based on traffic in the area and other calls to the on-call personnel during Storms.

Response times during business hours. Monday thru Friday are less than 30 minutes.

During business hours response time is usually less than 15 minutes for initial evaluation. Ater business hours. response time is usually less than 30 minutes for initial evaluation.

After hours takes our on-call technicians up to an hour to respond

also may vary by location. if there is a problem chances are there is heavy traffic. Most people are pretty good about moving so you can get to the light to repair it.
Time of day. traffic response time varies by amount of traffic on the road. Time of year delays due to weather. ice storms and high winds and heavy rain may delay response to scene. If weather is a factor. there may be other intersections experiencing similar problems. In this case a triage of sorts is set up to evaluate the busier intersections first.

If storm related could be slower. If a technician happens to be in the area could be quicker. [We are] an hour or so away from the…District Office.

18) Does a policy exist for the provision of traffic control by police officers at malfunctioning signals?

Yes-9 No-16 Did Not Respond-1

If "Yes", describe:

more practice than policy. local authorities can always assume control of signal intersections.

Not aware of provision.

Department of Transporation Signal employees are not to direct traffic. If traffic direction is needed. the local law enforcement is to be contacted and they are in control of traffic.

Depends o0n time of day and problem. An officer is just a call away in our small town.

Not a specific writen policy. but police will come to direct traffic if the problem is not likely to be fixed in less than a few minutes.

If a signalized intersection with high traffic volumes is in flash for an extended period of time or during peak hour traffic conditions. a police officer is requested to perfrom traffic control until the signal is back in operation.

Police Officers maintain traffic control if needed.

For malfunctioning signals - No. For flashing or out signals there is no formal policy. I think it is up to the Police officer. sometimes they are providing control. but most of the time no one is around.

No stated Policy. Officers typically direct traffic during these events at major intersections. but not at the minor locations.

The policy is implied. and is dependent on available police manpower.

I have never seen a "written" policy. However. based on field experience. most times traffic control will be provided by sheriff deputies. Some cases. late night or very light traffic. deputies will not be assigned traffic control. or it is determined that conditions don't warrant the need for an officer's presence.
In most cases the determination of need is decided by responding officer. However. anytime we request prescence. one will be provided.

if they are the ones who intiatied the call they are usually the first on the scene and remain there until the problem is repaired.

officers stay on scene till problem is fixed or can be handled by traffic dept.

They "work" the intersection if needed. Depends on which signal and what time of day.

19) Are police officers used to temporarily provide traffic control while technicians conduct regular maintenance?

Yes-8 No-3 Sometimes - 14

<u>Signal Equipment</u>

20) Do you use the current GDOT specifications for Surge Protection and Grounding and Bonding or a different specification?

(GDOT Specifications are provided at Section 925.2.02-A-14, Surge Protection and Section 647.3.05 – Z & AA, Grounding)

For Surge Protection, specifications match those recommended by GDOT- 25 of 26

For Grounding, specifications match those recommended by GDOT- 26 of 26

Alternate specifications utilized. (If possible, please provide below a web link or contact information for obtaining a copy of the specifications)- None

21) Are uninterruptible power supplies (UPS) utilized for any signals within your jurisdiction?

Yes-5 No-21

22) What percentage of signals within the jurisdiction have communications capabilities either via a closed loop or direct connect system?

42% average

Flashing Signal Operations

23) Indicate which types of flashing operation are currently utilized within your jurisdiction:

Red / Red-0

Yellow / Red-14

A combination of Red / Red and Yellow / Red-12

24) Describe the policy within your jurisdiction for utilizing either red/red or yellow/red signal displays under malfunction or technician flash.

our practice is the use engineering judgement that includes determining the ability of each approach to pass in each flashing condition.

When a traffic signal is operated in the flashing mode. a flashing yellow signal indication should be used for the major street and a flashing red signal indication should be used for the other approaches unless flashing red signal indications are used on all approaches.

M.U.T.C.D.

Mainline flash yellow.while side streets flash red.

typical Main Yellow / Side Red. One or two exceptions with All Red

Approved by Chief Engineer's Office.

State Route mainline flashes yellow and resets green. Side street flashes red and resets red.

If the problem is to bad and it may take a while to get it corrected we will remove the cabinet and install a new one. Then we will work this cabinet over in the shop. There are not to many times we have to do this.

red/red is the standard for newer. high-volume intersections. yellow/red is utilized everywhere else

intersections that have significnt differences in major street and minor street traffic volumes are programmed for yellow/red flash operations. intersections that have similar traffic volumes or have a potential adjacent impact are programmed for red/red.

red/red signal displays are used mainly at intersections with balance traffic flow. typical for CBD. (Central Business District)

We follow GDOT

Yellow on the major street and red on the minor street as defined by traffic volume

Yellow flash is displayed for the main line traffic. Phase 2 & 6. Red flash is displayed for the side street traffic. Phase 4 & 8.

Red / Red at two crossing arterials or 'major' intersections...

Red / Yellow ar all 'minor' intersections...
Based on Engineers Judgement and/or GDOT Permit.

Based on entering approach speeds and/or volumes. width of intersection.

The vast majority of our signals are yellow/red. HOwever. there are a couple of signals that use red/red. I am not aware of any written policy governing the use between the two methods of flash. The two signals that use red/red were once multi way stops and this may have played into the decision to use red/red. These are on-system signals (operated and maintained by the Georgia Department of Transportation).

The traffic volumes entering each intersection are evaluated. determining which leg is considered the major street and the minor street. The major street receives the yellow displays and the minor street receives the red displays.

none

If the two intersecting roads have fairly balanced volumes. then red/red is set up in the cabinet.

Whatever GDOT programs into the signals

25) Is *program* flash (regularly scheduled flashing intersection control) utilized within your jurisdiction?

Yes-5 No-21

Maintenance Programs

26) As a part of your regular signal maintenance program, is the grounding/bonding within the signal cabinet tested?

Yes-15 If yes, what is the average duration between testing?

6 months (listed by 4 agencies)

6 to 12 months (listed by 3 agencies)

12 months (listed by 7)

6 to 24 months

varies

No-11

27) Have you implemented any programs or measures to reduce the instances of malfunction flash within your jurisdiction?

Yes-12 No-12 Did Not Respond-1

If yes, please briefly describe these measures in the space below and indicate whether or not they were successful in meeting their intended outcomes:

Preventive maintenance (*listed by 6 agencies)*

Updated equipment (*listed by 5 agencies)*

GDOT practices

Record malfunctions and troubleshoot

Additional Comments

28) Please provide any additional comments that you may have regarding signal operations during malfunction or technician flash (i.e. hardware issues, equipment configurations, mitigation strategies, or any other lessons learned).

The department has started a program that will deploy battery back-up systems at traffic signals.
Other than normal malfunction flash, the 2070 controller has caused us more trouble calls than anything else.
[We are] in the process of adding battery backup systems at each intersection.

Thanks to the State of Georgia for going to one style of cabinet and controller. This will help out everyone for many years.

Without proper documentation of past malfunctions and controller, conflict monitor, and equipment diagnosis, trouble shooting the appropriate repairs has required repeat repairs to signal locations.

We are still using 20 to 25 year old equipment that has grown weaker over the years. We are changing these out with new 2070 controllers and 2010 monitors. We should see a change.

Question 10: Of the fifty signals within our county boundary. Forty of them are on state routes (on-system) and the state ultimately has maintenance responsibilities. Of the ten signals wholly owned and controlled by the county (off-system) three of these are interconnected with on-system signals and their timings are controlled by the state. We are not authorized to make any timing changes to signals under GDOT supervision without getting prior approval from the state. We serve GDOT as a front-line maintenance and trouble shooting response for the signals on state routes within the county. Therefore, the majority of our trouble calls involve state maintained signal equipment. We report all trouble calls to the state and they will reimburse us for any equipment we use in the repairs of these signals. We will call the state for assistance whenever we have a problem with an on-system signal that we can not repair/replace by ourselves. I would estimate that this occurs maybe once a year when the state will actually need to dispatch one of their employees to complete repairs.

Question 11: we have no formal policy or assigned journal for recording occurrences of malfunction flash. However, I keep a running WORD document in which I record location and brief description of problem/solution. I work in the Traffic Engineering Department. The bucket truck operator works in the Roads & Bridges Department. He turns in work orders to Roads & Bridges for all the calls he may go on and for routine maintenance work that he does during normal business hours. In most cases, whenever we respond to GDOT signal we will let them know that we had a call and what we did. Therefore, even though no formal recordation (is that a word?) taking place, we have the means to track down most, if not all, tasks involving traffic signals.

It is practically impossible to achieve the 5 ohms or less grounding that is specified by the Georgia DOT. We have modified our specifications to allow for 25 ohms or less regarding grounding.

Problem with railroad pre-emption causing flashing problem at one location

-Upon opening the cabinet at the problem intersection, make immediate note (and document) and the status of the conflict monitor. Ask yourself, "does it make sense"
-Use your nose and hands-if something has been hit it will smell and be HOT.
-If everything checks out and the controller is a 2070, check the UNIT DATA start-up time. If it is anything other than "0" then the monitor will not reset and every time there is a power interruption the signal will not recover from a power interruption hence a tech will be called.

All signals are On-system, owned and maintained by GDOT. Their policies should govern operations.

Survey Follow-Up

29) Please indicate below if you are willing to participate in follow up correspondence, which may be via e-mail or telephone.

Yes-25 No-1

APPENDIX B

NATIONAL SURVEY

Initial e-mail message requesting survey response

Dear [recipient's name],

The Georgia Institute of Technology in cooperation with the Georgia Department of Transportation is conducting a survey as part of a study of intersection operations under malfunction flash control. The intent of this survey is to gather both regional and nationwide information related to the frequency of malfunction flash, methods of notification that a signal is in malfunction flash, equipment standards, and maintenance. The primary outcome of this survey and subsequent study efforts will be the development of policy recommendations for the use of red/red and yellow/red malfunction flash operation. Additionally, the survey will increase awareness of new technology being used around the county to prevent malfunctions from occurring and to expedite agency response to malfunctions.

Your response to this survey will greatly assist in addressing this critical safety issue. If you choose to respond to this survey please be assured that no agency identifying information will be released as part of any report. Survey responses will be aggregated to allow for a general picture of malfunction flash signal operation practices in the United States, not within any particular jurisdiction. If you feel that someone else at your agency is more appropriate to complete this survey, or to approve of the survey completion, please reply to this e-mail with their name and contact information (including e-mail) so that we may seek their input on this important safety issue.

The survey can be accessed here:
http://www.ce.gatech.edu/research/malfunctionflash/national/

Username: signal
Password: flash

If you have any questions or comments regarding this survey please do not hesitate to contact us at malfunction.flash@ce.gatech.edu. Also, please feel free to contact me directly at michael.hunter@ce.gatech.edu or (404)385-1243, or to contact David Jared, P.E., GDOT research contact, at David.Jared@dot.state.ga.us or (404)363-7569.

Best regards,

Michael P. Hunter, Ph.D.
Assistant Professor
Georgia Institute of Technology
School of Civil and Environmental Engineering
Atlanta, Georgia 30332
michael.hunter@ce.gatech.edu
Phone: (404)385-1243 Fax: (404)894-2278

Follow-up e-mail message requesting survey response

Dear [recipient's name],

Several weeks ago, I contacted you regarding a survey of selected agencies across the United States that maintain traffic signals. The intent of this survey is to gather both regional and nationwide information related to the frequency of malfunction flash, methods of notification that a signal is in malfunction flash, equipment standards, and maintenance of signal equipment.

The survey can be accessed here:
http://www.ce.gatech.edu/research/malfunctionflash/national/

Username: signal
Password: flash

If you have any questions or comments regarding this survey please do not hesitate to contact us at malfunction.flash@ce.gatech.edu. Also, please feel free to contact me directly at michael.hunter@ce.gatech.edu or (404)385-1243, or to contact David Jared, P.E., GDOT research contact, at David.Jared@dot.state.ga.us or (404)363-7569. If you believe you are not the appropriate person to complete this survey it would be greatly appreciated if you could reply to this email with the name of the correct contact.

I would like to thank you in advance for taking the time to complete this survey. I greatly appreciate your efforts in helping address this critical safety issue.

Best regards,

Michael P. Hunter, Ph.D.
Assistant Professor
Georgia Institute of Technology
School of Civil and Environmental Engineering
Atlanta, Georgia 30332
michael.hunter@ce.gatech.edu
Phone: (404)385-1243 Fax: (404)894-2278

Introductory webpage presented to respondents before the survey itself

Enter the survey here (requires userid and password sent in e-mail request)

Survey Background

Evaluation Study of Intersection Operations under Flashing Signal Control

The Georgia Institute of Technology in cooperation with the Georgia Department of Transportation is conducting a survey as part of a study of intersection operations under malfunction flash control. The intent of this survey is to gather both regional and nationwide information related to the frequency of malfunction flash, methods of notification that a signal is in malfunction flash, equipment standards, and maintenance. The primary outcome of this survey and subsequent study efforts will be the development of policy recommendations for the use of red/red and yellow/red malfunction flash operation. Additionally, the survey will increase awareness of new technology being used around the county to prevent malfunctions from occurring and to expedite agency response to malfunctions.

Your response to this survey will greatly assist in addressing this critical safety issue. If you choose to respond to this survey please be assured that no agency identifying information will be released as part of any report. Survey responses will be aggregated to allow for a general picture of malfunction flash signal operation practices in the United States, not within any particular jurisdiction

If you have any questions or comments regarding this survey please do not hesitate to contact us at malfunction.flash@ce.gatech.edu. Also, please feel free to contact me directly at michael.hunter@ce.gatech.edu or (404)385-1243, or to contact David Jared, P.E., GDOT research contact, at David.Jared@dot.state.ga.us or (404)363-7569.

Best Regards,

Michael Hunter
Assistant Professor
Georgia Institute of Technology
School of Civil and Environmental Engineering
Atlanta, Georgia 30332
michael.hunter@ce.gatech.edu
Phone: (404)385-1243 Fax: (404)894-2278

Respondents

21 agencies

Response

General Information

Questions 1 through 9 ask for contact information about the person filling out the survey and the agency with which they are associated.

Background

10) Number of signals in your jurisdiction:

Range from 46 to 12,000, Average 2076, Median 992

11) Are records maintained for occurrences of malfunction flash?

Yes-20 No-1

12) If possible, approximate the percentage of flashing signal occurrences that are likely attributed to the following sources

Averages:

Power Interruption	29 %
Lightning	29%
Equipment Malfunction	33%
Other (explain below)	11%

[We use] a 2010 ECL conflict monitor which is using all the extended features. most of our wiring is in underground conduit when it rains we see voltage between phases and R/A/G on the same phase often high enough to trip the conflict monitor.
We are actively rewiring any intersection with trips on rainy days. We have also switched to a wire connector which is rated for direct burial use any time a new connection is required or a new controller is installed.
[We] currently has about 2000 intersections that use conflict monitors. the rest are still electromechanical controllers but we have a replacement program on going and the the number should rise to about 7000 over the next few years.

equipment damaged by vehicles/trucks

We continue to have software related problems causing flash operations with a particular brand of traffic control equipment.

Resulting from traffic signal equipment being damaged by traffic accidents. THIS IS OUR "other"

With solid state equipment it is normal to have random glitches that send the signal into flash.

traffic signal control program conflict. accidents (knockdowns). storm damage other than lightning. manual flash control left on. pests.
These percentages are based on estimates from the district crews.

Bad cables with cracking or poor insulation

Percentages based on: Record Review-2 Expert Judgment-19

13) Approximately how many malfunction flash signal trouble calls are received per month?

Ranges from 1 to 180. Calls per signal: Average-.044, Median-.03

14) What methods are used to identify when a signal goes into malfunction flash?

Citizen notification- 21 of 21

Inspection of signals by agency crews- 10 of 21

Automatic notification (please describe) - 7 of 21

Central communications network

System operations

Monitoring of closed loop systems / central systems.

Reported by the network computer

Our closed Loop Signal Systems will notify us if a signal is in flash.

I2 Traffic Management Software System

On-lone communication equipment will indicate intersection in flash mode

Other- 14 of 21

911. Police. other agency notification

Law Enforcement and other employees

Police. [We have] has inspectors in the field around the clock as well as around the clock monitoring of the central system

Police Officers

Local law enforcement. and elected leaders

Law Enforcement. other DOT personnel

Police Dept.

Law enforcement

Reports to police

Law enforcment notification

911. Law enforcement

1. Signals on our SCATS system will show an alarm 2. Police notification

notification by local law enforcement

Notify by field personnel

15) In your jurisdiction, who would a citizen call to report a malfunctioning signal? Describe the chain of notification that would occur, starting with the citizen and ending with the person that would make the necessary repairs.

Citizen calls law enforcement- (listed by 4 agencies)

Citizen calls Customer Service of City Hall Operator

311 systems (listed by 3 agencies)

Central contact number

Citizen calls Traffic Engineering Division

Citizen calls [DOT] dispatch

Citizen calls Traffic Control Center

Citizen calls individual municipality

Citizen calls city one call center

Citizen calls division field operations

Citizen calls 911 and the call is forwarded to:

On call personnel (listed by 4 agencies)

16) Once the agency is notified, what are the typical response and repair times?

20 min- 2 hours (some signals are as much as 90 miles away)

30 min.-1 hour (listed by 2 agencies)

30 min. - 3 hours

1 hour (listed by 5 agencies)

1-2 hours (listed by 5 agencies)

1-4 hours

2-4 hours

2 hours response, varied repair (listed by 2 agencies)

2, 12, or 48 hours

4 hours

17) Does the response time vary by time of day or time of year? If so, describe.

Yes-14 No-7

Response time can vary greatly during peak hours due to traffic conditions and weather conditions during certain times of year as well as holiday traffic can affect travel times.

Depends on location and daily work schedule

Off business hours = less employees working after hours.

During work hours. response time quicker. After hours and week-ends greater due to limited personnel.

Time of year e.g. snow. sleet etc.

Weather and traffic conditions

off hours can add 20 minutes. snow and ice on roadways can slow travel time.
Due to weather conditions and location of technician responding.

it may take additional time to respond.

Fewer technicians available during late night hours will delay responses sometimes.

Depending on time of day. day of week/holiday. number of others in flash. and safety impact of intersection in flash (minor signals may wait while we are repairng bigger problems at other locations).

Response can vary by time of day. Technicians will have to be called back in the problem is after normal business hours. This can add significant time.

mainly depends on the weather condition.

During normal work hours. response time varies based on the location of the signal and where our crews are working. After-hours calls generally take longer to respond to.

18) Does a policy exist for the provision of traffic control by police officers at malfunctioning signals?

Yes-4 No-17

If "Yes", describe

If a request is made (listed by 2 agencies)

If it's a busy intersection or during rush hour

No policy, but it is done sometimes (listed by 3 agencies)

Only if the signal is dark

19) Are police officers used to temporarily provide traffic control while technicians conduct regular maintenance?

No (listed by 6 agencies)

Only for some situations (listed by 8 agencies)

Yes (listed by 7 agencies)

Signal Equipment

20) We are interested in the specifications / requirements for Surge Protection and Grounding and Bonding used in your jurisdiction.
If possible, please provide a web link or contact information for obtaining a copy of the specifications in the space provided below.

21) Are uninterruptible power supplies (UPS) utilized for any signals within your jurisdiction?

Yes-8 No-12

22) What percentage of signals within the jurisdiction have communications capabilities either via a closed loop or direct connect system?

Average-49%

Flashing Signal Operations

23) Indicate which types of flashing operation are currently utilized within your jurisdiction:

Red / Red- 6

Yellow / Red- 10

A combination of Red / Red and Yellow / Red- 5

24) Describe the policy within your jurisdiction for utilizing either red/red or yellow/red signal displays under malfunction or technician flash.

The decision to change a signal from flashing yellow/red to red/red is based on the size of the intersection. number of approach lanes per approach. volumes comparison between the two roadway. etc.

Main street to flash yellow and side street red unless special need to do otherwise.

yellow on the main street all other flash red

Standard used for at least the past 33 years I have been with the City

All but a few flash yellow/red.....there is no policy i'm aware of...it is a regional/local decision based upon complexity/geometry of intersection.

Main St. flashes yellow; side street flashes red

always red-red

Generally. yellow flash on main approaches. flash red on side streets and for protected left turn arrow. Have very few locations which rest in red and would therefore flash red-red.

Main Street gets yellow & minor Street gets red flash

Our specifications

The main street is flashed yellow and the side street is flashed red

Region Traffic Engineers decision

main street flashes yellow

side street flashes red

We only use red/red flash.

We have a Board Policy that does not allow us to program flash major intersections. When these go into malfunction/conflict flash they will be red/red. Most others are yellow/red unless other issues arise that may require red/red.

Follow the state's engineering manual

98% are red/red flashing operations. Depending on locations. engineer may choose to use yellow/red operations.

We always flash yellow on the main street and red on the sidestreet and on main street protected left turns.

25) Is *program* flash (regularly scheduled flashing intersection control) utilized within your jurisdiction?

Yes-9 No-12

Maintenance Programs

26) As a part of your regular signal maintenance program, is the grounding/bonding within the signal cabinet tested?

Yes-11 If yes, what is the average duration between testing?

12 months (listed by 10 agencies)

18 months

No-10

27) Have you implemented any programs or measures to reduce the instances of malfunction flash within your jurisdiction?

Yes-14 No-7

If yes, please briefly describe these measures in the space below and indicate whether or not they were successful in meeting their intended outcomes:

Scheduled preventive maintenance (listed by 6 agencies)

Monitoring of "problem" intersections

Upgraded equipment

Tested grounding (listed by 4 agencies)

Replacement of bulbs with LEDs (listed by 3 agencies)

Installed battery backup systems (listed by 2 agencies)

Additional Comments

28) Please provide any additional comments that you may have regarding signal operations during malfunction or technician flash (i.e. hardware issues, equipment configurations, mitigation strategies, or any other lessons learned).

We have found that the more thing that we monitor the more flash calls resulted. This is mainly due to the fact that the system is old and the electromechanical were very fault tolerant. Our new ATC controllers are not.

Most instances responded to by State DOT forces involve load switch failure or critical display absent (green arrow. etc)

We do not have a serious problem with malfunction flash trouble calls. [We have] minimal lightning and reasonably stable power.

We will be looking to implement more red/red flash at crossing arterial intersections.

Late night flash used to be the general operational practice. However, due to crash rates we now generally operate signals 24-7 unless late night flash is deemed appropriate.

[We] performs annual testing with certified test equipment of conflicting display monitoring equipment.

Clean, steady 60 Hz power is the biggest factor in reliable signal operation.

If configured to flash upon power outage. The BBS units can hold a traffic signal in flash for six to eight hours (or more in some cases).

Many of our signals were built more than 25 to 30 years ago. Many cables are cracking or their insulations are stripped. If we could have replaced the cable at locations with repetitive flasher calls, we believe it will lessen the flash calls during severe weather conditions.

<u>Survey Follow-Up</u>

29) Please indicate below if you are willing to participate in follow up correspondence, which may be via e-mail or telephone.

Yes-18 No-3

APPENDIX C

AERIAL PHOTOGRAPHS OF STUDY LOCATIONS

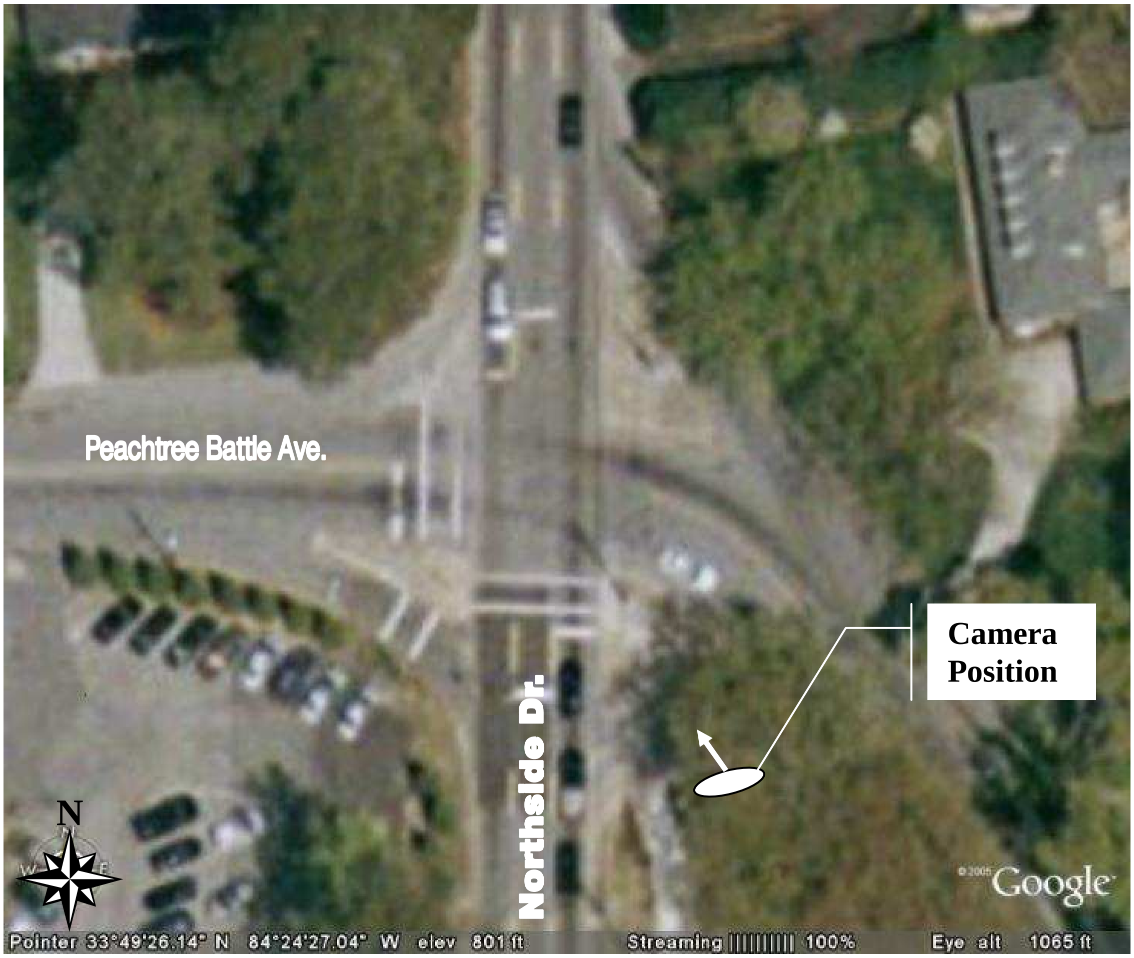


Figure C.1 Aerial Photograph Northside Drive and Peachtree Battle Avenue Intersection

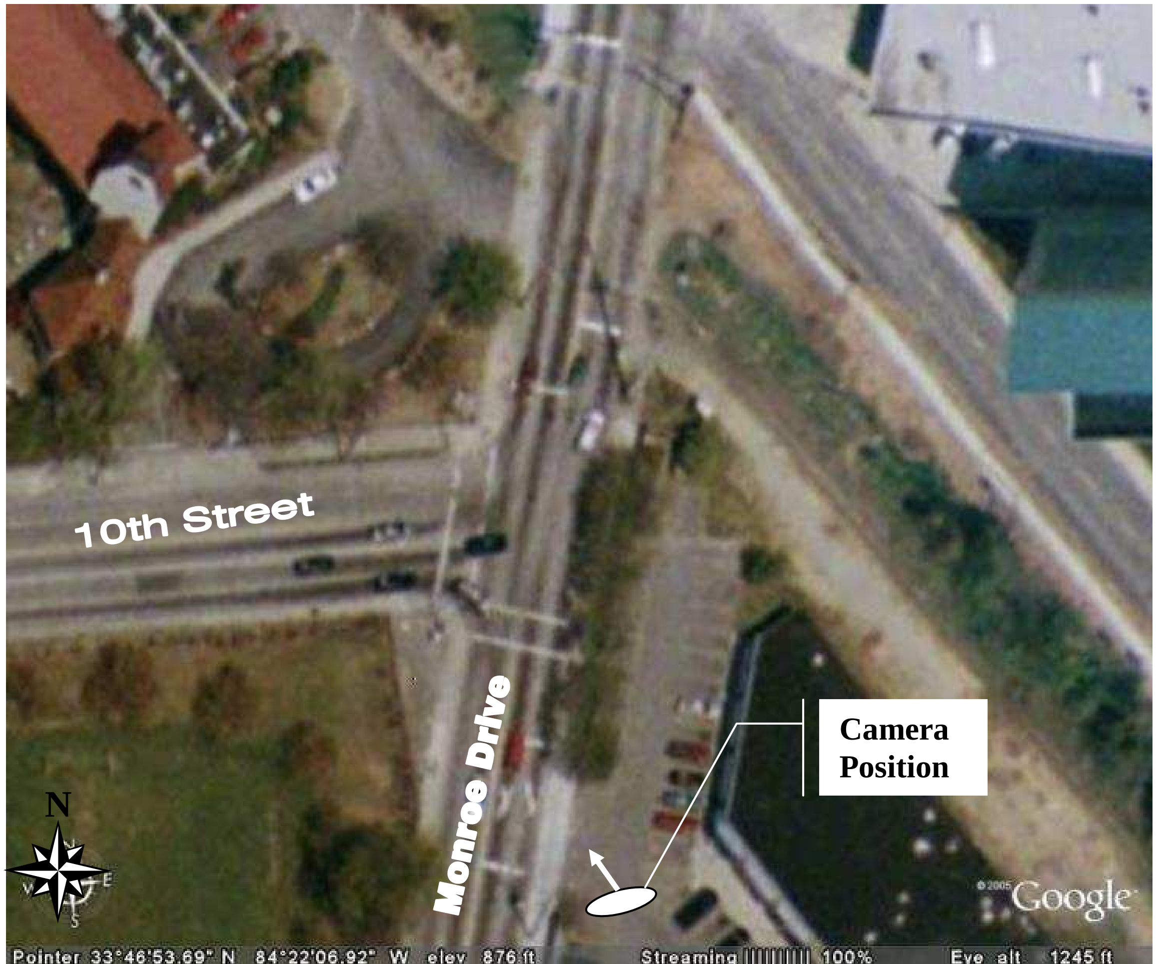


Figure C.2 Aerial Photograph Monroe Drive and 10th Street Intersection

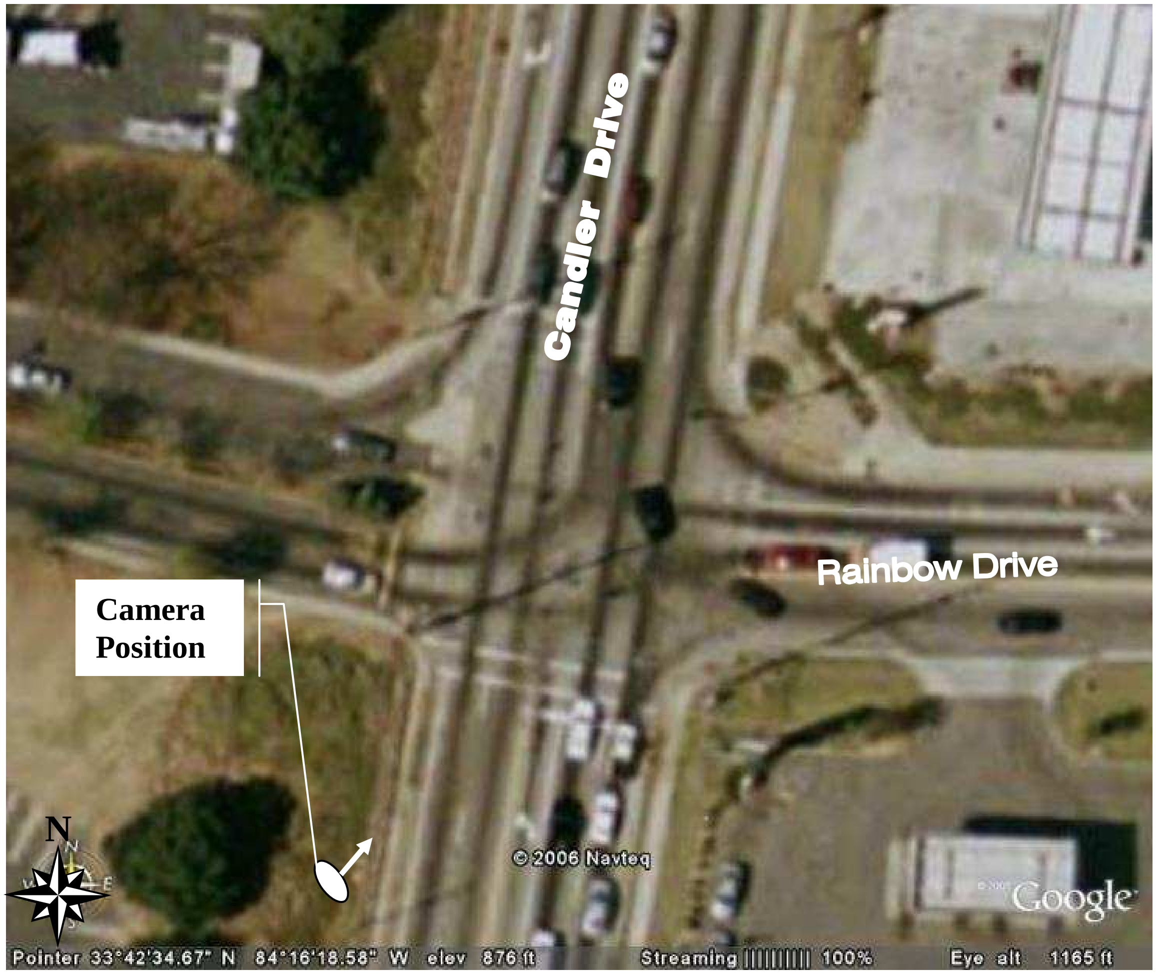


Figure C.3 Rainbow Drive and Candler Drive Intersection

Figure C.4 Aerial Photograph North Highland Avenue and University Drive Intersection

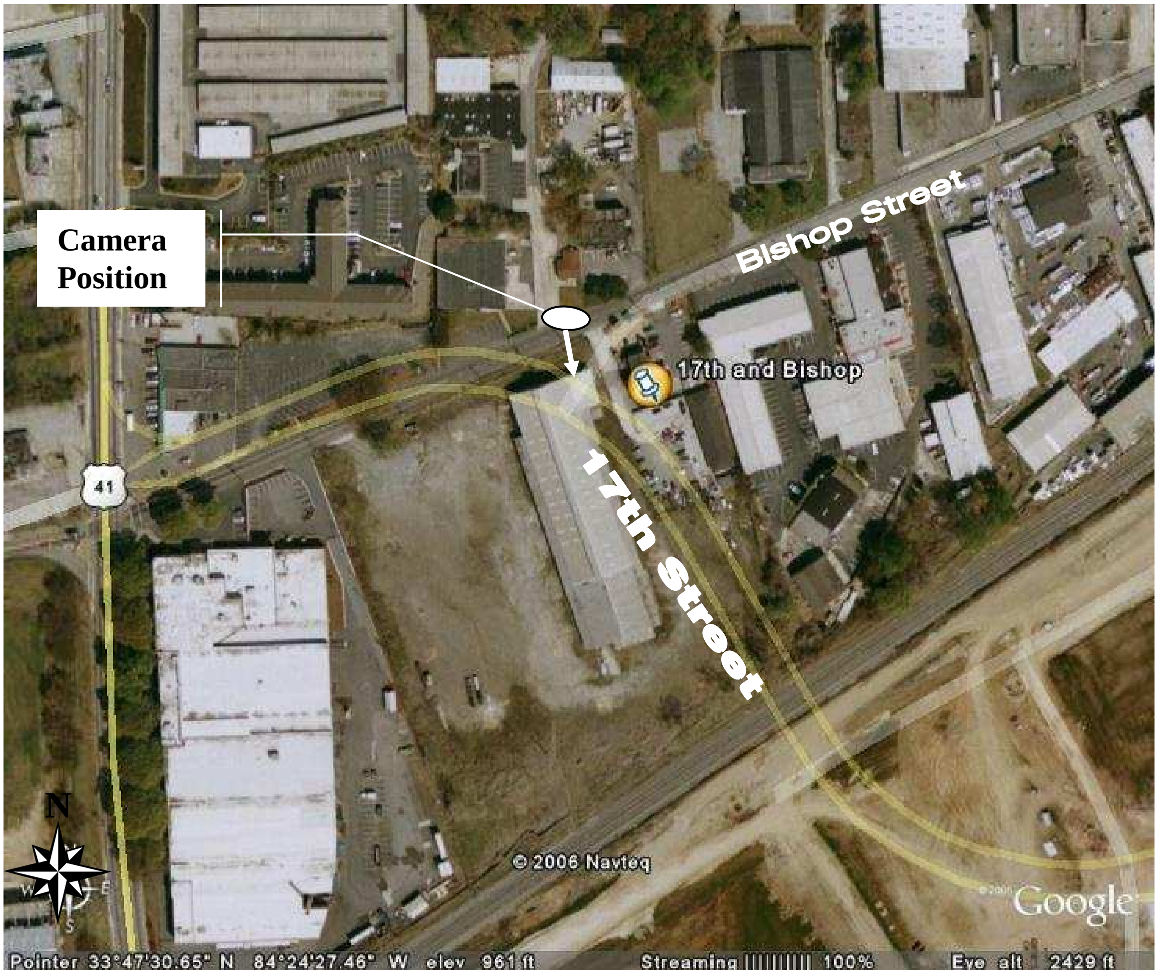


Figure C.5 Aerial Photograph 17th Street and Bishop Street Intersection

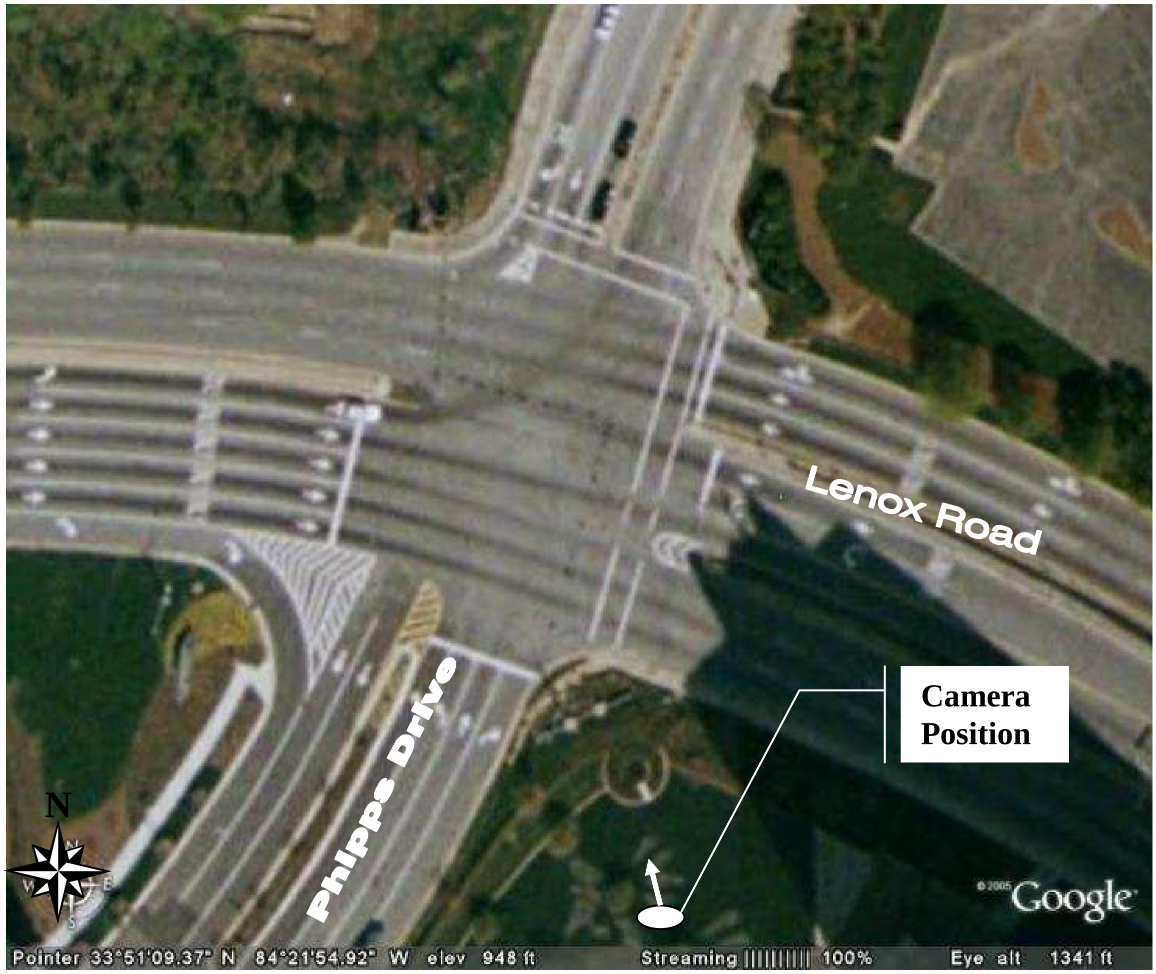


Figure C.6 Aerial Photograph Lenox Road and Phipps Drive Intersection

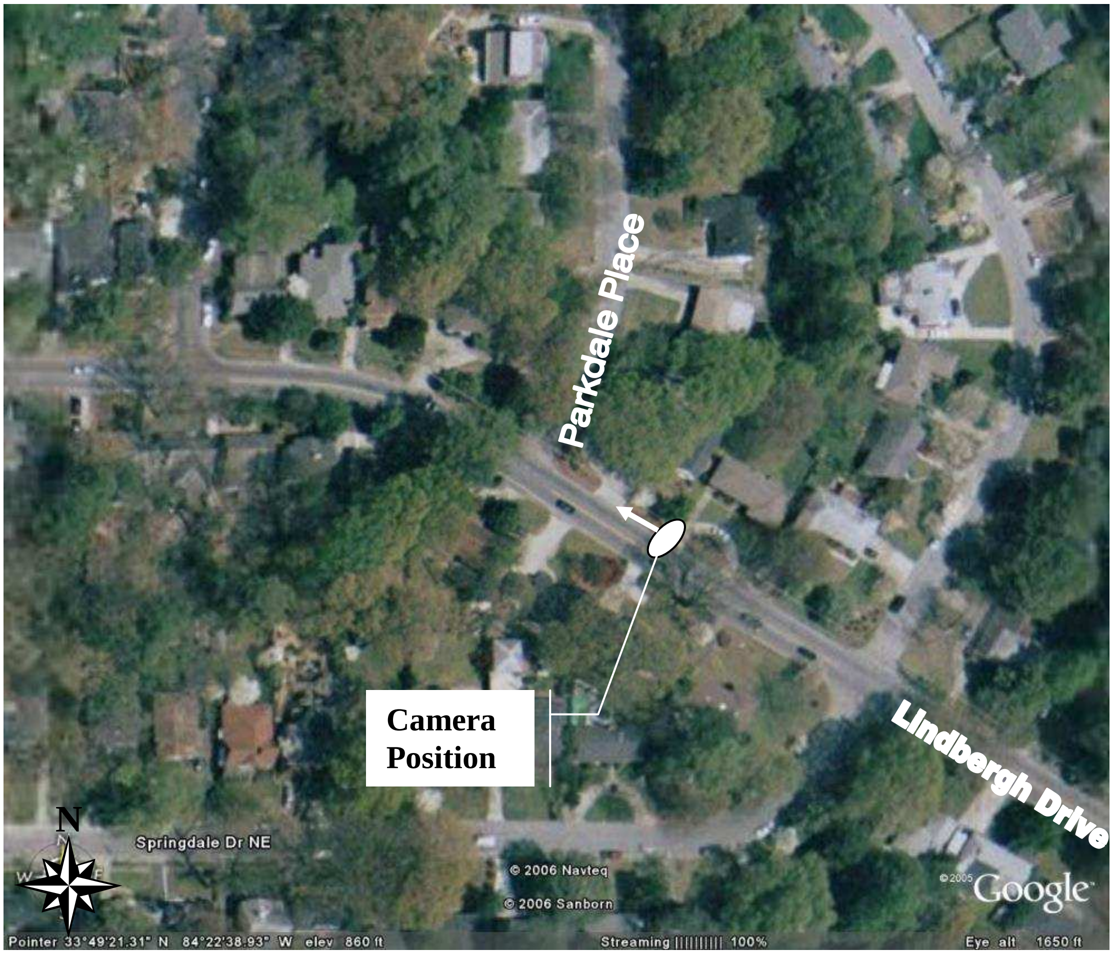


Figure C.7 Lindbergh Drive and Parkdale Place Intersection
Drive and Parkdale Place Intersection Data

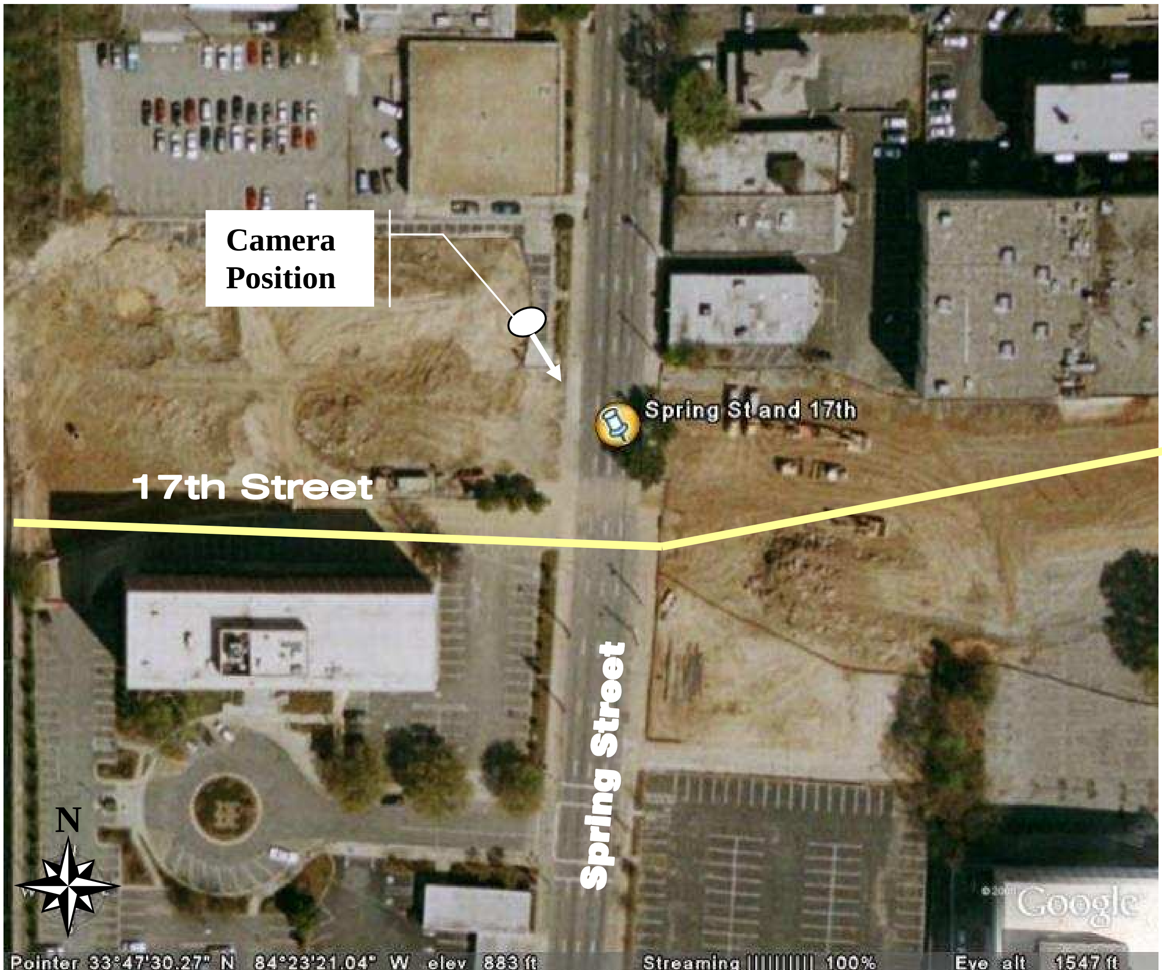


Figure C.8 Aerial Photograph Spring Street and 17th Street Intersection

Figure C.9 Aerial Photograph West Peachtree Street and 11th Street Intersection

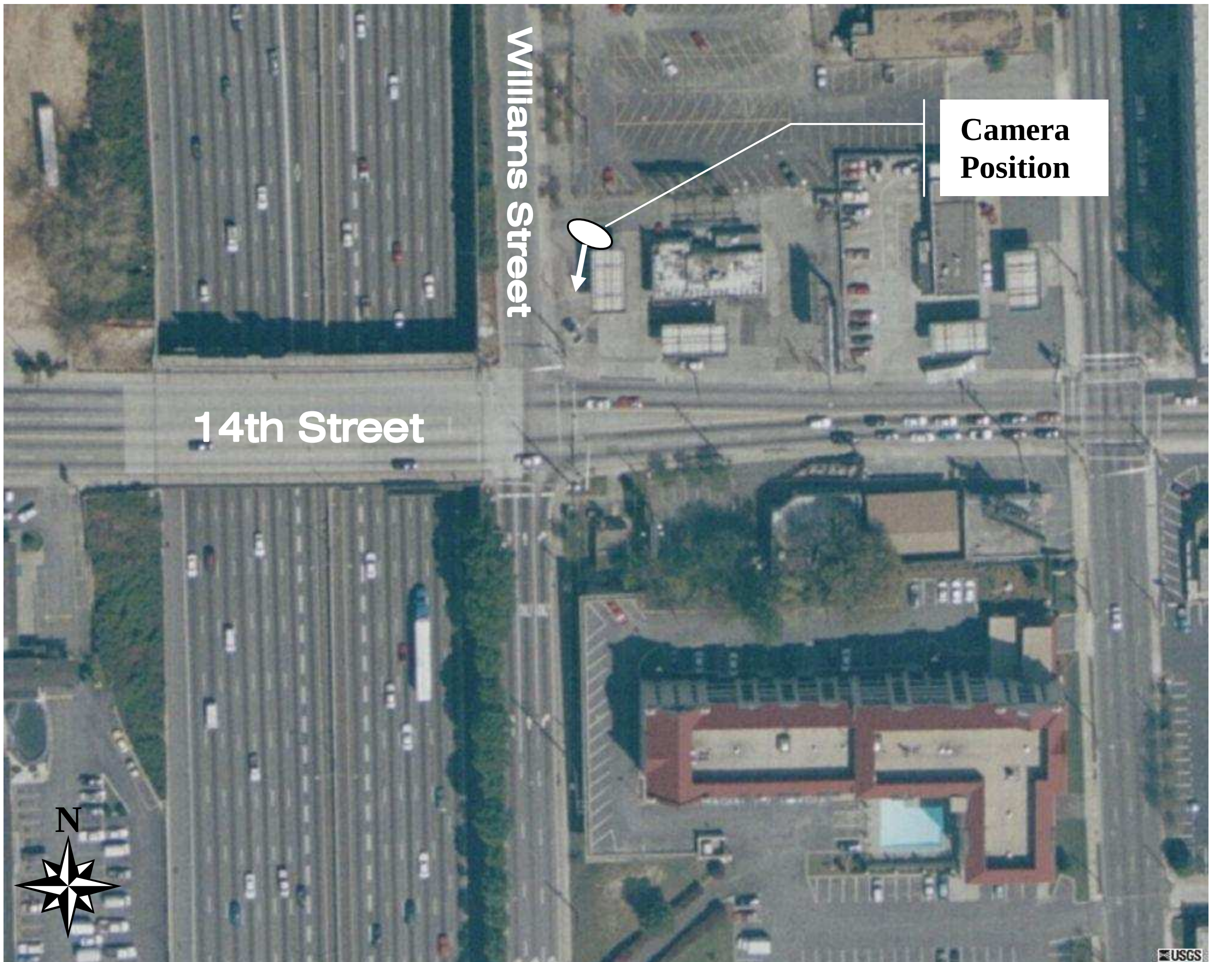


Figure C.10 Aerial Photograph 14th Street and Williams Street Intersection

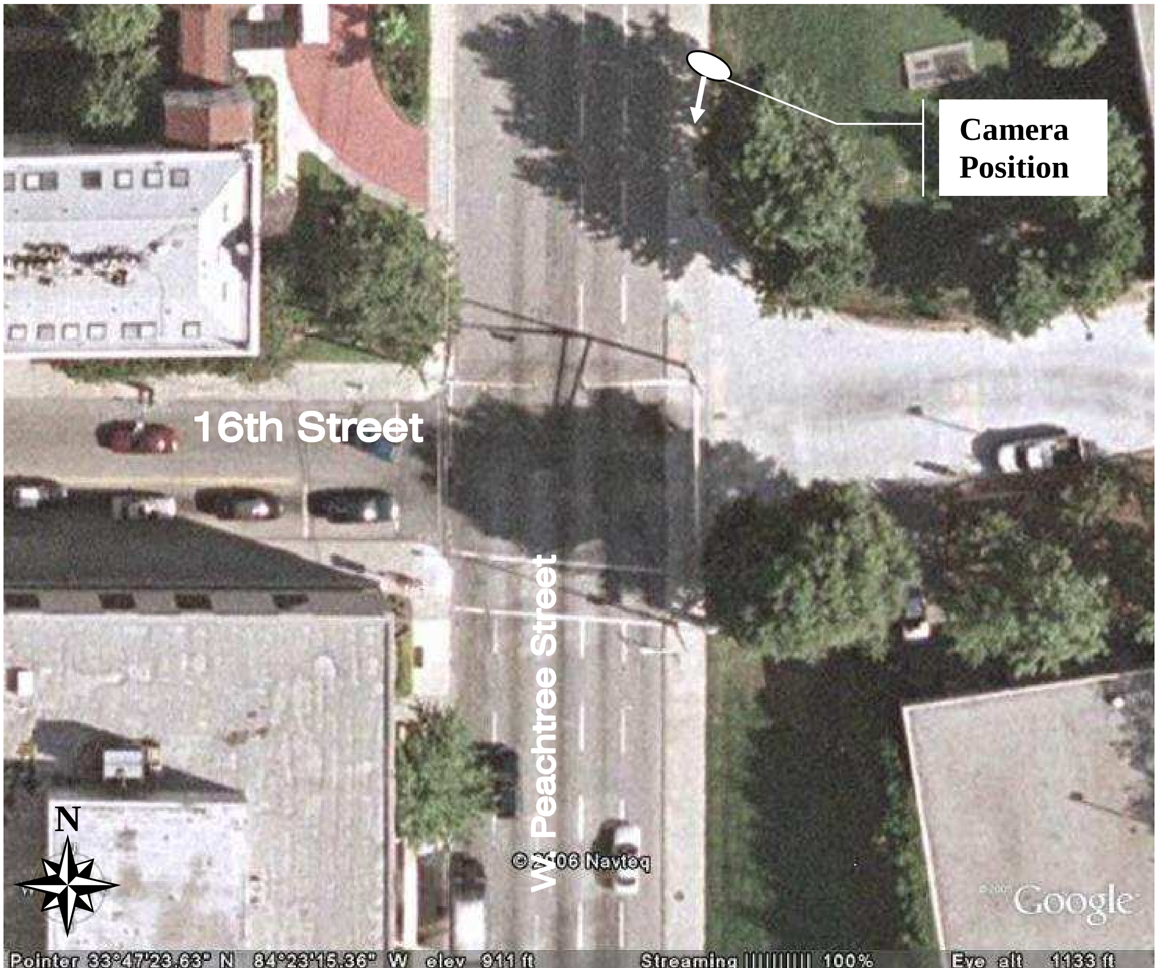


Figure C.11 Aerial Photograph West Peachtree Street and 16th Street Intersection

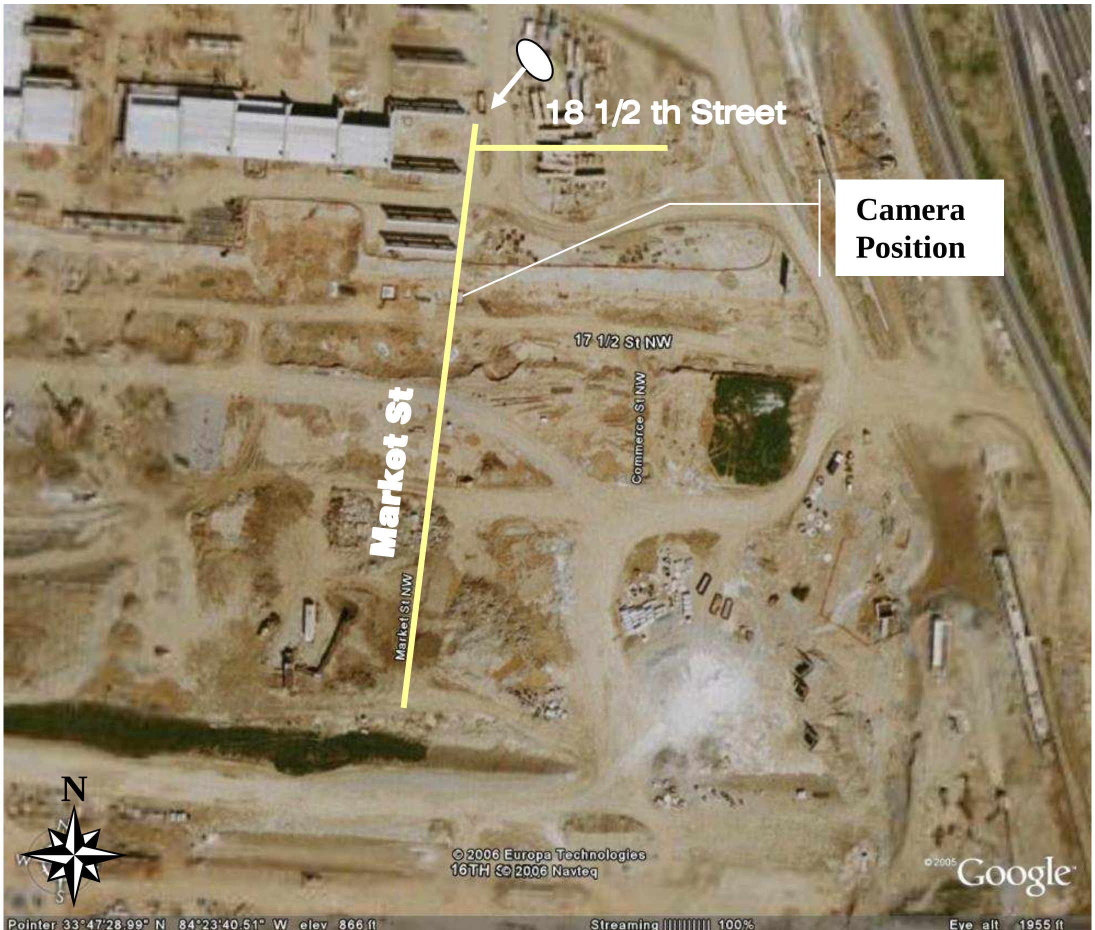


Figure C.12 Aerial Photograph Market Street and 18th ½ Street Intersection

Figure C.13 Aerial Photograph Piedmont Avenue and The Prado Intersection

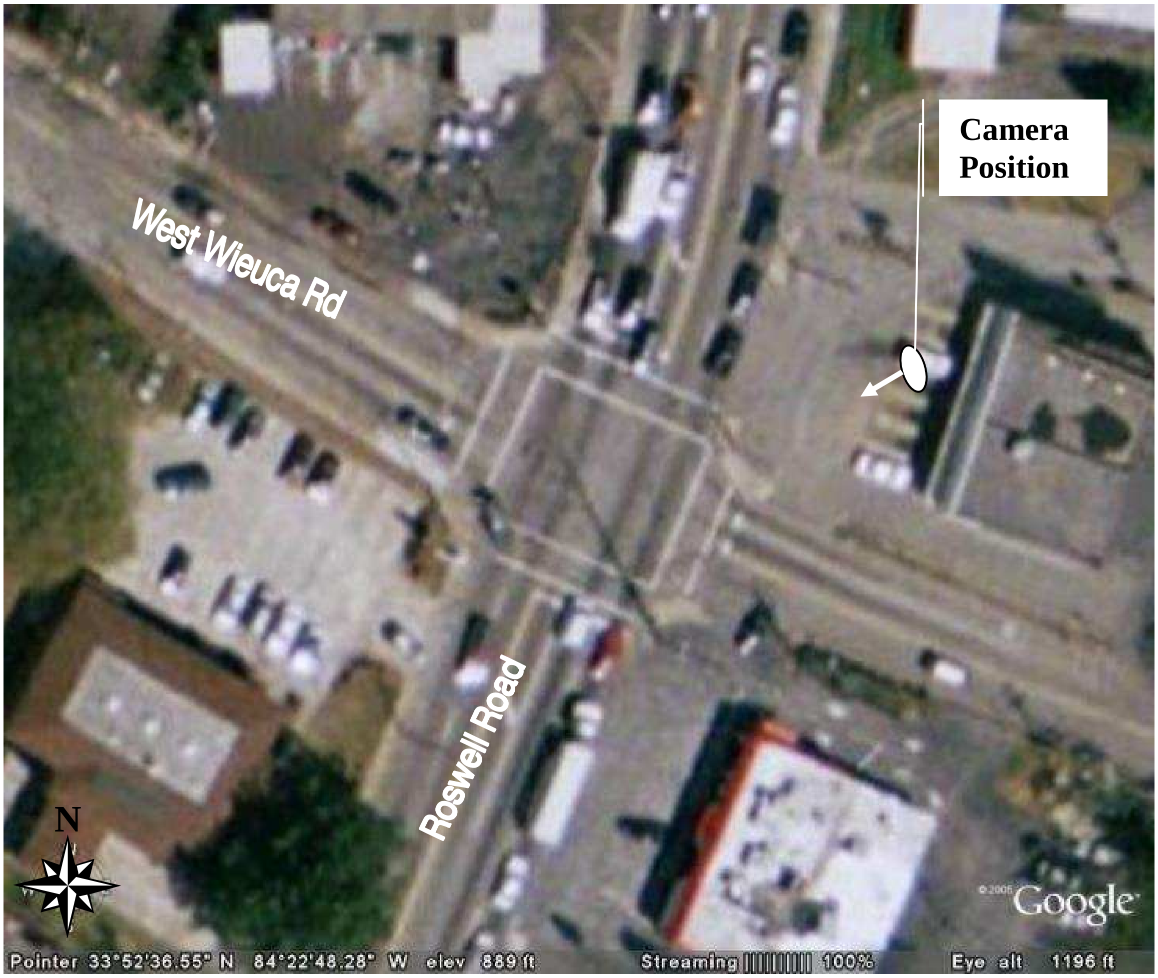


Figure C.14 Aerial Photograph Roswell Road and West Wieuca Road Intersection

Figure C.15 Aerial Photograph Lindbergh Drive and Parkdale Place Intersection

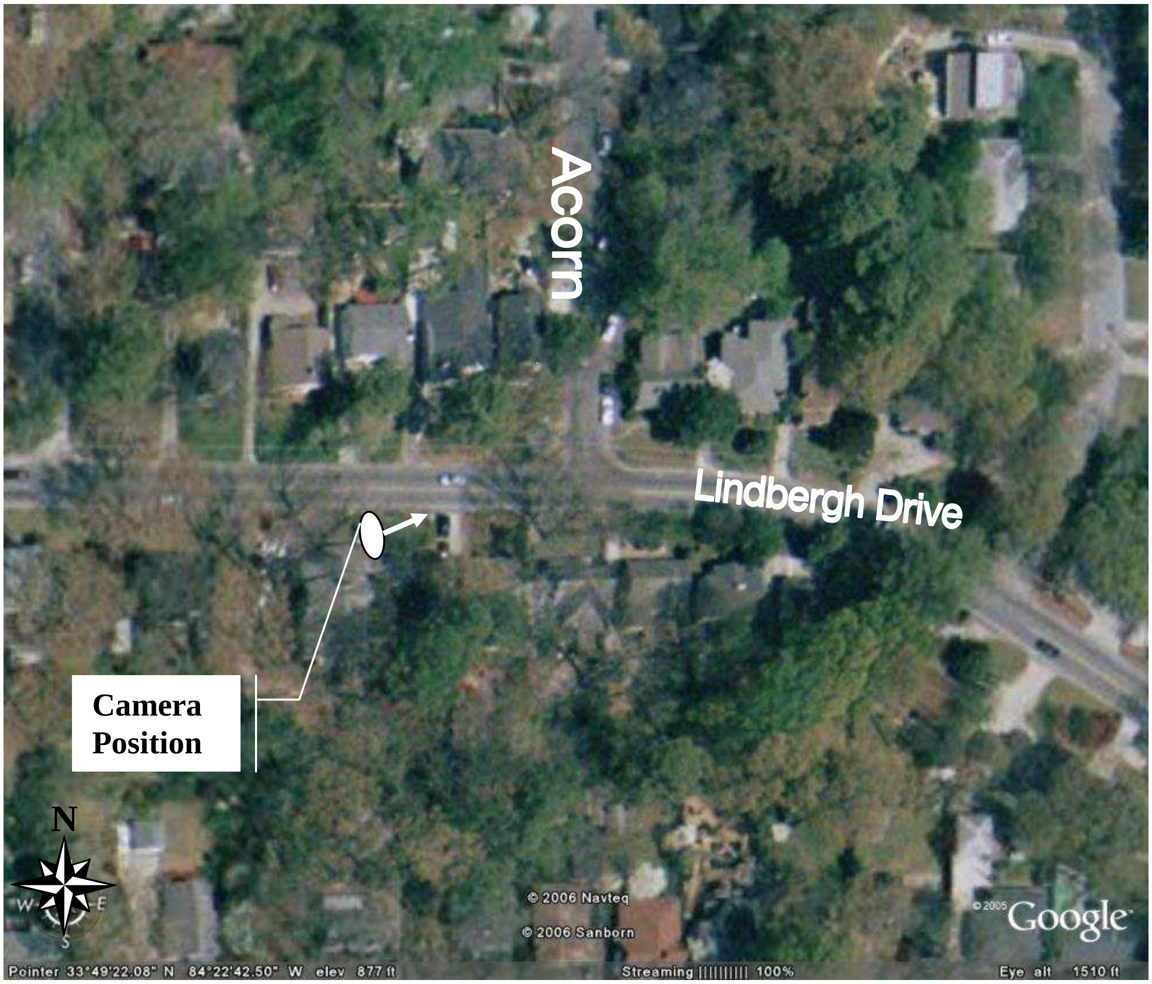


Figure C.16 Aerial Photograph Lindbergh Drive and Acorn Avenue Intersection

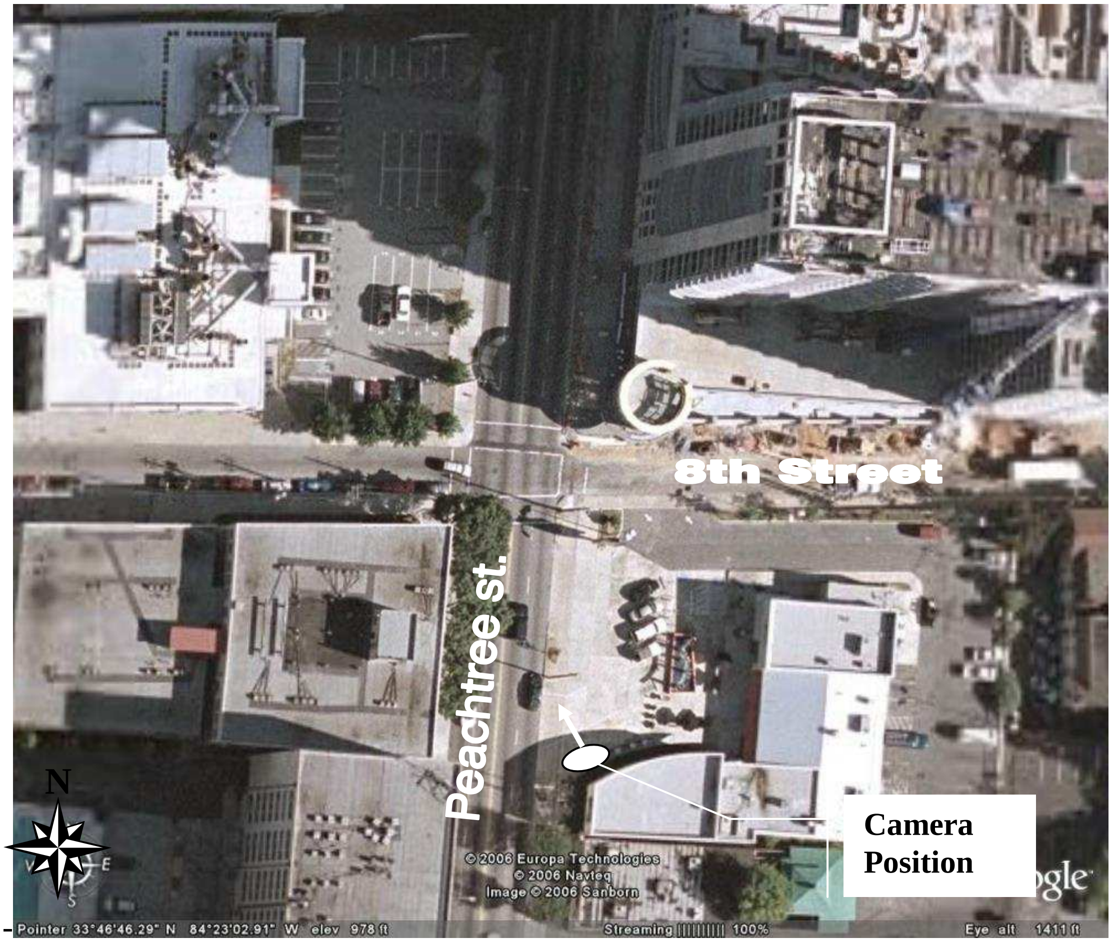


Figure C.17 Aerial Photograph Peachtree Street and 8th Street Intersection

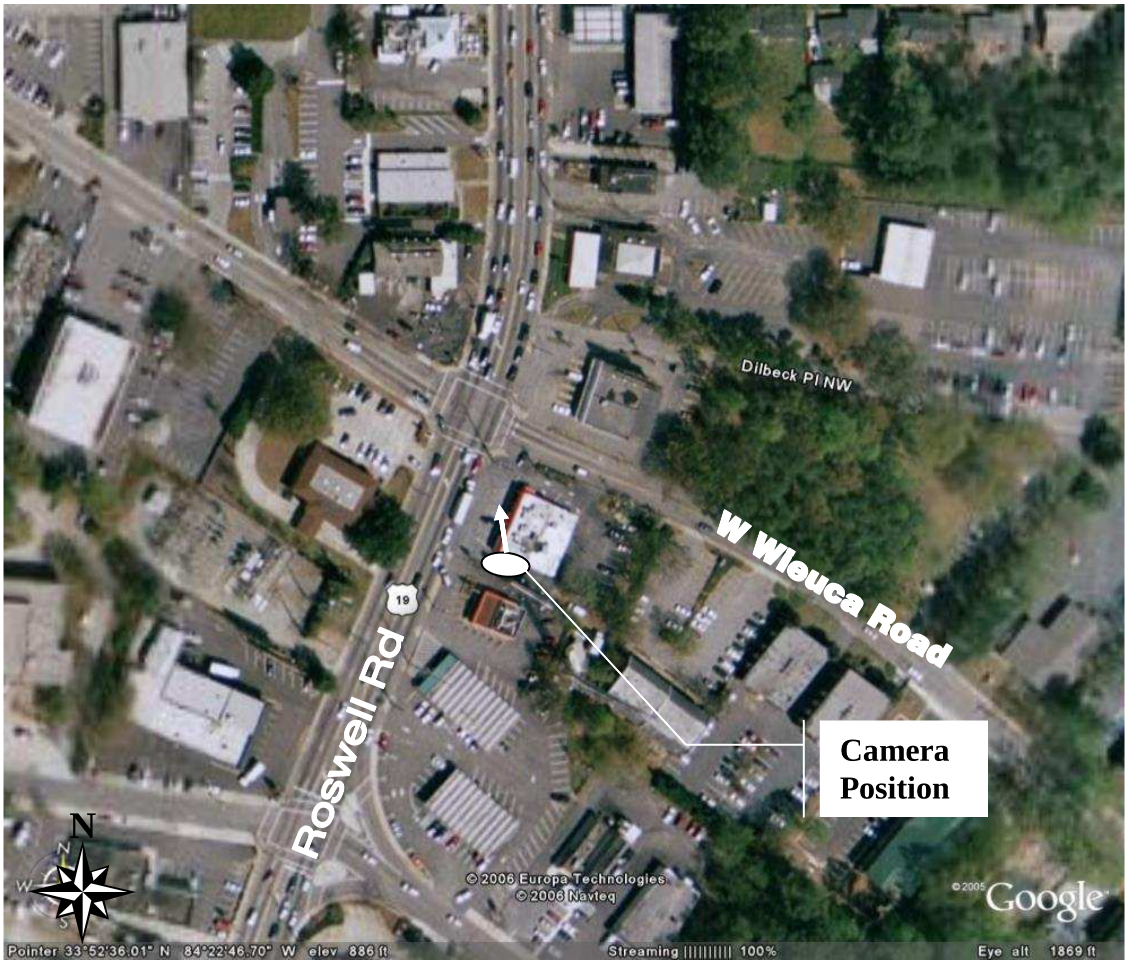


Figure C.18 Aerial Photograph Roswell Road and West Wieuca Road Intersection

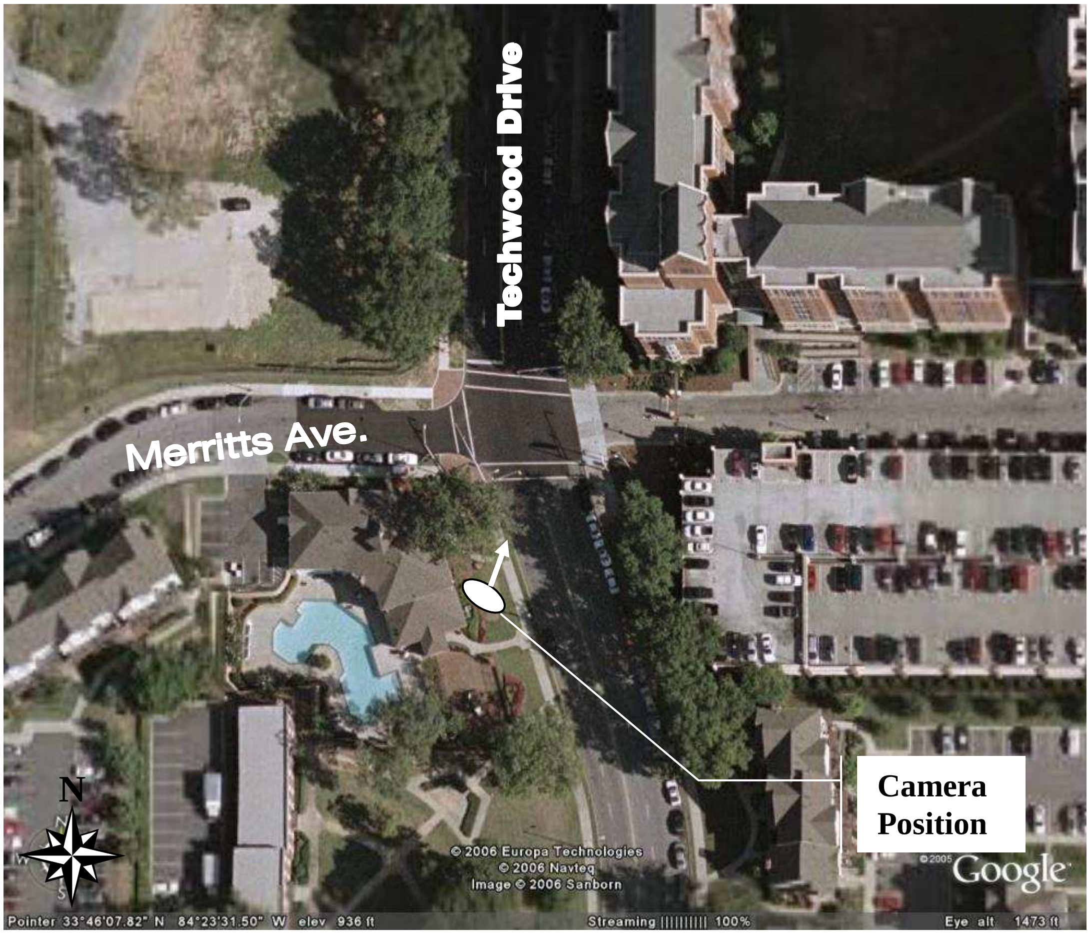


Figure C.19 Aerial Photograph Techwood Drive and Merritts Avenue Intersection

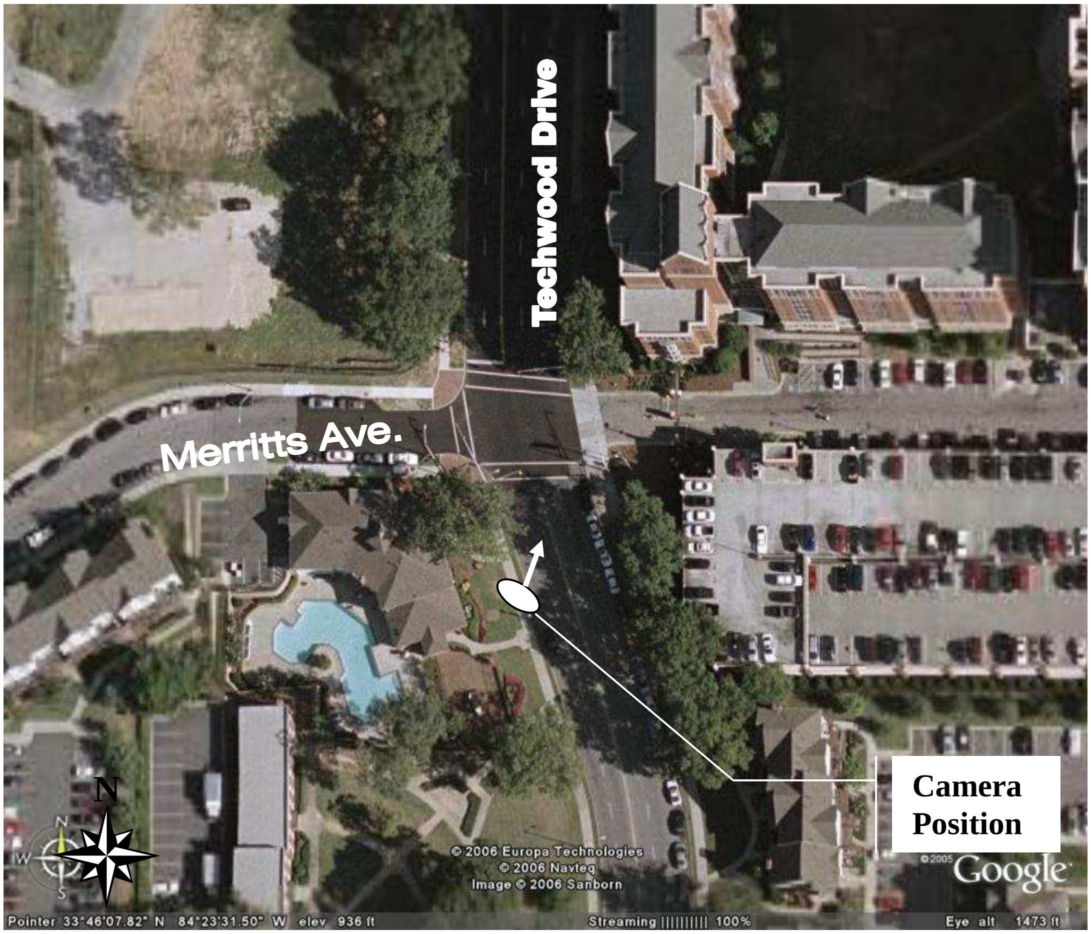


Figure C.20 Aerial Photograph Techwood Drive and Merritts Avenue Intersection

Figure C.21 Aerial Photograph 17th Street and Market Street Intersection

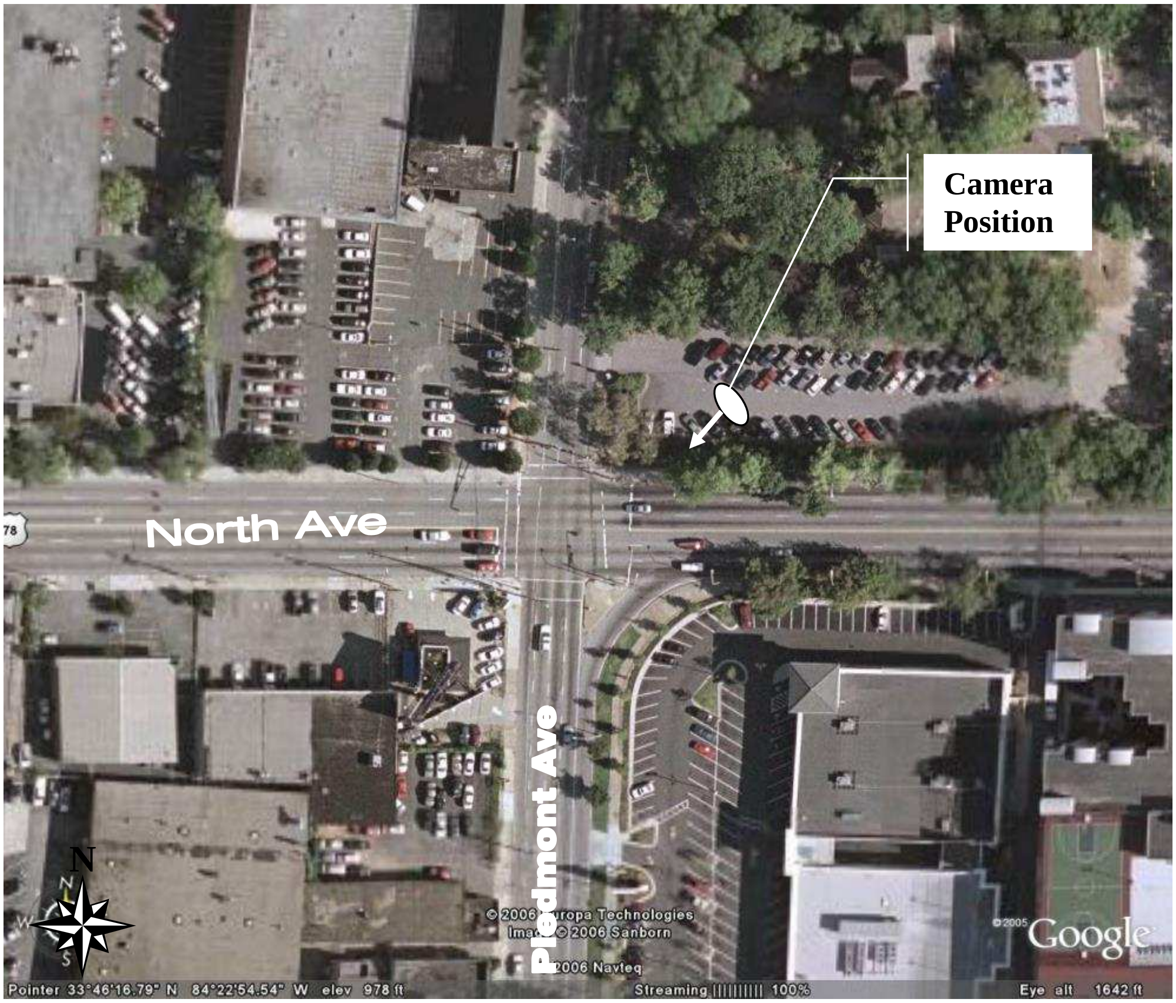


Figure C.22 Aerial Photograph Piedmont Avenue and North Avenue Intersection

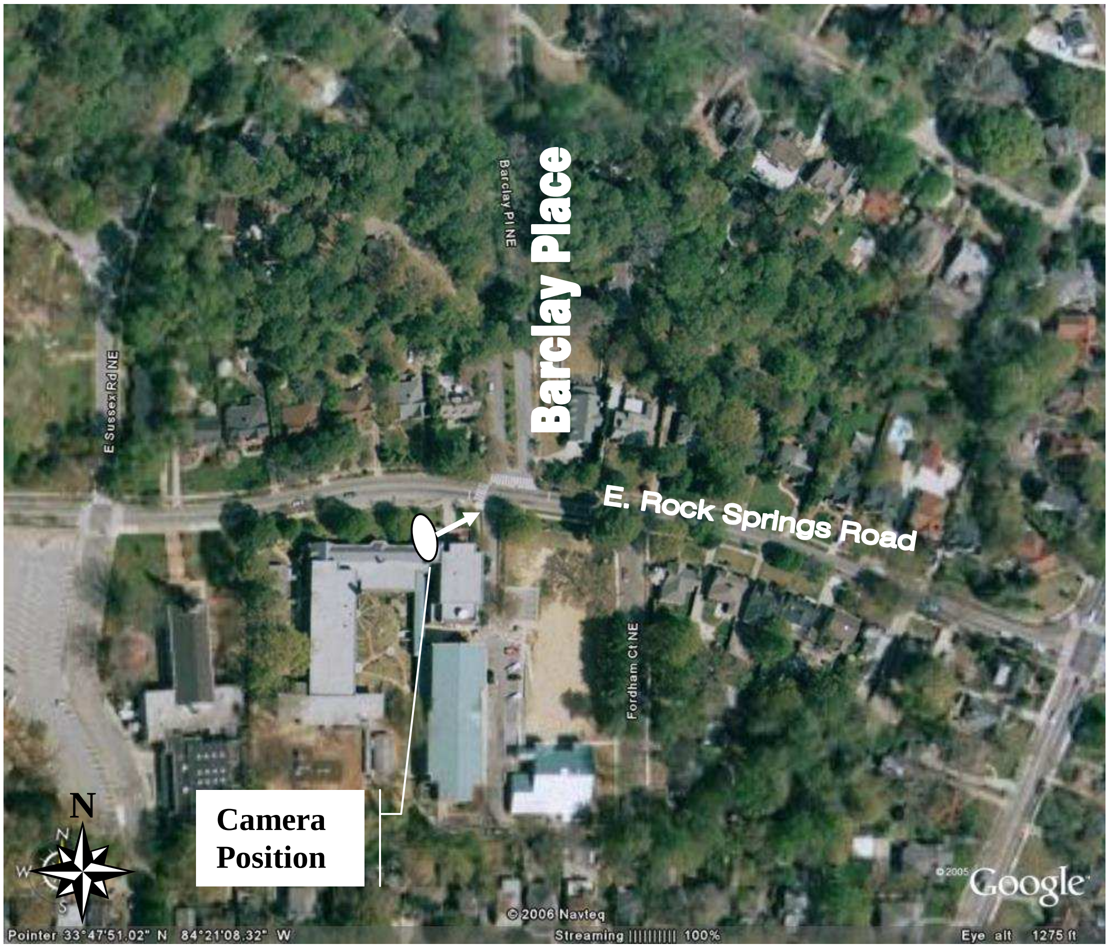


Figure C.23 Aerial Photograph East Rock Springs Road and Barclay Place Intersection

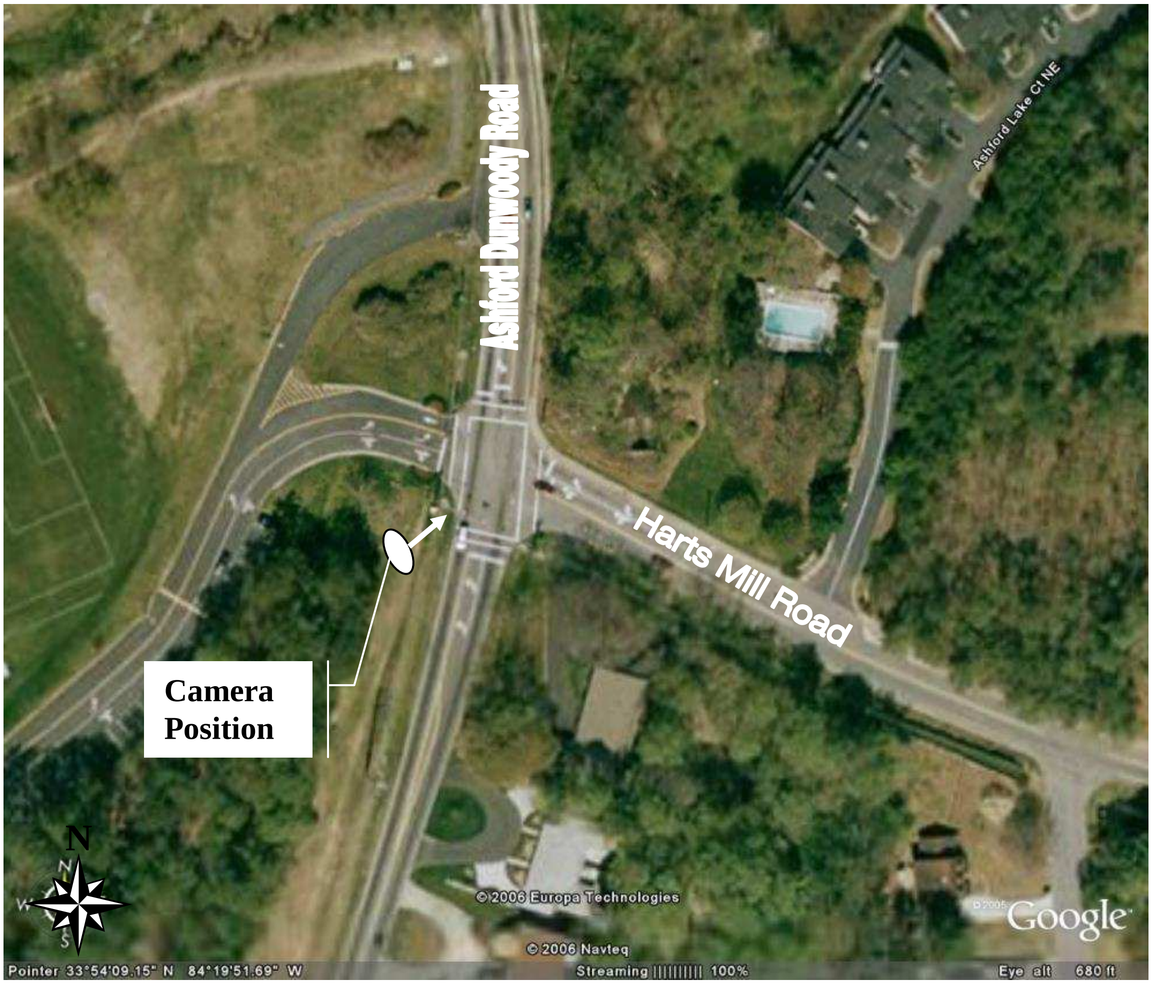


Figure C.24 Aerial Photograph Ashford Dunwoody Road and Harts Mill Road Intersection

Figure C.25 Aerial Photograph Spring Street and 8th Street Intersection

Figure C.26 Aerial Photograph 10th Street and Hemphill Avenue Intersection

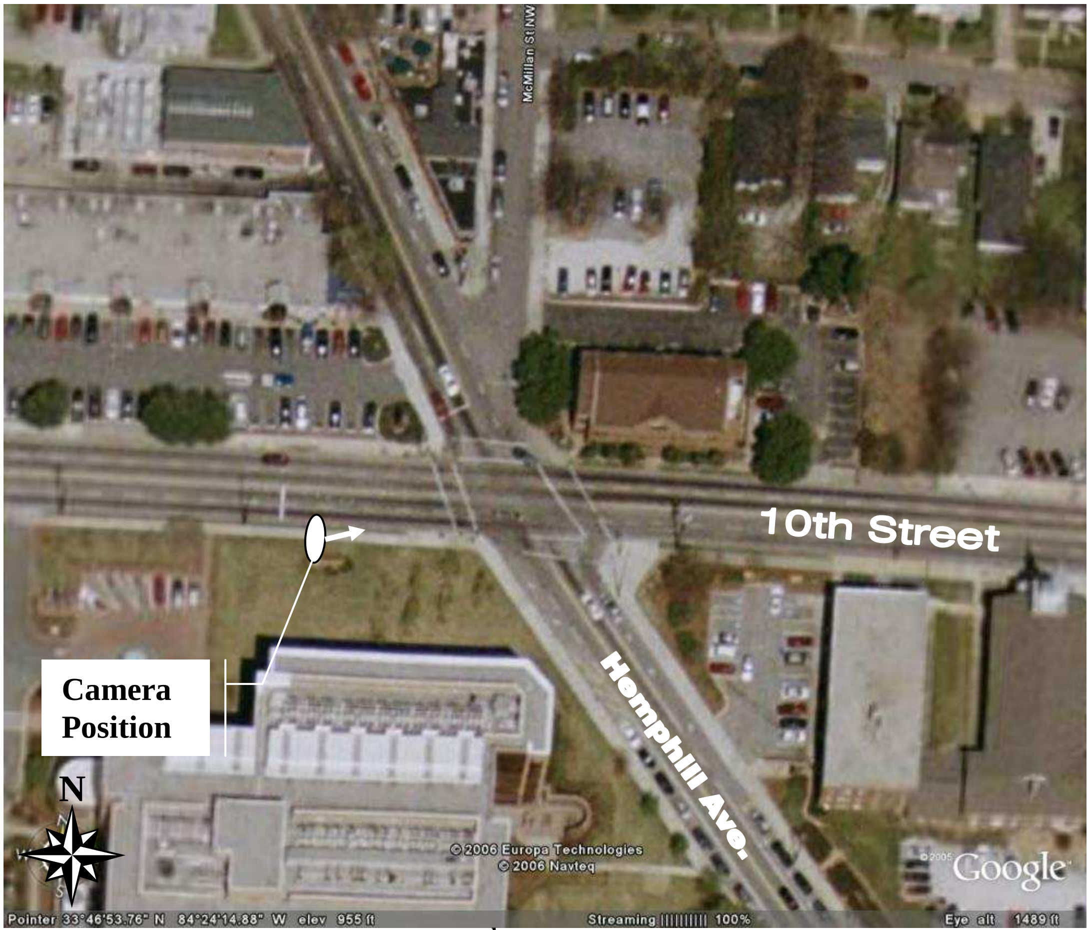


Figure C.27 Aerial Photograph 10th Street and Hemphill Avenue Intersection

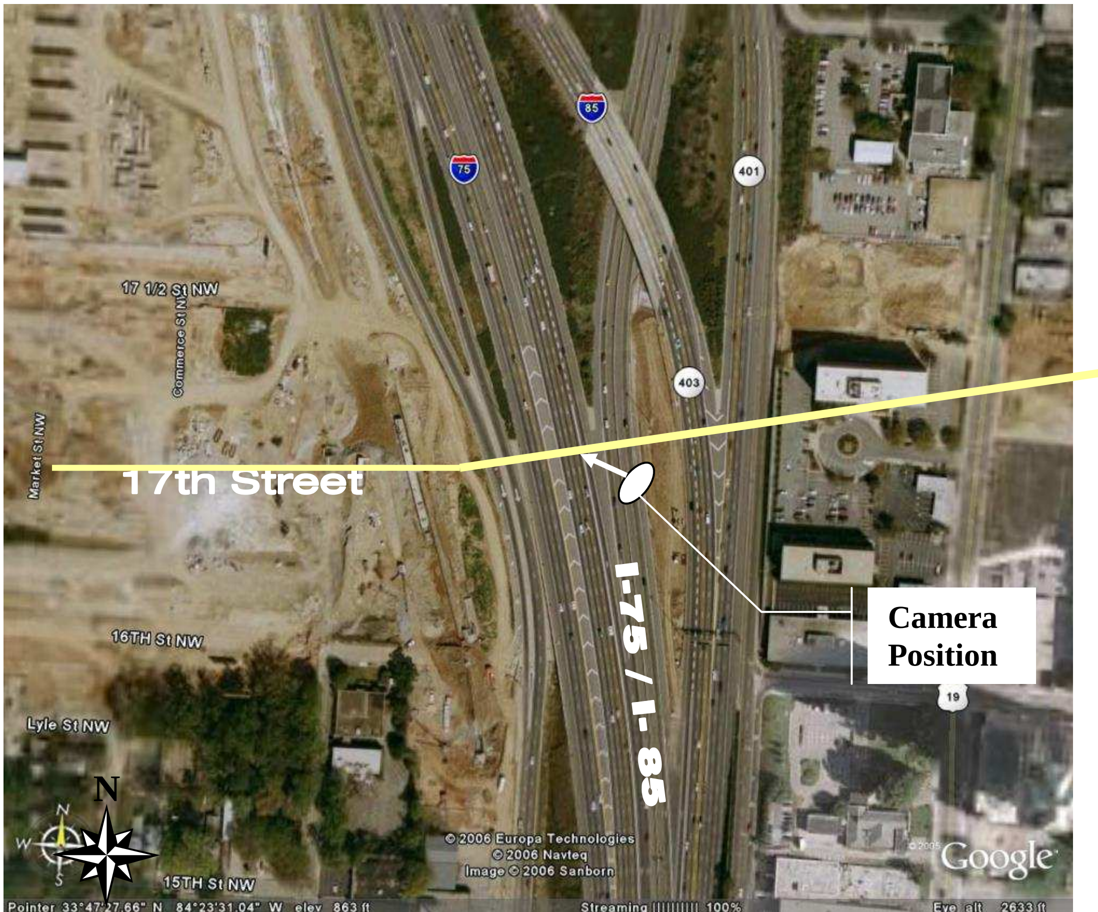


Figure C.28 Aerial Photograph 17th Street and I-75/I-85 Southbound Off Ramp Intersection

Figure C.29 Aerial Photograph Market Street and 18th ½ Street Intersection

Figure C.30 Aerial Photograph Paces Ferry Road and Paces Mill Drive Intersection

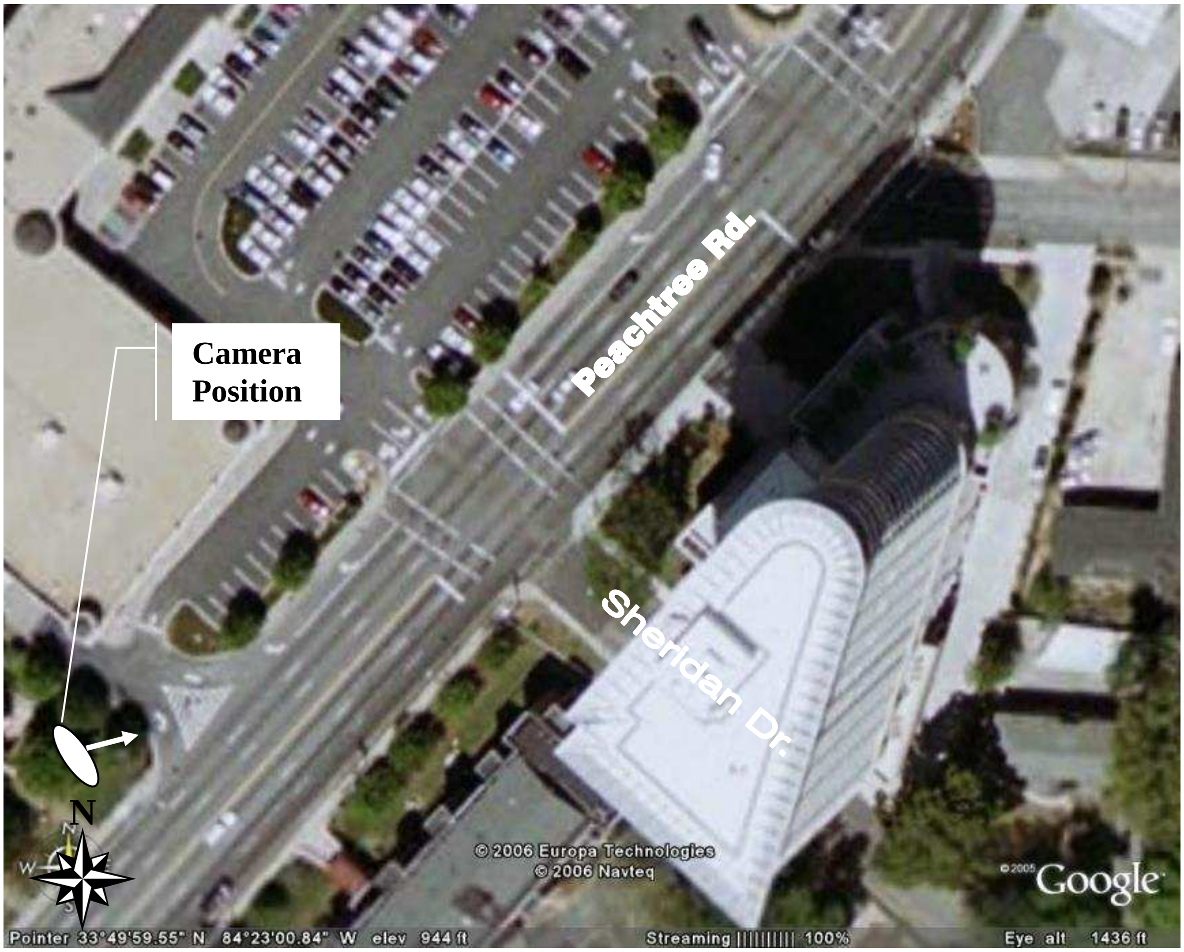


Figure C.31 Aerial Photograph Peachtree Road and Sheridan Drive Intersection

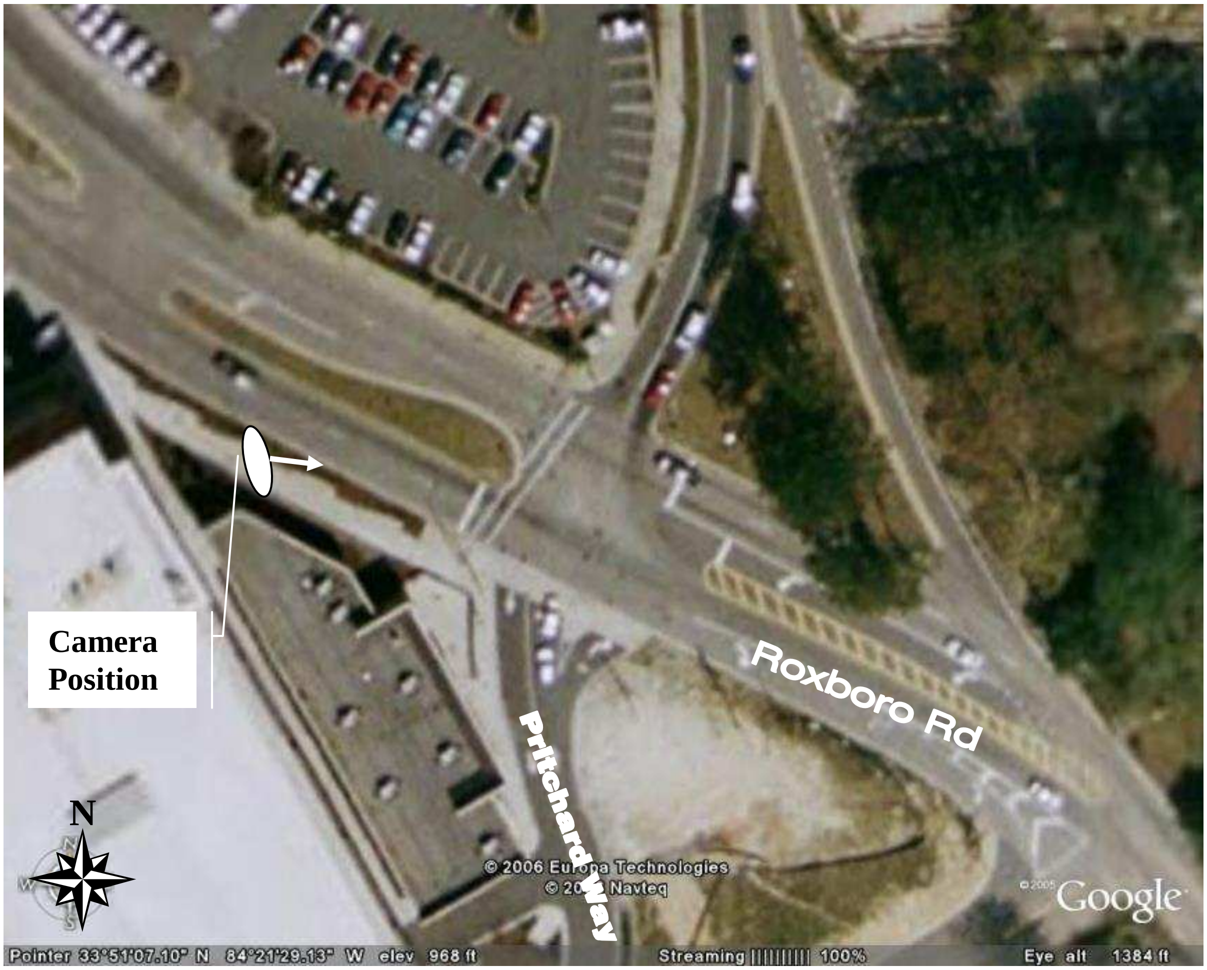


Figure C.32 Aerial Photograph Roxboro Road and Pritchard Drive Intersection
NOTE: Current intersection configuration is different than aerial photo

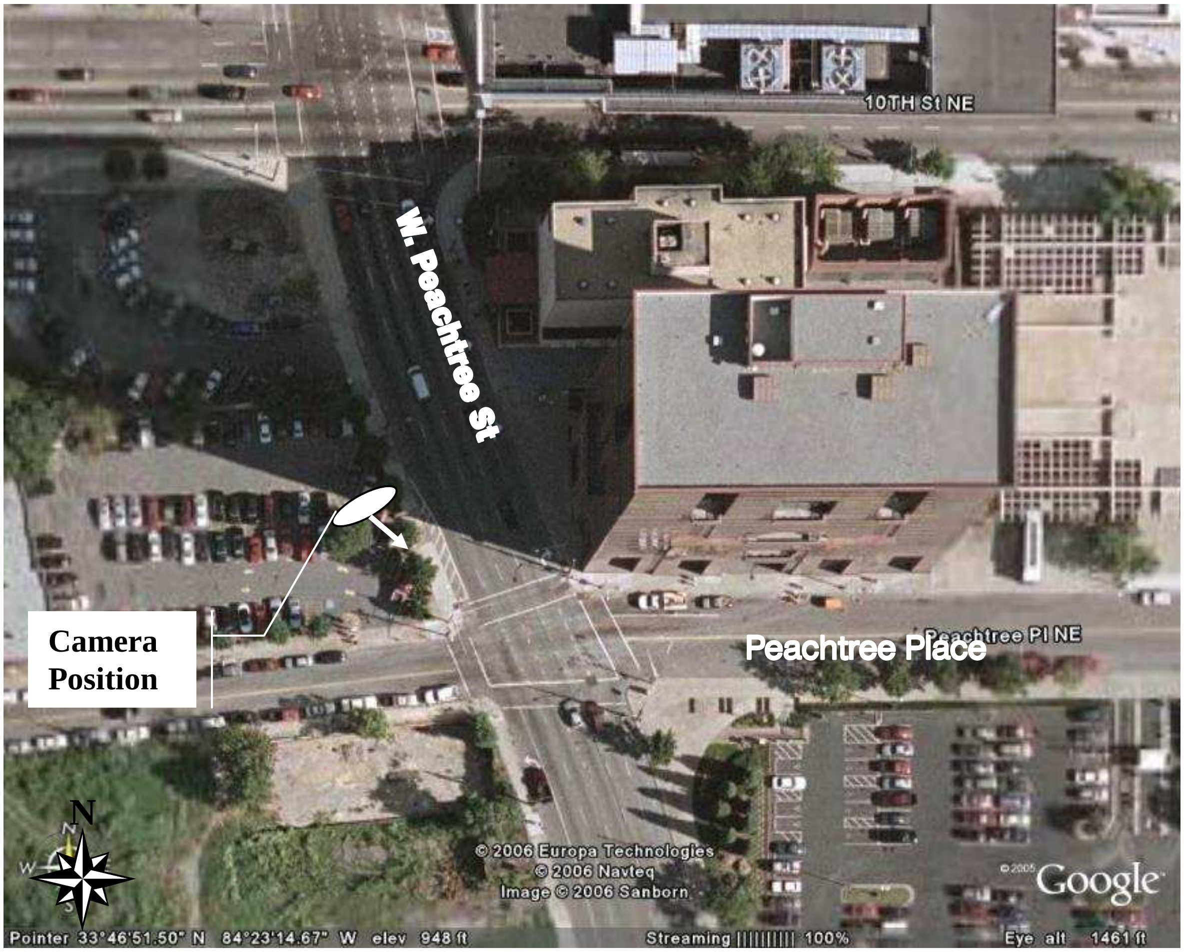


Figure C.33 Aerial Photograph West Peachtree Street and Peachtree Place Intersection
Note: Lane configuration different than in photo

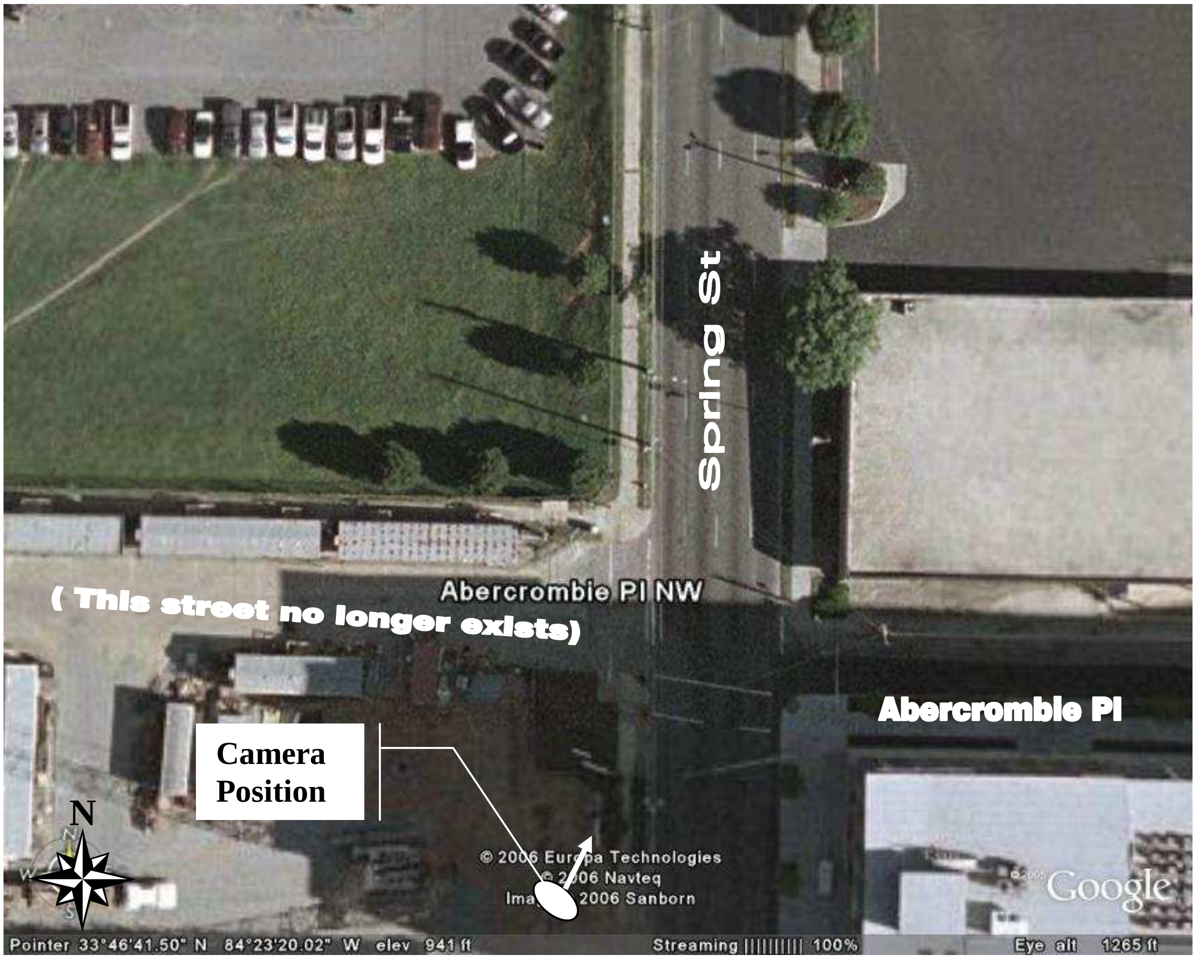


Figure C.34 Aerial Photograph Spring Street and Abercrombie Place Intersection

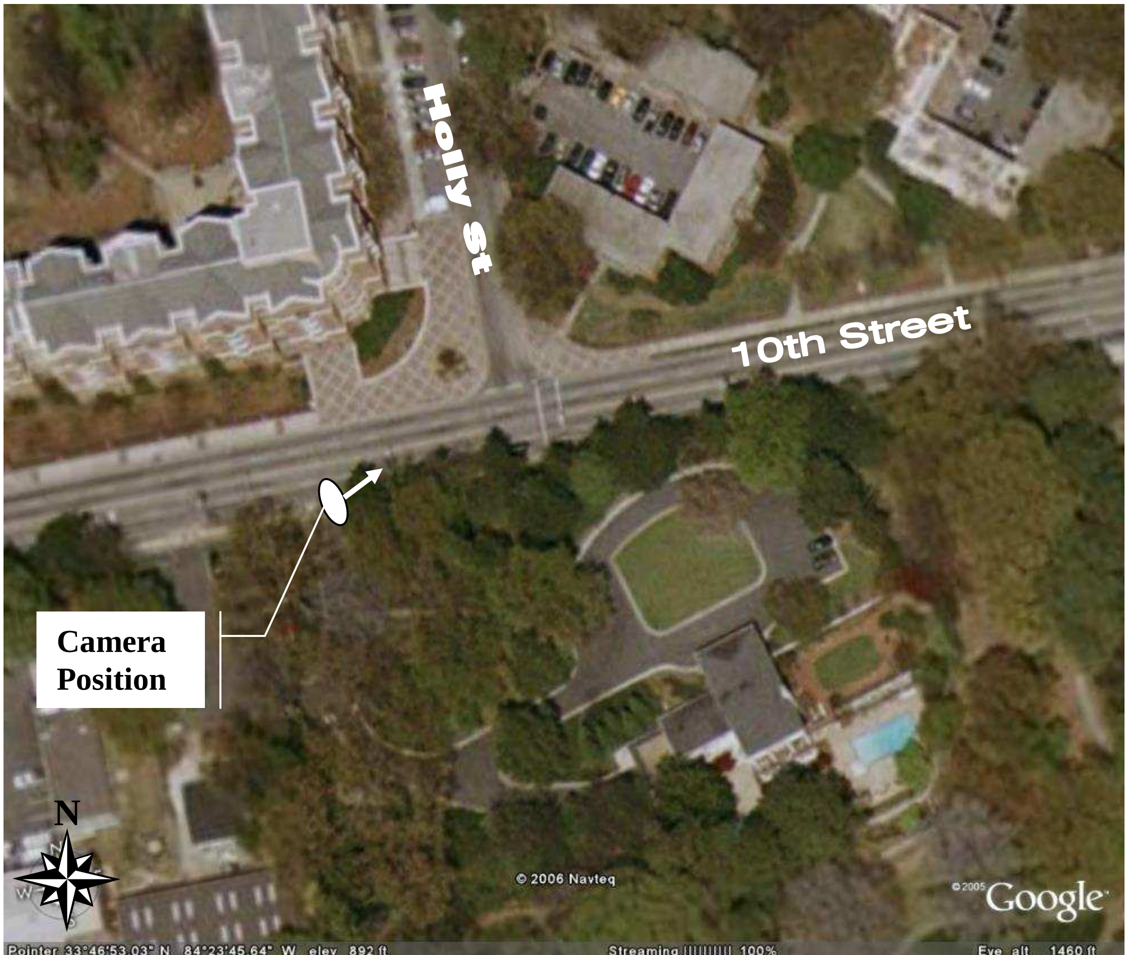


Figure C.35 Aerial Photograph 10th Street and Holly Street Intersection

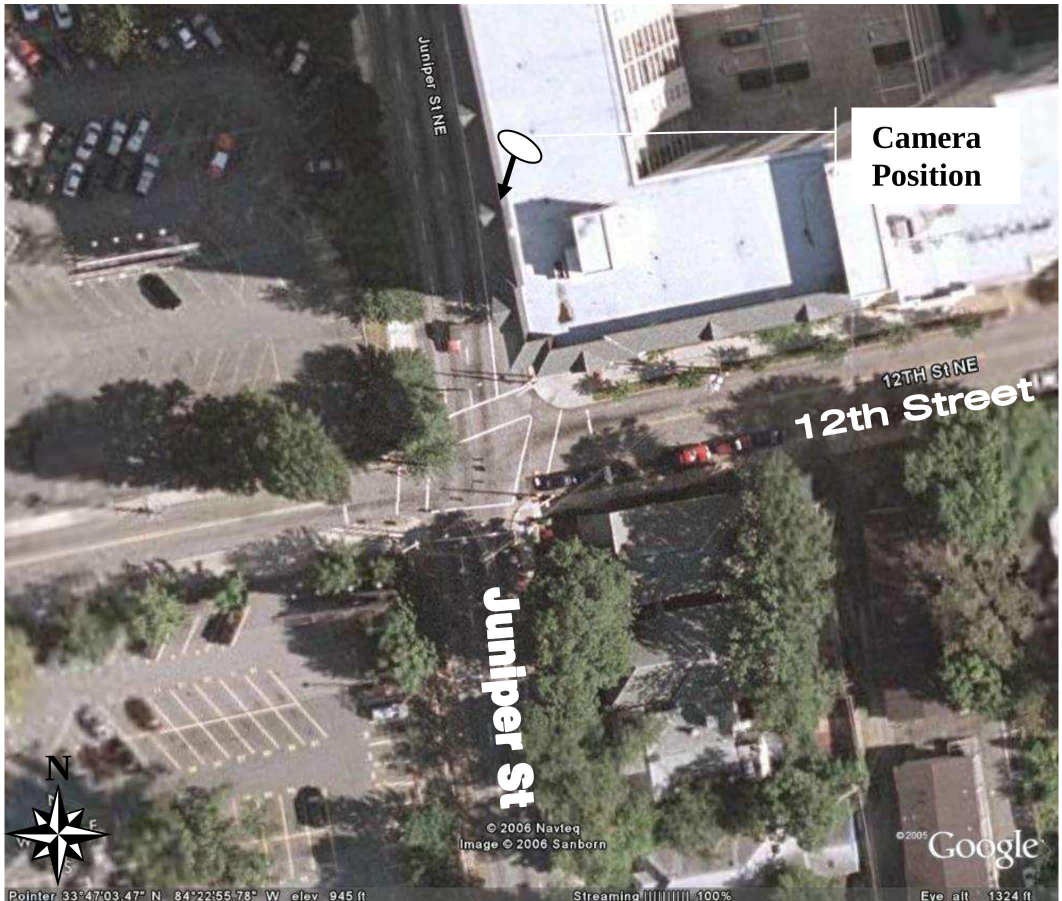


Figure C.36 Aerial Photograph Juniper Street and 12th Street Intersection
Note: At time of filming, building where camera is positioned had been torn down.

Figure C.37 Aerial Photograph Charles Allen Drive and 8th Street Intersection

Figure C.38 Aerial Photograph Charles Allen Drive and 8th Street Intersection

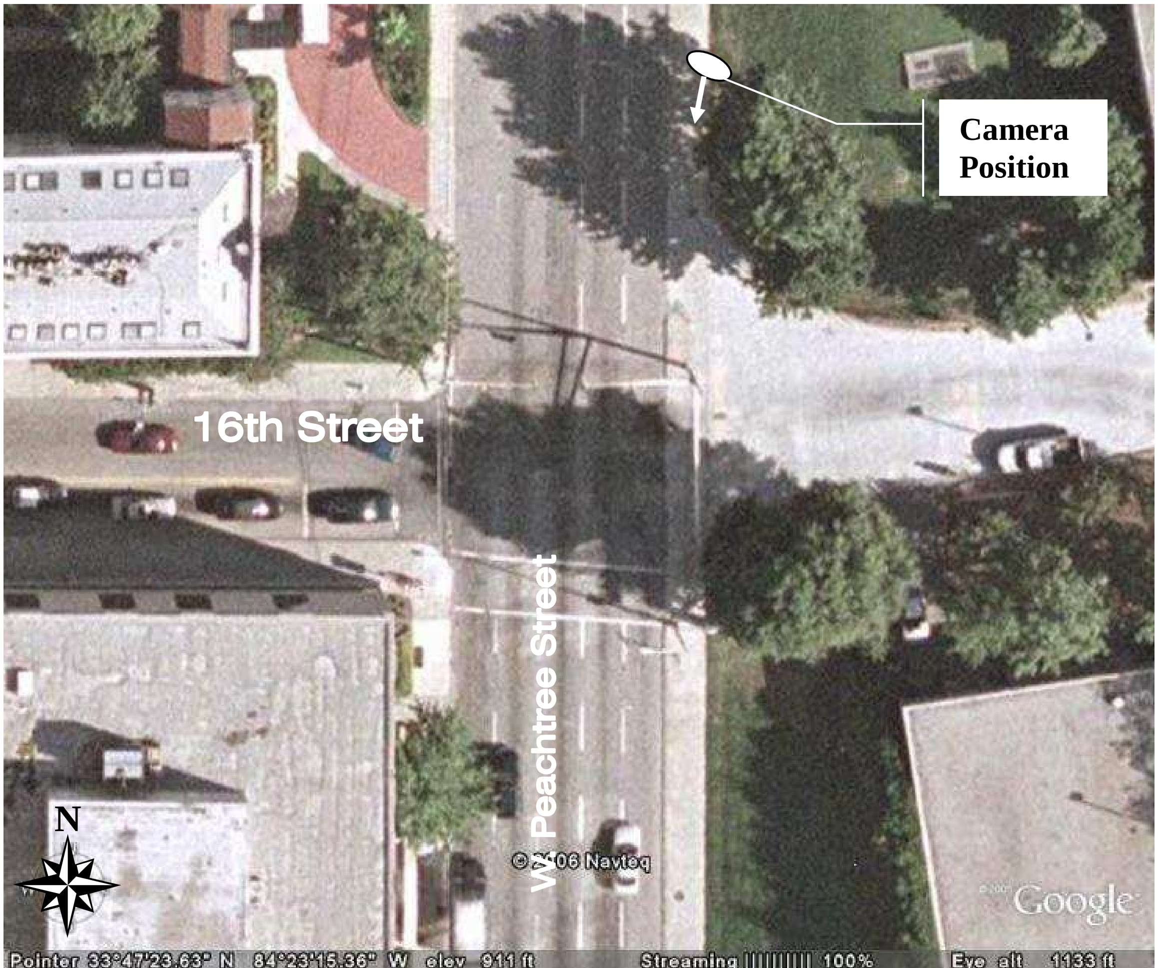


Figure C.39 Aerial Photograph West Peachtree Street and 16th Street Intersection

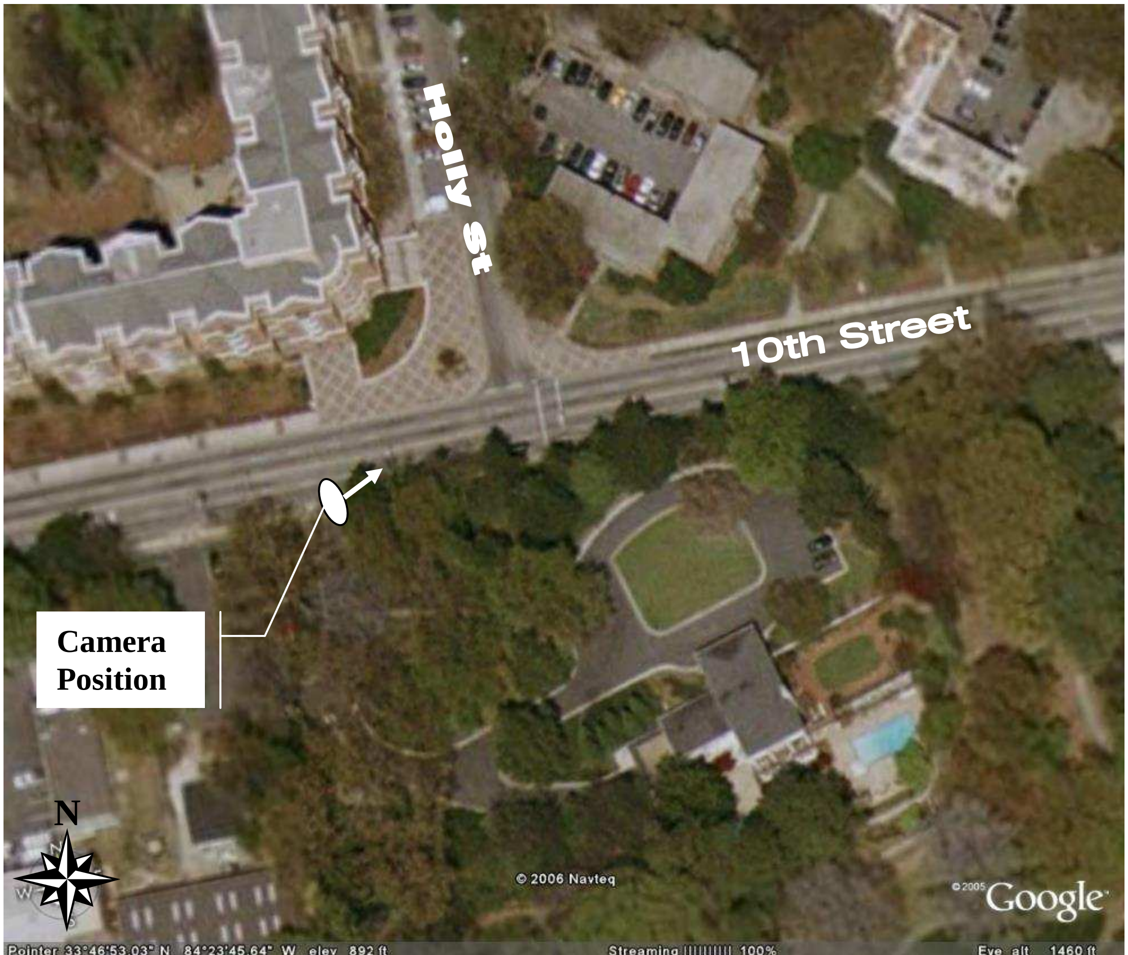


Figure C.40 Aerial Photograph 10th Street and Holly Street Intersection

Figure C.41 10th Street and I-75/85 SB Ramps Intersection

Figure C.42 Aerial Photograph Peachtree Street and Pine Street Intersection

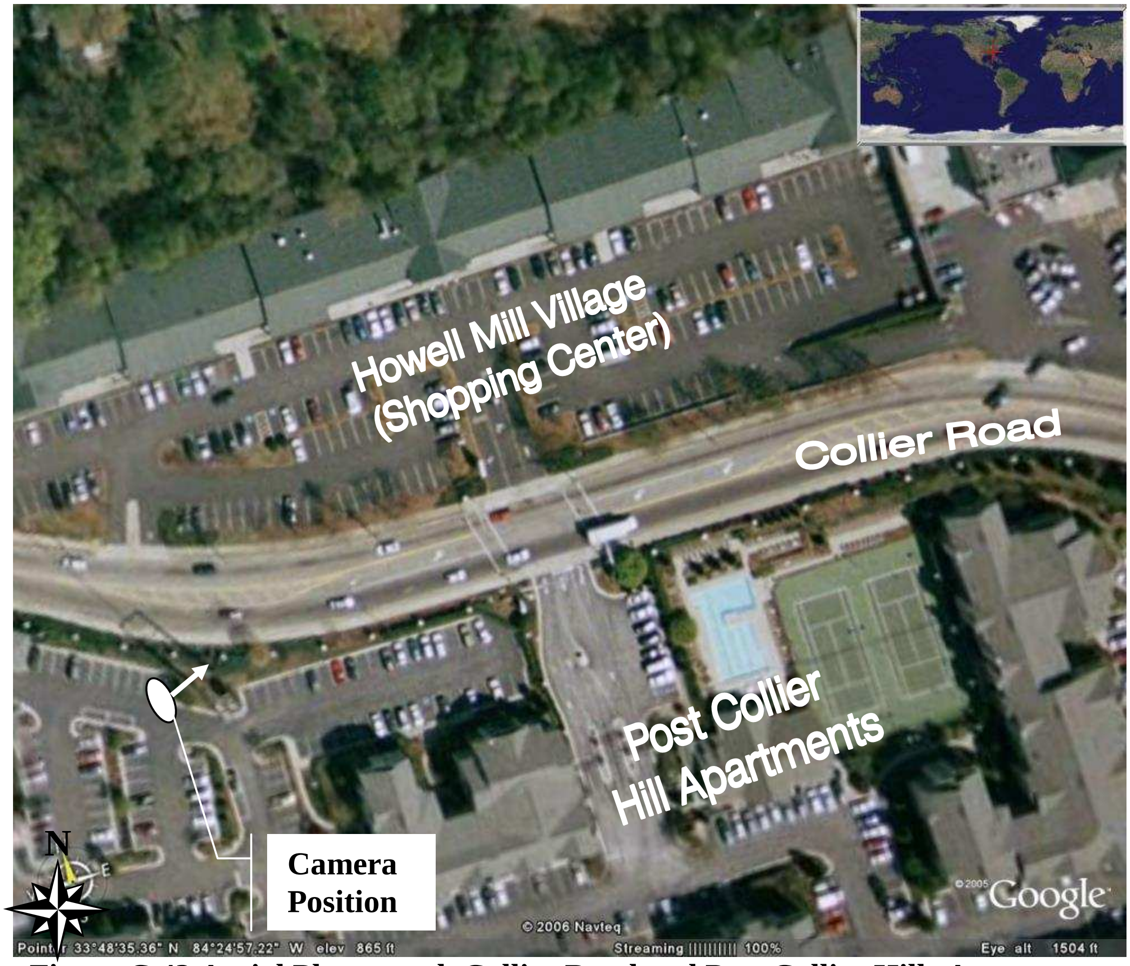


Figure C.43 Aerial Photograph Collier Road and Post Collier Hills Apartments Intersection

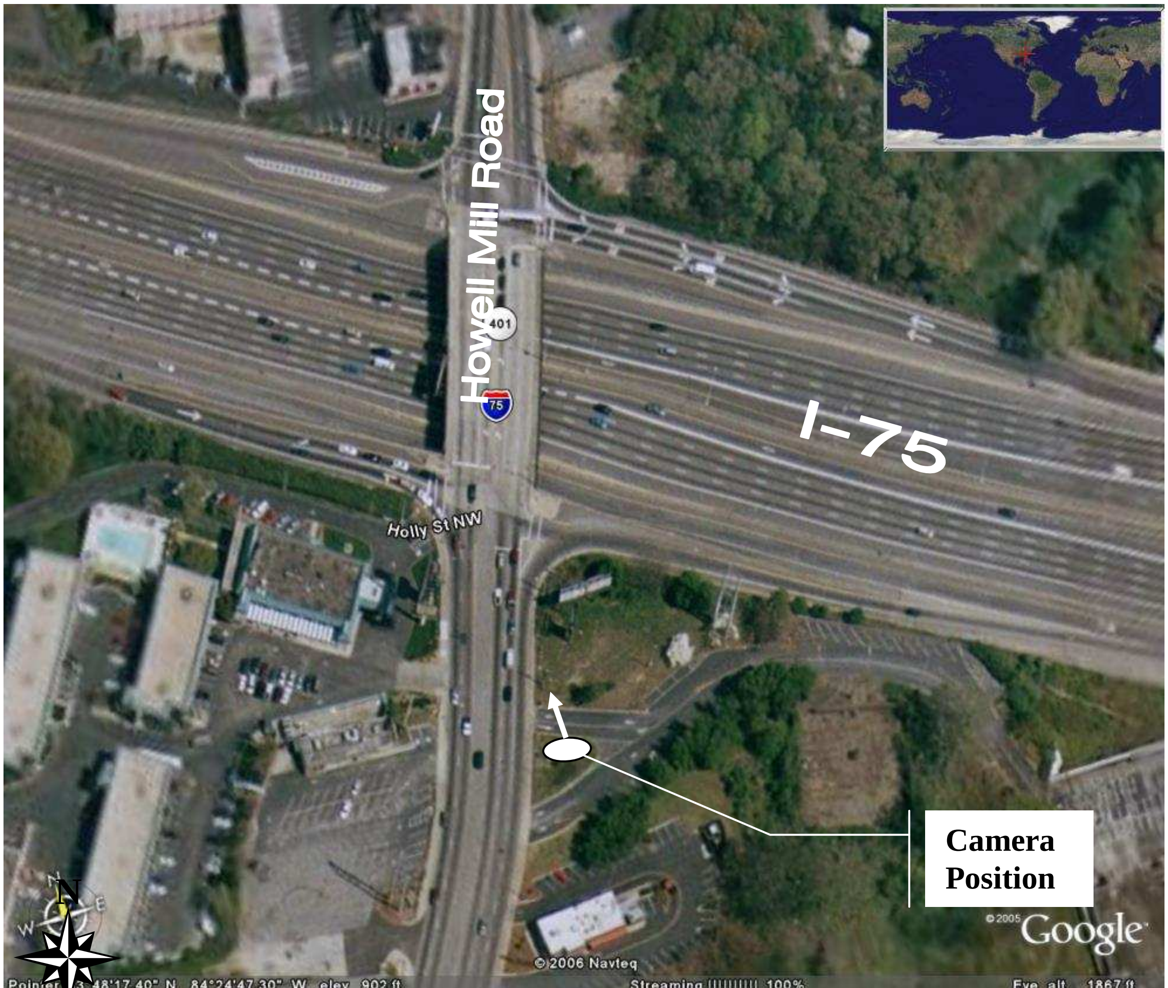


Figure C.44 Aerial Photograph Howell Mill Road and I-75 SB Ramp Intersection

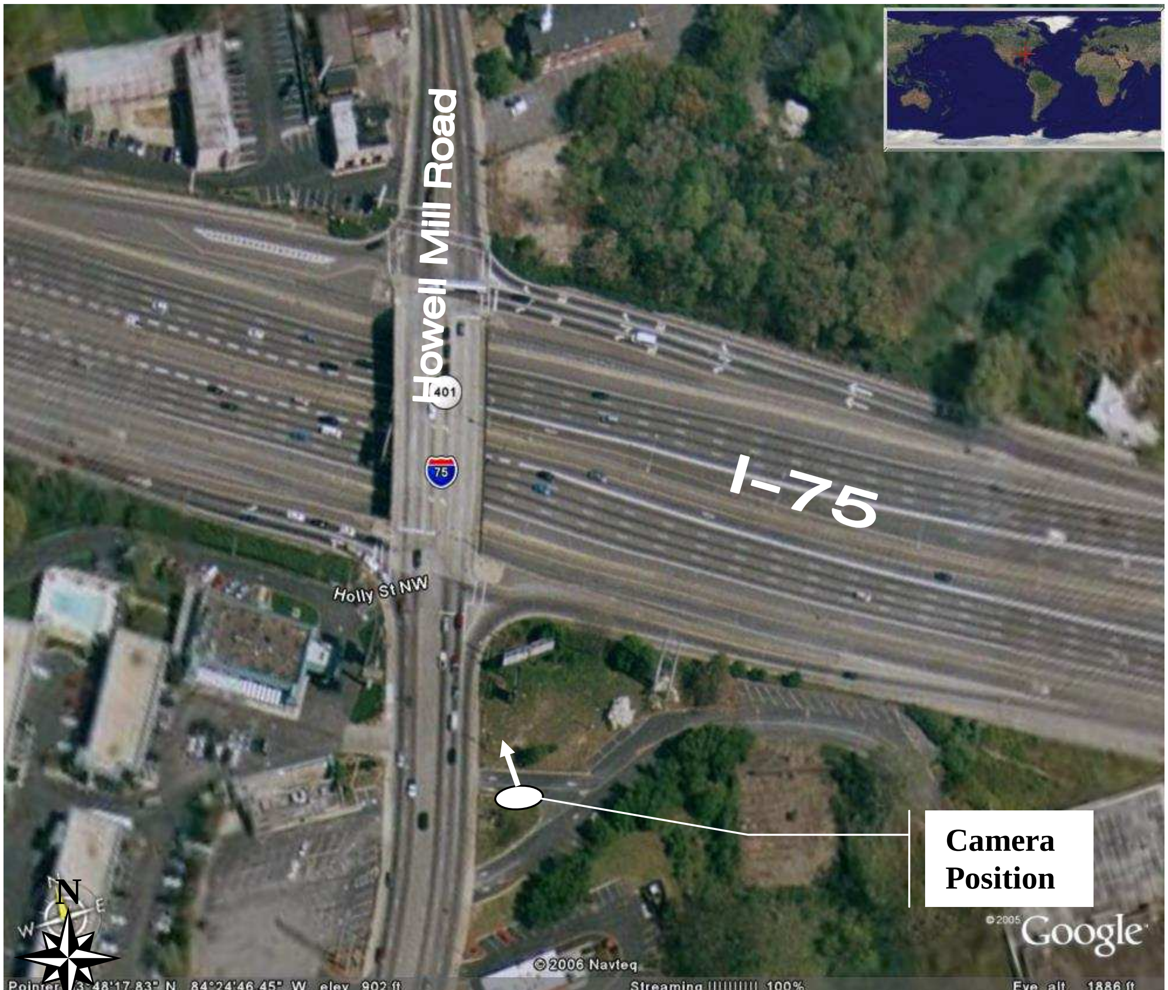


Figure C.45 Aerial Photograph Howell Mill Road and I-75 NB Ramp Intersection

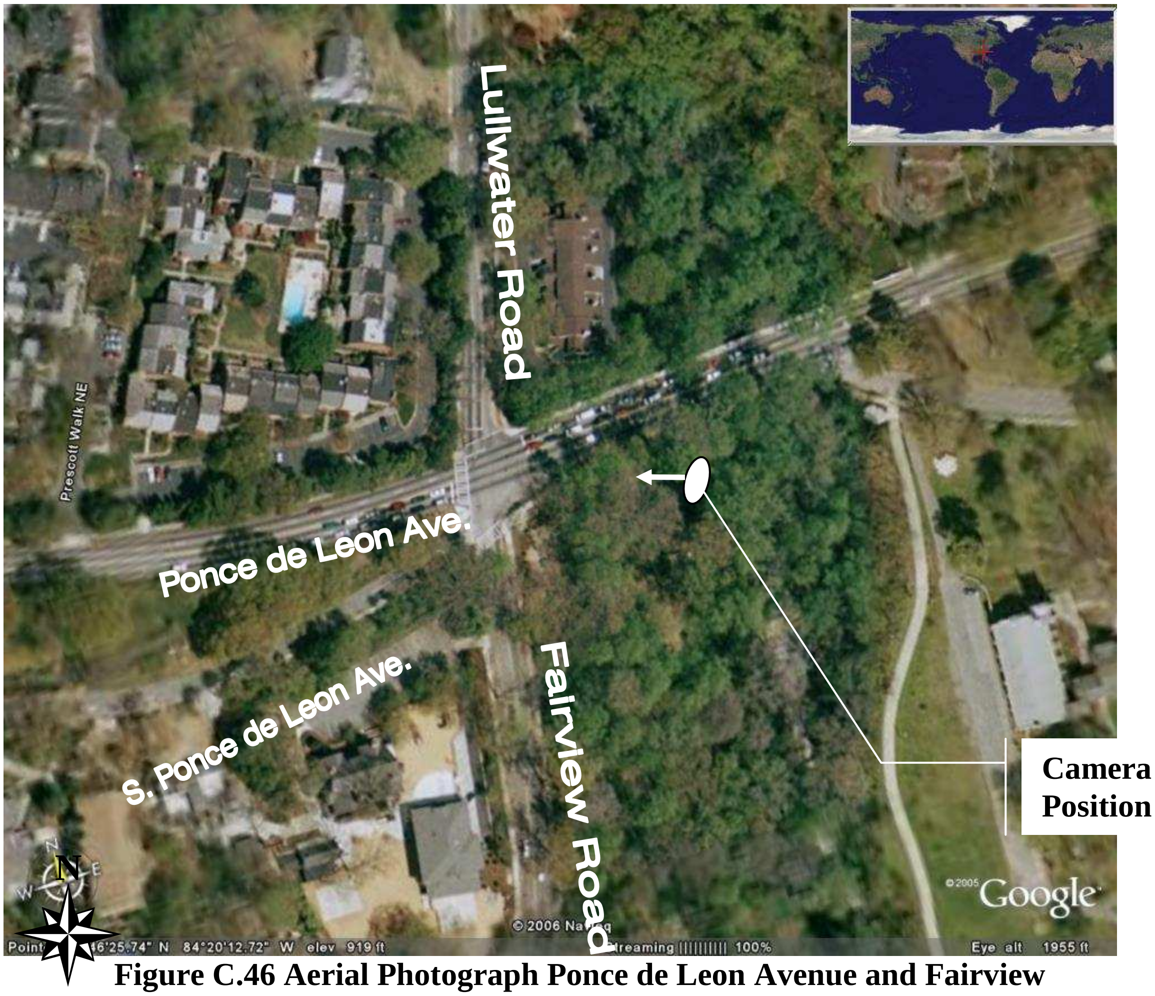


Figure C.46 Aerial Photograph Ponce de Leon Avenue and Fairview Road/Lullwater Road Intersection

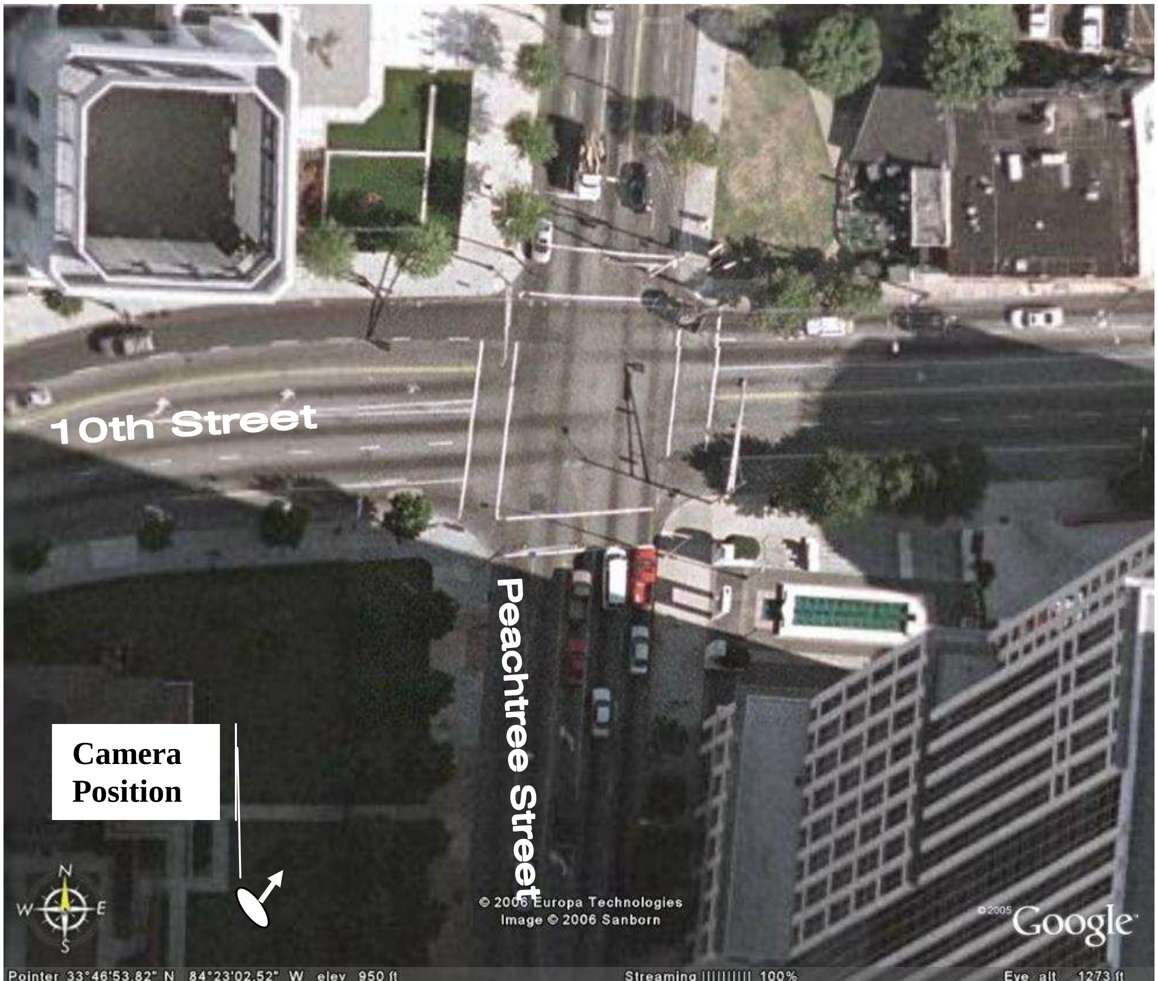


Figure C.47 Aerial Photograph Peachtree Street and 10th Street Intersection

Figure C.48 Aerial Photograph Ponce De Leon Avenue and Frederica Street Intersection

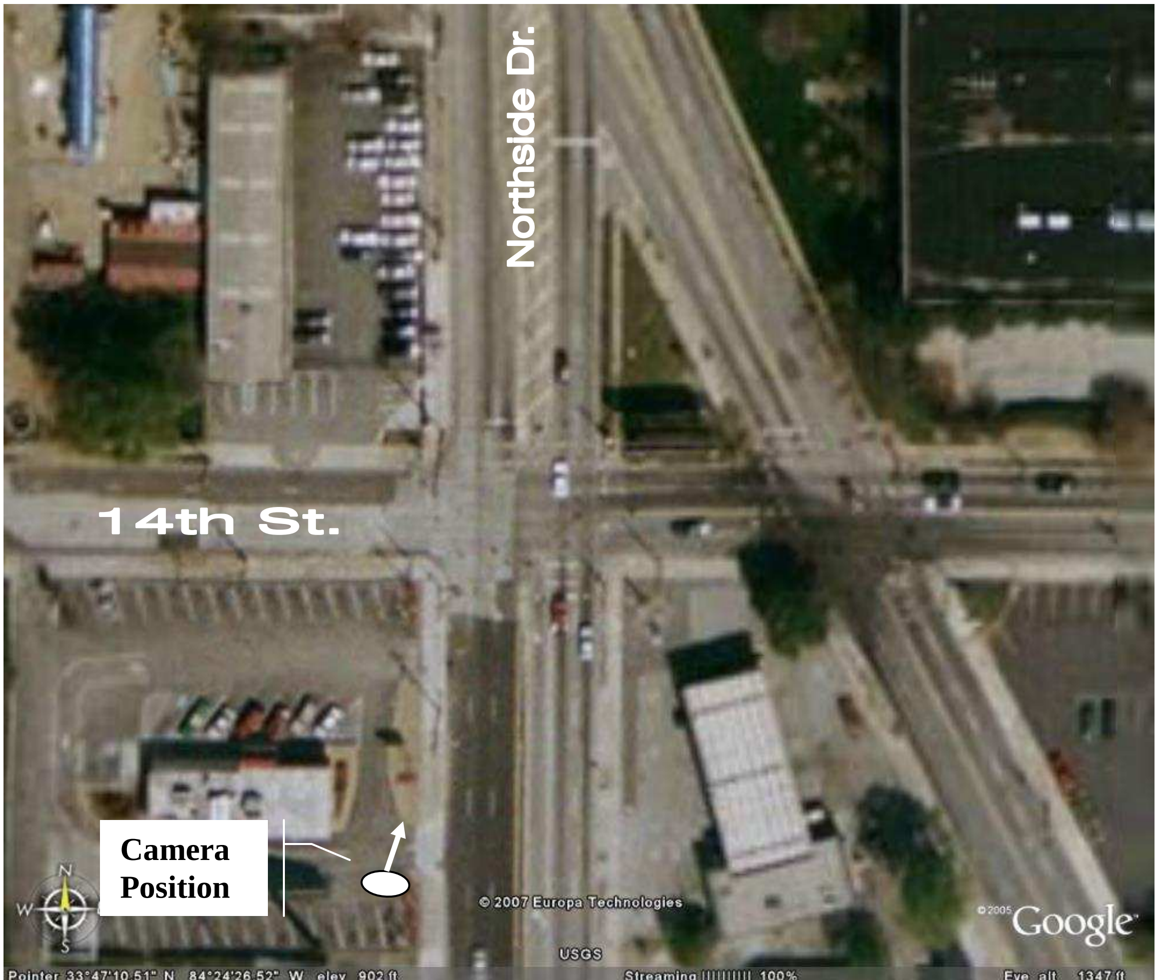


Figure C.49 Aerial Photograph Northside Drive and 14th Street Intersection

Figure C.50 Aerial Photograph 14th Street and State Street Intersection

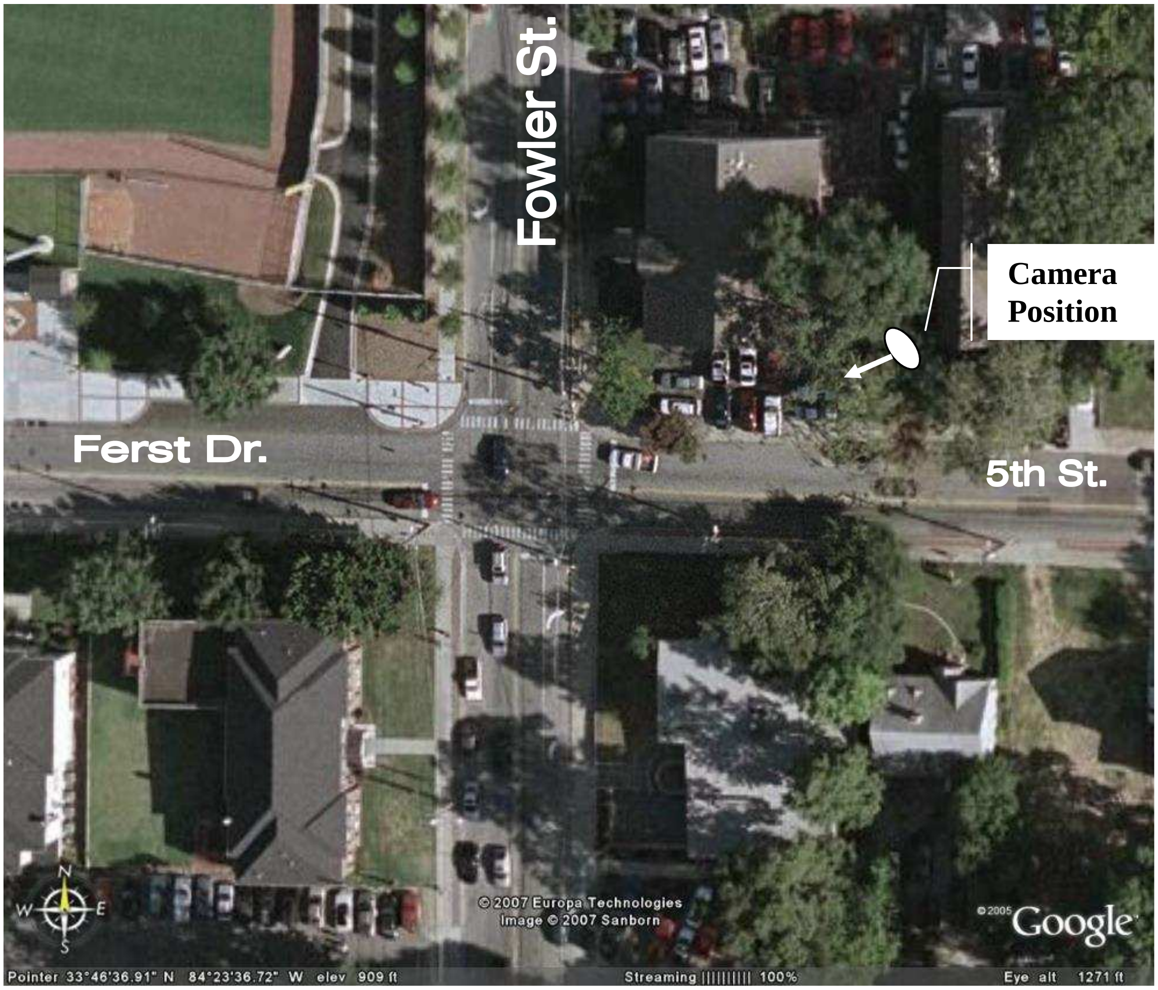


Figure C.51 Aerial Photograph Fowler Street at Fifth Street/Ferst Drive Intersection

APPENDIX D

TRAFFIC CONDITIONS AND GEOMETRY OF STUDY LOCATIONS

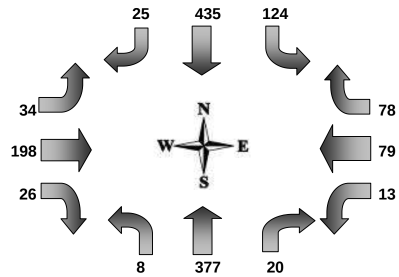
INTERSECTION	Northside and Peachtree Battle	
STATUS & FLASH MODE	Malfunction Yellow/Red	
CITY/COUNTY	Atlanta/Fulton	
DATE	May 11 2005	
DAY	Wednesday	
START TIME	9:00	
END TIME	10:05	
LIGHT CONDITIONS	Daylight	
WEATHER	Clear	

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.

Southbound
Northside Dr.

Eastbound
Peachtree Battle Ave.



Westbound
Peachtree Battle Ave.

Northbound
Northside Dr.

KEY STATISTICS		
Major Volume for Duration of Video	1029	
Major Volume - first 60 min OR scaled up	989	(First 60 Min.)
Minor Volume for Duration of Video	436	
Minor Volume - first 60 min OR scaled up	428	(First 60 Min.)
Minor:Major Volume Ratio	0.42	
Video Length in Minutes	62.42	
Percent Time Minor Vehicle Present	78.29%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		SB			NB			WB			EB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
9:00	9:05	12	39	5	0	24	0	1	8	7	3	18	1	118
9:05	9:10	22	38	1	0	31	4	0	7	7	2	29	4	145
9:10	9:15	9	49	2	2	36	2	3	7	8	5	23	2	148
9:15	9:20	8	43	3	1	38	2	0	6	7	3	17	4	132
9:20	9:25	12	41	1	0	46	2	0	2	8	5	21	1	139
9:25	9:30	12	44	1	1	33	1	0	7	3	4	10	3	119
9:30	9:35	8	39	3	0	34	3	2	6	6	3	13	2	119
9:35	9:40	7	30	3	0	31	2	0	8	4	2	14	3	104
9:40	9:45	7	29	1	0	29	1	3	2	7	2	19	3	103
9:45	9:50	11	32	1	2	24	1	1	13	6	3	12	0	106
9:50	9:55	11	29	2	2	20	1	0	6	11	0	10	2	94
9:55	10:00	5	22	2	0	31	1	3	7	4	2	12	1	90
10:00	10:05	6	20	2	0	10	2	1	4	1	0	2	0	48
TOTAL		130	455	27	8	387	22	14	83	79	34	200	26	1465

STOPPING	SB			NB			WB			EB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	97	226	8	7	267	9	14	83	79	34	200	26
Average Stop Time	00:06.9	00:05.2	00:05.9	00:04.4	00:05.3	00:04.2	00:07.7	00:06.8	00:03.0	00:05.6	00:06.9	00:03.7
		00:05.7			00:05.3			00:05.2			00:06.4	
Max Stop Time	00:28.0	00:23.0	00:12.0	00:10.0	00:18.0	00:13.0	00:25.0	00:22.0	00:12.0	00:13.0	00:43.0	00:15.0
% of Vehicle Stopping	74.62%	49.67%	29.63%	87.50%	68.99%	40.91%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
		54.08%			67.87%			100.00%			100.00%	
% of Platoon Stopping	72.73%	59.11%	38.89%	87.50%	79.64%	37.50%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
		60.78%			77.90%			100.00%			100.00%	
% Stopping if Present	80.20%	59.70%	30.00%	80.00%	77.34%	50.00%						
		62.94%			75.75%							
% Stopping if Absent	55.17%	21.67%	28.57%	100.00%	47.71%	0.00%						
		28.21%			47.41%							
% Stopping if Opposing Left Turn Waiting		50.00%			62.86%							
% Stopping if No LT		49.11%			66.04%							

ORIENTATION AND LANE CONFIGURATION	SB	NB	WB	EB
	Towards Camera	Away From Camera	From Right Side	From Left Side
Left Turn Lanes	0	0	0	0
Left/Thru Lanes	1	1	1	1
Thru Only Lanes	0	0	0	0
Right/Thru Lanes	1	0	0	0
Right Turn Lanes	0	1	1	1
Left/Thru/Right Lanes	0	0	0	0
Left/Right Lanes	0	0	0	0
Total Lanes	2	2	2	2
State and Federal Routes	GA 3/US 41	GA 3/US 41	None	None
Functional Classification	Minor Arterial	Minor Arterial	Collector	Collector

Figure D.1 Northside Dr. and Peachtree Battle Ave. Traffic Conditions and Geometry

INTERSECTION	Monroe Drive and 10th Street
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	August 17 2005
DAY	Wednesday
START TIME	16:50
END TIME	17:35
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

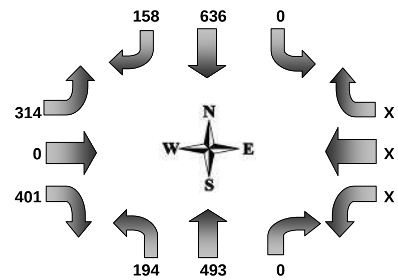
Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.

Southbound: Monroe Dr.

Eastbound: 10th St.

Westbound

Northbound: Monroe Dr.



KEY STATISTICS		
Major Volume for Duration of Video	1099	
Major Volume - first 60 min OR scaled up	1481	(Scaled Up)
Minor Volume for Duration of Video	531	
Minor Volume - first 60 min OR scaled up	715	(Scaled Up)
Minor:Major Volume Ratio	0.48	
Video Length in Minutes	44.53	
Percent Time Minor Vehicle Present	91.77%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		SB			NB			EB			WB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
16:50	16:55	0	56	7	18	39	0	21	0	25	0	0	0	166
16:55	17:00	0	55	16	21	45	0	19	0	38	0	0	0	194
17:00	17:05	0	64	11	10	40	0	25	0	32	0	0	0	182
17:05	17:10	0	67	9	19	40	0	20	0	21	0	0	0	176
17:10	17:15	0	44	16	18	37	0	28	0	33	0	0	0	176
17:15	17:20	0	46	12	15	44	0	32	0	38	0	0	0	187
17:20	17:25	0	47	16	17	33	0	32	0	37	0	0	0	182
17:25	17:30	0	49	17	18	42	0	27	0	39	0	0	0	192
17:30	17:35	0	44	13	8	46	0	29	0	35	0	0	0	175
TOTAL		0	472	117	144	366	0	233	0	298	0	0	0	1630

STOPPING	SB			NB			EB			WB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	0	320	40	132	164	0	198	0	221	0	0	0
Average Stop Time	00:00.0	00:07.3	00:04.9	00:08.7	00:04.9	00:00.0	00:09.0	00:00.0	00:05.5	00:00.0	00:00.0	00:00.0
		00:07.0			00:06.6			00:07.1			00:00.0	
Max Stop Time	00:00.0	00:32.0	00:18.0	00:25.0	00:15.0	00:00.0	00:30.0	00:00.0	00:22.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	0.00%	67.80%	34.19%	91.67%	44.81%	0.00%	84.98%	0.00%	74.16%	0.00%	0.00%	0.00%
		61.12%			58.04%			78.91%			0.00%	
% of Platoon Stopping	0.00%	79.74%	50.67%	97.96%	58.59%	0.00%	89.47%	0.00%	83.67%	0.00%	0.00%	0.00%
		72.52%			71.62%			85.57%			0.00%	
% Stopping if Present	0.00%	70.81%	36.45%	93.60%	45.40%	0.00%						
		63.81%			58.44%							
% Stopping if Absent	0.00%	44.44%	10.00%	78.95%	37.93%	0.00%						
		39.06%			54.17%							
% Stopping if Opposing Left Turn Waiting		65.48%			0.00%							
% Stopping if No LT		61.67%			44.81%							

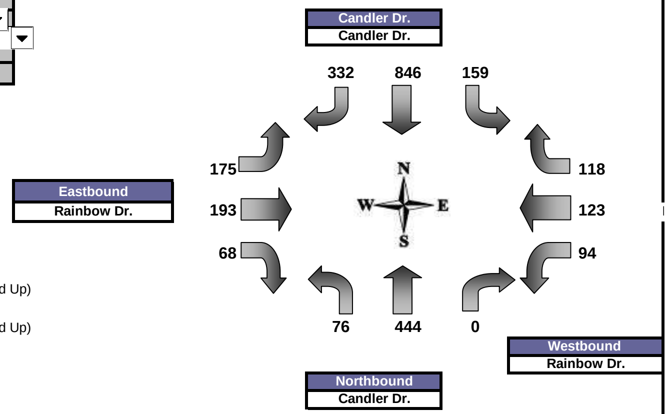
ORIENTATION AND LANE CONFIGURATION	SB	NB	EB	WB
	Towards Camera	Away From Camera	From Right Side	From Left Side
Left Turn Lanes	0	0	2	-
Left/Thru Lanes	0	1	0	-
Thru Only Lanes	1	1	0	-
Right/Thru Lanes	1	0	0	-
Right Turn Lanes	0	0	1	-
Left/Thru/Right Lanes	0	0	0	-
Left/Right Lanes	0	0	0	-
Total Lanes	2	2	3	0
State and Federal Routes	None	None	None	-
Functional Classification	Minor Arterial	Minor Arterial	Minor Arterial	-

Figure D.2 Monroe Dr. and 10th St. Traffic Conditions and Geometry

INTERSECTION	Candler Drive and Rainbow Drive
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	(unincorporated area)/DeKalb
DATE	August 12 2005
DAY	Friday
START TIME	15:05
END TIME	15:30
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	711	
Major Volume - first 60 min OR scaled up	1857	(Scaled Up)
Minor Volume for Duration of Video	295	
Minor Volume - first 60 min OR scaled up	771	(Scaled Up)
Minor:Major Volume Ratio	0.41	
Video Length in Minutes	22.97	
Percent Time Minor Vehicle Present	92.09%	

CAR COUNT		Major Street Approach #1 SB			Major Street Approach #2 NB			Minor Street Approach #1 WB			Minor Street Approach #2 EB			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
15:05	15:10	10	62	17	4	43	0	4	10	11	17	19	7	204
15:10	15:15	13	63	38	7	34	0	11	11	8	16	13	7	221
15:15	15:20	13	87	32	7	25	0	7	7	7	9	17	4	215
15:20	15:25	14	69	18	7	35	0	8	15	13	16	19	7	221
15:25	15:30	11	43	22	4	33	0	6	4	6	9	6	1	145
TOTAL		61	324	127	29	170	0	36	47	45	67	74	26	1006

STOPPING	SB			NB			WB			EB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	44	172	14	24	114	0	0	0	0	66	72	26
Average Stop Time	00:17.7	00:10.9	00:05.2	00:17.3	00:19.2	00:00.0	00:00.0	00:00.0	00:00.0	00:09.1	00:09.1	00:08.8
		00:11.8			00:18.9			00:00.0			00:09.1	
Max Stop Time	01:10.0	00:36.0	00:15.0	00:56.0	01:43.0	00:00.0	00:00.0	00:00.0	00:00.0	00:35.0	00:40.0	00:50.0
% of Vehicle Stopping	72.13%	53.09%	11.02%	82.76%	67.06%	0.00%	0.00%	0.00%	0.00%	98.51%	97.30%	100.00%
		44.92%			69.35%			0.00%			98.20%	
% of Platoon Stopping	93.75%	79.27%	11.29%	94.44%	82.80%	0.00%	0.00%	0.00%	0.00%	100.00%	97.30%	100.00%
		54.38%			84.68%			0.00%			98.96%	
% Stopping if Present	74.14%	56.36%	11.76%	90.91%	66.46%	0.00%						
		46.90%			69.35%							
% Stopping if Absent	33.33%	33.33%	0.00%	57.14%	83.33%	0.00%						
		28.81%			69.23%							
% Stopping if Opposing Left Turn Waiting		52.38%			61.25%							
% Stopping if No LT		49.26%			70.00%							

ORIENTATION AND LANE CONFIGURATION	SB Towards Camera	NB Away From Camera	WB From Right Side	EB From Left Side
Left Turn Lanes	1	1	0	0
Left/Thru Lanes	0	0	1	1
Thru Only Lanes	2	2	0	0
Right/Thru Lanes	0	0	0	1
Right Turn Lanes	1	0	1	0
Left/Thru/Right Lanes	0	0	0	0
Left/Right Lanes	0	0	0	0
Total Lanes	4	3	2	2
State and Federal Routes	GA 155	GA 155	None	None
Functional Classification	Minor Arterial	Minor Arterial	Collector	Collector

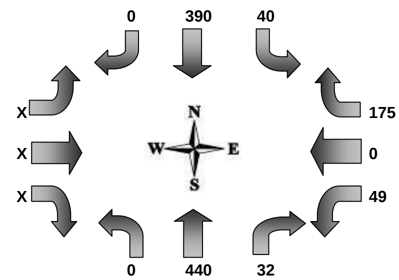
Figure D.3 Candler Drive and Rainbow Drive Traffic Conditions and Geometry

INTERSECTION	North Highland Ave. and University Drive
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	September 21 2005
DAY	Wednesday
START TIME	8:25
END TIME	9:30
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.

Southbound
N. Highland



Eastbound

Westbound
University

Northbound
N. Highland

KEY STATISTICS		
Major Volume for Duration of Video	919	
Major Volume - first 60 min OR scaled up	902	(First 60 Min.)
Minor Volume for Duration of Video	227	
Minor Volume - first 60 min OR scaled up	224	(First 60 Min.)
Minor:Major Volume Ratio	0.25	
Video Length in Minutes	61.18	
Percent Time Minor Vehicle Present	47.26%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		SB			NB			WB			EB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:25	8:30	6	40	0	0	49	2	3	0	10	0	0	0	110
8:30	8:35	2	37	0	0	37	2	10	0	21	0	0	0	109
8:35	8:40	3	40	0	0	38	7	3	0	12	0	0	0	103
8:40	8:45	1	48	0	0	40	1	6	0	16	0	0	0	112
8:45	8:50	0	21	0	0	38	4	5	0	18	0	0	0	86
8:50	8:55	2	34	0	0	37	1	4	0	23	0	0	0	101
8:55	9:00	1	27	0	0	30	3	4	0	12	0	0	0	77
9:00	9:05	5	39	0	0	33	4	2	0	8	0	0	0	91
9:05	9:10	3	26	0	0	37	3	4	0	21	0	0	0	94
9:10	9:15	4	27	0	0	38	2	2	0	17	0	0	0	90
9:15	9:20	10	26	0	0	34	0	4	0	9	0	0	0	83
9:20	9:25	3	25	0	0	29	3	2	0	8	0	0	0	70
9:25	9:30	7	3	0	0	6	1	0	0	3	0	0	0	20
TOTAL		47	393	0	0	446	33	49	0	178	0	0	0	1146

STOPPING	SB			NB			WB			EB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	20	0	0	0	82	4	49	0	178	0	0	0
Average Stop Time	00:04.6	00:00.0	00:00.0	00:00.0	00:03.8	00:07.5	00:09.0	00:00.0	00:04.1	00:00.0	00:00.0	00:00.0
		00:04.6			00:04.0			00:05.2			00:00.0	
Max Stop Time	00:15.0	00:00.0	00:00.0	00:00.0	00:12.0	00:16.0	00:35.0	00:00.0	00:21.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	42.55%	0.00%	0.00%	0.00%	18.39%	12.12%	100.00%	0.00%	100.00%	0.00%	0.00%	0.00%
		4.55%			17.95%			100.00%			0.00%	
% of Platoon Stopping	55.56%	0.00%	0.00%	0.00%	27.21%	16.00%	100.00%	0.00%	100.00%	0.00%	0.00%	0.00%
		6.80%			26.33%			100.00%			0.00%	
% Stopping if Present	42.11%	0.00%	0.00%	0.00%	22.56%	23.08%						
		4.19%			22.60%							
% Stopping if Absent	42.86%	0.00%	0.00%	0.00%	15.14%	5.00%						
		4.82%			14.39%							
% Stopping if Opposing Left Turn Waiting		0.00%			30.77%							
% Stopping if No LT		0.00%			17.86%							

ORIENTATION AND LANE CONFIGURATION	SB	NB	WB	EB
	Towards Camera	Away From Camera	From Right Side	From Left Side
Left Turn Lanes	0	0	1	-
Left/Thru Lanes	1	0	0	-
Thru Only Lanes	0	0	0	-
Right/Thru Lanes	0	1	0	-
Right Turn Lanes	0	0	1	-
Left/Thru/Right Lanes	0	0	0	-
Left/Right Lanes	0	0	0	-
Total Lanes	1	1	2	0
State and Federal Routes	None	None	None	-
Functional Classification	Collector	Collector	Local	-

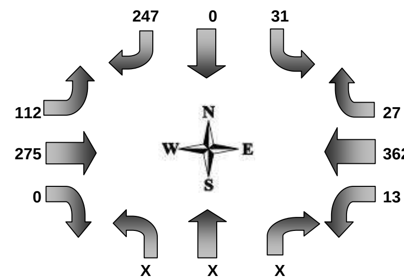
Figure D.4 North Highland Avenue and Universtiy Drive Traffic Conditions and Geometry

INTERSECTION	17th Street and Bishop Street
STATUS &FLASH MODE	New Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	September 26 2005
DAY	Monday
START TIME	16:45
END TIME	17:35
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.

Southbound
Bishop St.



Eastbound
17th St.

Westbound
17th St.

Northbound

KEY STATISTICS		
Major Volume for Duration of Video	608	
Major Volume - first 60 min OR scaled up	790	(Scaled Up)
Minor Volume for Duration of Video	214	
Minor Volume - first 60 min OR scaled up	278	(Scaled Up)
Minor:Major Volume Ratio	0.35	
Video Length in Minutes	46.18	
Percent Time Minor Vehicle Present	44.10%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		Westbound			Eastbound			SB			NB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
16:45	16:50	1	25	1	5	17	0	2	0	15	0	0	0	66
16:50	16:55	2	31	5	9	28	0	3	0	16	0	0	0	94
16:55	17:00	1	31	1	7	15	0	4	0	19	0	0	0	78
17:00	17:05	1	24	2	14	31	0	3	0	17	0	0	0	92
17:05	17:10	1	26	4	8	24	0	2	0	37	0	0	0	102
17:10	17:15	1	35	2	15	23	0	4	0	33	0	0	0	113
17:15	17:20	0	29	1	5	21	0	2	0	20	0	0	0	78
17:20	17:25	3	35	4	9	24	0	2	0	18	0	0	0	95
17:25	17:30	0	33	0	11	25	0	2	0	13	0	0	0	84
17:30	17:35	0	10	1	3	4	0	0	0	2	0	0	0	20
TOTAL		10	279	21	86	212	0	24	0	190	0	0	0	822

STOPPING	Westbound			Eastbound			SB			NB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	4	11	1	29	3	0	17	0	103	0	0	0
Average Stop Time	00:09.0	00:04.8	00:02.0	00:06.1	00:04.7	00:00.0	00:09.2	00:00.0	00:03.8	00:00.0	00:00.0	00:00.0
		00:05.7			00:06.0			00:04.5			00:00.0	
Max Stop Time	00:17.0	00:08.0	00:02.0	00:15.0	00:11.0	00:00.0	00:32.0	00:00.0	00:22.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	40.00%	3.94%	4.76%	33.72%	1.42%	0.00%	70.83%	0.00%	54.21%	0.00%	0.00%	0.00%
		5.16%			10.74%			56.07%			0.00%	
% of Platoon Stopping	44.44%	5.14%	7.69%	40.30%	1.48%	0.00%	75.00%	0.00%	59.88%	0.00%	0.00%	0.00%
		7.11%			14.36%			61.54%			0.00%	
% Stopping if Present	50.00%	6.15%	14.29%	33.33%	1.09%	0.00%						
		7.19%			10.16%							
% Stopping if Absent	37.50%	2.01%	0.00%	34.00%	1.67%	0.00%						
		3.51%			11.18%							
% Stopping if Opposing Left Turn Waiting		7.89%			0.00%							
% Stopping if No LT		2.69%			1.47%							

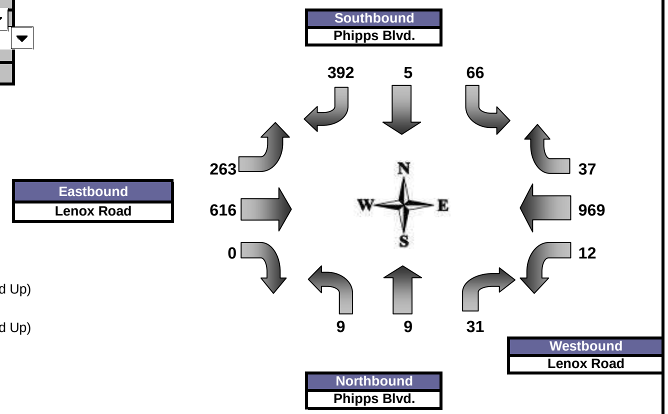
ORIENTATION AND LANE CONFIGURATION	Westbound	Eastbound	SB	NB
	Towards Camera	Away From Camera	From Left Side	From Right Side
Left Turn Lanes	1	1	1	-
Left/Thru Lanes	0	0	0	-
Thru Only Lanes	2	3	0	-
Right/Thru Lanes	1	0	0	-
Right Turn Lanes	0	0	1	-
Left/Thru/Right Lanes	0	0	0	-
Left/Right Lanes	0	0	0	-
Total Lanes	4	4	2	0
State and Federal Routes	None	None	None	-
Functional Classification	Collector	Collector	Collector	-

Figure D.5 17th Street and Bishop Street Traffic Conditions and Geometry

INTERSECTION	Lenox Road and Phipps Drive
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	September 30 2005
DAY	Friday
START TIME	21:25
END TIME	22:20
LIGHT CONDITIONS	Dark - Streetlights
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	1631	
Major Volume - first 60 min OR scaled up	1897	(Scaled Up)
Minor Volume for Duration of Video	441	
Minor Volume - first 60 min OR scaled up	513	(Scaled Up)
Minor:Major Volume Ratio	0.27	
Video Length in Minutes	51.58	
Percent Time Minor Vehicle Present	80.90%	

CAR COUNT		Major Street Approach #1 EB			Major Street Approach #2 WB			Minor Street Approach #1 SB			Minor Street Approach #2 NB			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
21:25	21:30	20	66	0	0	87	4	5	0	30	0	2	6	220
21:30	21:35	21	45	0	0	64	3	1	0	21	1	0	2	158
21:35	21:40	17	54	0	1	78	6	2	0	31	0	0	2	191
21:40	21:45	20	60	0	2	90	5	5	0	33	1	0	2	218
21:45	21:50	30	49	0	4	72	3	9	1	33	0	3	1	205
21:50	21:55	20	59	0	0	80	2	4	1	31	1	0	2	200
21:55	22:00	26	48	0	1	68	0	8	2	45	0	0	2	200
22:00	22:05	25	45	0	2	104	4	7	0	42	0	1	2	232
22:05	22:10	22	44	0	0	81	2	6	0	43	1	2	4	205
22:10	22:15	20	43	0	0	82	2	9	0	24	4	0	2	186
22:15	22:20	5	17	0	0	27	1	1	0	4	0	0	2	57
TOTAL		226	530	0	10	833	32	57	4	337	8	8	27	2072

STOPPING	EB			WB			SB			NB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	176	100	0	10	349	15	54	4	255	7	8	22
Average Stop Time	00:10.4	00:05.0	00:00.0	00:12.2	00:06.7	00:04.5	00:18.4	00:29.7	00:05.1	00:13.6	00:13.1	00:08.8
		00:08.4			00:06.8			00:07.7			00:10.6	
Max Stop Time	00:36.0	01:03.0	00:00.0	00:30.0	00:44.0	00:18.0	01:02.0	01:07.0	00:27.0	00:27.0	00:38.0	00:28.0
% of Vehicle Stopping	77.88%	18.87%	0.00%	100.00%	41.90%	46.88%	94.74%	100.00%	75.67%	87.50%	100.00%	81.48%
		36.51%			42.74%			78.64%			86.05%	
% of Platoon Stopping	87.02%	26.17%	0.00%	100.00%	52.61%	58.33%	100.00%	100.00%	90.00%	87.50%	100.00%	84.00%
		49.28%			54.13%			90.97%			87.50%	
% Stopping if Present	78.45%	21.08%	0.00%	100.00%	44.09%	45.83%						
		37.64%			44.64%							
% Stopping if Absent	75.56%	7.14%	0.00%	100.00%	33.53%	50.00%						
		31.01%			35.68%							
% Stopping if Opposing Left Turn Waiting		11.76%			34.56%							
% Stopping if No LT		19.35%			30.21%							

ORIENTATION AND LANE CONFIGURATION	EB From Left Side	WB From Right Side	SB Towards Camera	NB Away From Camera
Left Turn Lanes	1	1	1	2
Left/Thru Lanes	0	0	0	0
Thru Only Lanes	4	3	1	1
Right/Thru Lanes	0	1	0	0
Right Turn Lanes	1	0	1	1
Left/Thru/Right Lanes	0	0	0	0
Left/Right Lanes	0	0	0	0
Total Lanes	6	5	3	4
State and Federal Routes	GA 141	GA 141	None	None
Functional Classification	Minor Arterial	Minor Arterial	Local	Local

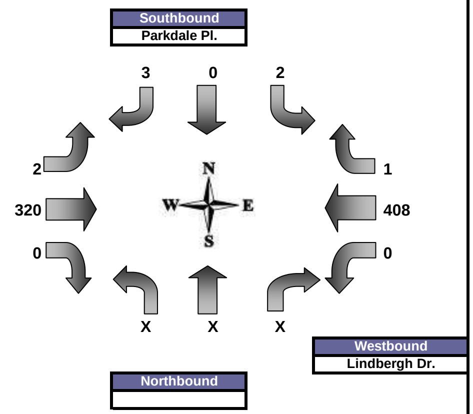
Figure D.6 Lenox Road and Phipps Drive Traffic Conditions and Geometry

INTERSECTION	Lindbergh Drive and Parkdale Place 1		
STATUS & FLASH MODE	Beacon Yellow/Red		
CITY/COUNTY	Atlanta/Fulton		
DATE	October	9	2005
DAY	Sunday		
START TIME	17:00		
END TIME	18:05		
LIGHT CONDITIONS	Daylight		
WEATHER	Clear		

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.

Eastbound
Lindbergh Dr.



KEY STATISTICS		
Major Volume for Duration of Video	739	
Major Volume - first 60 min OR scaled up	731	(First 60 Min.)
Minor Volume for Duration of Video	5	
Minor Volume - first 60 min OR scaled up	5	(First 60 Min.)
Minor:Major Volume Ratio	0.01	
Video Length in Minutes	60.43	
Percent Time Minor Vehicle Present	2.76%	

CAR COUNT		Major Street Approach #1 Eastbound			Major Street Approach #2 Westbound			Minor Street Approach #1 SB			Minor Street Approach #2 NB			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
17:00	17:05	0	29	0	0	41	0	0	0	1	0	0	0	71
17:05	17:10	0	34	0	0	29	0	0	0	0	0	0	0	63
17:10	17:15	0	35	0	0	54	0	0	0	0	0	0	0	89
17:15	17:20	0	26	0	0	43	0	0	0	0	0	0	0	69
17:20	17:25	0	23	0	0	31	1	0	0	0	0	0	0	55
17:25	17:30	0	32	0	0	38	0	0	0	0	0	0	0	70
17:30	17:35	1	18	0	0	33	0	0	0	1	0	0	0	53
17:35	17:40	0	19	0	0	23	0	1	0	0	0	0	0	43
17:40	17:45	1	27	0	0	34	0	1	0	1	0	0	0	64
17:45	17:50	0	24	0	0	23	0	0	0	0	0	0	0	47
17:50	17:55	0	25	0	0	27	0	0	0	0	0	0	0	52
17:55	18:00	0	28	0	0	32	0	0	0	0	0	0	0	60
18:00	18:05	0	4	0	0	4	0	0	0	0	0	0	0	8
TOTAL		2	324	0	0	412	1	2	0	3	0	0	0	744

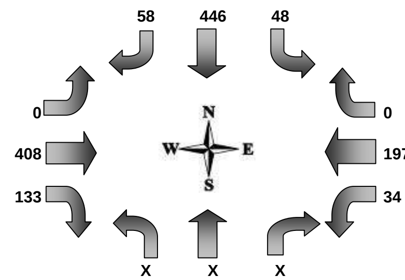
STOPPING	Eastbound			Westbound			SB			NB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	0	0	0	0	0	0	2	0	3	0	0	0
Average Stop Time	00:00.0	00:00.0	00:00.0	00:00.0	00:00.0	00:00.0	00:33.0	00:00.0	00:04.7	00:00.0	00:00.0	00:00.0
		00:00.0			00:00.0			00:16.0			00:00.0	
Max Stop Time	00:00.0	00:00.0	00:00.0	00:00.0	00:00.0	00:00.0	00:42.0	00:00.0	00:08.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	100.00%	0.00%	0.00%	0.00%
		0.00%			0.00%			100.00%			0.00%	
% of Platoon Stopping	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	100.00%	0.00%	0.00%	0.00%
		0.00%			0.00%			100.00%			0.00%	
% Stopping if Present	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%						
		0.00%			0.00%							
% Stopping if Absent	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%						
		0.00%			0.00%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		0.00%			0.00%							

ORIENTATION AND LANE CONFIGURATION	Eastbound Towards Camera	Westbound Away From Camera	SB From Right Side	NB From Left Side
Left Turn Lanes	0	0	0	-
Left/Thru Lanes	1	0	0	-
Thru Only Lanes	0	0	0	-
Right/Thru Lanes	0	1	0	-
Right Turn Lanes	0	0	0	-
Left/Thru/Right Lanes	0	0	0	-
Left/Right Lanes	0	0	1	-
Total Lanes	1	1	1	0
State and Federal Routes	GA 236	GA 236	None	-
Functional Classification	Minor Arterial	Minor Arterial	Local	-

Figure D.7 Lindbergh Drive and Parkdale Place 1 Traffic Conditions and Geometry

INTERSECTION	Spring Street and 17th Street		
STATUS & FLASH MODE	Malfunction Yellow/Red		
CITY/COUNTY	Atlanta/Fulton		
DATE	October	15	2005
DAY	Saturday		
START TIME	10:55		
END TIME	12:30		
LIGHT CONDITIONS	Daylight		
WEATHER	Clear		

Equivilent Hourly Traffic Volumes
Actual volume from first 60 min. of video OR adjusted volume from videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	878	
Major Volume - first 60 min OR scaled up	535	(First 60 Min.)
Minor Volume for Duration of Video	1191	
Minor Volume - first 60 min OR scaled up	764	(First 60 Min.)
Minor:Major Volume Ratio	1.36	
Video Length in Minutes	90.88	
Percent Time Minor Vehicle Present	85.44%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		SB			NB			EB			WB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
10:55	11:00	5	34	4	0	0	0	0	30	11	1	12	0	97
11:00	11:05	4	30	4	0	0	0	0	32	10	1	17	0	98
11:05	11:10	2	36	2	0	0	0	0	37	9	1	19	0	106
11:10	11:15	4	35	4	0	0	0	0	30	3	6	13	0	95
11:15	11:20	6	40	10	0	0	0	0	29	12	4	16	0	117
11:20	11:25	3	21	4	0	0	0	0	38	11	4	20	0	101
11:25	11:30	5	41	6	0	0	0	0	36	10	3	18	0	119
11:30	11:35	10	45	4	0	0	0	0	33	15	2	13	0	122
11:35	11:40	8	37	9	0	0	0	0	27	15	7	15	0	118
11:40	11:45	0	35	1	0	0	0	0	34	8	1	16	0	95
11:45	11:50	1	42	5	0	0	0	0	39	10	1	13	0	111
11:50	11:55	3	32	3	0	0	0	0	42	17	2	21	0	120
11:55	12:00	2	52	6	0	0	0	0	31	13	2	16	0	122
12:00	12:05	7	36	4	0	0	0	0	38	10	3	17	0	115
12:05	12:10	4	47	9	0	0	0	0	37	10	4	7	0	118
12:10	12:15	4	49	11	0	0	0	0	42	13	3	11	0	133
12:15	12:20	5	38	10	0	0	0	0	49	16	3	28	0	149
12:20	12:25	3	50	6	0	0	0	0	37	9	3	25	0	133
12:25	12:30	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL		76	700	102	0	0	0	0	641	202	51	297	0	2069

STOPPING	SB			NB			EB			WB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	46	320	42	0	0	0	0	475	121	46	280	0
Average Stop Time	00:08.8	00:07.2	00:04.6	00:00.0	00:00.0	00:00.0	00:00.0	00:06.5	00:04.3	00:09.8	00:06.7	00:00.0
		00:07.1			00:00.0			00:06.1			00:07.1	
Max Stop Time	00:17.0	00:30.0	00:18.0	00:00.0	00:00.0	00:00.0	00:00.0	00:51.0	00:40.0	00:41.0	00:41.0	00:00.0
% of Vehicle Stopping	60.53%	45.43%	41.18%	0.00%	0.00%	0.00%	0.00%	73.63%	59.90%	90.20%	93.27%	0.00%
		46.24%			0.00%			70.34%			92.82%	
% of Platoon Stopping	65.91%	53.99%	53.57%	0.00%	0.00%	0.00%	0.00%	85.60%	66.67%	91.30%	96.76%	0.00%
		55.08%			0.00%			81.14%			95.90%	
% Stopping if Present	62.12%	47.91%	40.66%	0.00%	0.00%	0.00%						
		48.27%			0.00%							
% Stopping if Absent	50.00%	25.64%	45.45%	0.00%	0.00%	0.00%						
		30.30%			0.00%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		45.43%			0.00%							

ORIENTATION AND LANE CONFIGURATION	SB	NB	EB	WB
	Towards Camera	Away From Camera	From Left Side	From Right Side
Left Turn Lanes	0	-	0	0
Left/Thru Lanes	1	-	0	1
Thru Only Lanes	2	-	2	1
Right/Thru Lanes	1	-	0	0
Right Turn Lanes	0	-	1	0
Left/Thru/Right Lanes	0	-	0	0
Left/Right Lanes	0	-	0	0
Total Lanes	4	0	3	2
State and Federal Routes	GA 9/US 19	-	None	None
Functional Classification	Minor Arterial	-	Collector	Collector

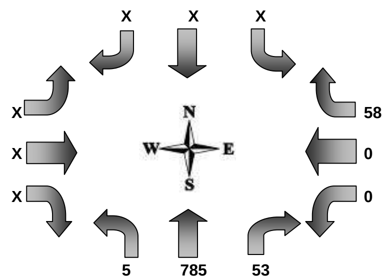
Figure D.8 Spring Street and 17th Street Traffic Conditions and Geometry

INTERSECTION	W. Peachtree Street and 11th Street
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	October 15 2005
DAY	Saturday
START TIME	13:05
END TIME	14:30
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.

Southbound



Eastbound

Westbound

11th St.

Northbound

W Peachtree St.

KEY STATISTICS		
Major Volume for Duration of Video	1171	
Major Volume - first 60 min OR scaled up	843	(First 60 Min.)
Minor Volume for Duration of Video	88	
Minor Volume - first 60 min OR scaled up	58	(First 60 Min.)
Minor:Major Volume Ratio	0.08	
Video Length in Minutes	85.15	
Percent Time Minor Vehicle Present	16.38%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		SB			NB			WB			EB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
13:05	13:10	0	0	0	0	89	3	0	0	1	0	0	0	93
13:10	13:15	0	0	0	0	66	6	0	0	9	0	0	0	81
13:15	13:20	0	0	0	0	65	7	0	0	3	0	0	0	75
13:20	13:25	0	0	0	0	80	1	0	0	2	0	0	0	83
13:25	13:30	0	0	0	0	58	5	0	0	6	0	0	0	69
13:30	13:35	0	0	0	0	77	6	0	0	9	0	0	0	92
13:35	13:40	0	0	0	0	60	3	0	0	2	0	0	0	65
13:40	13:45	0	0	0	0	50	3	0	0	5	0	0	0	58
13:45	13:50	0	0	0	2	51	5	0	0	4	0	0	0	62
13:50	13:55	0	0	0	0	55	6	0	0	3	0	0	0	64
13:55	14:00	0	0	0	1	71	4	0	0	3	0	0	0	79
14:00	14:05	0	0	0	2	63	4	0	0	11	0	0	0	80
14:05	14:10	0	0	0	0	59	6	0	0	7	0	0	0	72
14:10	14:15	0	0	0	2	60	1	0	0	7	0	0	0	70
14:15	14:20	0	0	0	1	63	5	0	0	2	0	0	0	71
14:20	14:25	0	0	0	0	64	3	0	0	9	0	0	0	76
14:25	14:30	0	0	0	1	62	1	0	0	5	0	0	0	69
TOTAL		0	0	0	9	1093	69	0	0	88	0	0	0	1259

STOPPING	SB			NB			WB			EB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	0	0	0	0	8	1	0	0	88	0	0	0
Average Stop Time	00:00.0	00:00.0	00:00.0	00:00.0	00:02.9	00:07.0	00:00.0	00:00.0	00:05.8	00:00.0	00:00.0	00:00.0
		00:00.0			00:03.3			00:05.8			00:00.0	
Max Stop Time	00:00.0	00:00.0	00:00.0	00:00.0	00:04.0	00:07.0	00:00.0	00:00.0	00:37.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	0.00%	0.00%	0.00%	0.00%	0.73%	1.45%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%
		0.00%			0.77%			100.00%			0.00%	
% of Platoon Stopping	0.00%	0.00%	0.00%	0.00%	0.61%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%
		0.00%			0.55%			100.00%			0.00%	
% Stopping if Present	0.00%	0.00%	0.00%	0.00%	1.15%	0.00%						
		0.00%			1.04%							
% Stopping if Absent	0.00%	0.00%	0.00%	0.00%	0.65%	1.89%						
		0.00%			0.72%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		0.00%			0.73%							

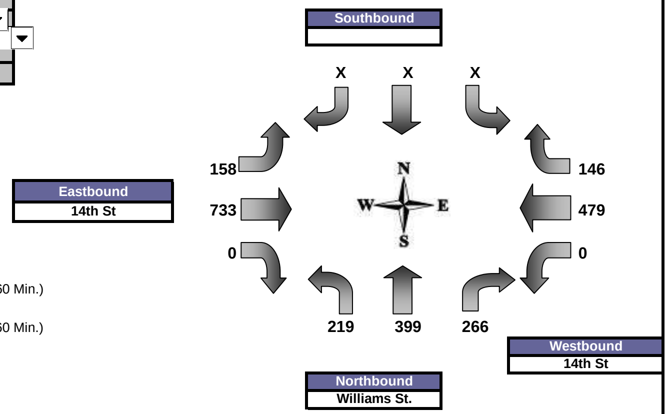
ORIENTATION AND LANE CONFIGURATION	SB	NB	WB	EB
	Towards Camera	Away From Camera	From Right Side	From Left Side
Left Turn Lanes	-	0	0	-
Left/Thru Lanes	-	0	0	-
Thru Only Lanes	-	3	0	-
Right/Thru Lanes	-	1	0	-
Right Turn Lanes	-	0	1	-
Left/Thru/Right Lanes	-	0	0	-
Left/Right Lanes	-	0	0	-
Total Lanes	0	4	1	0
State and Federal Routes	-	None	None	-
Functional Classification	-	Minor Arterial	Local	-

Figure D.9 W. Peachtree Street and 11th Street Traffic Conditions and Geometry

INTERSECTION	14th Street and Williams Street
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	October 22 2005
DAY	Saturday
START TIME	13:20
END TIME	14:20
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	1516	
Major Volume - first 60 min OR scaled up	1516	(First 60 Min.)
Minor Volume for Duration of Video	884	
Minor Volume - first 60 min OR scaled up	884	(First 60 Min.)
Minor:Major Volume Ratio	0.58	
Video Length in Minutes	60.43	
Percent Time Minor Vehicle Present	98.81%	

CAR COUNT		Major Street Approach #1 Eastbound			Major Street Approach #2 Westbound			Minor Street Approach #1 NB			Minor Street Approach #2 SB			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
13:20	13:25	13	65	0	0	32	8	20	32	17	0	0	0	187
13:25	13:30	14	58	0	0	34	10	16	26	22	0	0	0	180
13:30	13:35	11	62	0	0	43	13	16	38	24	0	0	0	207
13:35	13:40	12	67	0	0	39	8	22	38	19	0	0	0	205
13:40	13:45	17	62	0	0	42	9	17	32	21	0	0	0	200
13:45	13:50	20	68	0	0	32	11	22	33	23	0	0	0	209
13:50	13:55	11	53	0	0	36	16	20	37	29	0	0	0	202
13:55	14:00	15	63	0	0	48	11	17	38	21	0	0	0	213
14:00	14:05	11	64	0	0	37	12	23	32	22	0	0	0	201
14:05	14:10	14	66	0	0	45	14	13	43	23	0	0	0	218
14:10	14:15	9	53	0	0	52	20	17	26	21	0	0	0	198
14:15	14:20	11	52	0	0	39	14	16	24	24	0	0	0	180
TOTAL		158	733	0	0	479	146	219	399	266	0	0	0	2400

STOPPING	Eastbound			Westbound			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	69	515	0	0	212	75	178	304	170	0	0	0
Average Stop Time	00:08.4	00:08.6	00:00.0	00:00.0	00:05.6	00:05.5	00:10.6	00:10.3	00:09.0	00:00.0	00:00.0	00:00.0
		00:08.5			00:05.6			00:10.0			00:00.0	
Max Stop Time	00:22.0	00:44.0	00:00.0	00:00.0	00:20.0	00:16.0	00:38.0	00:47.0	00:39.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	43.67%	69.88%	0.00%	0.00%	44.07%	51.37%	81.28%	76.19%	62.96%	0.00%	0.00%	0.00%
		65.23%			45.78%			73.47%			0.00%	
% of Platoon Stopping	43.48%	85.81%	0.00%	0.00%	57.63%	68.29%	95.52%	86.13%	80.00%	0.00%	0.00%	0.00%
		77.96%			60.17%			87.87%			0.00%	
% Stopping if Present	43.95%	70.60%	0.00%	0.00%	44.54%	51.37%						
		65.83%			46.14%							
% Stopping if Absent	0.00%	37.50%	0.00%	0.00%	0.00%	0.00%						
		35.29%			0.00%							
% Stopping if Opposing Left Turn Waiting		0.00%			54.17%							
% Stopping if No LT		69.88%			38.04%							

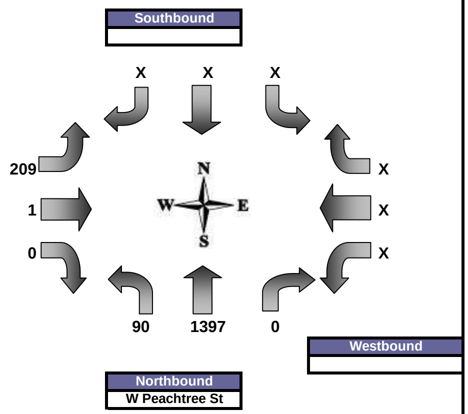
ORIENTATION AND LANE CONFIGURATION	Eastbound Towards Camera	Westbound Away From Camera	NB From Right Side	SB From Left Side
Left Turn Lanes	1	0	0	-
Left/Thru Lanes	0	0	1	-
Thru Only Lanes	2	1	1	-
Right/Thru Lanes	0	1	0	-
Right Turn Lanes	0	0	1	-
Left/Thru/Right Lanes	0	0	0	-
Left/Right Lanes	0	0	0	-
Total Lanes	3	2	3	0
State and Federal Routes	GA 9/US 19	GA 9/US 19	None	-
Functional Classification	Minor Arterial	Minor Arterial	Collector	-

Figure D.10 14th Street and Williams Street Traffic Conditions and Geometry

INTERSECTION	W. Peachtree and 16th 1
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	October 22 2005
DAY	Saturday
START TIME	15:30
END TIME	16:30
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	1487	
Major Volume - first 60 min OR scaled up	1487	(First 60 Min.)
Minor Volume for Duration of Video	210	
Minor Volume - first 60 min OR scaled up	210	(First 60 Min.)
Minor:Major Volume Ratio	0.14	
Video Length in Minutes	60.72	
Percent Time Minor Vehicle Present	71.37%	

CAR COUNT		Major Street Approach #1 NB			Major Street Approach #2 SB			Minor Street Approach #1 EB			Minor Street Approach #2 WB			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
15:30	15:35	8	112	0	0	0	0	21	0	0	0	0	0	141
15:35	15:40	14	121	0	0	0	0	17	0	0	0	0	0	152
15:40	15:45	6	103	0	0	0	0	12	0	0	0	0	0	121
15:45	15:50	5	131	0	0	0	0	12	0	0	0	0	0	148
15:50	15:55	8	131	0	0	0	0	22	0	0	0	0	0	161
15:55	16:00	8	137	0	0	0	0	19	0	0	0	0	0	164
16:00	16:05	7	109	0	0	0	0	18	0	0	0	0	0	134
16:05	16:10	9	109	0	0	0	0	19	0	0	0	0	0	137
16:10	16:15	7	102	0	0	0	0	20	0	0	0	0	0	129
16:15	16:20	6	111	0	0	0	0	21	1	0	0	0	0	139
16:20	16:25	4	115	0	0	0	0	13	0	0	0	0	0	132
16:25	16:30	8	116	0	0	0	0	15	0	0	0	0	0	139
TOTAL		90	1397	0	0	0	0	209	1	0	0	0	0	1697

STOPPING	NB			SB			EB			WB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	39	120	0	0	0	0	196	1	0	0	0	0
Average Stop Time	00:05.8	00:04.8	00:00.0	00:00.0	00:00.0	00:00.0	00:09.8	00:02.0	00:00.0	00:00.0	00:00.0	00:00.0
		00:05.0			00:00.0			00:09.8			00:00.0	
Max Stop Time	00:31.0	00:15.0	00:00.0	00:00.0	00:00.0	00:00.0	01:22.0	00:02.0	00:00.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	42.86%	8.55%	0.00%	0.00%	0.00%	0.00%	92.89%	100.00%	0.00%	0.00%	0.00%	0.00%
		10.62%			0.00%			92.92%			0.00%	
% of Platoon Stopping	43.24%	17.36%	0.00%	0.00%	0.00%	0.00%	95.07%	100.00%	0.00%	0.00%	0.00%	0.00%
		20.53%			0.00%			95.10%			0.00%	
% Stopping if Present	53.97%	9.97%	0.00%	0.00%	0.00%	0.00%						
		12.39%			0.00%							
% Stopping if Absent	17.86%	3.74%	0.00%	0.00%	0.00%	0.00%						
		4.87%			0.00%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		8.55%			0.00%							

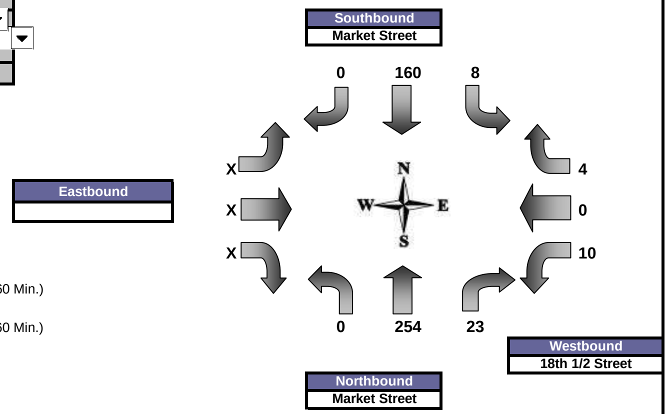
ORIENTATION AND LANE CONFIGURATION	NB Towards Camera	SB Away From Camera	EB From Right Side	WB From Left Side
Left Turn Lanes	0	-	1	-
Left/Thru Lanes	1	-	0	-
Thru Only Lanes	4	-	0	-
Right/Thru Lanes	0	-	0	-
Right Turn Lanes	0	-	0	-
Left/Thru/Right Lanes	0	-	0	-
Left/Right Lanes	0	-	0	-
Total Lanes	5	0	1	0
State and Federal Routes	GA 9/US 19	-	None	-
Functional Classification	Minor Arterial	-	Local	-

Figure D.11 W. Peachtree and 16th 1 Traffic Conditions and Geometry

INTERSECTION	Market Street and 18th 1/2 Street 1
STATUS & FLASH MODE	New Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	October 26 2005
DAY	Wednesday
START TIME	14:30
END TIME	15:35
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	456	
Major Volume - first 60 min OR scaled up	445	(First 60 Min.)
Minor Volume for Duration of Video	14	
Minor Volume - first 60 min OR scaled up	14	(First 60 Min.)
Minor:Major Volume Ratio	0.03	
Video Length in Minutes	62.35	
Percent Time Minor Vehicle Present	3.10%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		NB			SB			WB			EB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
14:30	14:35	0	22	0	3	16	0	0	0	0	0	0	0	41
14:35	14:40	0	28	1	0	13	0	1	0	0	0	0	0	43
14:40	14:45	0	29	3	1	11	0	0	0	0	0	0	0	44
14:45	14:50	0	20	1	0	20	0	2	0	0	0	0	0	43
14:50	14:55	0	17	0	1	9	0	1	0	0	0	0	0	28
14:55	15:00	0	20	3	1	12	0	1	0	1	0	0	0	38
15:00	15:05	0	15	1	0	12	0	0	0	0	0	0	0	28
15:05	15:10	0	28	2	1	17	0	3	0	0	0	0	0	51
15:10	15:15	0	16	4	0	9	0	0	0	0	0	0	0	29
15:15	15:20	0	27	1	0	13	0	1	0	1	0	0	0	43
15:20	15:25	0	15	2	0	17	0	1	0	0	0	0	0	35
15:25	15:30	0	17	5	1	11	0	0	0	2	0	0	0	36
15:30	15:35	0	7	0	0	4	0	0	0	0	0	0	0	11
TOTAL		0	261	23	8	164	0	10	0	4	0	0	0	470

STOPPING	NB			SB			WB			EB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	0	56	5	3	14	0	10	0	3	0	0	0
Average Stop Time	00:00.0	00:03.8	00:05.2	00:06.7	00:03.1	00:00.0	00:04.9	00:00.0	00:03.7	00:00.0	00:00.0	00:00.0
		00:03.9			00:03.7			00:04.6			00:00.0	
Max Stop Time	00:00.0	00:18.0	00:11.0	00:10.0	00:07.0	00:00.0	00:08.0	00:00.0	00:06.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	0.00%	21.46%	21.74%	37.50%	8.54%	0.00%	100.00%	0.00%	75.00%	0.00%	0.00%	0.00%
		21.48%			9.88%			92.86%			0.00%	
% of Platoon Stopping	0.00%	21.97%	20.00%	37.50%	8.92%	0.00%	100.00%	0.00%	75.00%	0.00%	0.00%	0.00%
		21.81%			10.30%			92.86%			0.00%	
% Stopping if Present	0.00%	57.14%	0.00%	0.00%	16.67%	0.00%						
		57.14%			16.67%							
% Stopping if Absent	0.00%	20.47%	21.74%	37.50%	8.23%	0.00%						
		20.58%			9.64%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		21.96%			8.54%							

ORIENTATION AND LANE CONFIGURATION	NB	SB	WB	EB
	Towards Camera	Away From Camera	From Left Side	From Left Side
Left Turn Lanes	0	0	0	-
Left/Thru Lanes	0	1	0	-
Thru Only Lanes	1	1	0	-
Right/Thru Lanes	1	0	0	-
Right Turn Lanes	0	0	0	-
Left/Thru/Right Lanes	0	0	0	-
Left/Right Lanes	0	0	1	-
Total Lanes	2	2	1	0
State and Federal Routes	None	None	None	-
Functional Classification	Local	Local	Local	-

Figure D.12 Market Street and 18th 1/2 Street 1 Traffic Conditions and Geometry

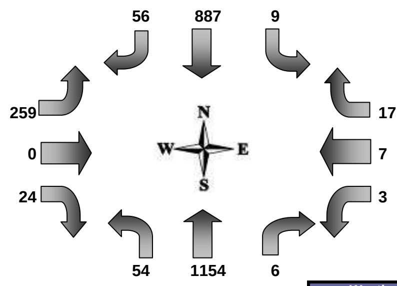
INTERSECTION	Piedmont Avenue and The Prado
STATUS & FLASH MODE	Malfunction Red/Red
CITY/COUNTY	Atlanta/Fulton
DATE	November 15 2005
DAY	Tuesday
START TIME	17:35
END TIME	18:30
LIGHT CONDITIONS	Dusk
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.

Southbound
Piedmont

Eastbound
The Prado



Westbound
Driveway

Northbound
Piedmont

KEY STATISTICS		
Major Volume for Duration of Video	1918	
Major Volume - first 60 min OR scaled up	2167	(Scaled Up)
Minor Volume for Duration of Video	274	
Minor Volume - first 60 min OR scaled up	310	(Scaled Up)
Minor:Major Volume Ratio	0.14	
Video Length in Minutes	53.12	
Percent Time Minor Vehicle Present	71.95%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		NB			SB			EB			WB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
17:35	17:40	4	110	1	0	72	4	13	0	2	0	1	2	209
17:40	17:45	6	101	4	0	76	4	22	0	1	1	1	2	218
17:45	17:50	4	83	0	0	69	1	25	0	2	0	1	2	187
17:50	17:55	4	88	0	1	72	5	19	0	3	1	0	0	193
17:55	18:00	7	79	0	1	67	2	28	0	2	0	1	1	188
18:00	18:05	2	108	0	4	83	4	16	0	1	0	2	4	224
18:05	18:10	3	102	0	0	67	6	21	0	2	1	0	1	203
18:10	18:15	5	97	0	1	69	10	23	0	2	0	0	1	208
18:15	18:20	7	103	0	0	84	6	20	0	3	0	0	0	223
18:20	18:25	4	98	0	1	80	5	25	0	2	0	0	0	215
18:25	18:30	2	53	0	0	46	3	17	0	1	0	0	2	124
TOTAL		48	1022	5	8	785	50	229	0	21	3	6	15	2192

STOPPING	NB			SB			EB			WB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	45	859	4	5	682	30	224	0	20	3	6	15
Average Stop Time	00:07.3	00:04.1	00:03.2	00:08.4	00:04.8	00:02.4	00:05.7	00:00.0	00:04.7	00:07.7	00:06.5	00:07.7
		00:04.3			00:04.7			00:05.6			00:07.4	
Max Stop Time	00:19.0	00:17.0	00:07.0	00:13.0	00:22.0	00:05.0	01:11.0	00:00.0	00:15.0	00:13.0	00:14.0	00:12.0
% of Vehicle Stopping	93.75%	84.05%	80.00%	62.50%	86.88%	60.00%	97.82%	0.00%	95.24%	100.00%	100.00%	100.00%
		84.47%			85.05%			97.60%			100.00%	
% of Platoon Stopping	94.74%	90.29%	100.00%	100.00%	94.10%	68.00%	98.66%	0.00%	94.44%	100.00%	100.00%	100.00%
		90.56%			92.57%			98.35%			100.00%	
% Stopping if Present	96.97%	87.13%	100.00%	66.67%	90.77%	56.67%						
		87.60%			88.62%							
% Stopping if Absent	86.67%	77.81%	75.00%	50.00%	79.71%	65.00%						
		78.15%			78.52%							
% Stopping if Opposing Left Turn Waiting		90.91%			91.43%							
% Stopping if No LT		83.96%			86.11%							

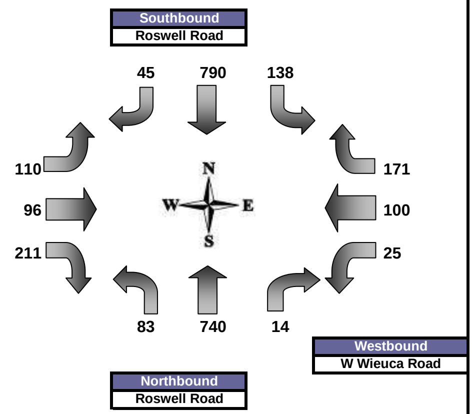
ORIENTATION AND LANE CONFIGURATION	NB	SB	EB	WB
	Towards Camera	Away From Camera	From Right Side	From Left Side
Left Turn Lanes	1	1	1	0
Left/Thru Lanes	0	0	0	0
Thru Only Lanes	1	1	0	0
Right/Thru Lanes	1	1	1	0
Right Turn Lanes	0	0	0	0
Left/Thru/Right Lanes	0	0	0	1
Left/Right Lanes	0	0	0	0
Total Lanes	3	3	2	1
State and Federal Routes	None	None	None	None
Functional Classification	Minor Arterial	Minor Arterial	Local	Local

Figure D.13 Piedmont Avevue and The Prado Traffic Conditions and Geometry

INTERSECTION	Roswell Road and W. Wieuca Road 1
STATUS & FLASH MODE	Malfunction Red/Red
CITY/COUNTY	Atlanta/Fulton
DATE	January 14 2006
DAY	Saturday
START TIME	11:20
END TIME	12:25
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



Eastbound
W Wieuca Road

KEY STATISTICS		
Major Volume for Duration of Video	1900	
Major Volume - first 60 min OR scaled up	1810	(First 60 Min.)
Minor Volume for Duration of Video	740	
Minor Volume - first 60 min OR scaled up	713	(First 60 Min.)
Minor:Major Volume Ratio	0.39	
Video Length in Minutes	62.53	
Percent Time Minor Vehicle Present	92.94%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		NB			SB			WB			EB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
11:20	11:25	4	56	2	11	65	5	0	9	17	10	10	12	201
11:25	11:30	6	46	3	7	61	1	0	11	10	9	9	20	183
11:30	11:35	3	59	2	10	72	5	4	5	11	13	6	23	213
11:35	11:40	11	69	0	12	67	3	2	10	14	6	7	16	217
11:40	11:45	9	65	1	15	67	2	0	7	9	9	7	12	203
11:45	11:50	9	61	1	13	64	3	0	13	16	9	8	21	218
11:50	11:55	7	68	0	11	62	4	3	7	9	9	9	28	217
11:55	12:00	5	72	1	12	68	2	4	9	16	14	0	21	224
12:00	12:05	4	48	1	18	64	9	4	7	18	9	7	9	198
12:05	12:10	9	62	1	14	56	2	3	5	18	10	9	20	209
12:10	12:15	8	57	1	9	66	4	3	8	19	9	15	13	212
12:15	12:20	8	77	1	6	78	5	2	9	14	3	9	16	228
12:20	12:25	5	37	1	7	39	1	1	5	4	3	4	10	117
TOTAL		88	777	15	145	829	46	26	105	175	113	100	221	2640

STOPPING	NB			SB			WB			EB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	70	626	13	134	716	27	18	61	115	109	93	199
Average Stop Time	00:08.9	00:07.3	00:05.5	00:10.2	00:06.7	00:04.9	00:08.4	00:07.7	00:06.3	00:11.3	00:09.4	00:07.0
		00:07.4			00:07.2			00:06.9			00:08.7	
Max Stop Time	00:32.0	00:55.0	00:09.0	00:43.0	00:23.0	00:15.0	00:18.0	00:28.0	00:27.0	01:02.0	00:28.0	00:30.0
% of Vehicle Stopping	79.55%	80.57%	86.67%	92.41%	86.37%	58.70%	69.23%	58.10%	65.71%	96.46%	93.00%	90.05%
		80.57%			85.98%			63.40%			92.40%	
% of Platoon Stopping	78.43%	87.12%	81.82%	94.64%	93.09%	60.00%	70.83%	57.89%	69.03%	98.36%	95.65%	95.83%
		85.95%			91.81%			65.88%			96.23%	
% Stopping if Present	81.71%	83.02%	84.62%	92.03%	87.64%	59.09%						
		82.91%			86.93%							
% Stopping if Absent	50.00%	57.89%	100.00%	100.00%	76.34%	50.00%						
		58.33%			77.45%							
% Stopping if Opposing Left Turn Waiting		78.95%			90.99%							
% Stopping if No LT		82.28%			84.89%							

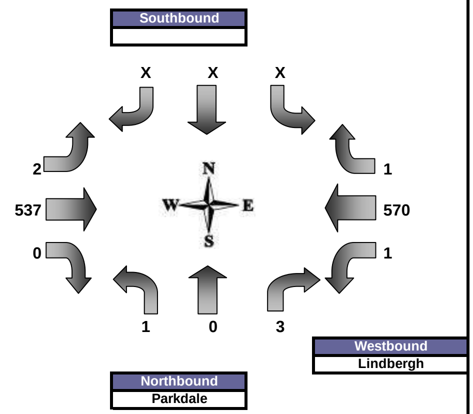
ORIENTATION AND LANE CONFIGURATION	NB	SB	WB	EB
	Towards Camera	Away From Camera	From Left Side	From Right Side
Left Turn Lanes	1	1	0	1
Left/Thru Lanes	0	0	1	0
Thru Only Lanes	1	1	0	0
Right/Thru Lanes	1	1	0	1
Right Turn Lanes	0	0	1	0
Left/Thru/Right Lanes	0	0	0	0
Left/Right Lanes	0	0	0	0
Total Lanes	3	3	2	2
State and Federal Routes	GA 9/US 19	GA 9/US 19	None	None
Functional Classification	Minor Arterial	Minor Arterial	Collector	Collector

Figure D.14 Roswell Road and W. Wieuca Road 1 Traffic Conditions and Geometry

INTERSECTION	Lindbergh Drive and Parkdale Place 2
STATUS & FLASH MODE	Beacon Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	February 15 2006
DAY	Wednesday
START TIME	7:45
END TIME	8:50
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	1143	
Major Volume - first 60 min OR scaled up	1111	(First 60 Min.)
Minor Volume for Duration of Video	4	
Minor Volume - first 60 min OR scaled up	4	(First 60 Min.)
Minor:Major Volume Ratio	0.00	
Video Length in Minutes	62.52	
Percent Time Minor Vehicle Present	1.28%	

CAR COUNT		Major Street Approach #1 EB			Major Street Approach #2 WB			Minor Street Approach #1 NB			Minor Street Approach #2			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
7:45	7:50	0	38	0	0	66	0	0	0	0	0	0	0	104
7:50	7:55	1	36	0	0	39	0	0	0	1	0	0	0	77
7:55	8:00	0	38	0	0	44	0	0	0	0	0	0	0	82
8:00	8:05	0	51	0	0	46	0	0	0	1	0	0	0	98
8:05	8:10	0	49	0	0	33	0	0	0	0	0	0	0	82
8:10	8:15	0	51	0	0	49	0	0	0	0	0	0	0	100
8:15	8:20	1	44	0	0	51	0	0	0	0	0	0	0	96
8:20	8:25	0	50	0	0	42	0	0	0	0	0	0	0	92
8:25	8:30	0	45	0	0	54	1	0	0	1	0	0	0	101
8:30	8:35	0	46	0	0	48	0	1	0	0	0	0	0	95
8:35	8:40	0	55	0	1	39	0	0	0	0	0	0	0	95
8:40	8:45	0	34	0	0	59	0	0	0	0	0	0	0	93
8:45	8:50	0	19	0	0	13	0	0	0	0	0	0	0	32
TOTAL		2	556	0	1	583	1	1	0	3	0	0	0	1147

STOPPING	EB			WB			NB					
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	0	0	0	1	0	0	1	0	3	0	0	0
Average Stop Time	00:00.0	00:00.0	00:00.0	00:04.0	00:00.0	00:00.0	00:05.0	00:00.0	00:09.0	00:00.0	00:00.0	00:00.0
		00:00.0			00:04.0			00:08.0			00:00.0	
Max Stop Time	00:00.0	00:00.0	00:00.0	00:04.0	00:00.0	00:00.0	00:05.0	00:00.0	00:22.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	100.00%	0.00%	100.00%	0.00%	0.00%	0.00%
		0.00%			0.17%			100.00%			0.00%	
% of Platoon Stopping	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	100.00%	0.00%	100.00%	0.00%	0.00%	0.00%
		0.00%			0.32%			100.00%			0.00%	
% Stopping if Present	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%						
		0.00%			0.00%							
% Stopping if Absent	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%						
		0.00%			0.17%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		0.00%			0.00%							

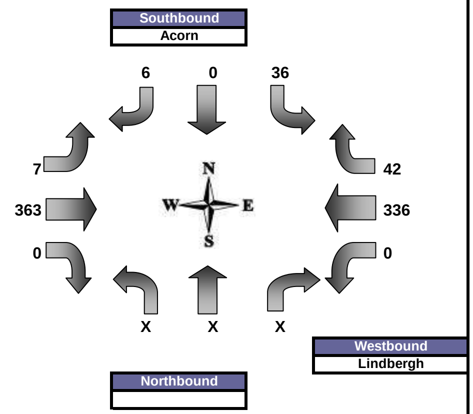
ORIENTATION AND LANE CONFIGURATION	EB Towards Camera	WB Away From Camera	NB From Right Side	From Left Side
Left Turn Lanes	0	0	0	-
Left/Thru Lanes	1	0	0	-
Thru Only Lanes	0	0	0	-
Right/Thru Lanes	0	1	0	-
Right Turn Lanes	0	0	0	-
Left/Thru/Right Lanes	0	0	0	-
Left/Right Lanes	0	0	1	-
Total Lanes	1	1	1	0
State and Federal Routes	GA 236	GA 236	None	-
Functional Classification	Minor Arterial	Minor Arterial	Local	-

Figure D.15 Lindbergh Drive and Parkdale Place 2 Traffic Conditions and Geometry

INTERSECTION	Lindbergh Drive and Acorn Avenue
STATUS & FLASH MODE	Beacon Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	February 17 2006
DAY	Friday
START TIME	7:00
END TIME	8:05
LIGHT CONDITIONS	Sunrise
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	790	
Major Volume - first 60 min OR scaled up	748	(First 60 Min.)
Minor Volume for Duration of Video	42	
Minor Volume - first 60 min OR scaled up	42	(First 60 Min.)
Minor:Major Volume Ratio	0.05	
Video Length in Minutes	62.37	
Percent Time Minor Vehicle Present	13.31%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		WB			EB			SB			NB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
7:00	7:05	0	20	3	1	28	0	1	0	0	0	0	0	53
7:05	7:10	0	19	1	0	21	0	2	0	0	0	0	0	43
7:10	7:15	0	13	2	1	33	0	4	0	0	0	0	0	53
7:15	7:20	0	17	1	0	22	0	4	0	1	0	0	0	45
7:20	7:25	0	23	1	0	33	0	2	0	0	0	0	0	59
7:25	7:30	0	28	1	1	30	0	5	0	1	0	0	0	66
7:30	7:35	0	24	1	0	44	0	2	0	1	0	0	0	72
7:35	7:40	0	42	4	1	27	0	0	0	0	0	0	0	74
7:40	7:45	0	31	2	1	32	0	4	0	1	0	0	0	71
7:45	7:50	0	45	9	0	32	0	2	0	0	0	0	0	88
7:50	7:55	0	45	12	1	29	0	5	0	1	0	0	0	93
7:55	8:00	0	29	5	1	32	0	5	0	1	0	0	0	73
8:00	8:05	0	18	3	1	20	0	0	0	0	0	0	0	42
TOTAL		0	354	45	8	383	0	36	0	6	0	0	0	832

STOPPING	WB			EB			SB			NB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	0	0	1	5	0	0	36	0	6	0	0	0
Average Stop Time	00:00.0	00:00.0	00:03.0	00:02.6	00:00.0	00:00.0	00:08.3	00:00.0	00:07.3	00:00.0	00:00.0	00:00.0
		00:03.0			00:02.6			00:08.1			00:00.0	
Max Stop Time	00:00.0	00:00.0	00:03.0	00:05.0	00:00.0	00:00.0	00:46.0	00:00.0	00:21.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	0.00%	0.00%	2.22%	62.50%	0.00%	0.00%	100.00%	0.00%	100.00%	0.00%	0.00%	0.00%
		0.25%			1.28%			100.00%			0.00%	
% of Platoon Stopping	0.00%	0.00%	2.56%	62.50%	0.00%	0.00%	100.00%	0.00%	100.00%	0.00%	0.00%	0.00%
		0.39%			1.71%			100.00%			0.00%	
% Stopping if Present	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%						
		0.00%			0.00%							
% Stopping if Absent	0.00%	0.00%	2.63%	71.43%	0.00%	0.00%						
		0.30%			1.44%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		0.00%			0.00%							

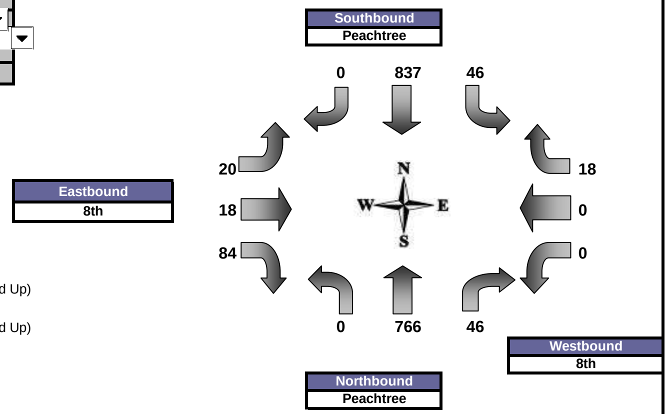
ORIENTATION AND LANE CONFIGURATION	WB	EB	SB	NB
	Towards Camera	Away From Camera	From Left Side	From Right Side
Left Turn Lanes	0	0	0	-
Left/Thru Lanes	0	1	0	-
Thru Only Lanes	0	0	0	-
Right/Thru Lanes	1	0	0	-
Right Turn Lanes	0	0	0	-
Left/Thru/Right Lanes	0	0	0	-
Left/Right Lanes	0	0	1	-
Total Lanes	1	1	1	0
State and Federal Routes	GA 236	GA 236	None	-
Functional Classification	Minor Arterial	Minor Arterial	Local	-

Figure D.16 Lindbergh Drive and Acorn Drive Traffic Conditions and Geometry

INTERSECTION	Peachtree Street and 8th Street
STATUS & FLASH MODE	New Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	March 1 2006
DAY	Wednesday
START TIME	17:10
END TIME	17:35
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	668	
Major Volume - first 60 min OR scaled up	1695	(Scaled Up)
Minor Volume for Duration of Video	55	
Minor Volume - first 60 min OR scaled up	140	(Scaled Up)
Minor:Major Volume Ratio	0.08	
Video Length in Minutes	23.65	
Percent Time Minor Vehicle Present	54.40%	

CAR COUNT		Major Street Approach #1 SB			Major Street Approach #2 NB			Minor Street Approach #1 EB			Minor Street Approach #2 WB			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
17:10	17:15	4	77	0	0	62	5	2	0	9	0	0	1	160
17:15	17:20	4	74	0	0	54	1	1	0	5	0	0	3	142
17:20	17:25	5	71	0	0	76	3	1	3	4	0	0	0	163
17:25	17:30	3	67	0	0	63	4	3	2	8	0	0	3	153
17:30	17:35	2	41	0	0	47	5	1	2	7	0	0	3	105
TOTAL		18	330	0	0	302	18	8	7	33	0	0	7	723

STOPPING	SB			NB			EB			WB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	9	18	0	0	24	7	8	7	28	0	0	7
Average Stop Time	00:13.2	00:05.3	00:00.0	00:00.0	00:03.5	00:02.4	00:07.7	00:16.3	00:14.9	00:00.0	00:00.0	00:06.7
		00:07.9			00:03.2			00:13.8			00:06.7	
Max Stop Time	00:33.0	00:12.0	00:00.0	00:00.0	00:08.0	00:06.0	00:17.0	00:58.0	00:42.0	00:00.0	00:00.0	00:18.0
% of Vehicle Stopping	50.00%	5.45%	0.00%	0.00%	7.95%	38.89%	100.00%	100.00%	84.85%	0.00%	0.00%	100.00%
		7.76%			9.69%			89.58%			100.00%	
% of Platoon Stopping	50.00%	11.21%	0.00%	0.00%	14.39%	40.00%	100.00%	100.00%	90.32%	0.00%	0.00%	100.00%
		15.13%			16.88%			93.48%			100.00%	
% Stopping if Present	53.85%	7.73%	0.00%	0.00%	8.82%	40.00%						
		10.45%			10.96%							
% Stopping if Absent	40.00%	1.63%	0.00%	0.00%	7.23%	37.50%						
		3.13%			8.62%							
% Stopping if Opposing Left Turn Waiting		0.00%			4.65%							
% Stopping if No LT		5.45%			8.37%							

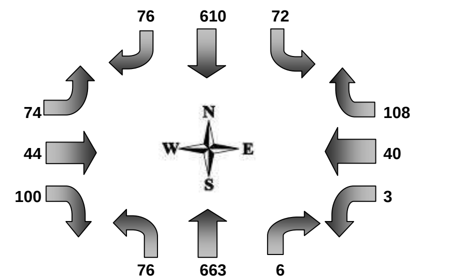
ORIENTATION AND LANE CONFIGURATION	SB Towards Camera	NB Away From Camera	EB From Left Side	WB From Right Side
Left Turn Lanes	0	0	0	0
Left/Thru Lanes	1	0	0	0
Thru Only Lanes	1	1	0	0
Right/Thru Lanes	0	1	0	0
Right Turn Lanes	0	0	0	0
Left/Thru/Right Lanes	0	0	1	1
Left/Right Lanes	0	0	0	0
Total Lanes	2	2	1	1
State and Federal Routes	None	None	None	None
Functional Classification	Minor Arterial	Minor Arterial	Local	Local

Figure D.17 Peachtree Street and 8th Street Traffic Conditions and Geometry

INTERSECTION	Roswell Road and W Wieuca Road 2
STATUS & FLASH MODE	Malfunction Red/Red
CITY/COUNTY	Atlanta/Fulton
DATE	March 5 2006
DAY	Sunday
START TIME	10:30
END TIME	11:25
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	1308	
Major Volume - first 60 min OR scaled up	1503	(Scaled Up)
Minor Volume for Duration of Video	321	
Minor Volume - first 60 min OR scaled up	369	(Scaled Up)
Minor:Major Volume Ratio	0.25	
Video Length in Minutes	52.22	
Percent Time Minor Vehicle Present	68.98%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		SB			NB			EB			WB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
10:30	10:35	1	50	3	3	67	0	6	5	7	0	4	13	159
10:35	10:40	5	52	7	3	61	1	8	2	6	0	5	11	161
10:40	10:45	9	52	7	4	41	0	2	3	8	0	3	14	143
10:45	10:50	6	66	8	1	57	1	7	4	13	0	3	9	175
10:50	10:55	8	43	6	9	54	0	8	4	8	0	3	8	151
10:55	11:00	6	45	9	10	57	1	4	6	9	1	4	7	159
11:00	11:05	7	51	5	12	41	0	11	1	7	0	5	8	148
11:05	11:10	5	57	4	9	51	1	2	2	7	1	3	4	146
11:10	11:15	6	52	6	8	59	0	7	1	11	0	3	7	160
11:15	11:20	6	43	5	4	56	1	6	9	6	0	2	6	144
11:20	11:25	4	20	6	3	33	0	3	1	5	1	0	7	83
TOTAL		63	531	66	66	577	5	64	38	87	3	35	94	1629

STOPPING	SB			NB			EB			WB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	63	467	36	63	486	5	60	36	77	3	32	81
Average Stop Time	00:07.1	00:04.9	00:03.2	00:06.1	00:04.9	00:04.4	00:09.2	00:08.4	00:04.9	00:08.3	00:08.7	00:05.3
		00:05.0			00:05.0			00:07.1			00:06.3	
Max Stop Time	00:24.0	00:18.0	00:09.0	00:20.0	00:34.0	00:07.0	00:34.0	00:31.0	00:33.0	00:17.0	00:25.0	00:17.0
% of Vehicle Stopping	100.00%	87.95%	54.55%	95.45%	84.23%	100.00%	93.75%	94.74%	88.51%	100.00%	91.43%	86.17%
		85.76%			85.49%			91.53%			87.88%	
% of Platoon Stopping	100.00%	90.85%	57.50%	92.50%	90.00%	100.00%	96.36%	97.22%	87.84%	100.00%	96.55%	88.64%
		88.03%			90.41%			92.73%			90.83%	
% Stopping if Present	100.00%	90.18%	60.87%	95.35%	86.43%	100.00%						
		87.83%			87.47%							
% Stopping if Absent	100.00%	84.39%	40.00%	95.65%	80.56%	100.00%						
		82.33%			82.16%							
% Stopping if Opposing Left Turn Waiting		92.50%			86.08%							
% Stopping if No LT		87.84%			83.19%							

ORIENTATION AND LANE CONFIGURATION	SB	NB	EB	WB
	Towards Camera	Away From Camera	From Left Side	From Right Side
Left Turn Lanes	1	1	1	0
Left/Thru Lanes	0	0	0	1
Thru Only Lanes	1	1	0	0
Right/Thru Lanes	1	1	1	0
Right Turn Lanes	0	0	0	1
Left/Thru/Right Lanes	0	0	0	0
Left/Right Lanes	0	0	0	0
Total Lanes	3	3	2	2
State and Federal Routes	GA 9/US 19	GA 9/US 19	None	None
Functional Classification	Minor Arterial	Minor Arterial	Collector	Collector

Figure D.18 Roswell Road and W. Wieuca Road 2 Traffic Conditions and Geometry

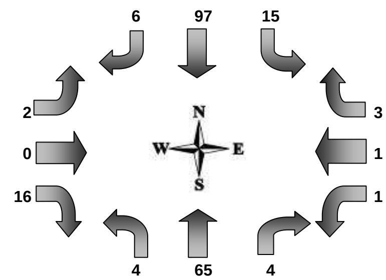
INTERSECTION	Techwood Drive and Merritts Avenue 1
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	March 7 2006
DAY	Tuesday
START TIME	22:00
END TIME	23:05
LIGHT CONDITIONS	Dark - Streetlights
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.

Southbound
Techwood

Eastbound
Merritts



Westbound
Merritts

Northbound
Techwood

KEY STATISTICS		
Major Volume for Duration of Video	197	
Major Volume - first 60 min OR scaled up	191	(First 60 Min.)
Minor Volume for Duration of Video	23	
Minor Volume - first 60 min OR scaled up	23	(First 60 Min.)
Minor:Major Volume Ratio	0.12	
Video Length in Minutes	62.50	
Percent Time Minor Vehicle Present	4.69%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		SB			NB			EB			WB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
22:00	22:05	1	12	0	0	4	0	0	0	1	0	0	0	18
22:05	22:10	1	9	0	0	9	1	1	0	3	0	0	0	24
22:10	22:15	1	7	2	2	8	1	1	0	2	0	0	1	25
22:15	22:20	2	7	0	1	4	1	0	0	1	0	0	0	16
22:20	22:25	2	9	0	0	3	0	0	0	0	0	0	1	15
22:25	22:30	0	5	1	0	6	0	0	0	3	1	0	1	17
22:30	22:35	3	7	2	0	4	0	0	0	1	0	0	0	17
22:35	22:40	0	9	0	1	5	0	0	0	2	0	0	0	17
22:40	22:45	1	5	0	0	0	0	0	0	0	0	1	0	7
22:45	22:50	3	11	0	0	7	1	0	0	1	0	0	0	23
22:50	22:55	1	8	0	0	8	0	0	0	1	0	0	0	18
22:55	23:00	0	8	1	0	7	0	0	0	1	0	0	0	17
23:00	23:05	1	4	0	0	1	0	0	0	0	0	0	0	6
TOTAL		16	101	6	4	66	4	2	0	16	1	1	3	220

STOPPING	SB			NB			EB			WB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	2	2	0	2	6	0	1	0	3	1	1	2
Average Stop Time	00:07.0	00:01.0	00:00.0	00:04.5	00:03.3	00:00.0	00:06.0	00:00.0	00:04.7	00:04.0	00:52.0	00:04.0
		00:04.0			00:03.6			00:05.0			00:16.0	
Max Stop Time	00:12.0	00:02.0	00:00.0	00:07.0	00:05.0	00:00.0	00:06.0	00:00.0	00:06.0	00:04.0	00:52.0	00:05.0
% of Vehicle Stopping	12.50%	1.98%	0.00%	50.00%	9.09%	0.00%	50.00%	0.00%	18.75%	100.00%	100.00%	66.67%
		3.25%			10.81%			22.22%			80.00%	
% of Platoon Stopping	12.50%	2.17%	0.00%	50.00%	10.17%	0.00%	50.00%	0.00%	18.75%	100.00%	100.00%	66.67%
		3.54%			11.94%			22.22%			80.00%	
% Stopping if Present	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%						
		20.00%			0.00%							
% Stopping if Absent	6.67%	2.04%	0.00%	50.00%	9.68%	0.00%						
		2.54%			11.43%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		1.98%			9.23%							

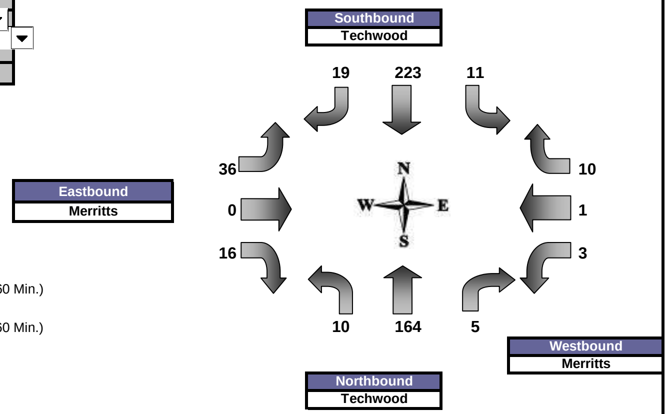
ORIENTATION AND LANE CONFIGURATION	SB	NB	EB	WB
	Towards Camera	Away From Camera	From Left Side	From Right Side
Left Turn Lanes	0	0	0	0
Left/Thru Lanes	0	0	0	0
Thru Only Lanes	0	0	0	0
Right/Thru Lanes	0	0	0	0
Right Turn Lanes	0	0	0	0
Left/Thru/Right Lanes	1	1	1	1
Left/Right Lanes	0	0	0	0
Total Lanes	1	1	1	1
State and Federal Routes	None	None	None	None
Functional Classification	Minor Arterial	Minor Arterial	Local	Local

Figure D.19 Techwood Drive and Merritts Avenue 1 Traffic Conditions and Geometry

INTERSECTION	Techwood Drive and Merritts Avenue 2
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	March 9 2006
DAY	Thursday
START TIME	17:20
END TIME	18:25
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	456	
Major Volume - first 60 min OR scaled up	432	(First 60 Min.)
Minor Volume for Duration of Video	67	
Minor Volume - first 60 min OR scaled up	66	(First 60 Min.)
Minor:Major Volume Ratio	0.15	
Video Length in Minutes	62.62	
Percent Time Minor Vehicle Present	15.76%	

CAR COUNT		Major Street Approach #1 SB			Major Street Approach #2 NB			Minor Street Approach #1 EB			Minor Street Approach #2 WB			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
17:20	17:25	1	23	2	1	13	0	1	0	3	0	0	0	44
17:25	17:30	0	23	4	1	12	0	7	0	1	0	0	2	50
17:30	17:35	1	23	1	1	16	0	4	0	0	1	0	0	47
17:35	17:40	2	31	2	0	19	1	2	0	1	0	0	2	60
17:40	17:45	0	19	1	0	17	0	1	0	1	0	0	2	41
17:45	17:50	1	16	0	3	21	1	1	0	2	1	1	0	47
17:50	17:55	1	17	3	1	12	0	3	0	1	0	0	0	38
17:55	18:00	3	16	1	0	12	0	3	0	3	0	0	0	38
18:00	18:05	0	16	2	1	7	0	3	0	1	0	0	2	32
18:05	18:10	0	7	0	1	12	2	0	0	1	1	0	1	25
18:10	18:15	1	16	1	1	11	1	5	0	1	0	0	0	37
18:15	18:20	1	16	2	0	12	0	6	0	1	0	0	1	39
18:20	18:25	1	10	2	1	10	0	1	0	0	0	0	0	25
TOTAL		12	233	21	11	174	5	37	0	16	3	1	10	523

STOPPING	SB			NB			EB			WB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	3	19	2	2	4	0	35	0	11	3	1	10
Average Stop Time	00:04.7	00:04.2	00:06.5	00:03.5	00:03.3	00:00.0	00:07.1	00:00.0	00:03.5	00:01.3	00:22.0	00:04.0
		00:04.4			00:03.3			00:06.2			00:04.7	
Max Stop Time	00:09.0	00:19.0	00:12.0	00:05.0	00:05.0	00:00.0	00:21.0	00:00.0	00:12.0	00:03.0	00:22.0	00:07.0
% of Vehicle Stopping	25.00%	8.15%	9.52%	18.18%	2.30%	0.00%	94.59%	0.00%	68.75%	100.00%	100.00%	100.00%
		9.02%			3.16%			86.79%			100.00%	
% of Platoon Stopping	27.27%	10.33%	11.11%	22.22%	2.11%	0.00%	94.59%	0.00%	66.67%	100.00%	100.00%	100.00%
		11.27%			3.25%			86.54%			100.00%	
% Stopping if Present	0.00%	9.62%	0.00%	0.00%	6.67%	0.00%						
		9.43%			6.06%							
% Stopping if Absent	25.00%	7.73%	10.00%	22.22%	1.39%	0.00%						
		8.92%			2.55%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		8.30%			2.35%							

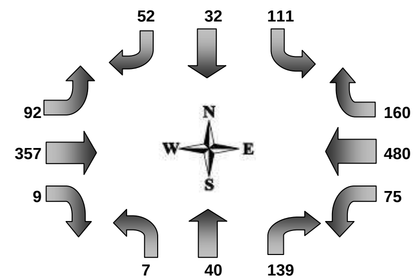
ORIENTATION AND LANE CONFIGURATION	SB Towards Camera	NB Away From Camera	EB From Left Side	WB From Right Side
Left Turn Lanes	0	0	0	0
Left/Thru Lanes	0	0	0	0
Thru Only Lanes	0	0	0	0
Right/Thru Lanes	0	0	0	0
Right Turn Lanes	0	0	0	0
Left/Thru/Right Lanes	1	1	1	1
Left/Right Lanes	0	0	0	0
Total Lanes	1	1	1	1
State and Federal Routes	None	None	None	None
Functional Classification	Minor Arterial	Minor Arterial	Local	Local

Figure D.20 Techwood Drive and Merritts Avenue 2 Traffic Conditions and Geometry

INTERSECTION	17th Street and Market Street
STATUS & FLASH MODE	Malfunction Red/Red
CITY/COUNTY	Atlanta/Fulton
DATE	March 9 2006
DAY	Thursday
START TIME	15:50
END TIME	16:55
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	1228	
Major Volume - first 60 min OR scaled up	1173	(First 60 Min.)
Minor Volume for Duration of Video	403	
Minor Volume - first 60 min OR scaled up	381	(First 60 Min.)
Minor:Major Volume Ratio	0.33	
Video Length in Minutes	62.67	
Percent Time Minor Vehicle Present	74.47%	

CAR COUNT		Major Street Approach #1 WB			Major Street Approach #2 EB			Minor Street Approach #1 NB			Minor Street Approach #2 SB			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
15:50	15:55	7	28	11	10	25	0	0	1	7	13	3	4	109
15:55	16:00	9	40	9	5	19	4	0	5	11	4	1	6	113
16:00	16:05	3	45	11	5	40	2	2	5	12	11	2	7	145
16:05	16:10	4	30	15	8	24	0	0	2	10	7	3	4	107
16:10	16:15	6	38	12	10	38	0	0	1	13	7	3	6	134
16:15	16:20	6	42	13	2	35	0	1	3	11	6	2	2	123
16:20	16:25	7	42	18	8	21	1	1	1	12	11	1	1	124
16:25	16:30	8	47	10	6	33	0	0	2	13	10	7	6	142
16:30	16:35	9	37	15	8	23	0	0	6	6	10	3	3	120
16:35	16:40	7	42	13	12	33	0	1	5	12	11	0	5	141
16:40	16:45	5	43	22	8	38	2	2	6	17	14	7	1	165
16:45	16:50	4	46	11	10	28	0	0	3	15	7	0	7	131
16:50	16:55	3	24	9	2	15	2	2	3	5	9	0	3	77
TOTAL		78	504	169	94	372	11	9	43	144	120	32	55	1631

STOPPING	WB			EB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	70	443	52	85	306	4	9	41	120	112	30	48
Average Stop Time	00:07.7	00:06.2	00:03.7	00:10.6	00:05.5	00:04.8	00:10.4	00:09.2	00:05.8	00:08.3	00:10.1	00:05.9
		00:06.2			00:06.6			00:06.8			00:08.0	
Max Stop Time	00:21.0	00:41.0	00:10.0	01:08.0	00:39.0	00:08.0	00:17.0	00:28.0	00:32.0	00:31.0	00:25.0	00:25.0
% of Vehicle Stopping	89.74%	87.90%	30.77%	90.43%	82.26%	36.36%	100.00%	95.35%	83.33%	93.33%	93.75%	87.27%
		75.23%			82.81%			86.73%			91.79%	
% of Platoon Stopping	88.89%	88.61%	39.36%	92.42%	82.14%	28.57%	100.00%	97.44%	86.40%	95.19%	96.67%	91.11%
		77.62%			83.08%			89.53%			94.41%	
% Stopping if Present	93.10%	91.22%	34.43%	95.89%	85.24%	40.00%						
		78.42%			86.16%							
% Stopping if Absent	80.00%	80.13%	21.28%	71.43%	74.26%	0.00%						
		67.43%			73.17%							
% Stopping if Opposing Left Turn Waiting		91.84%			85.71%							
% Stopping if No LT		85.31%			81.79%							

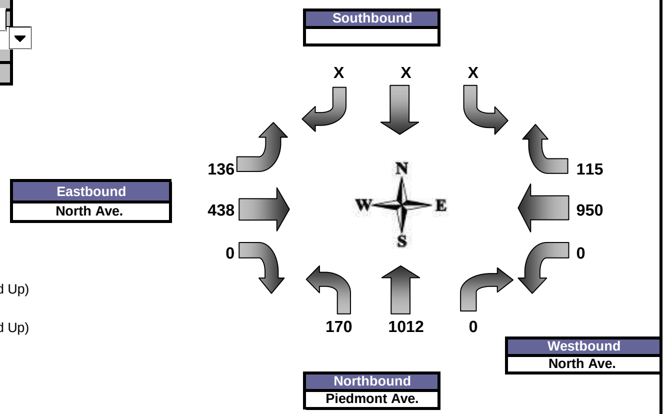
ORIENTATION AND LANE CONFIGURATION	WB Towards Camera	EB Away From Camera	NB From Right Side	SB From Left Side
Left Turn Lanes	1	1	1	2
Left/Thru Lanes	0	0	0	0
Thru Only Lanes	2	2	1	0
Right/Thru Lanes	1	1	1	1
Right Turn Lanes	0	0	0	0
Left/Thru/Right Lanes	0	0	0	0
Left/Right Lanes	0	0	0	0
Total Lanes	4	4	3	3
State and Federal Routes	None	None	None	None
Functional Classification	Collector	Collector	Local	Local

Figure D.21 17th Street and Market Street Traffic Conditions and Geometry

INTERSECTION	North Avenue and Piedmont Avenue
STATUS & FLASH MODE	Malfunction Red/Red
CITY/COUNTY	Atlanta/Fulton
DATE	March 10 2006
DAY	Friday
START TIME	9:00
END TIME	9:20
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	471	
Major Volume - first 60 min OR scaled up	1638	(Scaled Up)
Minor Volume for Duration of Video	340	
Minor Volume - first 60 min OR scaled up	1183	(Scaled Up)
Minor:Major Volume Ratio	0.72	
Video Length in Minutes	17.25	
Percent Time Minor Vehicle Present	96.14%	

CAR COUNT		Major Street Approach #1 EB			Major Street Approach #2 WB			Minor Street Approach #1 NB			Minor Street Approach #2			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
9:00	9:05	13	33	0	0	80	8	21	85	0	0	0	0	240
9:05	9:10	13	43	0	0	94	9	14	91	0	0	0	0	264
9:10	9:15	11	46	0	0	72	13	12	91	0	0	0	0	245
9:15	9:20	2	4	0	0	27	3	2	24	0	0	0	0	62
TOTAL		39	126	0	0	273	33	49	291	0	0	0	0	811

STOPPING	EB			WB			NB					
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	39	105	0	0	206	25	35	244	0	0	0	0
Average Stop Time	00:13.4	00:09.1	00:00.0	00:00.0	00:08.9	00:07.8	00:10.5	00:09.3	00:00.0	00:00.0	00:00.0	00:00.0
		00:10.3			00:08.8			00:09.4			00:00.0	
Max Stop Time	00:47.0	00:25.0	00:00.0	00:00.0	00:20.0	00:16.0	00:27.0	00:34.0	00:00.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	100.00%	83.33%	0.00%	0.00%	75.46%	75.76%	71.43%	83.85%	0.00%	0.00%	0.00%	0.00%
		87.27%			75.49%			82.06%			0.00%	
% of Platoon Stopping	100.00%	93.55%	0.00%	0.00%	91.86%	100.00%	60.00%	93.90%	0.00%	0.00%	0.00%	0.00%
		95.12%			92.31%			90.22%			0.00%	
% Stopping if Present	100.00%	83.33%	0.00%	0.00%	76.12%	75.76%						
		87.27%			76.08%							
% Stopping if Absent	0.00%	0.00%	0.00%	0.00%	40.00%	0.00%						
		0.00%			40.00%							
% Stopping if Opposing Left Turn Waiting		0.00%			74.10%							
% Stopping if No LT		83.33%			78.10%							

ORIENTATION AND LANE CONFIGURATION	EB Towards Camera	WB Away From Camera	NB From Left Side	From Right Side
Left Turn Lanes	0	0	0	-
Left/Thru Lanes	1	0	1	-
Thru Only Lanes	2	2	3	-
Right/Thru Lanes	0	1	0	-
Right Turn Lanes	0	0	0	-
Left/Thru/Right Lanes	0	0	0	-
Left/Right Lanes	0	0	0	-
Total Lanes	3	3	4	0
State and Federal Routes	GA8/US29/US78/US278	None	None	-
Functional Classification	Principal Arterial	Minor Arterial	Minor Arterial	-

Figure D.22 North Avenue and Piedmont Avenue Traffic Conditions and Geometry

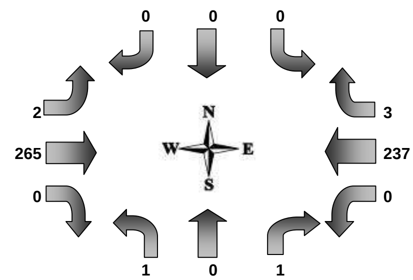
INTERSECTION	E Rock Springs Road and Barclay Place
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	March 12 2006
DAY	Sunday
START TIME	17:30
END TIME	18:35
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.

Southbound
Barclay Place

Eastbound
East Rock Springs Road



Westbound
East Rock Springs Road

Northbound
School Parking Lot

KEY STATISTICS		
Major Volume for Duration of Video	525	
Major Volume - first 60 min OR scaled up	507	(First 60 Min.)
Minor Volume for Duration of Video	2	
Minor Volume - first 60 min OR scaled up	2	(First 60 Min.)
Minor:Major Volume Ratio	0.00	
Video Length in Minutes	62.47	
Percent Time Minor Vehicle Present	0.59%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		WB			EB			SB			NB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
17:30	17:35	0	29	1	0	21	0	0	0	0	0	0	0	51
17:35	17:40	0	17	0	0	26	0	0	0	0	0	0	1	44
17:40	17:45	0	23	0	1	25	0	0	0	0	0	0	0	49
17:45	17:50	0	18	0	0	23	0	0	0	0	0	0	0	41
17:50	17:55	0	16	0	0	19	0	0	0	0	0	0	0	35
17:55	18:00	0	29	0	0	24	0	0	0	0	0	0	0	53
18:00	18:05	0	12	0	0	16	0	0	0	0	0	0	0	28
18:05	18:10	0	17	0	0	26	0	0	0	0	0	0	0	43
18:10	18:15	0	27	1	0	27	0	0	0	0	0	0	0	55
18:15	18:20	0	16	0	0	19	0	0	0	0	0	0	0	35
18:20	18:25	0	17	0	1	17	0	0	0	0	0	0	0	35
18:25	18:30	0	16	1	0	22	0	0	0	0	1	0	0	40
18:30	18:35	0	6	0	0	12	0	0	0	0	0	0	0	18
TOTAL		0	243	3	2	277	0	0	0	0	1	0	1	527

STOPPING	WB			EB			SB			NB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	0	0	0	1	0	0	0	0	0	1	0	1
Average Stop Time	00:00.0	00:00.0	00:00.0	00:02.0	00:00.0	00:00.0	00:00.0	00:00.0	00:00.0	00:03.0	00:00.0	00:11.0
		00:00.0			00:02.0			00:00.0			00:07.0	
Max Stop Time	00:00.0	00:00.0	00:00.0	00:02.0	00:00.0	00:00.0	00:00.0	00:00.0	00:00.0	00:03.0	00:00.0	00:11.0
% of Vehicle Stopping	0.00%	0.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	100.00%
		0.00%			0.36%			0.00%			100.00%	
% of Platoon Stopping	0.00%	0.00%	0.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	100.00%
		0.00%			0.45%			0.00%			100.00%	
% Stopping if Present	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%						
		0.00%			0.00%							
% Stopping if Absent	0.00%	0.00%	0.00%	50.00%	0.00%	0.00%						
		0.00%			0.36%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		0.00%			0.00%							

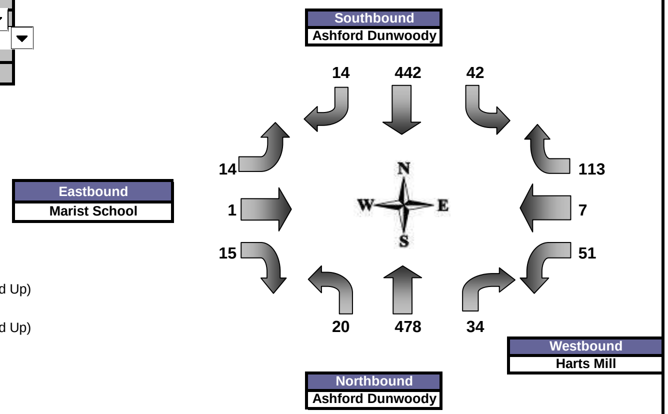
ORIENTATION AND LANE CONFIGURATION	WB	EB	SB	NB
	Towards Camera	Away From Camera	From Left Side	From Right Side
Left Turn Lanes	0	0	0	0
Left/Thru Lanes	0	0	0	0
Thru Only Lanes	0	0	0	0
Right/Thru Lanes	0	0	0	0
Right Turn Lanes	0	0	0	0
Left/Thru/Right Lanes	1	1	1	1
Left/Right Lanes	0	0	0	0
Total Lanes	1	1	1	1
State and Federal Routes	None	None	None	None
Functional Classification	Collector	Collector	Local	Local

Figure D.23 E. Rock Springs Road and Barclay Place Traffic Conditions and Geometry

INTERSECTION	Ashford Dunwoody Rd and Harts Mill Rd
STATUS & FLASH M0DE	Malfunction Yellow/Red
CITY/COUNTY	(unincorporated area)/DeKalb
DATE	March 14 2006
DAY	Tuesday
START TIME	9:20
END TIME	10:10
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	829	
Major Volume - first 60 min OR scaled up	1030	(Scaled Up)
Minor Volume for Duration of Video	162	
Minor Volume - first 60 min OR scaled up	201	(Scaled Up)
Minor:Major Volume Ratio	0.20	
Video Length in Minutes	48.28	
Percent Time Minor Vehicle Present	49.09%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		SB			NB			WB			EB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
9:20	9:25	4	27	3	2	44	3	1	3	16	1	0	1	105
9:25	9:30	4	42	2	3	49	2	6	1	12	1	0	2	124
9:30	9:35	2	40	0	1	44	2	7	2	7	3	0	1	109
9:35	9:40	1	28	1	2	43	1	6	0	12	1	0	1	96
9:40	9:45	4	41	2	0	41	3	5	0	10	0	0	2	108
9:45	9:50	3	44	0	3	34	3	4	0	9	0	0	2	102
9:50	9:55	3	40	2	1	41	2	5	0	11	0	1	0	106
9:55	10:00	4	32	0	4	37	6	1	0	7	3	0	0	94
10:00	10:05	7	37	1	0	36	2	3	0	4	2	0	2	94
10:05	10:10	2	25	0	0	16	3	3	0	3	0	0	1	53
TOTAL		34	356	11	16	385	27	41	6	91	11	1	12	991

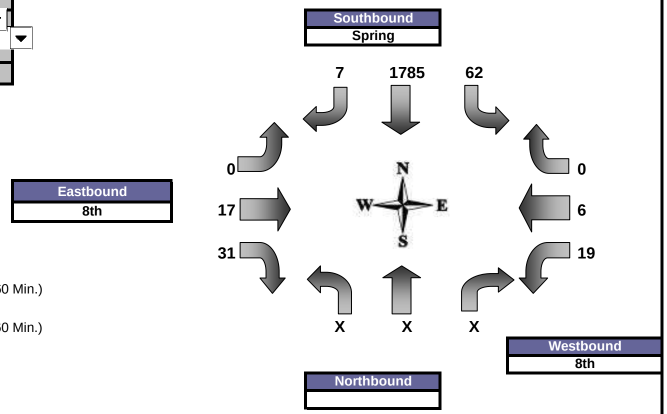
STOPPING	SB			NB			WB			EB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	14	23	1	6	25	0	38	5	51	11	1	8
Average Stop Time	00:10.1	00:04.1	06:40.0	00:08.8	00:03.9	00:00.0	00:12.9	00:09.8	00:07.5	00:15.3	00:22.0	00:08.6
		00:16.8			00:04.8			00:09.8			00:13.0	
Max Stop Time	00:35.0	00:13.0	06:40.0	00:23.0	00:07.0	00:00.0	00:43.0	00:25.0	00:32.0	00:44.0	00:22.0	00:31.0
% of Vehicle Stopping	41.18%	6.46%	9.09%	37.50%	6.49%	0.00%	92.68%	83.33%	56.04%	100.00%	100.00%	66.67%
		9.48%			7.24%			68.12%			83.33%	
% of Platoon Stopping	48.00%	10.40%	0.00%	30.77%	10.13%	0.00%	94.74%	75.00%	60.00%	100.00%	100.00%	66.67%
		14.10%			10.29%			71.79%			83.33%	
% Stopping if Present	42.86%	9.68%	12.50%	50.00%	9.35%	0.00%						
		13.02%			9.96%							
% Stopping if Absent	38.46%	2.94%	0.00%	30.00%	2.92%	0.00%						
		5.38%			4.06%							
% Stopping if Opposing Left Turn Waiting		6.25%			5.26%							
% Stopping if No LT		6.21%			6.73%							

ORIENTATION AND LANE CONFIGURATION	SB	NB	WB	EB
	Towards Camera	Away From Camera	From Right Side	From Left Side
Left Turn Lanes	1	1	1	1
Left/Thru Lanes	0	0	0	0
Thru Only Lanes	1	0	0	0
Right/Thru Lanes	0	1	1	1
Right Turn Lanes	1	0	0	0
Left/Thru/Right Lanes	0	0	0	0
Left/Right Lanes	0	0	0	0
Total Lanes	3	2	2	2
State and Federal Routes	None	None	None	None
Functional Classification	Principal Arterial	Principal Arterial	Collector	Collector

Figure D.24 Ashford Dunwoody Road and Harts Mill Road Traffic Conditions and Geometry

INTERSECTION	Spring Street and 8th Street
STATUS & FLASH MODE	New Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	March 15 2006
DAY	Wednesday
START TIME	8:00
END TIME	9:05
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes
Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	1934	
Major Volume - first 60 min OR scaled up	1854	(First 60 Min.)
Minor Volume for Duration of Video	74	
Minor Volume - first 60 min OR scaled up	73	(First 60 Min.)
Minor:Major Volume Ratio	0.04	
Video Length in Minutes	62.55	
Percent Time Minor Vehicle Present	31.79%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		SB			0			EB			WB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	8:05	7	139	0	0	0	0	0	1	1	1	0	0	149
8:05	8:10	5	155	0	0	0	0	0	2	2	1	1	0	166
8:10	8:15	5	151	0	0	0	0	0	2	3	1	0	0	162
8:15	8:20	2	132	0	0	0	0	0	0	0	2	1	0	137
8:20	8:25	6	138	0	0	0	0	0	3	3	0	0	0	150
8:25	8:30	1	156	0	0	0	0	0	0	5	2	1	0	165
8:30	8:35	6	151	2	0	0	0	0	2	2	3	0	0	166
8:35	8:40	8	156	1	0	0	0	0	1	2	1	0	0	169
8:40	8:45	7	152	1	0	0	0	0	1	3	3	0	0	167
8:45	8:50	7	136	2	0	0	0	0	0	3	2	1	0	151
8:50	8:55	3	156	0	0	0	0	0	3	2	1	1	0	166
8:55	9:00	5	163	1	0	0	0	0	2	5	2	1	0	179
9:00	9:05	5	75	0	0	0	0	0	1	0	0	0	0	81
TOTAL		67	1860	7	0	0	0	0	18	31	19	6	0	2008

STOPPING	SB			0.0%			EB			WB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	6	24	0	0	0	0	0	18	29	15	6	0
Average Stop Time	00:03.0	00:04.4	00:00.0	00:00.0	00:00.0	00:00.0	00:00.0	00:12.1	00:13.6	00:13.2	00:24.3	00:00.0
		00:04.1			00:00.0			00:13.0			00:16.4	
Max Stop Time	00:06.0	00:16.0	00:00.0	00:00.0	00:00.0	00:00.0	00:00.0	00:53.0	00:42.0	00:29.0	01:12.0	00:00.0
% of Vehicle Stopping	8.96%	1.29%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	93.55%	78.95%	100.00%	0.00%
		1.55%			0.00%			95.92%			84.00%	
% of Platoon Stopping	5.00%	3.28%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	96.67%	78.95%	100.00%	0.00%
		3.36%			0.00%			97.92%			84.00%	
% Stopping if Present	6.67%	2.44%	0.00%	0.00%	0.00%	0.00%						
		2.52%			0.00%							
% Stopping if Absent	9.62%	0.60%	0.00%	0.00%	0.00%	0.00%						
		0.98%			0.00%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		1.29%			0.00%							

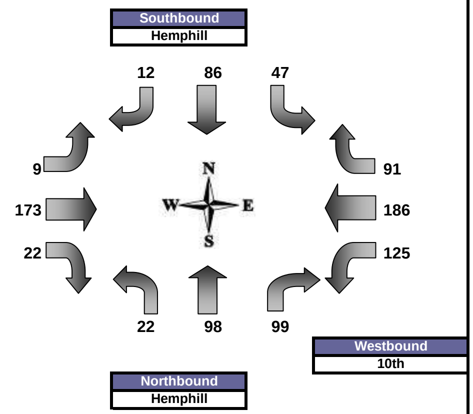
ORIENTATION AND LANE CONFIGURATION	SB	NB	EB	WB
	Towards Camera	Away From Camera	From Left Side	From Right Side
Left Turn Lanes	0	-	0	0
Left/Thru Lanes	1	-	0	1
Thru Only Lanes	2	-	0	0
Right/Thru Lanes	1	-	1	0
Right Turn Lanes	0	-	0	0
Left/Thru/Right Lanes	0	-	0	0
Left/Right Lanes	0	-	0	0
Total Lanes	4	0	1	1
State and Federal Routes	None	None	None	None
Functional Classification	Minor Arterial	-	Local	Local

Figure D.25 Spring Street and 8th Street Traffic Conditions and Geometry

INTERSECTION	10th Street and Hemphill Avenue 1		
STATUS & FLASH MODE	Malfunction Yellow/Red		
CITY/COUNTY	Atlanta/Fulton		
DATE	April	4	2006
DAY	Tuesday		
START TIME	20:45		
END TIME	21:50		
LIGHT CONDITIONS	Dark - Streetlights		
WEATHER	Clear		

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	629	
Major Volume - first 60 min OR scaled up	606	(First 60 Min.)
Minor Volume for Duration of Video	380	
Minor Volume - first 60 min OR scaled up	364	(First 60 Min.)
Minor:Major Volume Ratio	0.60	
Video Length in Minutes	62.55	
Percent Time Minor Vehicle Present	75.43%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of
		Westbound			Eastbound			Southbound			Northbound			Entering
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Vehicles
20:45	20:50	10	13	6	1	12	1	2	11	3	3	11	7	80
20:50	20:55	13	17	10	1	19	0	4	7	0	1	8	9	89
20:55	21:00	6	12	1	1	21	3	6	6	1	2	6	7	72
21:00	21:05	9	21	6	0	18	3	3	4	0	2	7	8	81
21:05	21:10	7	13	11	1	16	1	9	7	1	2	5	16	89
21:10	21:15	12	15	8	1	20	1	4	4	1	1	7	7	81
21:15	21:20	12	19	10	0	11	2	1	9	0	1	12	7	84
21:20	21:25	15	19	4	0	13	0	4	8	1	3	7	6	80
21:25	21:30	9	23	10	0	9	3	2	11	2	3	12	11	95
21:30	21:35	9	5	9	2	9	3	1	5	1	1	4	9	58
21:35	21:40	11	16	8	0	11	1	6	7	1	3	5	7	76
21:40	21:45	12	13	8	2	14	4	5	7	1	0	14	5	85
21:45	21:50	2	8	0	1	10	2	2	5	1	1	3	4	39
TOTAL		127	194	91	10	183	24	49	91	13	23	101	103	1009

STOPPING	Westbound			Eastbound			Southbound			Northbound		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	74	94	40	7	78	17	43	83	9	21	98	75
Average Stop Time	00:05.2	00:07.0	00:05.9	00:07.7	00:06.6	00:03.9	00:10.7	00:09.0	00:04.8	00:09.5	00:09.8	00:05.3
		00:06.2			00:06.2			00:09.3			00:08.0	
Max Stop Time	00:16.0	00:44.0	00:23.0	00:12.0	00:33.0	00:10.0	00:50.0	00:26.0	00:09.0	00:22.0	00:51.0	00:21.0
% of Vehicle Stopping	58.27%	48.45%	43.96%	70.00%	42.62%	70.83%	87.76%	91.21%	69.23%	91.30%	97.03%	72.82%
		50.49%			47.00%			88.24%			85.46%	
% of Platoon Stopping	61.11%	51.97%	53.13%	75.00%	45.45%	71.43%	93.48%	95.40%	100.00%	95.45%	98.96%	86.59%
		55.16%			50.00%			95.07%			93.50%	
% Stopping if Present	62.77%	55.10%	41.27%	70.00%	52.76%	73.68%						
		54.61%			56.41%							
% Stopping if Absent	45.45%	27.66%	50.00%	0.00%	19.64%	60.00%						
		38.89%			22.95%							
% Stopping if Opposing Left Turn Waiting		50.00%			40.91%							
% Stopping if No LT		48.44%			41.89%							

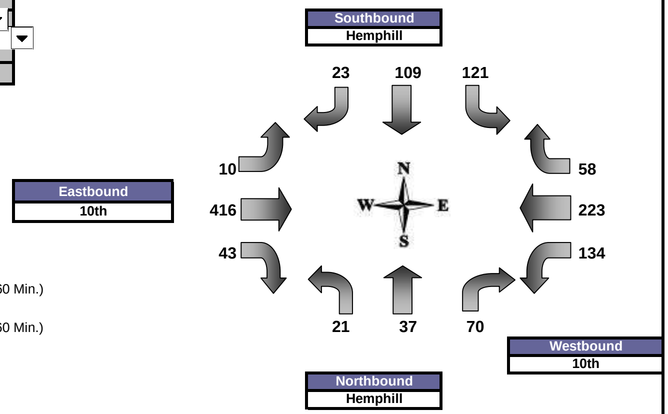
ORIENTATION AND LANE CONFIGURATION	Westbound Towards Camera	Eastbound Away From Camera	Southbound From Left Side	Northbound From Right Side
Left Turn Lanes	0	0	0	0
Left/Thru Lanes	1	1	1	1
Thru Only Lanes	0	0	0	0
Right/Thru Lanes	1	1	0	1
Right Turn Lanes	0	0	1	0
Left/Thru/Right Lanes	0	0	0	0
Left/Right Lanes	0	0	0	0
Total Lanes	2	2	2	2
State and Federal Routes	None	None	None	None
Functional Classification	Minor Arterial	Minor Arterial	Local	Local

Figure D.26 10th Street and Hemphill Avenue 1 Traffic Conditions and Geometry

INTERSECTION	10th Street and Hemphill Avenue 2
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	April 5 2006
DAY	Wednesday
START TIME	7:40
END TIME	8:45
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	921	
Major Volume - first 60 min OR scaled up	884	(First 60 Min.)
Minor Volume for Duration of Video	395	
Minor Volume - first 60 min OR scaled up	381	(First 60 Min.)
Minor:Major Volume Ratio	0.43	
Video Length in Minutes	62.55	
Percent Time Minor Vehicle Present	79.54%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		WB			EB			SB			NB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
7:40	7:45	11	14	6	0	36	2	11	4	0	0	1	4	89
7:45	7:50	12	10	7	0	25	0	10	9	3	1	6	5	88
7:50	7:55	11	24	4	2	23	5	9	10	3	2	3	12	108
7:55	8:00	19	25	2	1	37	4	12	14	2	0	9	4	129
8:00	8:05	11	27	4	1	39	5	15	11	3	3	2	6	127
8:05	8:10	8	19	4	1	35	4	10	6	1	3	4	9	104
8:10	8:15	7	11	6	2	34	3	9	11	1	0	2	7	93
8:15	8:20	11	27	4	0	35	6	9	7	1	4	2	2	108
8:20	8:25	11	10	7	0	38	4	17	7	3	1	3	4	105
8:25	8:30	13	21	3	2	33	5	9	11	3	2	0	4	106
8:30	8:35	11	16	6	1	48	1	6	11	0	2	1	8	111
8:35	8:40	9	19	5	0	33	4	4	8	3	3	4	5	97
8:40	8:45	2	15	1	0	16	3	3	8	0	1	1	1	51
TOTAL		136	238	59	10	432	46	124	117	23	22	38	71	1316

STOPPING	WB			EB			SB			NB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	73	114	26	10	307	33	113	101	19	19	35	62
Average Stop Time	00:07.9	00:07.2	00:06.2	00:09.7	00:09.2	00:05.6	00:08.5	00:07.6	00:06.4	00:08.7	00:10.5	00:07.7
		00:07.3			00:08.8			00:07.9			00:08.7	
Max Stop Time	00:19.0	00:24.0	00:40.0	00:30.0	00:40.0	00:19.0	00:38.0	00:22.0	00:19.0	00:20.0	00:28.0	00:26.0
% of Vehicle Stopping	53.68%	47.90%	44.07%	100.00%	71.06%	71.74%	91.13%	86.32%	82.61%	86.36%	92.11%	87.32%
		49.19%			71.72%			88.26%			88.55%	
% of Platoon Stopping	58.41%	51.98%	47.73%	100.00%	76.09%	78.38%	91.13%	85.71%	81.25%	85.71%	94.29%	92.19%
		53.59%			77.09%			88.16%			91.67%	
% Stopping if Present	51.89%	48.44%	55.81%	100.00%	76.58%	66.67%						
		50.44%			76.03%							
% Stopping if Absent	60.00%	45.65%	12.50%	100.00%	56.03%	100.00%						
		44.57%			59.20%							
% Stopping if Opposing Left Turn Waiting		0.00%			78.79%							
% Stopping if No LT		48.28%			66.56%							

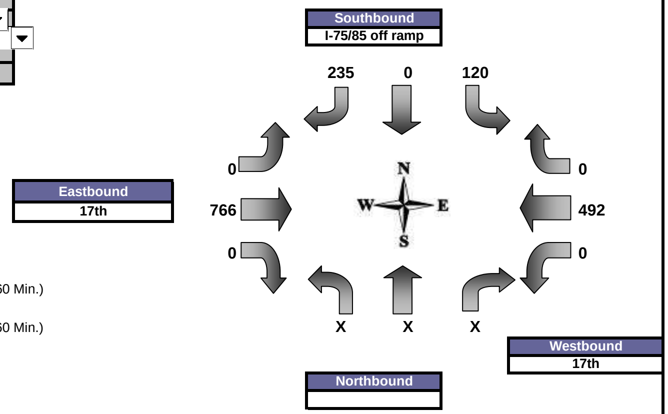
ORIENTATION AND LANE CONFIGURATION	WB	EB	SB	NB
	Towards Camera	Away From Camera	From Left Side	From Right Side
Left Turn Lanes	0	0	0	0
Left/Thru Lanes	1	1	1	1
Thru Only Lanes	0	0	0	0
Right/Thru Lanes	1	1	0	1
Right Turn Lanes	0	0	1	0
Left/Thru/Right Lanes	0	0	0	0
Left/Right Lanes	0	0	0	0
Total Lanes	2	2	2	2
State and Federal Routes	None	None	None	None
Functional Classification	Minor Arterial	Minor Arterial	Local	Local

Figure D.27 10th Street and Hemphill Avenue 2 Traffic Conditions and Geometry

INTERSECTION	17th Street and I-75/85 SB Off Ramp
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	April 5 2006
DAY	Wednesday
START TIME	16:00
END TIME	17:05
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	1322	
Major Volume - first 60 min OR scaled up	1258	(First 60 Min.)
Minor Volume for Duration of Video	370	
Minor Volume - first 60 min OR scaled up	355	(First 60 Min.)
Minor:Major Volume Ratio	0.28	
Video Length in Minutes	62.62	
Percent Time Minor Vehicle Present	68.01%	

CAR COUNT		Major Street Approach #1 EB			Major Street Approach #2 WB			Minor Street Approach #1 SB			Minor Street Approach #2			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
16:00	16:05	0	52	0	0	34	0	5	0	13	0	0	0	104
16:05	16:10	0	48	0	0	35	0	18	0	19	0	0	0	120
16:10	16:15	0	73	0	0	37	0	8	0	17	0	0	0	135
16:15	16:20	0	80	0	0	33	0	16	0	19	0	0	0	148
16:20	16:25	0	69	0	0	43	0	13	0	18	0	0	0	143
16:25	16:30	0	65	0	0	37	0	11	0	17	0	0	0	130
16:30	16:35	0	61	0	0	47	0	8	0	19	0	0	0	135
16:35	16:40	0	66	0	0	44	0	9	0	24	0	0	0	143
16:40	16:45	0	73	0	0	51	0	9	0	21	0	0	0	154
16:45	16:50	0	59	0	0	43	0	9	0	15	0	0	0	126
16:50	16:55	0	56	0	0	39	0	9	0	27	0	0	0	131
16:55	17:00	0	64	0	0	49	0	5	0	26	0	0	0	144
17:00	17:05	0	33	0	0	31	0	8	0	7	0	0	0	79
TOTAL		0	799	0	0	523	0	128	0	242	0	0	0	1692

STOPPING	EB			WB			SB					
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	0	24	0	0	27	0	117	0	141	0	0	0
Average Stop Time	00:00.0	00:19.3	00:00.0	00:00.0	00:06.4	00:00.0	00:14.1	00:00.0	00:05.3	00:00.0	00:00.0	00:00.0
		00:19.3			00:06.4			00:09.3			00:00.0	
Max Stop Time	00:00.0	03:36.0	00:00.0	00:00.0	00:32.0	00:00.0	01:46.0	00:00.0	00:19.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	0.00%	3.00%	0.00%	0.00%	5.16%	0.00%	91.41%	0.00%	58.26%	0.00%	0.00%	0.00%
		3.00%			5.16%			69.73%			0.00%	
% of Platoon Stopping	0.00%	4.63%	0.00%	0.00%	6.07%	0.00%	94.38%	0.00%	64.36%	0.00%	0.00%	0.00%
		4.63%			6.07%			74.01%			0.00%	
% Stopping if Present	0.00%	3.44%	0.00%	0.00%	6.57%	0.00%						
		3.44%			6.57%							
% Stopping if Absent	0.00%	2.02%	0.00%	0.00%	0.79%	0.00%						
		2.02%			0.79%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		3.00%			5.16%							

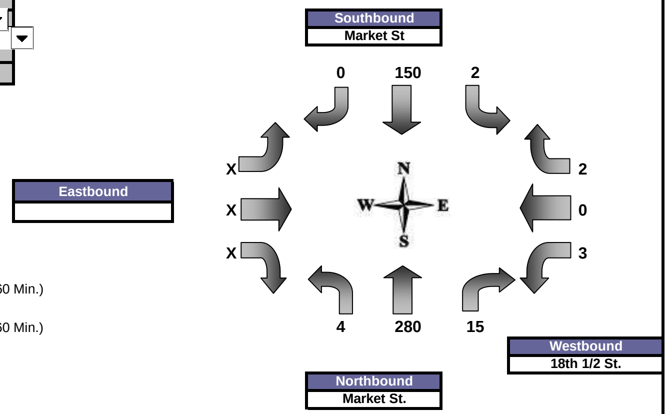
ORIENTATION AND LANE CONFIGURATION	EB Towards Camera	WB Away From Camera	SB From Right Side	From Left Side
Left Turn Lanes	0	0	2	-
Left/Thru Lanes	0	0	0	-
Thru Only Lanes	3	3	0	-
Right/Thru Lanes	0	0	0	-
Right Turn Lanes	0	0	1	-
Left/Thru/Right Lanes	0	0	0	-
Left/Right Lanes	0	0	0	-
Total Lanes	3	3	3	0
State and Federal Routes	None	None	I-75/85 ramp	-
Functional Classification	Collector	Collector	Ramp	-

Figure D.28 17th Street and I-75/85 Southbound Off Ramp Traffic Conditions and Geometry

INTERSECTION	Market Street and 18th 1/2 Street 2
STATUS & FLASH MODE	New Red/Red
CITY/COUNTY	Atlanta/Fulton
DATE	April 5 2006
DAY	Wednesday
START TIME	17:20
END TIME	18:25
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	480	
Major Volume - first 60 min OR scaled up	451	(First 60 Min.)
Minor Volume for Duration of Video	5	
Minor Volume - first 60 min OR scaled up	5	(First 60 Min.)
Minor:Major Volume Ratio	0.01	
Video Length in Minutes	62.63	
Percent Time Minor Vehicle Present	1.62%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		NB			SB			WB						
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
17:20	17:25	1	29	1	0	11	0	1	0	0	0	0	0	43
17:25	17:30	0	17	0	0	6	0	0	0	0	0	0	0	23
17:30	17:35	0	15	1	0	10	0	0	0	1	0	0	0	27
17:35	17:40	0	13	1	1	10	0	0	0	0	0	0	0	25
17:40	17:45	0	17	0	0	12	0	0	0	0	0	0	0	29
17:45	17:50	2	29	4	0	8	0	2	0	0	0	0	0	45
17:50	17:55	0	25	2	0	23	0	0	0	0	0	0	0	50
17:55	18:00	0	23	3	1	9	0	0	0	0	0	0	0	36
18:00	18:05	0	26	1	0	12	0	0	0	0	0	0	0	39
18:05	18:10	0	32	0	0	19	0	0	0	0	0	0	0	51
18:10	18:15	1	26	2	0	12	0	0	0	1	0	0	0	42
18:15	18:20	0	28	0	0	18	0	0	0	0	0	0	0	46
18:20	18:25	0	22	1	0	6	0	0	0	0	0	0	0	29
TOTAL		4	302	16	2	156	0	3	0	2	0	0	0	485

STOPPING	NB			SB			WB					
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	1	185	6	1	90	0	3	0	2	0	0	0
Average Stop Time	00:07.0	00:03.9	00:04.3	00:07.0	00:03.7	00:00.0	00:11.7	00:00.0	00:03.0	00:00.0	00:00.0	00:00.0
		00:04.0			00:03.7			00:08.2			00:00.0	
Max Stop Time	00:07.0	00:17.0	00:10.0	00:07.0	00:35.0	00:00.0	00:25.0	00:00.0	00:05.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	25.00%	61.26%	37.50%	50.00%	57.69%	0.00%	100.00%	0.00%	100.00%	0.00%	0.00%	0.00%
		59.63%			57.59%			100.00%			0.00%	
% of Platoon Stopping	25.00%	63.46%	42.86%	50.00%	58.33%	0.00%	100.00%	0.00%	100.00%	0.00%	0.00%	0.00%
		61.87%			58.22%			100.00%			0.00%	
% Stopping if Present	0.00%	80.00%	0.00%	0.00%	100.00%	0.00%						
		80.00%			100.00%							
% Stopping if Absent	25.00%	60.94%	37.50%	50.00%	57.14%	0.00%						
		59.31%			57.05%							
% Stopping if Opposing Left Turn Waiting		0.00%			50.00%							
% Stopping if No LT		61.46%			57.79%							

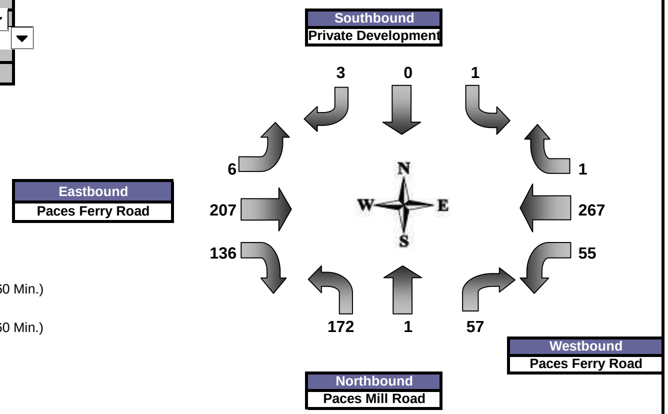
ORIENTATION AND LANE CONFIGURATION	NB	SB	WB	
	Towards Camera	Away From Camera	From Left Side	From Right Side
Left Turn Lanes	0	0	0	-
Left/Thru Lanes	0	1	0	-
Thru Only Lanes	1	1	0	-
Right/Thru Lanes	1	0	0	-
Right Turn Lanes	0	0	0	-
Left/Thru/Right Lanes	0	0	0	-
Left/Right Lanes	0	0	1	-
Total Lanes	2	2	1	0
State and Federal Routes	None	None	None	-
Functional Classification	Local	Local	Local	-

Figure D.29 Market Street and 18th 1/2 Street 2 Traffic Conditions and Geometry

INTERSECTION	Paces Ferry Road and Paces Mill Drive
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	(unincorporated area)/Cobb
DATE	April 9 2006
DAY	Sunday
START TIME	18:10
END TIME	19:15
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	692	
Major Volume - first 60 min OR scaled up	672	(First 60 Min.)
Minor Volume for Duration of Video	238	
Minor Volume - first 60 min OR scaled up	234	(First 60 Min.)
Minor:Major Volume Ratio	0.34	
Video Length in Minutes	62.63	
Percent Time Minor Vehicle Present	57.61%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		WB			EB			WB			SB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
18:10	18:15	5	26	0	1	16	12	17	0	5	0	0	0	82
18:15	18:20	6	18	0	0	20	14	14	0	10	0	0	0	82
18:20	18:25	4	23	0	1	19	14	8	0	9	0	0	0	78
18:25	18:30	4	25	0	3	14	8	15	0	7	0	0	0	76
18:30	18:35	7	25	0	0	15	8	13	1	4	1	0	0	74
18:35	18:40	3	32	0	0	22	15	12	0	4	0	0	1	89
18:40	18:45	3	24	0	0	12	8	11	0	0	0	0	1	59
18:45	18:50	2	19	0	0	21	9	10	0	3	0	0	1	65
18:50	18:55	9	18	0	0	15	10	19	0	3	0	0	0	74
18:55	19:00	2	18	1	0	21	16	18	0	2	0	0	0	78
19:00	19:05	6	17	0	1	17	11	18	0	7	0	0	0	77
19:05	19:10	4	22	0	0	15	11	17	0	3	0	0	0	72
19:10	19:15	1	12	0	0	4	3	4	0	0	0	0	0	24
TOTAL		56	279	1	6	211	139	176	1	57	1	0	3	930

STOPPING	WB			EB			WB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	28	101	1	2	91	7	169	1	46	1	0	3
Average Stop Time	00:05.8	00:05.5	00:05.0	00:04.5	00:04.3	00:03.0	00:06.9	00:19.0	00:04.0	00:14.0	00:00.0	00:04.3
		00:05.6			00:04.2			00:06.4			00:06.7	
Max Stop Time	00:15.0	00:18.0	00:05.0	00:08.0	00:13.0	00:05.0	01:02.0	00:19.0	00:11.0	00:14.0	00:00.0	00:05.0
% of Vehicle Stopping	50.00%	36.20%	100.00%	33.33%	43.13%	5.04%	96.02%	100.00%	80.70%	100.00%	0.00%	100.00%
		38.69%			28.09%			92.31%			100.00%	
% of Platoon Stopping	53.85%	44.30%	100.00%	25.00%	50.94%	5.45%	96.57%	100.00%	82.14%	100.00%	0.00%	100.00%
		46.26%			32.23%			93.10%			100.00%	
% Stopping if Present	58.33%	52.31%	100.00%	50.00%	54.39%	2.41%						
		53.89%			32.66%							
% Stopping if Absent	35.00%	22.15%	0.00%	25.00%	29.90%	8.93%						
		23.67%			22.29%							
% Stopping if Opposing Left Turn Waiting		0.00%			33.33%							
% Stopping if No LT		36.20%			44.44%							

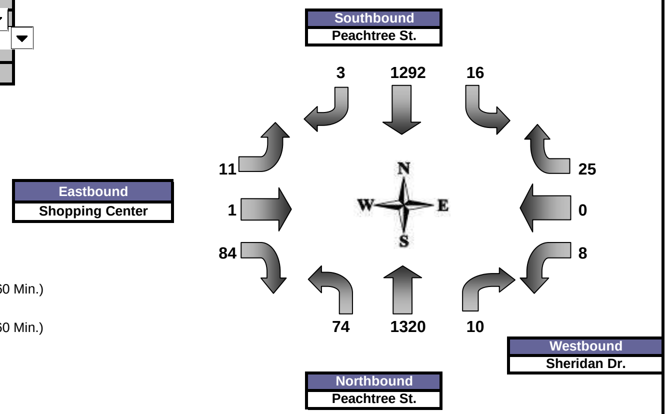
ORIENTATION AND LANE CONFIGURATION	WB	EB	WB	SB
	Towards Camera	Away From Camera	From Right Side	From Left Side
Left Turn Lanes	0	0	0	0
Left/Thru Lanes	0	1	0	0
Thru Only Lanes	0	0	0	0
Right/Thru Lanes	0	0	0	0
Right Turn Lanes	0	1	0	0
Left/Thru/Right Lanes	1	0	1	1
Left/Right Lanes	0	0	0	0
Total Lanes	1	2	1	1
State and Federal Routes	None	None	None	None
Functional Classification	Local	Collector	Collector	Local

Figure D.30 Paces Ferry Road and Paces Mill Drive Traffic Conditions and Geometry

INTERSECTION	Peachtree Road and Sheridan Drive
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	April 22 2006
DAY	Saturday
START TIME	13:10
END TIME	14:15
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	2821	
Major Volume - first 60 min OR scaled up	2715	(First 60 Min.)
Minor Volume for Duration of Video	132	
Minor Volume - first 60 min OR scaled up	129	(First 60 Min.)
Minor:Major Volume Ratio	0.05	
Video Length in Minutes	62.50	
Percent Time Minor Vehicle Present	46.27%	

CAR COUNT		Major Street Approach #1 SB			Major Street Approach #2 NB			Minor Street Approach #1 EB			Minor Street Approach #2 WB			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
13:10	13:15	2	111	0	6	109	1	0	0	10	0	0	1	240
13:15	13:20	0	108	0	7	94	3	1	0	9	1	0	4	227
13:20	13:25	0	97	0	3	110	0	0	0	6	1	0	0	217
13:25	13:30	2	94	0	10	100	1	2	0	8	2	0	2	221
13:30	13:35	1	108	1	6	116	0	0	0	3	0	0	2	237
13:35	13:40	2	94	1	8	116	0	1	1	13	2	0	1	239
13:40	13:45	1	116	0	8	110	0	1	0	8	0	0	2	246
13:45	13:50	1	95	0	5	110	1	0	0	6	2	0	2	222
13:50	13:55	2	139	1	4	125	0	0	0	0	0	0	7	278
13:55	14:00	1	126	0	5	110	0	2	0	5	0	0	1	250
14:00	14:05	4	118	0	4	111	1	2	0	11	0	0	2	253
14:05	14:10	0	86	0	8	109	3	2	0	5	0	0	1	214
14:10	14:15	2	55	2	1	45	1	0	0	1	0	0	2	109
TOTAL		18	1347	5	75	1365	11	11	1	85	8	0	27	2953

STOPPING	SB			NB			EB			WB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	17	53	1	43	64	0	8	1	60	8	0	24
Average Stop Time	00:22.1	00:05.2	01:48.0	00:13.1	00:06.2	00:00.0	00:09.6	00:32.0	00:10.3	00:36.7	00:00.0	00:22.2
		00:10.7			00:09.0			00:10.5			00:25.8	
Max Stop Time	01:18.0	00:27.0	01:48.0	00:41.0	00:30.0	00:00.0	00:22.0	00:32.0	01:02.0	01:36.0	00:00.0	01:39.0
% of Vehicle Stopping	94.44%	3.93%	20.00%	57.33%	4.69%	0.00%	72.73%	100.00%	70.59%	100.00%	0.00%	88.89%
		5.18%			7.37%			71.13%			91.43%	
% of Platoon Stopping	90.91%	5.91%	50.00%	62.50%	7.14%	0.00%	80.00%	100.00%	75.00%	100.00%	0.00%	88.89%
		8.26%			10.43%			75.82%			91.43%	
% Stopping if Present	90.00%	4.98%	33.33%	66.67%	7.26%	0.00%						
		6.36%			10.06%							
% Stopping if Absent	100.00%	2.93%	0.00%	51.11%	2.72%	0.00%						
		4.04%			5.33%							
% Stopping if Opposing Left Turn Waiting		3.57%			7.59%							
% Stopping if No LT		4.08%			4.17%							

ORIENTATION AND LANE CONFIGURATION	SB	NB	EB	WB
	Towards Camera	Away From Camera	From Right Side	From Left Side
Left Turn Lanes	0	0	0	1
Left/Thru Lanes	1	1	0	0
Thru Only Lanes	2	1	0	0
Right/Thru Lanes	0	1	0	1
Right Turn Lanes	1	0	0	0
Left/Thru/Right Lanes	0	0	1	0
Left/Right Lanes	0	0	0	0
Total Lanes	4	3	1	2
State and Federal Routes	GA 9/US 19	GA 9/US 19	None	None
Functional Classification	Principal Arterial	Principal Arterial	Local	Local

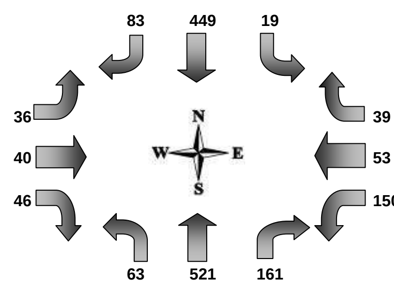
Figure D.31 Peachtree Road and Sheridan Drive Traffic Conditions and Geometry

INTERSECTION	Roxboro Road and Pritchard Drive
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	April 22 2006
DAY	Saturday
START TIME	15:00
END TIME	16:05
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.

Southbound
Roxboro Road



Eastbound
Pritchard Way

Westbound
Pritchard Way

Northbound
Roxboro Road

KEY STATISTICS		
Major Volume for Duration of Video	1362	
Major Volume - first 60 min OR scaled up	1296	(First 60 Min.)
Minor Volume for Duration of Video	392	
Minor Volume - first 60 min OR scaled up	364	(First 60 Min.)
Minor:Major Volume Ratio	0.29	
Video Length in Minutes	62.75	
Percent Time Minor Vehicle Present	75.27%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		NB			SB			EB			WB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
15:00	15:05	10	53	8	3	36	9	7	4	3	16	8	3	160
15:05	15:10	6	44	16	2	28	4	3	8	7	11	4	5	138
15:10	15:15	2	31	16	0	51	4	3	0	4	19	3	2	135
15:15	15:20	7	52	16	0	38	10	2	5	2	17	7	4	160
15:20	15:25	5	49	13	1	26	5	5	3	5	8	7	3	130
15:25	15:30	3	44	9	1	34	7	1	2	5	12	2	4	124
15:30	15:35	4	39	19	0	35	7	1	2	5	9	5	3	129
15:35	15:40	2	36	14	2	34	8	1	1	2	9	5	1	115
15:40	15:45	6	41	8	2	46	5	1	5	1	11	3	3	132
15:45	15:50	8	46	12	4	39	9	4	4	4	13	3	2	148
15:50	15:55	6	44	21	1	36	9	3	3	6	15	2	3	149
15:55	16:00	4	42	9	3	46	6	5	3	2	10	4	6	140
16:00	16:05	1	29	8	0	25	3	3	3	3	11	6	2	94
TOTAL		64	550	169	19	474	86	39	43	49	161	59	41	1754

STOPPING	NB			SB			EB			WB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	46	184	29	16	179	36	35	39	32	142	54	36
Average Stop Time	00:09.3	00:06.1	00:03.2	00:12.3	00:05.9	00:02.7	00:08.3	00:08.9	00:05.9	00:10.9	00:11.1	00:05.6
		00:06.4			00:05.9			00:07.8			00:10.1	
Max Stop Time	00:32.0	00:18.0	00:08.0	01:14.0	00:29.0	00:09.0	00:24.0	00:22.0	00:17.0	00:38.0	00:46.0	00:18.0
% of Vehicle Stopping	71.88%	33.45%	17.16%	84.21%	37.76%	41.86%	89.74%	90.70%	65.31%	88.20%	91.53%	87.80%
		33.08%			39.90%			80.92%			88.89%	
% of Platoon Stopping	75.00%	47.72%	18.67%	76.92%	44.83%	41.79%	94.12%	90.00%	67.39%	94.81%	95.12%	100.00%
		44.32%			45.45%			82.50%			95.65%	
% Stopping if Present	75.51%	38.14%	18.85%	90.91%	46.33%	45.07%						
		37.24%			47.28%							
% Stopping if Absent	60.00%	19.86%	12.77%	75.00%	15.79%	26.67%						
		21.18%			19.87%							
% Stopping if Opposing Left Turn Waiting		75.68%			46.94%							
% Stopping if No LT		29.82%			35.57%							

ORIENTATION AND LANE CONFIGURATION	NB	SB	EB	WB
	Towards Camera	Away From Camera	From Right Side	From Left Side
Left Turn Lanes	1	1	1	1
Left/Thru Lanes	0	0	0	0
Thru Only Lanes	2	2	0	0
Right/Thru Lanes	0	0	1	1
Right Turn Lanes	1	1	0	0
Left/Thru/Right Lanes	0	0	0	0
Left/Right Lanes	0	0	0	0
Total Lanes	4	4	2	2
State and Federal Routes	None	None	None	None
Functional Classification	Minor Arterial	Minor Arterial	Local	Local

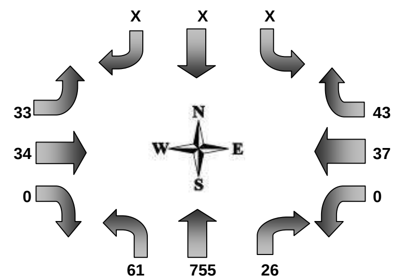
Figure D.32 Roxboro Road and Pritchard Drive Traffic Conditions and Geometry

INTERSECTION	W. Peachtree Street and Peachtree Place
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	April 22 2006
DAY	Saturday
START TIME	17:00
END TIME	18:05
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes
Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.

Southbound

Eastbound
Peachtree Place



Westbound
Peachtree Place

Northbound
W Peachtree Street

KEY STATISTICS		
Major Volume for Duration of Video	883	
Major Volume - first 60 min OR scaled up	842	(First 60 Min.)
Minor Volume for Duration of Video	154	
Minor Volume - first 60 min OR scaled up	147	(First 60 Min.)
Minor:Major Volume Ratio	0.17	
Video Length in Minutes	62.43	
Percent Time Minor Vehicle Present	42.42%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		NB			0			EB			WB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
17:00	17:05	8	56	3	0	0	0	4	6	0	0	3	2	82
17:05	17:10	5	72	4	0	0	0	3	4	0	0	8	2	98
17:10	17:15	9	80	1	0	0	0	4	2	0	0	2	4	102
17:15	17:20	5	48	0	0	0	0	0	5	0	0	3	0	61
17:20	17:25	6	60	2	0	0	0	4	4	0	0	2	5	83
17:25	17:30	2	78	4	0	0	0	3	2	0	0	6	1	96
17:30	17:35	8	69	4	0	0	0	2	1	0	0	0	8	92
17:35	17:40	2	63	0	0	0	0	1	1	0	0	4	3	74
17:40	17:45	6	50	1	0	0	0	2	2	0	0	0	6	67
17:45	17:50	2	70	2	0	0	0	3	1	0	0	5	5	88
17:50	17:55	3	59	4	0	0	0	5	2	0	0	2	5	80
17:55	18:00	5	50	1	0	0	0	2	4	0	0	2	2	66
18:00	18:05	3	37	1	0	0	0	3	2	0	0	0	2	48
TOTAL		64	792	27	0	0	0	36	36	0	0	37	45	1037

STOPPING	NB			0.0%			EB			WB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	11	26	1	0	0	0	29	31	0	0	25	24
Average Stop Time	00:05.9	00:11.4	00:07.0	00:00.0	00:00.0	00:00.0	00:15.4	00:12.6	00:00.0	00:00.0	00:11.3	00:08.6
		00:09.7			00:00.0			00:14.0			00:10.0	
Max Stop Time	00:15.0	03:01.0	00:07.0	00:00.0	00:00.0	00:00.0	00:44.0	00:41.0	00:00.0	00:00.0	00:43.0	00:40.0
% of Vehicle Stopping	17.19%	3.28%	3.70%	0.00%	0.00%	0.00%	80.56%	86.11%	0.00%	0.00%	67.57%	53.33%
		4.30%			0.00%			83.33%			59.76%	
% of Platoon Stopping	22.86%	6.17%	7.69%	0.00%	0.00%	0.00%	85.29%	86.11%	0.00%	0.00%	75.76%	57.50%
		8.36%			0.00%			85.71%			65.75%	
% Stopping if Present	24.24%	4.29%	10.00%	0.00%	0.00%	0.00%						
		6.11%			0.00%							
% Stopping if Absent	9.68%	2.49%	0.00%	0.00%	0.00%	0.00%						
		2.86%			0.00%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		3.28%			0.00%							

ORIENTATION AND LANE CONFIGURATION	NB	SB	EB	WB
	Towards Camera	Away From Camera	From Right Side	From Left Side
Left Turn Lanes	0	-	0	0
Left/Thru Lanes	1	-	1	0
Thru Only Lanes	2	-	0	1
Right/Thru Lanes	1	-	0	0
Right Turn Lanes	0	-	0	1
Left/Thru/Right Lanes	0	-	0	0
Left/Right Lanes	0	-	0	0
Total Lanes	4	0	1	2
State and Federal Routes	None	-	None	None
Functional Classification	Minor Arterial	-	Local	Local

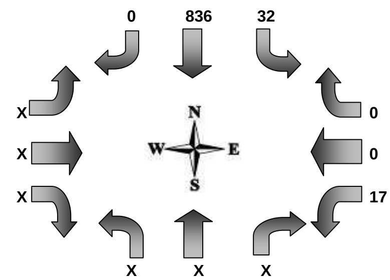
Figure D.33 W. Peachtree Street and Peachtree Place Traffic Conditions and Geometry

INTERSECTION	Spring Street and Abercrombie Place
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	April 22 2006
DAY	Saturday
START TIME	18:15
END TIME	19:05
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.

Southbound
Spring



Eastbound

Westbound
Abercrombie

Northbound

KEY STATISTICS		
Major Volume for Duration of Video	657	
Major Volume - first 60 min OR scaled up	868	(Scaled Up)
Minor Volume for Duration of Video	13	
Minor Volume - first 60 min OR scaled up	17	(Scaled Up)
Minor:Major Volume Ratio	0.02	
Video Length in Minutes	45.42	
Percent Time Minor Vehicle Present	4.70%	

CAR COUNT		Major Street Approach #1 SB			Major Street Approach #2 0			Minor Street Approach #1 WB			Minor Street Approach #2			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
18:15	18:20	1	65	0	0	0	0	2	0	0	0	0	0	68
18:20	18:25	3	72	0	0	0	0	0	0	0	0	0	0	75
18:25	18:30	3	66	0	0	0	0	4	0	0	0	0	0	73
18:30	18:35	4	73	0	0	0	0	1	0	0	0	0	0	78
18:35	18:40	1	69	0	0	0	0	1	0	0	0	0	0	71
18:40	18:45	1	66	0	0	0	0	1	0	0	0	0	0	68
18:45	18:50	2	71	0	0	0	0	1	0	0	0	0	0	74
18:50	18:55	5	71	0	0	0	0	1	0	0	0	0	0	77
18:55	19:00	4	73	0	0	0	0	2	0	0	0	0	0	79
19:00	19:05	0	7	0	0	0	0	0	0	0	0	0	0	7
TOTAL		24	633	0	0	0	0	13	0	0	0	0	0	670

STOPPING	SB			0.0%			WB					
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	0	3	0	0	0	0	8	0	0	0	0	0
Average Stop Time	00:00.0	00:10.7	00:00.0	00:00.0	00:00.0	00:00.0	00:10.0	00:00.0	00:00.0	00:00.0	00:00.0	00:00.0
		00:10.7			00:00.0			00:10.0			00:00.0	
Max Stop Time	00:00.0	00:27.0	00:00.0	00:00.0	00:00.0	00:00.0	00:36.0	00:00.0	00:00.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	0.00%	0.47%	0.00%	0.00%	0.00%	0.00%	61.54%	0.00%	0.00%	0.00%	0.00%	0.00%
		0.46%			0.00%			61.54%			0.00%	
% of Platoon Stopping	0.00%	0.90%	0.00%	0.00%	0.00%	0.00%	66.67%	0.00%	0.00%	0.00%	0.00%	0.00%
		0.84%			0.00%			66.67%			0.00%	
% Stopping if Present	0.00%	5.26%	0.00%	0.00%	0.00%	0.00%						
		4.55%			0.00%							
% Stopping if Absent	0.00%	0.33%	0.00%	0.00%	0.00%	0.00%						
		0.31%			0.00%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		0.47%			0.00%							

ORIENTATION AND LANE CONFIGURATION	SB Towards Camera	Away From Camera	WB From Right Side	From Left Side
Left Turn Lanes	0	-	1	-
Left/Thru Lanes	1	-	0	-
Thru Only Lanes	3	-	0	-
Right/Thru Lanes	0	-	0	-
Right Turn Lanes	0	-	0	-
Left/Thru/Right Lanes	0	-	0	-
Left/Right Lanes	0	-	0	-
Total Lanes	4	0	1	0
State and Federal Routes	None	-	None	-
Functional Classification	Minor Arterial	-	Local	-

Figure D.34 Spring Street and Abercrombie Place Traffic Conditions and Geometry

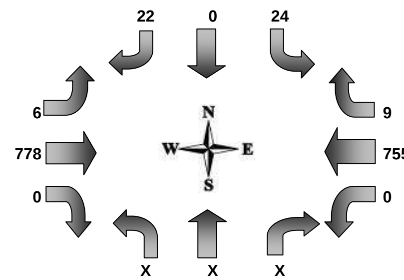
INTERSECTION	10th Street and Holly Street 1
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	May 4 2006
DAY	Thursday
START TIME	12:30
END TIME	13:35
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.

Southbound
Holly Street

Eastbound
10th Street



Westbound
10th Street

Northbound

KEY STATISTICS		
Major Volume for Duration of Video	1615	
Major Volume - first 60 min OR scaled up	1548	(First 60 Min.)
Minor Volume for Duration of Video	48	
Minor Volume - first 60 min OR scaled up	46	(First 60 Min.)
Minor:Major Volume Ratio	0.03	
Video Length in Minutes	62.52	
Percent Time Minor Vehicle Present	22.13%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		WB			EB			SB						
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
12:30	12:35	0	70	0	0	52	0	2	0	2	0	0	0	126
12:35	12:40	0	57	0	0	69	0	0	0	3	0	0	0	129
12:40	12:45	0	65	0	1	62	0	2	0	4	0	0	0	134
12:45	12:50	0	65	0	2	63	0	2	0	0	0	0	0	132
12:50	12:55	0	66	0	0	61	0	3	0	4	0	0	0	134
12:55	13:00	0	54	1	0	80	0	0	0	1	0	0	0	136
13:00	13:05	0	71	1	0	65	0	4	0	3	0	0	0	144
13:05	13:10	0	48	0	2	65	0	1	0	1	0	0	0	117
13:10	13:15	0	72	5	0	63	0	3	0	2	0	0	0	145
13:15	13:20	0	59	0	1	80	0	0	0	2	0	0	0	142
13:20	13:25	0	55	0	0	70	0	5	0	0	0	0	0	130
13:25	13:30	0	73	2	0	48	0	2	0	0	0	0	0	125
13:30	13:35	0	34	0	1	32	0	1	0	1	0	0	0	69
TOTAL		0	789	9	7	810	0	25	0	23	0	0	0	1663

STOPPING	WB			EB			SB					
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	0	15	1	4	7	0	25	0	19	0	0	0
Average Stop Time	00:00.0	00:06.0	00:08.0	00:07.5	00:11.0	00:00.0	00:17.8	00:00.0	00:10.5	00:00.0	00:00.0	00:00.0
		00:06.1			00:09.7			00:14.7			00:00.0	
Max Stop Time	00:00.0	00:20.0	00:08.0	00:13.0	00:54.0	00:00.0	01:29.0	00:00.0	00:52.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	0.00%	1.90%	11.11%	57.14%	0.86%	0.00%	100.00%	0.00%	82.61%	0.00%	0.00%	0.00%
		2.01%			1.35%			91.67%			0.00%	
% of Platoon Stopping	0.00%	2.74%	16.67%	50.00%	1.47%	0.00%	100.00%	0.00%	82.61%	0.00%	0.00%	0.00%
		2.95%			2.04%			91.67%			0.00%	
% Stopping if Present	0.00%	3.37%	0.00%	50.00%	0.60%	0.00%						
		3.37%			1.19%							
% Stopping if Absent	0.00%	1.47%	11.11%	60.00%	0.93%	0.00%						
		1.61%			1.39%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		1.92%			0.86%							

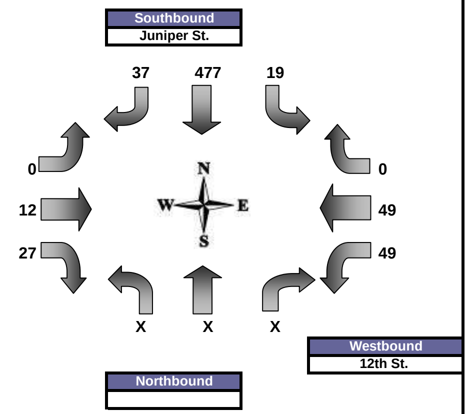
ORIENTATION AND LANE CONFIGURATION	WB	EB	SB	
	Towards Camera	Away From Camera	From Left Side	From Right Side
Left Turn Lanes	0	0	0	-
Left/Thru Lanes	0	1	0	-
Thru Only Lanes	1	1	0	-
Right/Thru Lanes	1	0	0	-
Right Turn Lanes	0	0	0	-
Left/Thru/Right Lanes	0	0	0	-
Left/Right Lanes	0	0	1	-
Total Lanes	2	2	1	0
State and Federal Routes	None	None	None	-
Functional Classification	Minor Arterial	Minor Arterial	Local	-

Figure D.35 10th Street and Holly Street 1 Traffic Conditions and Geometry

INTERSECTION	Juniper Street and 12th Street
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	May 7 2006
DAY	Sunday
START TIME	12:15
END TIME	13:20
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	547	
Major Volume - first 60 min OR scaled up	533	(First 60 Min.)
Minor Volume for Duration of Video	146	
Minor Volume - first 60 min OR scaled up	137	(First 60 Min.)
Minor:Major Volume Ratio	0.27	
Video Length in Minutes	62.62	
Percent Time Minor Vehicle Present	40.35%	

CAR COUNT					Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
					SB			EB			WB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
12:15	12:20	0	0	0	2	47	0	0	0	2	1	4	0	56
12:20	12:25	0	0	0	1	46	3	0	2	2	3	3	0	60
12:25	12:30	0	0	0	3	37	4	0	2	1	5	3	0	55
12:30	12:35	0	0	0	1	39	1	0	0	3	4	2	0	50
12:35	12:40	0	0	0	7	53	0	0	3	2	7	2	0	74
12:40	12:45	0	0	0	5	50	1	0	1	4	7	5	0	73
12:45	12:50	0	0	0	2	34	2	0	1	1	4	7	0	51
12:50	12:55	0	0	0	2	33	0	0	0	5	5	12	0	57
12:55	13:00	0	0	0	3	37	2	0	1	5	4	3	0	55
13:00	13:05	0	0	0	6	32	1	0	1	0	2	4	0	46
13:05	13:10	0	0	0	3	44	2	0	1	1	3	3	0	57
13:10	13:15	0	0	0	2	25	3	0	0	1	4	1	0	36
13:15	13:20	0	0	0	1	13	0	0	2	2	4	1	0	23
TOTAL		0	0	0	38	490	19	0	14	29	53	50	0	693

STOPPING				SB			EB			WB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	0	0	0	17	66	12	0	14	27	51	43	0
Average Stop Time	00:00.0	00:00.0	00:00.0	00:05.4	00:05.2	00:03.7	00:00.0	00:08.1	00:09.1	00:06.5	00:11.5	00:00.0
		00:00.0			00:05.1			00:08.8			00:08.8	
Max Stop Time	00:00.0	00:00.0	00:00.0	00:20.0	00:32.0	00:08.0	00:00.0	00:19.0	00:52.0	00:23.0	00:46.0	00:00.0
% of Vehicle Stopping	0.00%	0.00%	0.00%	44.74%	13.47%	63.16%	0.00%	100.00%	93.10%	96.23%	86.00%	0.00%
		0.00%			17.37%			95.35%			91.26%	
% of Platoon Stopping	0.00%	0.00%	0.00%	46.67%	15.96%	56.25%	0.00%	100.00%	93.10%	96.23%	89.58%	0.00%
		0.00%			20.40%			95.35%			93.07%	
% Stopping if Present	0.00%	0.00%	0.00%	42.86%	17.35%	85.71%						
		0.00%			21.20%							
% Stopping if Absent	0.00%	0.00%	0.00%	45.83%	10.88%	50.00%						
		0.00%			14.85%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		0.00%			13.47%							

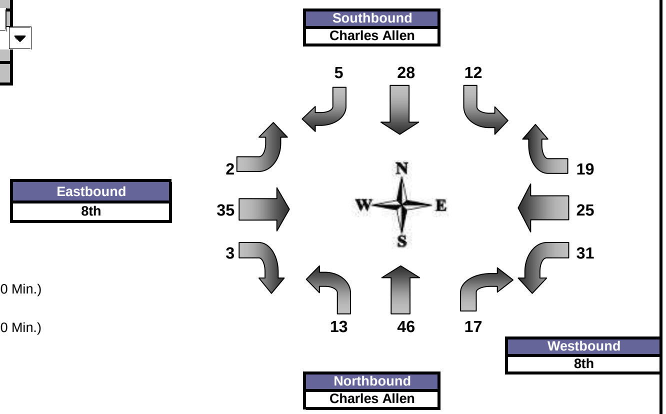
ORIENTATION AND LANE CONFIGURATION		SB	EB	WB
		Away From Camera	From Right Side	From Left Side
Left Turn Lanes	-	1	0	0
Left/Thru Lanes	-	0	0	1
Thru Only Lanes	-	2	0	0
Right/Thru Lanes	-	1	1	0
Right Turn Lanes	-	0	0	0
Left/Thru/Right Lanes	-	0	0	0
Left/Right Lanes	-	0	0	0
Total Lanes	0	4	1	1
State and Federal Routes	-	None	None	None
Functional Classification	-	Minor Arterial	Local	Local

Figure D.36 Juniper Street and 12th Street Traffic Conditions and Geometry

INTERSECTION	Charles Allen Drive and 8th Street 1
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	May 7 2006
DAY	Sunday
START TIME	19:30
END TIME	20:35
LIGHT CONDITIONS	Dusk
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	127	
Major Volume - first 60 min OR scaled up	121	(First 60 Min.)
Minor Volume for Duration of Video	119	
Minor Volume - first 60 min OR scaled up	115	(First 60 Min.)
Minor:Major Volume Ratio	0.94	
Video Length in Minutes	62.77	
Percent Time Minor Vehicle Present	21.24%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		NB			SB			EB			WB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
19:30	19:35	0	4	5	1	1	1	0	5	1	1	2	1	22
19:35	19:40	0	3	1	1	4	1	0	3	0	3	0	2	18
19:40	19:45	1	3	0	0	3	1	0	5	0	5	5	1	24
19:45	19:50	0	4	2	2	1	0	0	2	0	1	0	3	15
19:50	19:55	0	3	0	4	3	0	0	4	0	2	0	2	18
19:55	20:00	3	5	3	1	1	0	0	4	1	5	1	1	25
20:00	20:05	0	3	1	2	0	0	0	1	0	1	2	0	10
20:05	20:10	0	1	2	0	2	1	0	1	0	3	3	2	15
20:10	20:15	3	3	1	0	2	0	0	5	0	1	3	2	20
20:15	20:20	1	2	2	0	3	1	0	1	1	2	4	1	18
20:20	20:25	4	5	0	0	5	0	0	3	0	4	3	1	25
20:25	20:30	1	10	0	1	3	0	2	1	0	3	2	3	26
20:30	20:35	0	0	1	1	4	0	0	0	1	2	1	0	10
TOTAL		13	46	18	13	32	5	2	35	4	33	26	19	246

STOPPING	NB			SB			EB			WB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	7	10	10	6	7	3	2	34	4	31	24	15
Average Stop Time	00:06.9	00:03.1	00:02.2	00:02.2	00:05.0	00:01.7	00:02.0	00:04.4	00:03.5	00:04.1	00:04.4	00:02.1
		00:03.7			00:03.3			00:04.2			00:03.8	
Max Stop Time	00:27.0	00:09.0	00:06.0	00:04.0	00:13.0	00:03.0	00:03.0	00:16.0	00:08.0	00:12.0	00:16.0	00:05.0
% of Vehicle Stopping	53.85%	21.74%	55.56%	46.15%	21.88%	60.00%	100.00%	97.14%	100.00%	93.94%	92.31%	78.95%
		35.06%			32.00%			97.56%			89.74%	
% of Platoon Stopping	58.33%	21.74%	55.56%	46.15%	22.58%	60.00%	100.00%	97.14%	100.00%	93.94%	92.31%	78.95%
		35.53%			32.65%			97.56%			89.74%	
% Stopping if Present	66.67%	50.00%	100.00%	0.00%	60.00%	66.67%						
		62.50%			50.00%							
% Stopping if Absent	50.00%	13.89%	46.67%	54.55%	14.81%	50.00%						
		27.87%			27.50%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		21.74%			20.69%							

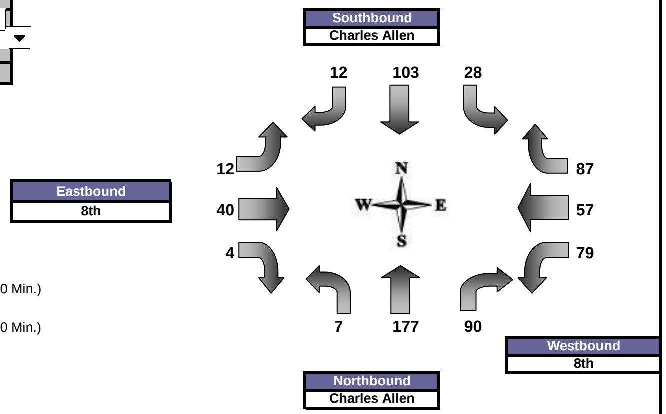
ORIENTATION AND LANE CONFIGURATION	NB	SB	EB	WB
	Towards Camera	Away From Camera	From Right Side	From Left Side
Left Turn Lanes	0	0	0	0
Left/Thru Lanes	0	0	0	1
Thru Only Lanes	0	0	0	0
Right/Thru Lanes	0	0	0	0
Right Turn Lanes	0	0	0	1
Left/Thru/Right Lanes	1	1	1	0
Left/Right Lanes	0	0	0	0
Total Lanes	1	1	1	2
State and Federal Routes	None	None	None	None
Functional Classification	Local	Local	Local	Local

Figure D.37 Charles Allen Drive and 8th Street Traffic Conditions and Geometry

INTERSECTION	Charles Allen Drive and 8th Street 2		
STATUS & FLASH MODE	Malfunction Yellow/Red		
CITY/COUNTY	Atlanta/Fulton		
DATE	May	8	2006
DAY	Monday		
START TIME	7:40		
END TIME	8:45		
LIGHT CONDITIONS	Daylight		
WEATHER	Clear		

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	426	
Major Volume - first 60 min OR scaled up	417	(First 60 Min.)
Minor Volume for Duration of Video	297	
Minor Volume - first 60 min OR scaled up	279	(First 60 Min.)
Minor:Major Volume Ratio	0.70	
Video Length in Minutes	62.67	
Percent Time Minor Vehicle Present	55.00%	

CAR COUNT		Major Street Approach #1 NB			Major Street Approach #2 SB			Minor Street Approach #1 EB			Minor Street Approach #2 WB			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
7:40	7:45	0	13	9	2	3	0	0	2	1	5	3	6	44
7:45	7:50	0	13	10	1	5	0	1	4	0	7	1	4	46
7:50	7:55	1	15	7	2	3	1	2	3	0	4	4	5	47
7:55	8:00	1	15	8	1	9	0	2	5	0	7	2	7	57
8:00	8:05	1	24	12	4	12	2	0	4	0	10	0	9	78
8:05	8:10	1	20	12	6	13	0	1	2	1	11	5	20	92
8:10	8:15	1	19	12	3	8	0	2	3	0	6	8	19	81
8:15	8:20	0	12	6	1	12	1	0	2	0	9	6	5	54
8:20	8:25	0	12	6	2	5	6	0	4	0	6	9	5	55
8:25	8:30	0	8	4	0	15	1	2	2	0	10	5	4	51
8:30	8:35	1	15	2	3	10	1	1	4	1	3	10	3	54
8:35	8:40	1	11	2	3	8	0	1	5	1	1	4	0	37
8:40	8:45	0	6	1	0	2	0	1	4	0	5	6	2	27
TOTAL		7	183	91	28	105	12	13	44	4	84	63	89	723

STOPPING	NB			SB			EB			WB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	5	100	38	21	49	9	13	44	4	78	62	86
Average Stop Time	00:07.2	00:04.9	00:03.7	00:05.1	00:04.6	00:02.9	00:05.2	00:05.3	00:04.3	00:07.5	00:05.5	00:04.8
		00:04.7			00:04.5			00:05.2			00:05.9	
Max Stop Time	00:14.0	00:23.0	00:12.0	00:11.0	00:18.0	00:07.0	00:07.0	00:17.0	00:07.0	00:28.0	00:12.0	00:13.0
% of Vehicle Stopping	71.43%	54.64%	41.76%	75.00%	46.67%	75.00%	100.00%	100.00%	100.00%	92.86%	98.41%	96.63%
		50.89%			54.48%			100.00%			95.76%	
% of Platoon Stopping	71.43%	58.48%	44.58%	80.77%	50.52%	75.00%	100.00%	100.00%	100.00%	93.06%	98.33%	98.68%
		54.41%			58.52%			100.00%			96.63%	
% Stopping if Present	80.00%	71.72%	49.09%	100.00%	59.02%	75.00%						
		64.15%			66.23%							
% Stopping if Absent	50.00%	34.52%	30.56%	56.25%	29.55%	75.00%						
		33.61%			41.18%							
% Stopping if Opposing Left Turn Waiting		50.00%			0.00%							
% Stopping if No LT		54.24%			45.63%							

ORIENTATION AND LANE CONFIGURATION	NB Towards Camera	SB Away From Camera	EB From Right Side	WB From Left Side
Left Turn Lanes	0	0	0	0
Left/Thru Lanes	0	0	0	1
Thru Only Lanes	0	0	0	0
Right/Thru Lanes	0	0	0	0
Right Turn Lanes	0	0	0	1
Left/Thru/Right Lanes	1	1	1	0
Left/Right Lanes	0	0	0	0
Total Lanes	1	1	1	2
State and Federal Routes	None	None	None	None
Functional Classification	Local	Local	Local	Local

Figure D.38 Charles Allen Drive and 8th Street 2 Traffic Conditions and Geometry

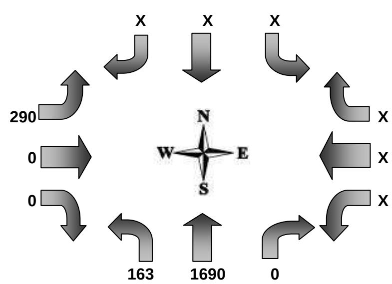
INTERSECTION	W. Peachtree Street and 16th Street 2		
STATUS & FLASH MODE	Malfunction Yellow/Red		
CITY/COUNTY	Atlanta/Fulton		
DATE	May	8	2006
DAY	Monday		
START TIME	18:15		
END TIME	19:20		
LIGHT CONDITIONS	Daylight		
WEATHER	Clear		

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.

Southbound

Eastbound
16th Street



Westbound

Northbound
W Peachtree Street

KEY STATISTICS		
Major Volume for Duration of Video	1896	
Major Volume - first 60 min OR scaled up	1853	(First 60 Min.)
Minor Volume for Duration of Video	299	
Minor Volume - first 60 min OR scaled up	290	(First 60 Min.)
Major:Minor Volume Ratio	6.34	
Video Length in Minutes	62.68	
Percent Time Minor Vehicle Present	85.00%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		NB			0			EB						
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
18:15	18:20	16	136	0	0	0	0	27	0	0	0	0	0	179
18:20	18:25	20	158	0	0	0	0	21	0	0	0	0	0	199
18:25	18:30	12	173	0	0	0	0	36	0	0	0	0	0	221
18:30	18:35	13	158	0	0	0	0	20	0	0	0	0	0	191
18:35	18:40	8	145	0	0	0	0	22	0	0	0	0	0	175
18:40	18:45	14	148	0	0	0	0	28	0	0	0	0	0	190
18:45	18:50	14	141	0	0	0	0	19	0	0	0	0	0	174
18:50	18:55	17	142	0	0	0	0	30	0	0	0	0	0	189
18:55	19:00	9	137	0	0	0	0	28	0	0	0	0	0	174
19:00	19:05	15	148	0	0	0	0	15	0	0	0	0	0	178
19:05	19:10	12	91	0	0	0	0	24	0	0	0	0	0	127
19:10	19:15	13	113	0	0	0	0	20	0	0	0	0	0	146
19:15	19:20	4	39	0	0	0	0	9	0	0	0	0	0	52
TOTAL		167	1729	0	0	0	0	299	0	0	0	0	0	2195

STOPPING	NB			0.0%			EB					
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	62	245	0	0	0	0	259	0	0	0	0	0
Average Stop Time	00:05.2	00:04.6	00:00.0	00:00.0	00:00.0	00:00.0	00:08.3	00:00.0	00:00.0	00:00.0	00:00.0	00:00.0
		00:04.7			00:00.0			00:08.3			00:00.0	
Max Stop Time	00:13.0	00:43.0	00:00.0	00:00.0	00:00.0	00:00.0	01:04.0	00:00.0	00:00.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	37.13%	14.17%	0.00%	0.00%	0.00%	0.00%	86.62%	0.00%	0.00%	0.00%	0.00%	0.00%
		16.19%			0.00%			86.62%			0.00%	
% of Platoon Stopping	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
		0.00%			0.00%			0.00%			0.00%	
% Stopping if Present	40.00%	15.48%	0.00%	0.00%	0.00%	0.00%						
		17.67%			0.00%							
% Stopping if Absent	18.18%	6.43%	0.00%	0.00%	0.00%	0.00%						
		7.38%			0.00%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		14.18%			0.00%							

ORIENTATION AND LANE CONFIGURATION	NB		EB	
	Towards Camera	Away From Camera	From Right Side	From Left Side
Left Turn Lanes	0	-	1	
Left/Thru Lanes	1	-	0	
Thru Only Lanes	4	-	0	
Right/Thru Lanes	0	-	0	
Right Turn Lanes	0	-	0	
Left/Thru/Right Lanes	0	-	0	
Left/Right Lanes	0	-	0	
Total Lanes	5	0	1	0
State and Federal Routes	GA 9/US 19	-	None	

Figure D.39 W. Peachtree Street and 16th 2 Street Traffic Condtions and Geometry

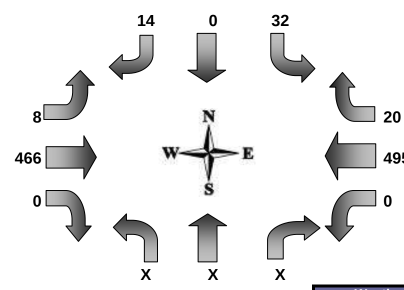
INTERSECTION	10th Street and Holly Street 2
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	May 20 2006
DAY	Saturday
START TIME	13:20
END TIME	14:25
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.

Southbound
Holly

Eastbound
10th



Westbound
10th

Northbound

KEY STATISTICS		
Major Volume for Duration of Video	1033	
Major Volume - first 60 min OR scaled up	989	(First 60 Min.)
Minor Volume for Duration of Video	48	
Minor Volume - first 60 min OR scaled up	46	(First 60 Min.)
Minor:Major Volume Ratio	0.05	
Video Length in Minutes	62.65	
Percent Time Minor Vehicle Present	16.44%	

CAR COUNT		Major Street Approach #1 WB			Major Street Approach #2 EB			Minor Street Approach #1 SB			Minor Street Approach #2			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
13:20	13:25	0	46	1	0	32	0	0	0	0	0	0	0	79
13:25	13:30	0	33	3	0	56	0	7	0	1	0	0	0	100
13:30	13:35	0	40	0	2	37	0	1	0	5	0	0	0	85
13:35	13:40	0	32	0	0	43	0	3	0	1	0	0	0	79
13:40	13:45	0	53	2	0	32	0	2	0	1	0	0	0	90
13:45	13:50	0	42	2	0	47	0	1	0	2	0	0	0	94
13:50	13:55	0	39	1	1	24	0	3	0	1	0	0	0	69
13:55	14:00	0	45	0	1	42	0	3	0	1	0	0	0	92
14:00	14:05	0	40	1	1	42	0	1	0	1	0	0	0	86
14:05	14:10	0	38	3	1	39	0	0	0	1	0	0	0	82
14:10	14:15	0	43	3	1	37	0	5	0	0	0	0	0	89
14:15	14:20	0	44	4	1	35	0	6	0	0	0	0	0	90
14:20	14:25	0	23	0	0	21	0	1	0	1	0	0	0	46
TOTAL		0	518	20	8	487	0	33	0	15	0	0	0	1081

STOPPING	WB			EB			SB					
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	0	11	0	5	12	0	32	0	14	0	0	0
Average Stop Time	00:00.0	00:04.4	00:00.0	00:09.8	00:02.8	00:00.0	00:10.5	00:00.0	00:06.6	00:00.0	00:00.0	00:00.0
		00:04.4			00:04.9			00:09.3			00:00.0	
Max Stop Time	00:00.0	00:12.0	00:00.0	00:23.0	00:08.0	00:00.0	00:45.0	00:00.0	00:27.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	0.00%	2.12%	0.00%	62.50%	2.46%	0.00%	96.97%	0.00%	93.33%	0.00%	0.00%	0.00%
		2.04%			3.43%			95.83%			0.00%	
% of Platoon Stopping	0.00%	3.07%	0.00%	50.00%	3.47%	0.00%	96.97%	0.00%	93.33%	0.00%	0.00%	0.00%
		2.92%			4.42%			95.83%			0.00%	
% Stopping if Present	0.00%	2.83%	0.00%	100.00%	2.13%	0.00%						
		2.75%			3.16%							
% Stopping if Absent	0.00%	1.94%	0.00%	57.14%	2.54%	0.00%						
		1.86%			3.50%							
% Stopping if Opposing Left Turn Waiting		0.00%			0.00%							
% Stopping if No LT		2.00%			2.46%							

ORIENTATION AND LANE CONFIGURATION	WB Towards Camera	EB Away From Camera	SB From Left Side	From Right Side
Left Turn Lanes	0	0	0	-
Left/Thru Lanes	0	1	0	-
Thru Only Lanes	1	1	0	-
Right/Thru Lanes	1	0	0	-
Right Turn Lanes	0	0	0	-
Left/Thru/Right Lanes	0	0	0	-
Left/Right Lanes	0	0	1	-
Total Lanes	2	2	1	0
State and Federal Routes	None	None	None	-
Functional Classification	Minor Arterial	Minor Arterial	Local	Local

Figure D.40 10th Street and Holly Street 2 Traffic Conditions and Geometry

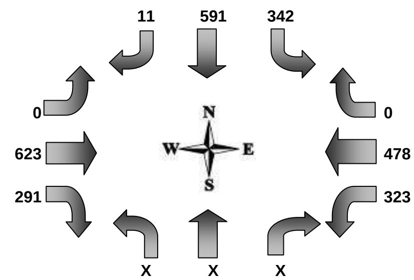
INTERSECTION	10th and I-75/85 SB ramps
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	June 12 2006
DAY	Monday
START TIME	15:10
END TIME	16:15
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.

Southbound
75-85 SB

Eastbound
10th St.



Westbound
10th St.

Northbound

KEY STATISTICS		
Major Volume for Duration of Video	1788	
Major Volume - first 60 min OR scaled up	1715	(First 60 Min.)
Minor Volume for Duration of Video	982	
Minor Volume - first 60 min OR scaled up	944	(First 60 Min.)
Minor:Major Volume Ratio	0.55	
Video Length in Minutes	62.58	
Percent Time Minor Vehicle Present	99.76%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		WB			EB			SB						
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
15:10	15:15	28	43	0	0	46	30	27	47	0	0	0	0	221
15:15	15:20	27	50	0	0	55	18	24	53	0	0	0	0	227
15:20	15:25	30	38	0	0	43	23	27	55	1	0	0	0	217
15:25	15:30	25	34	0	0	57	31	26	50	0	0	0	0	223
15:30	15:35	20	27	0	0	52	22	37	53	1	0	0	0	212
15:35	15:40	27	36	0	0	59	20	25	49	2	0	0	0	218
15:40	15:45	31	42	0	0	32	18	28	55	1	0	0	0	207
15:45	15:50	25	51	0	0	37	20	37	53	1	0	0	0	224
15:50	15:55	24	41	0	0	58	25	25	41	2	0	0	0	216
15:55	16:00	31	37	0	0	50	19	29	49	0	0	0	0	215
16:00	16:05	32	31	0	0	56	35	27	45	1	0	0	0	227
16:05	16:10	23	48	0	0	78	30	30	41	2	0	0	0	252
16:10	16:15	15	22	0	0	26	10	15	23	0	0	0	0	111
TOTAL		338	500	0	0	649	301	357	614	11	0	0	0	2770

STOPPING	WB			EB			SB					
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	253	322	0	0	380	126	298	486	10	0	0	0
Average Stop Time	00:11.0	00:07.7	00:00.0	00:00.0	00:08.5	00:06.2	00:09.9	00:09.5	00:06.2	00:00.0	00:00.0	00:00.0
		00:09.1			00:07.9			00:09.6			00:00.0	
Max Stop Time	00:57.0	00:26.0	00:00.0	00:00.0	01:17.0	00:20.0	00:36.0	00:44.0	00:11.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	74.85%	64.40%	0.00%	0.00%	58.55%	41.86%	83.47%	79.15%	90.91%	0.00%	0.00%	0.00%
		68.62%			53.26%			80.86%			0.00%	
% of Platoon Stopping	92.36%	81.55%	0.00%	0.00%	76.11%	56.25%	88.79%	93.39%	100.00%	0.00%	0.00%	0.00%
		85.68%			68.80%			91.98%			0.00%	
% Stopping if Present	74.93%	64.33%	0.00%	0.00%	58.55%	41.67%						
		68.59%			53.21%							
% Stopping if Absent	66.67%	100.00%	0.00%	0.00%	0.00%	100.00%						
		75.00%			100.00%							
% Stopping if Opposing Left Turn Waiting		0.00%			52.80%							
% Stopping if No LT		64.40%			54.05%							

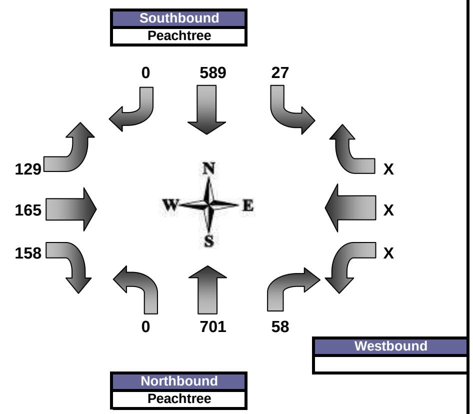
ORIENTATION AND LANE CONFIGURATION	WB	EB	SB	
	Towards Camera	Away From Camera	From Left Side	From Right Side
Left Turn Lanes	1	0	1	-
Left/Thru Lanes	0	0	1	-
Thru Only Lanes	2	2	0	-
Right/Thru Lanes	0	1	1	-
Right Turn Lanes	0	0	0	-
Left/Thru/Right Lanes	0	0	0	-
Left/Right Lanes	0	0	0	-
Total Lanes	3	3	3	0
State and Federal Routes	None	None	I-75/85 ramp	0
Functional Classification	Minor Arterial	Minor Arterial	Ramp	

Figure D.41 10th and I-75/85 SB Ramps Traffic Conditions and Geometry

INTERSECTION	Peachtree Street and Pine Street
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	June 12 2006
DAY	Monday
START TIME	16:35
END TIME	17:20
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	1020	
Major Volume - first 60 min OR scaled up	1376	(Scaled Up)
Minor Volume for Duration of Video	335	
Minor Volume - first 60 min OR scaled up	452	(Scaled Up)
Minor:Major Volume Ratio	0.33	
Video Length in Minutes	44.48	
Percent Time Minor Vehicle Present	84.56%	

CAR COUNT		Major Street Approach #1 SB			Major Street Approach #2 NB			Minor Street Approach #1 EB			Minor Street Approach #2			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
16:35	16:40	1	45	0	0	60	3	11	14	16	0	0	0	150
16:40	16:45	5	36	0	0	57	3	9	17	17	0	0	0	144
16:45	16:50	1	48	0	0	48	4	8	11	14	0	0	0	134
16:50	16:55	1	47	0	0	64	3	11	11	18	0	0	0	155
16:55	17:00	1	52	0	0	46	2	12	12	9	0	0	0	134
17:00	17:05	4	59	0	0	57	4	13	15	10	0	0	0	162
17:05	17:10	1	42	0	0	65	11	10	15	7	0	0	0	151
17:10	17:15	3	52	0	0	60	7	14	17	16	0	0	0	169
17:15	17:20	3	56	0	0	63	6	8	10	10	0	0	0	156
TOTAL		20	437	0	0	520	43	96	122	117	0	0	0	1355

STOPPING	SB			NB			EB					
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	16	242	0	0	247	25	78	101	85	0	0	0
Average Stop Time	00:05.9	00:06.7	00:00.0	00:00.0	00:05.4	00:05.2	00:11.5	00:10.5	00:05.6	00:00.0	00:00.0	00:00.0
		00:06.7			00:05.3			00:09.2			00:00.0	
Max Stop Time	00:13.0	00:48.0	00:00.0	00:00.0	00:19.0	00:12.0	00:44.0	00:34.0	00:23.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	80.00%	55.38%	0.00%	0.00%	47.50%	58.14%	81.25%	82.79%	72.65%	0.00%	0.00%	0.00%
		56.46%			48.31%			78.81%			0.00%	
% of Platoon Stopping	100.00%	65.10%	0.00%	0.00%	64.02%	60.00%	87.10%	91.25%	81.25%	0.00%	0.00%	0.00%
		66.42%			63.78%			86.49%			0.00%	
% Stopping if Present	82.35%	61.54%	0.00%	0.00%	50.85%	64.10%						
		62.54%			51.99%							
% Stopping if Absent	66.67%	34.34%	0.00%	0.00%	34.58%	0.00%						
		35.29%			33.33%							
% Stopping if Opposing Left Turn Waiting		0.00%			56.25%							
% Stopping if No LT		55.38%			47.18%							

ORIENTATION AND LANE CONFIGURATION	SB Towards Camera	NB Away From Camera	EB From Left Side	From Right Side
Left Turn Lanes	0	0	0	-
Left/Thru Lanes	1	0	2	-
Thru Only Lanes	1	2	0	-
Right/Thru Lanes	0	1	0	-
Right Turn Lanes	0	0	1	-
Left/Thru/Right Lanes	0	0	0	-
Left/Right Lanes	0	0	0	-
Total Lanes	2	3	3	0
State and Federal Routes	None	None	None	-
Functional Classification	Minor Arterial	Minor Arterial	Ramp	-

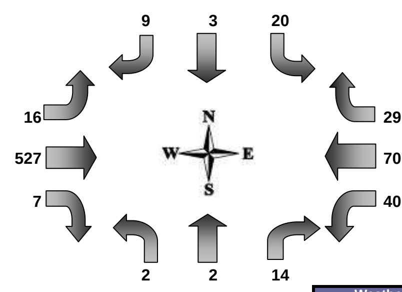
Figure D.42 Peachtree Street and Pine Street Traffic Conditions and Geometry

INTERSECTION	Collier Road and Post Collier Hills Apts
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	May 22 2006
DAY	Thursday
START TIME	16:45
END TIME	17:50
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.

Southbound
Howell Mill Village



Eastbound
Collier Rd.

Westbound
Collier Rd.

Northbound
Post Collier Hills Apts

KEY STATISTICS		
Major Volume for Duration of Video	1399	
Major Volume - first 60 min OR scaled up	1326	(First 60 Min.)
Minor Volume for Duration of Video	53	
Minor Volume - first 60 min OR scaled up	50	(First 60 Min.)
Minor:Major Volume Ratio	0.04	
Video Length in Minutes	62.22	
Percent Time Minor Vehicle Present	22.96%	

CAR COUNT		Major Street Approach #1 WB			Major Street Approach #2 EB			Minor Street Approach #1 SB			Minor Street Approach #2 NB			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
16:45	16:50	1	45	1	1	46	0	3	1	0	0	0	0	98
16:50	16:55	1	58	7	2	38	2	0	0	2	0	0	1	111
16:55	17:00	1	49	2	0	44	0	2	0	0	0	0	0	98
17:00	17:05	3	62	2	1	40	1	3	0	0	0	0	1	113
17:05	17:10	2	51	5	2	63	0	0	0	0	1	1	2	127
17:10	17:15	3	58	3	0	59	0	1	0	2	0	0	0	126
17:15	17:20	3	66	1	0	49	0	3	0	0	0	0	1	123
17:20	17:25	5	58	1	5	40	1	1	0	1	0	0	1	113
17:25	17:30	4	75	3	1	39	1	3	0	0	0	0	2	128
17:30	17:35	5	65	2	1	30	0	1	1	1	1	0	4	111
17:35	17:40	6	61	1	2	37	1	1	1	1	0	1	0	112
17:40	17:45	6	59	1	1	42	1	2	0	2	0	0	2	116
17:45	17:50	2	43	0	0	28	0	3	0	0	0	0	0	76
TOTAL		42	750	29	16	555	7	23	3	9	2	2	14	1452

STOPPING	WB			EB			SB			NB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	23	39	6	14	23	1	22	3	6	2	2	9
Average Stop Time	00:08.2	00:06.6	00:03.0	00:08.6	00:04.7	00:02.0	00:14.8	00:21.7	00:10.2	00:30.0	00:49.5	00:10.6
		00:06.8			00:06.1			00:14.6			00:19.5	
Max Stop Time	00:30.0	00:33.0	00:06.0	00:22.0	00:18.0	00:02.0	00:44.0	00:31.0	00:18.0	00:37.0	01:33.0	00:30.0
% of Vehicle Stopping	54.76%	5.20%	20.69%	87.50%	4.14%	14.29%	95.65%	100.00%	66.67%	100.00%	100.00%	64.29%
		8.28%			6.57%			88.57%			72.22%	
% of Platoon Stopping	51.72%	8.86%	26.09%	83.33%	5.82%	25.00%	95.65%	100.00%	66.67%	100.00%	100.00%	64.29%
		12.27%			8.49%			88.57%			72.22%	
% Stopping if Present	66.67%	9.58%	30.00%	75.00%	9.23%	0.00%						
		14.29%			11.03%							
% Stopping if Absent	50.00%	3.95%	15.79%	91.67%	2.59%	20.00%						
		6.49%			5.20%							
% Stopping if Opposing Left Turn Waiting		24.14%			7.14%							
% Stopping if No LT		4.46%			3.38%							

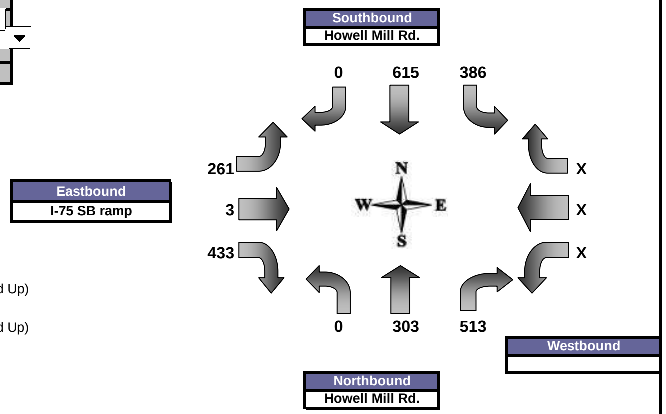
ORIENTATION AND LANE CONFIGURATION	WB	EB	SB	NB
	Towards Camera	Away From Camera	From Left Side	From Right Side
Left Turn Lanes	1	1	0	0
Left/Thru Lanes	0	0	1	1
Thru Only Lanes	0	0	0	0
Right/Thru Lanes	1	1	0	0
Right Turn Lanes	0	0	1	1
Left/Thru/Right Lanes	0	0	0	0
Left/Right Lanes	0	0	0	0
Total Lanes	2	2	2	2
State and Federal Routes	None	None	None	None
Functional Classification	Collector	Collector	Local	Local

Figure D.43 Collier Road and Post Collier Hills Apartments Traffic Conditions and Geometry

INTERSECTION	Howell Mill Road and I-75 SB Ramps	
STATUS & FLASH MODE	Malfunction Yellow/Red	
CITY/COUNTY	Atlanta/Fulton	
DATE	June 26 2006	
DAY	Monday	
START TIME	7:05	
END TIME	8:00	
LIGHT CONDITIONS	Daylight	
WEATHER	Clear	

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	1651	
Major Volume - first 60 min OR scaled up	1817	(Scaled Up)
Minor Volume for Duration of Video	633	
Minor Volume - first 60 min OR scaled up	697	(Scaled Up)
Minor:Major Volume Ratio	0.38	
Video Length in Minutes	54.52	
Percent Time Minor Vehicle Present	97.40%	

CAR COUNT		Major Street Approach #1 SB			Major Street Approach #2 NB			Minor Street Approach #1 EB			Minor Street Approach #2			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
7:05	7:10	17	56	0	0	21	27	17	0	30	0	0	0	168
7:10	7:15	26	41	0	0	23	41	15	0	34	0	0	0	180
7:15	7:20	27	48	0	0	22	33	25	1	23	0	0	0	179
7:20	7:25	32	48	0	0	22	40	22	0	35	0	0	0	199
7:25	7:30	39	55	0	0	27	37	17	0	38	0	0	0	213
7:30	7:35	39	54	0	0	24	40	26	0	27	0	0	0	210
7:35	7:40	44	56	0	0	22	42	22	1	38	0	0	0	225
7:40	7:45	32	50	0	0	24	58	25	0	43	0	0	0	232
7:45	7:50	32	53	0	0	33	51	25	0	39	0	0	0	233
7:50	7:55	28	53	0	0	33	43	26	1	43	0	0	0	227
7:55	8:00	35	45	0	0	24	54	17	0	43	0	0	0	218
TOTAL		351	559	0	0	275	466	237	3	393	0	0	0	2284

STOPPING	SB			NB			EB					
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	263	438	0	0	199	69	227	2	313	0	0	0
Average Stop Time	00:07.0	00:06.9	00:00.0	00:00.0	00:07.1	00:03.5	00:07.7	00:09.0	00:05.8	00:00.0	00:00.0	00:00.0
		00:06.9			00:06.1			00:06.6			00:00.0	
Max Stop Time	00:20.0	00:36.0	00:00.0	00:00.0	00:19.0	00:13.0	00:41.0	00:09.0	00:23.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	74.93%	78.35%	0.00%	0.00%	72.36%	14.81%	95.78%	66.67%	79.64%	0.00%	0.00%	0.00%
		77.03%			36.17%			85.62%			0.00%	
% of Platoon Stopping	85.23%	86.14%	0.00%	0.00%	82.22%	15.63%	96.86%	0.00%	86.29%	0.00%	0.00%	0.00%
		85.82%			36.88%			90.42%			0.00%	
% Stopping if Present	75.14%	79.12%	0.00%	0.00%	72.69%	14.82%						
		77.58%			36.51%							
% Stopping if Absent	60.00%	46.15%	0.00%	0.00%	50.00%	14.29%						
		50.00%			22.22%							
% Stopping if Opposing Left Turn Waiting		0.00%			58.65%							
% Stopping if No LT		78.35%			73.53%							

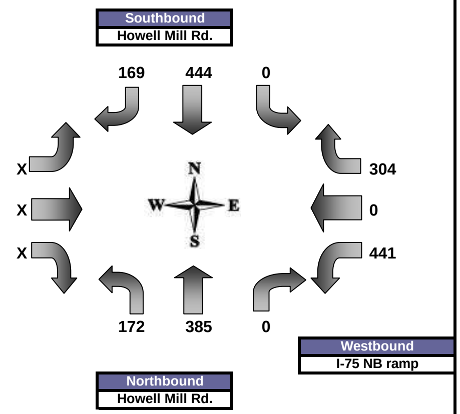
ORIENTATION AND LANE CONFIGURATION	SB Towards Camera	NB Away From Camera	EB From Left Side	From Right Side
Left Turn Lanes	1	0	1	-
Left/Thru Lanes	0	0	0	-
Thru Only Lanes	2	2	0	-
Right/Thru Lanes	0	0	1	-
Right Turn Lanes	0	1	0	-
Left/Thru/Right Lanes	0	0	0	-
Left/Right Lanes	0	0	0	-
Total Lanes	3	3	2	0
State and Federal Routes	None	None	I-75 Ramp	-
Functional Classification	Minor Arterial	Minor Arterial	Ramp	-

Figure D.44 Howell Mill Road and I-75 SB Ramps Traffic Conditions and Geometry

INTERSECTION	Howell Mill Road and I-75 NB Ramps
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	June 26 2006
DAY	Monday
START TIME	7:05
END TIME	8:00
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	1063	
Major Volume - first 60 min OR scaled up	1170	(Scaled Up)
Minor Volume for Duration of Video	677	
Minor Volume - first 60 min OR scaled up	745	(Scaled Up)
Minor:Major Volume Ratio	0.64	
Video Length in Minutes	54.52	
Percent Time Minor Vehicle Present	70.53%	

CAR COUNT		Major Street Approach #1 SB			Major Street Approach #2 NB			Minor Street Approach #1 WB			Minor Street Approach #2			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
7:05	7:10	0	29	8	9	26	0	44	0	18	0	0	0	134
7:10	7:15	0	31	16	12	30	0	29	0	20	0	0	0	138
7:15	7:20	0	37	9	13	30	0	35	0	21	0	0	0	145
7:20	7:25	0	41	16	21	25	0	38	0	21	0	0	0	162
7:25	7:30	0	35	17	12	27	0	40	0	37	0	0	0	168
7:30	7:35	0	50	13	13	38	0	36	0	29	0	0	0	179
7:35	7:40	0	55	23	12	31	0	41	0	36	0	0	0	198
7:40	7:45	0	32	16	14	35	0	36	0	28	0	0	0	161
7:45	7:50	0	31	13	13	43	0	35	0	23	0	0	0	158
7:50	7:55	0	22	13	21	37	0	38	0	21	0	0	0	152
7:55	8:00	0	40	10	16	28	0	29	0	22	0	0	0	145
TOTAL		0	403	154	156	350	0	401	0	276	0	0	0	1740

STOPPING	SB			NB			WB					
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	0	269	45	141	257	0	82	0	35	0	0	0
Average Stop Time	00:00.0	00:08.9	00:06.0	00:10.5	00:08.2	00:00.0	00:05.7	00:00.0	00:07.2	00:00.0	00:00.0	00:00.0
		00:08.5			00:09.0			00:06.1			00:00.0	
Max Stop Time	00:00.0	01:43.0	00:31.0	00:47.0	00:42.0	00:00.0	00:20.0	00:00.0	00:26.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	0.00%	66.75%	29.22%	90.38%	73.43%	0.00%	20.45%	0.00%	12.68%	0.00%	0.00%	0.00%
		56.37%			78.66%			17.28%			0.00%	
% of Platoon Stopping	0.00%	73.95%	41.41%	95.96%	81.07%	0.00%	34.18%	0.00%	13.08%	0.00%	0.00%	0.00%
		65.00%			85.38%			26.70%			0.00%	
% Stopping if Present	0.00%	70.10%	27.78%	89.32%	73.08%	0.00%						
		58.65%			78.46%							
% Stopping if Absent	0.00%	58.04%	32.61%	92.45%	73.94%	0.00%						
		50.63%			78.97%							
% Stopping if Opposing Left Turn Waiting		58.78%			0.00%							
% Stopping if No LT		68.48%			73.43%							

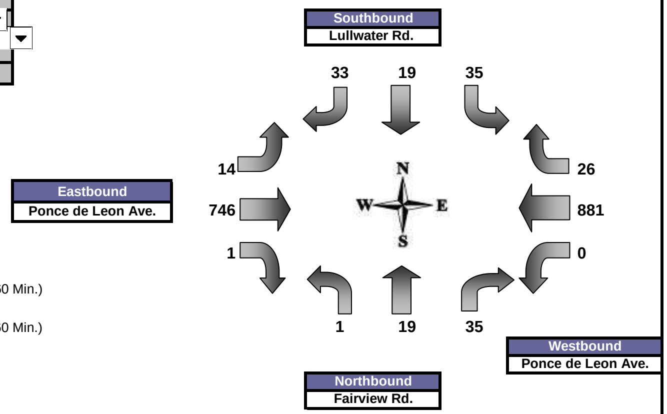
ORIENTATION AND LANE CONFIGURATION	SB Towards Camera	NB Away From Camera	WB From Right Side	From Left Side
Left Turn Lanes	0	1	1	-
Left/Thru Lanes	0	0	1	-
Thru Only Lanes	1	2	0	-
Right/Thru Lanes	1	0	0	-
Right Turn Lanes	0	0	1	-
Left/Thru/Right Lanes	0	0	0	-
Left/Right Lanes	0	0	0	-
Total Lanes	2	3	3	0
State and Federal Routes	None	None	I-75 Ramp	-
Functional Classification	Minor Arterial	Minor Arterial	Ramp	-

Figure D.45 Howell Mill Road and I-75 NB Ramps Traffic Conditions and Geometry

INTERSECTION	Ponce de Leon and Fairview/Lullwater
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/DeKalb
DATE	June 26 2006
DAY	Monday
START TIME	11:15
END TIME	12:20
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	1736	
Major Volume - first 60 min OR scaled up	1668	(First 60 Min.)
Minor Volume for Duration of Video	148	
Minor Volume - first 60 min OR scaled up	142	(First 60 Min.)
Minor:Major Volume Ratio	0.09	
Video Length in Minutes	62.60	
Percent Time Minor Vehicle Present	38.10%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		EB			WB			NB			SB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
11:15	11:20	2	50	0	0	66	1	0	0	1	3	1	1	125
11:20	11:25	2	60	0	0	57	2	0	5	3	4	1	0	134
11:25	11:30	0	62	0	0	57	4	1	0	1	3	2	3	133
11:30	11:35	0	50	0	0	83	3	0	1	1	3	2	4	147
11:35	11:40	2	66	0	0	67	2	0	1	2	4	2	8	154
11:40	11:45	1	67	0	0	70	4	0	1	1	1	0	6	151
11:45	11:50	1	70	0	0	91	4	0	0	2	1	4	2	175
11:50	11:55	0	61	0	0	79	0	0	1	3	2	1	1	148
11:55	12:00	4	67	0	0	81	4	0	2	6	7	0	5	176
12:00	12:05	0	62	0	0	76	1	0	2	3	2	5	0	151
12:05	12:10	2	67	0	0	62	1	0	2	9	2	1	1	147
12:10	12:15	0	64	1	0	92	0	0	4	3	3	0	2	169
12:15	12:20	0	33	0	0	33	2	0	1	0	2	0	3	74
TOTAL		14	779	1	0	914	28	1	20	35	37	19	36	1884

STOPPING	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	9	141	0	0	204	6	1	17	25	30	19	33
Average Stop Time	00:08.9	00:05.1	00:00.0	00:00.0	00:04.5	00:01.7	00:01.0	00:10.5	00:06.6	00:08.1	00:08.9	00:07.7
		00:05.4			00:04.4			00:08.0			00:08.1	
Max Stop Time	00:21.0	00:37.0	00:00.0	00:00.0	00:25.0	00:03.0	00:01.0	00:29.0	00:17.0	00:24.0	00:30.0	00:27.0
% of Vehicle Stopping	64.29%	18.10%	0.00%	0.00%	22.32%	21.43%	100.00%	85.00%	71.43%	81.08%	100.00%	91.67%
		18.89%			22.29%			76.79%			89.13%	
% of Platoon Stopping	50.00%	29.07%	0.00%	0.00%	35.13%	31.25%	100.00%	85.00%	73.53%	85.29%	100.00%	94.29%
		29.63%			34.96%			78.18%			92.05%	
% Stopping if Present	80.00%	31.93%	0.00%	0.00%	35.77%	15.38%						
		32.76%			34.80%							
% Stopping if Absent	55.56%	10.12%	0.00%	0.00%	16.97%	26.67%						
		10.91%			17.19%							
% Stopping if Opposing Left Turn Waiting		0.00%			29.41%							
% Stopping if No LT		18.10%			21.66%							

ORIENTATION AND LANE CONFIGURATION	EB	WB	NB	SB
	Towards Camera	Away From Camera	From Left Side	From Right Side
Left Turn Lanes	0	0	0	1
Left/Thru Lanes	1	1	0	0
Thru Only Lanes	0	0	0	0
Right/Thru Lanes	1	1	0	1
Right Turn Lanes	0	0	0	0
Left/Thru/Right Lanes	0	0	1	0
Left/Right Lanes	0	0	0	0
Total Lanes	2	2	1	2
State and Federal Routes	GA8/GA10/US23/US29/US78/US278		None	None
Functional Classification	Principal Arterial	Principal Arterial	Collector	Collector

Figure D.46 Ponce de Leon Avenue and Fairview Road/Lullwater Road Traffic Conditions and Geometry

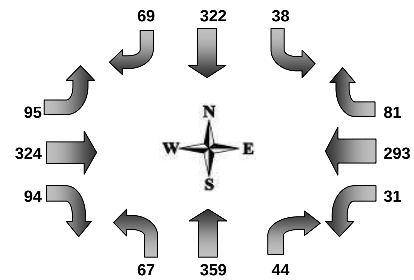
INTERSECTION	10th Street and Peachtree Street
STATUS & FLASH MODE	Malfunction Red/Red
CITY/COUNTY	Atlanta/Fulton
DATE	June 28 2006
DAY	Wednesday
START TIME	10:00
END TIME	10:40
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.

Southbound
Peachtree St.

Eastbound
10th St.



Westbound
10th St.

Northbound
Peachtree St.

KEY STATISTICS		
Major Volume for Duration of Video	598	
Major Volume - first 60 min OR scaled up	917	(Scaled Up)
Minor Volume for Duration of Video	587	
Minor Volume - first 60 min OR scaled up	900	(Scaled Up)
Minor:Major Volume Ratio	0.98	
Video Length in Minutes	39.13	
Percent Time Minor Vehicle Present	99.57%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		EB			WB			SB			NB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
10:00	10:05	8	48	15	2	28	9	3	26	5	8	26	2	180
10:05	10:10	10	28	6	2	22	11	2	33	7	3	31	4	159
10:10	10:15	11	27	3	3	25	6	3	35	8	3	29	2	155
10:15	10:20	10	23	8	5	17	1	1	22	7	11	27	4	136
10:20	10:25	9	21	5	2	28	9	5	21	3	4	32	5	144
10:25	10:30	7	25	8	1	31	8	3	25	9	2	31	5	155
10:30	10:35	3	15	7	5	22	2	6	26	4	10	30	4	134
10:35	10:40	4	24	9	0	18	7	2	22	2	3	28	3	122
TOTAL		62	211	61	20	191	53	25	210	45	44	234	29	1185

STOPPING	EB			WB			SB			NB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	52	179	39	20	171	44	22	176	35	42	188	13
Average Stop Time	00:10.7	00:08.5	00:06.6	00:12.0	00:09.5	00:06.2	00:08.5	00:09.1	00:05.0	00:09.8	00:07.2	00:05.1
		00:08.7			00:09.1			00:08.4			00:07.6	
Max Stop Time	00:45.0	00:25.0	00:24.0	00:37.0	00:45.0	00:41.0	00:21.0	00:26.0	00:16.0	00:33.0	00:44.0	00:08.0
% of Vehicle Stopping	83.87%	84.83%	63.93%	100.00%	89.53%	83.02%	88.00%	83.81%	77.78%	95.45%	80.34%	44.83%
		80.84%			89.02%			83.21%			79.15%	
% of Platoon Stopping	88.24%	90.98%	65.79%	100.00%	95.00%	92.68%	89.47%	90.51%	80.95%	96.30%	83.67%	41.18%
		85.57%			94.83%			88.58%			82.08%	
% Stopping if Present	83.87%	84.76%	63.93%	100.00%	89.47%	83.02%						
		80.78%			88.97%							
% Stopping if Absent	0.00%	100.00%	0.00%	0.00%	100.00%	0.00%						
		100.00%			100.00%							
% Stopping if Opposing Left Turn Waiting		82.35%			91.18%							
% Stopping if No LT		84.41%			88.55%							

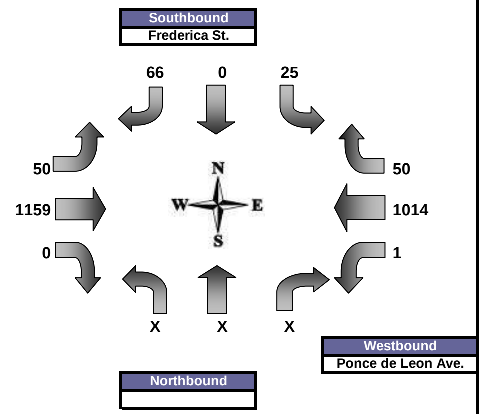
ORIENTATION AND LANE CONFIGURATION	EB	WB	SB	NB
	From Left Side	From Right Side	Towards Camera	Away From Camera
Left Turn Lanes	1	1	0	1
Left/Thru Lanes	0	0	1	0
Thru Only Lanes	2	1	0	1
Right/Thru Lanes	0	1	1	0
Right Turn Lanes	1	0	0	1
Left/Thru/Right Lanes	0	0	0	0
Left/Right Lanes	0	0	0	0
Total Lanes	4	3	2	3
State and Federal Routes	None	None	None	None
Functional Classification	Minor Arterial	Minor Arterial	Minor Arterial	Minor Arterial

Figure D.47 10th Street and Peachtree Street Traffic Conditions and Geometry

INTERSECTION	Ponce de Leon Ave. and Frederica St.
STATUS & FLASH MODE	Malfunction Yellow/Red
CITY/COUNTY	Atlanta/Fulton
DATE	July 30 2006
DAY	Sunday
START TIME	14:15
END TIME	15:20
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	2358	
Major Volume - first 60 min OR scaled up	2274	(First 60 Min.)
Minor Volume for Duration of Video	93	
Minor Volume - first 60 min OR scaled up	91	(First 60 Min.)
Minor:Major Volume Ratio	0.04	
Video Length in Minutes	62.58	
Percent Time Minor Vehicle Present	39.84%	

CAR COUNT		Major Street Approach #1 WB			Major Street Approach #2 EB			Minor Street Approach #1 SB			Minor Street Approach #2			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
14:15	14:20	0	91	1	0	81	0	1	0	9	0	0	0	183
14:20	14:25	0	94	3	5	97	0	1	0	5	0	0	0	205
14:25	14:30	0	66	7	9	112	0	4	0	4	0	0	0	202
14:30	14:35	0	106	3	3	110	0	2	0	6	0	0	0	230
14:35	14:40	0	95	4	4	87	0	2	0	6	0	0	0	198
14:40	14:45	0	66	5	4	112	0	1	0	3	0	0	0	191
14:45	14:50	0	83	6	5	107	0	3	0	7	0	0	0	211
14:50	14:55	1	93	4	5	80	0	2	0	8	0	0	0	193
14:55	15:00	0	80	3	2	88	0	2	0	2	0	0	0	177
15:00	15:05	0	83	8	6	103	0	3	0	5	0	0	0	208
15:05	15:10	0	73	2	2	100	0	3	0	7	0	0	0	187
15:10	15:15	0	84	4	5	82	0	1	0	4	0	0	0	180
15:15	15:20	0	34	0	4	46	0	0	0	2	0	0	0	86
TOTAL		1	1048	50	54	1205	0	25	0	68	0	0	0	2451

STOPPING	WB			EB			SB					
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	0	72	5	30	16	0	23	0	49	0	0	0
Average Stop Time	00:00.0	00:06.0	00:11.8	00:14.3	00:03.6	00:00.0	00:21.8	00:00.0	00:13.2	00:00.0	00:00.0	00:00.0
		00:06.4			00:10.6			00:15.9			00:00.0	
Max Stop Time	00:00.0	00:23.0	00:24.0	01:05.0	00:15.0	00:00.0	01:08.0	00:00.0	00:56.0	00:00.0	00:00.0	00:00.0
% of Vehicle Stopping	0.00%	6.87%	10.00%	55.56%	1.33%	0.00%	92.00%	0.00%	72.06%	0.00%	0.00%	0.00%
		7.01%			3.65%			77.42%			0.00%	
% of Platoon Stopping	0.00%	10.90%	16.67%	60.87%	1.29%	0.00%	92.00%	0.00%	75.38%	0.00%	0.00%	0.00%
		11.22%			4.61%			80.00%			0.00%	
% Stopping if Present	0.00%	10.41%	13.33%	61.54%	2.04%	0.00%						
		10.50%			3.57%							
% Stopping if Absent	0.00%	4.29%	8.57%	53.66%	0.84%	0.00%						
		4.52%			3.71%							
% Stopping if Opposing Left Turn Waiting		5.73%			0.00%							
% Stopping if No LT		6.82%			1.33%							

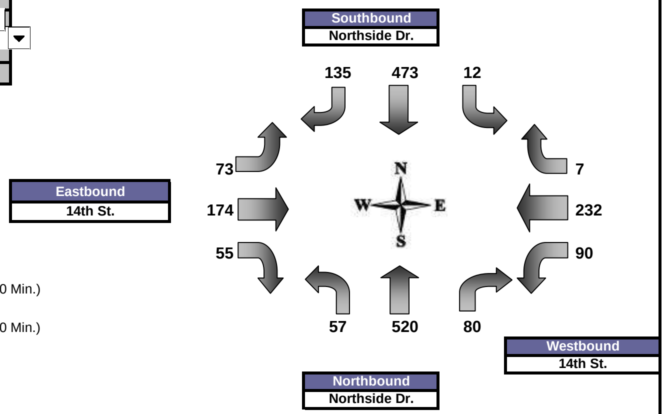
ORIENTATION AND LANE CONFIGURATION	WB Towards Camera	EB Away From Camera	SB From Left Side	From Right Side
Left Turn Lanes	0	0	0	-
Left/Thru Lanes	0	1	0	-
Thru Only Lanes	1	2	0	-
Right/Thru Lanes	1	0	0	-
Right Turn Lanes	0	0	1	-
Left/Thru/Right Lanes	0	0	1	-
Left/Right Lanes	0	0	0	-
Total Lanes	2	3	2	0
State and Federal Routes	GA8/GA10/US29/US78/US278	GA8/GA10/US29/US78/US278	None	-
Functional Classification	Principal Arterial	Principal Arterial	Local	-

Figure D.48 Ponce de Leon Avenue and Frederica Street Traffic Conditions and Geometry

INTERSECTION	Northside Drive and 14th Street
STATUS & FLASH MODE	Malfunction Red/Red
CITY/COUNTY	Atlanta/Fulton
DATE	August 22 2006
DAY	Tuesday
START TIME	10:20
END TIME	11:25
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	1332	
Major Volume - first 60 min OR scaled up	1277	(First 60 Min.)
Minor Volume for Duration of Video	664	
Minor Volume - first 60 min OR scaled up	631	(First 60 Min.)
Minor:Major Volume Ratio	0.50	
Video Length in Minutes	62.60	
Percent Time Minor Vehicle Present	92.25%	

CAR COUNT		Major Street Approach #1 SB			Major Street Approach #2 NB			Minor Street Approach #1 EB			Minor Street Approach #2 WB			Total of Entering Vehicles
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
10:20	10:25	0	49	12	3	45	9	2	20	3	11	19	0	173
10:25	10:30	0	47	7	3	49	9	4	18	6	13	29	1	186
10:30	10:35	2	45	8	4	42	6	6	18	7	2	15	0	155
10:35	10:40	2	42	17	7	45	4	5	14	4	8	24	0	172
10:40	10:45	0	34	10	3	41	9	4	21	6	4	18	2	152
10:45	10:50	2	33	8	5	27	8	6	14	7	10	18	0	138
10:50	10:55	1	40	18	4	42	7	7	13	5	8	16	0	161
10:55	11:00	2	28	5	2	34	4	10	10	7	9	22	0	133
11:00	11:05	1	39	11	4	53	5	8	6	1	8	15	2	153
11:05	11:10	2	42	13	7	46	7	7	19	4	5	19	1	172
11:10	11:15	0	34	16	8	48	6	7	11	3	6	15	1	155
11:15	11:20	0	40	10	7	48	6	7	10	2	6	22	0	158
11:20	11:25	0	15	2	5	32	1	2	9	5	5	12	0	88
TOTAL		12	488	137	62	552	81	75	183	60	95	244	7	1996

STOPPING	SB			NB			EB			WB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	12	446	113	59	496	58	70	169	50	73	206	6
Average Stop Time	00:08.9	00:08.3	00:05.4	00:10.4	00:07.2	00:04.7	00:11.3	00:09.2	00:07.7	00:07.3	00:07.6	00:07.0
		00:07.7			00:07.3			00:09.5			00:07.5	
Max Stop Time	00:18.0	00:41.0	00:38.0	00:49.0	00:31.0	00:12.0	00:41.0	00:35.0	00:22.0	00:18.0	00:24.0	00:11.0
% of Vehicle Stopping	100.00%	91.39%	82.48%	95.16%	89.86%	71.60%	93.33%	92.35%	83.33%	76.84%	84.43%	85.71%
		89.64%			88.20%			90.88%			82.37%	
% of Platoon Stopping	100.00%	94.58%	90.91%	89.66%	93.55%	74.07%	93.33%	94.07%	88.24%	80.00%	91.15%	83.33%
		93.70%			90.59%			92.68%			88.37%	
% Stopping if Present	100.00%	92.68%	82.93%	94.55%	90.52%	74.36%						
		90.73%			88.87%							
% Stopping if Absent	0.00%	80.39%	78.57%	100.00%	83.93%	0.00%						
		80.00%			81.82%							
% Stopping if Opposing Left Turn Waiting		96.77%			100.00%							
% Stopping if No LT		90.60%			89.49%							

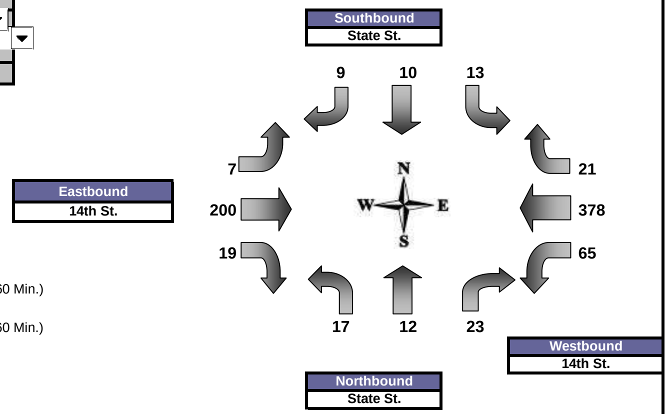
ORIENTATION AND LANE CONFIGURATION	SB Towards Camera	NB Away From Camera	EB From Left Side	WB From Right Side
Left Turn Lanes	1	1	0	0
Left/Thru Lanes	0	0	1	1
Thru Only Lanes	1	1	0	0
Right/Thru Lanes	1	1	1	1
Right Turn Lanes	0	0	0	0
Left/Thru/Right Lanes	0	0	0	0
Left/Right Lanes	0	0	0	0
Total Lanes	3	3	2	2
State and Federal Routes	GA 3/US 41	GA 3/US 19/US 41	None	GA 9/US 19
Functional Classification	Principal Arterial	Principal Arterial	Minor Arterial	Minor Arterial

Figure D.49 Northside Drive and 14th Street Traffic Conditions and Geometry

INTERSECTION	14th Street and State Street
STATUS & FLASH MODE	Malfunction Red/Red
CITY/COUNTY	Atlanta/Fulton
DATE	November 18 2006
DAY	Saturday
START TIME	9:30
END TIME	10:35
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	726	
Major Volume - first 60 min OR scaled up	690	(First 60 Min.)
Minor Volume for Duration of Video	87	
Minor Volume - first 60 min OR scaled up	84	(First 60 Min.)
Minor:Major Volume Ratio	0.12	
Video Length in Minutes	62.50	
Percent Time Minor Vehicle Present	19.63%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		EB			WB			NB			SB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
9:30	9:35	0	23	0	3	35	1	0	1	0	1	0	2	66
9:35	9:40	0	20	1	6	17	1	0	0	2	1	0	1	49
9:40	9:45	1	12	0	2	22	1	1	0	1	0	0	1	41
9:45	9:50	4	15	1	8	37	3	0	1	3	0	3	0	75
9:50	9:55	0	8	1	8	38	1	2	2	4	2	1	0	67
9:55	10:00	1	15	3	5	33	3	2	2	2	1	0	0	67
10:00	10:05	0	13	2	9	39	6	3	1	3	2	1	0	79
10:05	10:10	1	15	1	4	31	1	1	1	0	1	1	2	59
10:10	10:15	0	15	2	4	24	1	2	2	1	0	1	0	52
10:15	10:20	0	26	1	4	25	2	3	2	2	3	3	2	73
10:20	10:25	0	17	5	5	41	0	1	0	1	1	0	0	71
10:25	10:30	0	21	2	7	36	1	2	0	4	1	0	1	75
10:30	10:35	1	13	2	2	17	1	1	1	0	0	0	1	39
TOTAL		8	213	21	67	395	22	18	13	23	13	10	10	813

STOPPING	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	8	183	19	57	330	19	18	13	19	13	10	8
Average Stop Time	00:06.2	00:03.3	00:02.9	00:02.9	00:02.8	00:03.1	00:06.7	00:04.4	00:04.6	00:06.7	00:04.5	00:04.4
		00:03.3			00:02.8			00:05.3			00:05.4	
Max Stop Time	00:14.0	00:19.0	00:08.0	00:07.0	00:15.0	00:08.0	00:16.0	00:11.0	00:19.0	00:19.0	00:10.0	00:08.0
% of Vehicle Stopping	100.00%	85.92%	90.48%	85.07%	83.54%	86.36%	100.00%	100.00%	82.61%	100.00%	100.00%	80.00%
		86.78%			83.88%			92.59%			93.94%	
% of Platoon Stopping	100.00%	86.47%	90.48%	87.50%	83.96%	76.92%	100.00%	100.00%	82.61%	100.00%	100.00%	80.00%
		87.37%			84.25%			92.59%			93.94%	
% Stopping if Present	100.00%	93.02%	100.00%	86.67%	89.74%	100.00%						
		93.75%			89.90%							
% Stopping if Absent	100.00%	84.12%	88.89%	84.62%	82.02%	81.25%						
		85.05%			82.34%							
% Stopping if Opposing Left Turn Waiting		87.50%			83.33%							
% Stopping if No LT		84.74%			83.51%							

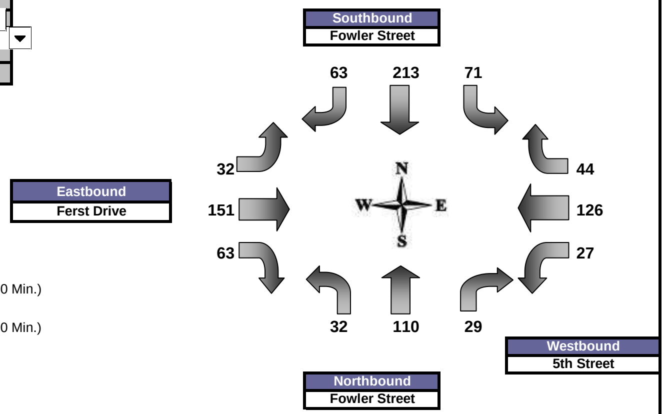
ORIENTATION AND LANE CONFIGURATION	EB	WB	NB	SB
	Towards Camera	Away From Camera	From Right Side	From Left Side
Left Turn Lanes	0	0	0	0
Left/Thru Lanes	1	1	0	0
Thru Only Lanes	0	0	0	0
Right/Thru Lanes	1	1	0	0
Right Turn Lanes	0	0	0	0
Left/Thru/Right Lanes	0	0	1	1
Left/Right Lanes	0	0	0	0
Total Lanes	2	2	1	1
State and Federal Routes	GA 9/US 19	GA 9/US 19	None	None
Functional Classification	Minor Arterial	Minor Arterial	Local	Local

Figure D.50 14th Street and State Street Traffic Conditions and Geometry

INTERSECTION	Fowler and 5th/Ferst
STATUS & FLASH MODE	Malfunction Red/Red
CITY/COUNTY	Atlanta/Fulton
DATE	December 1 2006
DAY	Friday
START TIME	12:20
END TIME	13:25
LIGHT CONDITIONS	Daylight
WEATHER	Clear

Equivilent Hourly Traffic Volumes

Actual volume from first 60 min. of video OR adjusted volume for videos less than 60 min.



KEY STATISTICS		
Major Volume for Duration of Video	535	
Major Volume - first 60 min OR scaled up	518	(First 60 Min.)
Minor Volume for Duration of Video	474	
Minor Volume - first 60 min OR scaled up	443	(First 60 Min.)
Minor:Major Volume Ratio	0.89	
Video Length in Minutes	62.53	
Percent Time Minor Vehicle Present	79.77%	

CAR COUNT		Major Street Approach #1			Major Street Approach #2			Minor Street Approach #1			Minor Street Approach #2			Total of Entering Vehicles
		NB			SB			EB			WB			
START	END	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
12:20	12:25	2	5	3	6	11	5	1	9	3	2	6	4	57
12:25	12:30	1	5	5	5	12	3	4	11	5	1	11	2	65
12:30	12:35	0	11	5	7	13	3	2	8	4	3	13	4	73
12:35	12:40	4	6	2	6	12	8	4	16	8	2	8	2	78
12:40	12:45	0	3	1	7	20	2	1	15	6	1	13	1	70
12:45	12:50	3	14	2	8	17	5	2	13	4	0	8	4	80
12:50	12:55	1	9	3	4	24	10	4	12	2	7	12	5	93
12:55	13:00	3	9	0	5	23	7	3	8	6	1	12	4	81
13:00	13:05	4	17	4	6	27	6	2	10	5	3	12	5	101
13:05	13:10	7	14	3	4	20	3	5	15	7	2	9	2	91
13:10	13:15	5	5	1	5	18	3	2	23	6	2	8	6	84
13:15	13:20	2	12	0	8	16	8	2	11	7	3	14	5	88
13:20	13:25	1	7	3	1	3	2	4	8	3	1	11	4	48
TOTAL		33	117	32	72	216	65	36	159	66	28	137	48	1009

STOPPING	NB			SB			EB			WB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Total # of Stops	32	114	24	62	196	45	36	155	60	28	132	41
Average Stop Time	00:06.4	00:05.8	00:04.2	00:04.8	00:04.5	00:03.6	00:09.1	00:08.0	00:05.3	00:07.1	00:05.5	00:03.6
		00:05.7			00:04.5			00:07.5			00:05.3	
Max Stop Time	00:18.0	00:26.0	00:16.0	00:11.0	00:17.0	00:13.0	00:28.0	00:41.0	00:20.0	00:15.0	00:15.0	00:12.0
% of Vehicle Stopping	96.97%	97.44%	75.00%	86.11%	90.74%	69.23%	100.00%	97.48%	90.91%	100.00%	96.35%	85.42%
		93.41%			85.84%			96.17%			94.37%	
% of Platoon Stopping	100.00%	98.26%	85.71%	91.04%	93.63%	84.00%	100.00%	97.40%	93.65%	100.00%	96.97%	86.96%
		96.57%			91.59%			96.65%			95.00%	
% Stopping if Present	96.55%	97.03%	77.27%	87.23%	91.23%	76.00%						
		94.08%			87.69%							
% Stopping if Absent	100.00%	100.00%	70.00%	84.00%	88.89%	46.67%						
		90.00%			80.00%							
% Stopping if Opposing Left Turn Waiting		80.00%			88.89%							
% Stopping if No LT		97.98%			90.72%							

ORIENTATION AND LANE CONFIGURATION	NB	SB	EB	WB
	Towards Camera	Away From Camera	From Right Side	From Left Side
Left Turn Lanes	0	0	1	1
Left/Thru Lanes	0	0	0	0
Thru Only Lanes	0	0	0	0
Right/Thru Lanes	0	0	1	1
Right Turn Lanes	0	0	0	0
Left/Thru/Right Lanes	1	1	0	0
Left/Right Lanes	0	0	0	0
Total Lanes	1	1	2	2
State and Federal Routes	None	None	None	None
Functional Classification	Local	Local	Local	Local

Figure D.51 Fowler and 5th/Ferst Traffic Conditions and Geometry

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