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16. Abstract

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The calibration of the model indicated that the model generally overestimates delays as compared to observed delays. The differences between observed and simulated were less for unsaturated conditions and more pronounced for saturated conditions. It appeared that the model does not have the capability to realistically estimate delays for saturated conditions.

Evaluation of grade separation of congested at-grade intersections showed that the reduction in delay was directly related to the flow rate at the intersection. The higher the flow rate, the greater the reduction in delay. The cut-off flow rate entering the critical intersection, at which grade separation would be an effective option, was found to be 5000 vph. The analysis indicated the beyond entering flow rate of 5000 vph, the delays at the at-grade intersection increase exponentially. In order to truly benefit from grade separation, intersections with an entering flow rate of more than 5000 vph would result in enough delay savings to justify the high cost of installation.

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# AN ANALYSIS OF EXPECTED DELAY REDUCTION BY REPLACING A CONGESTED AT-GRADE INTERSECTION WITH AN INTERCHANGE

by

Syed Shariq Raza
Research Assistant

and

Vergil G. Stover
Study Supervisor

Research Study Number 2-8-90-1237

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July 1991
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# METRIC (SI*) CONVERSION FACTORS

## APPROXIMATE CONVERSIONS TO SI UNITS

| Symbol | When You Know | Multiply By | To Find | Symbol |
|---|---|---|---|---|
| **LENGTH** | | | | |
| in | inches | 2.54 | centimetres | cm |
| ft | feet | 0.3048 | metres | m |
| yd | yards | 0.914 | metres | m |
| mi | miles | 1.61 | kilometres | km |
| **AREA** | | | | |
| $in^2$ | square inches | 645.2 | centimetres squared | $cm^2$ |
| $ft^2$ | square feet | 0.0929 | metres squared | $m^2$ |
| $yd^2$ | square yards | 0.836 | metres squared | $m^2$ |
| $mi^2$ | square miles | 2.59 | kilometres squared | $km^2$ |
| ac | acres | 0.395 | hectares | ha |
| **MASS (weight)** | | | | |
| oz | ounces | 28.35 | grams | g |
| lb | pounds | 0.454 | kilograms | kg |
| T | short tons (2000 lb) | 0.907 | megagrams | Mg |
| **VOLUME** | | | | |
| fl oz | fluid ounces | 29.57 | millilitres | mL |
| gal | gallons | 3.785 | litres | L |
| $ft^3$ | cubic feet | 0.0328 | metres cubed | $m^3$ |
| $yd^3$ | cubic yards | 0.0765 | metres cubed | $m^3$ |

NOTE: Volumes greater than 1000 L shall be shown in $m^3$.

**TEMPERATURE (exact)**

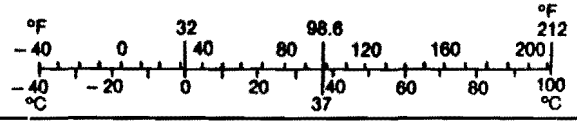
| °F | Fahrenheit temperature | 5/9 (after subtracting 32) | Celsius temperature | °C |
|---|---|---|---|---|


## APPROXIMATE CONVERSIONS TO SI UNITS

| Symbol | When You Know | Multiply By | To Find | Symbol |
|---|---|---|---|---|
| **LENGTH** | | | | |
| mm | millimetres | 0.039 | inches | in |
| m | metres | 3.28 | feet | ft |
| m | metres | 1.09 | yards | yd |
| km | kilometres | 0.621 | miles | mi |
| **AREA** | | | | |
| $mm^2$ | millimetres squared | 0.0016 | square inches | $in^2$ |
| $m^2$ | metres squared | 10.764 | square feet | $ft^2$ |
| $km^2$ | kilometres squared | 0.39 | square miles | $mi^2$ |
| ha | hectores (10 000 $m^2$) | 2.53 | acres | ac |
| **MASS (weight)** | | | | |
| g | grams | 0.0353 | ounces | oz |
| kg | kilograms | 2.205 | pounds | lb |
| Mg | megagrams (1 000 kg) | 1.103 | short tons | T |
| **VOLUME** | | | | |
| mL | millilitres | 0.034 | fluid ounces | fl oz |
| L | litres | 0.264 | gallons | gal |
| $m^3$ | metres cubed | 35.315 | cubic feet | $ft^3$ |
| $m^3$ | metres cubed | 1.308 | cubic yards | $yd^3$ |

**TEMPERATURE (exact)**

| °C | Celsius temperature | 9/5 (then add 32) | Fahrenheit temperature | °F |
|---|---|---|---|---|




These factors conform to the requirement of FHWA Order 5190.1A.

* SI is the symbol for the International System of Measurements

## ABSTRACT

This research has documented calibration of an off-line computer traffic simulation model, TRANSYT-7F, in terms of its suitability to model traffic flow through signalized streets, especially for saturated conditions. The later half of this research is devoted to evaluating the potential effectiveness of grade separation at congested intersections of two arterial streets.

The calibration of the model indicated that the model generally overestimates delays as compared to observed delays. The differences between observed and simulated were less for unsaturated conditions and more pronounced for saturated conditions. It appeared that the model does not have the capability to realistically estimate delays for saturated conditions.

Evaluation of grade separation of congested at-grade intersections showed that the reduction in delay was directly related to the flow rate at the intersection. The higher the flow rate, the greater the reduction in delay. The cut-off flow rate entering the critical intersection, at which grade separation would be an effective option, was found to be 5000 vph. The analysis indicated that beyond entering flow rate of 5000 vph, the delays at the at-grade intersection increase exponentially. In order to truly benefit from grade separation, intersections with an entering flow rate of more than 5000 vph would result in enough delay savings to justify the high cost of installation.

## SUMMARY

Congestion on urban freeways and arterial streets in our nation's largest cities is increasing annually at a rate of 2.5 percent. As a result, motorists are experiencing increasing delays, increases in fuel consumption, and additional vehicle maintenance costs. In 1987 alone, the congestion costs for the 39 largest cities in the United States were an estimated $41 billion.

Many engineers feel that grade separating selected congested intersections along an arterial will significantly reduce the delay incurred over the system, thereby justifying the cost. Therefore, the focus of this report is to address the issues relative to the replacement of a congested intersection with an interchange in terms of delay reduction on the system.

This report utilized data collected at six congested arterial-to-arterial at-grade intersections in Texas. The study locations were selected with the help of state and city officials on the basis of their severity of congestion. Three of the study intersections are located in the Houston area, while the remaining three study intersections are located in the Dallas/Fort Worth area.

The TRANSYT-7F model was calibrated to simulate the traffic flow and stop delays using the actual turning movement counts at each location for both 15-minute periods and hourly periods. Additional simulations were run for grade separating the north-south arterial and, likewise, grade separating the east-west arterial for each study location.

The analyses to evaluate the potential effectiveness of grade separation indicated that the reduction in delay due to grade separation depended on a number of variables, such as, flow rate through the system, the functional classification of the cross street, the prevalent flow rate on the cross street at the downstream intersection, and the time of day.

This research indicates that in order to maximize the benefits from grade separation,

only those intersections which have an entering flow rate of at least 5,000 vph need to be investigated. Grade separating locations with entering flow rates less than 5,000 vph do not significantly reduce the delay, and consequently, may not be a cost effective solution.

## DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Texas Department of Transportation (TxDOT) or the Federal Highway Administration (FHWA). This report does not constitute a standard, specification, or regulation. This report is not intended for construction, bidding, or permit purposes.

## IMPLEMENTATION STATEMENT

The data summarized in this project can be used by the Texas Department of Transportation (TxDOT) staff and planning sections of the urban public transit agencies in Texas to compare operations, service, ridership characteristics, mode share and impact of transit on roadway operation. Additional information in the appendix details the operation of transit systems in Texas since 1976 using TxDOT data and other transit statistics.

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# CHAPTER I

## INTRODUCTION

The object of this research project is to develop geometric guidelines and criteria for replacement of congested urban arterial-to-arterial at-grade intersections with interchanges. This report has addressed issues relative to replacement of a congested intersection by an interchange in terms of the decrease in delay on the system.

Congestion on urban freeways and arterial streets in the large cities of United States is, on the average, increasing annually at the rate of 2.5 percent, ranging from 2.0 percent for Chicago, Illinois, to 7.6 percent for San Diego, California (1). In Texas, congestion is growing in the five largest cities, namely Houston, Dallas, Fort Worth, Austin and San Antonio, at an annual rate of 3 percent, while the state-wide average annual growth rate is 2 percent (1).

The growth in congestion can be evidenced by looking at the increase in volume-to-capacity ratios in urban areas between the period 1981 to 1986 and the increase in vehicle-miles of travel per lane-mile (2, 3) presented in Tables 1 and 2 respectively.

Congestion causes delays to the motorists, increases fuel consumption as well as emissions, and adds to the maintenance cost of the vehicle. Congestion cost in 1987 for 39 of the largest cities of United States amounted to a staggering $ 41 billion. In 1987, the seven largest cities in Texas experienced congestion costs of $ 3.5 billion (2).

There are numerous reasons for the increase in congestion; a few of the notable causes are listed below:

1. Since 1950, the urban and suburban population of United States has increased by more than 85 percent (4), thereby increasing demand on the highway system.

2. Urban employment in the last 40 years has increased at a rate twice that of urban population growth. This dramatic increase in employment opportunities has resulted in an improved standard of living and affluence. This is manifested by the increase in the number of vehicles per worker in urban areas from 0.85 in 1960 to 1.34 in 1980. Today, the majority of urban households in United States have two or more vehicles (4).

**Table 1: Increase in Volume-to-Capacity Ratios in Urban Areas Between 1981-1986**

| Functional Class | Lane-Miles with V/C Ratio 0.71 to 0.95 | | Lane-Miles with V/C Ratio 0.95 and Up | |
|---|---|---|---|---|
| | 1981 | 1986 | 1981 | 1986 |
| Interstate | 14.5 | 20.4 | 16.6 | 24.9 |
| Freeway/Expressway | 11.4 | 14.7 | 15.8 | 18.8 |
| Major Arterial | 16.4 | 16.8 | 18.7 | 18 |
| Minor Arterial | 11.7 | 9.8 | 11.3 | 11.2 |

Source: Highway Statistics. FHWA, USDOT, 1986 (5).

**Table 2: Increase in the Percentage of Congested Road Miles Between 1983-1986**

| Functional Class | Percentage of Congested Miles | |
|---|---|---|
| | 1983 | 1985 |
| Interstate | 36.9 | 43.9 |
| Freeway/Expressway | 25.7 | 31.5 |
| Major Arterial | 34.0 | 35.9 |
| Minor Arterial | 20.0 | 21.3 |

Source: Highway Statistics. FHWA, USDOT, 1986 (5).

During the period 1950 to 1990, minimal efforts were directed towards developing alternate modes of transportation. Consequently, the explosive increase in travel demand fell on the urban freeway and arterial street systems, causing an increase in congestion on these facilities.

A variety of strategies are available to alleviate congestion. One option is to build new highways, keeping pace with the rate of growth in demand. This is seldom possible in the realm of the financial constraints faced by the local, state and federal governments. This can be authenticated by looking at the figures of public spending for new highways, in terms of constant dollars, in the United States. The federal expenditure for the construction of new highways peaked in the year 1965 and since then has been steadily decreasing. By the end of 1984, federal spending had dropped by approximately a third. The expenditures by state and local governments for new highways peaked in 1972 and decreased by more than 20 percent by the end of 1984. Annually, construction expenditures, in constant dollars, have dropped from $ 21.7 billion in 1965 to $ 11.6 billion in 1984, a decline of almost 50 percent (3).

In terms of a percentage of Gross National Product (GNP), the expenditures on new highways have decreased by more than half from 1957 to 1985 (3 percent of GNP in 1957 to 1.5 percent of GNP in 1985). This is far below the percentage of GNP spent by other industrialized countries like Switzerland, Japan and Austria (4). Other problems associated with construction of new highways include the phenomenal cost in acquiring right-of-way in built-up urban areas, environmental considerations and political pressures.

Other strategies available to alleviate congestion and improve flow on arterial streets are coordinating traffic signals, removing on street parking, widening streets at intersections to accommodate dual left and single right-turn bays at major intersections, and limiting access on arterial streets (6). However, the flow of traffic on arterial streets is constrained by the time shared space (the intersection) between arterial streets. Where left-turn volumes justify a separate signal phase, the through traffic on each approach is usually

limited to a maximum of 35 percent to 40 percent of available green time (7). Under these conditions, the queues on each approach do not clear during peak hours even when long cycle lengths are employed. Consequently, the queues spill over from one cycle to the next, and total delay at the intersection reaches phenomenal proportions. Under such circumstances, grade separation of the higher volume through movement is now being considered as an effective option for the elimination of the this "bottleneck."

Traditionally grade separation has been more commonly used for freeways. However the inherent advantages of grade separation relative to reducing delay, conflicts, and pollution, and increasing capacity and safety makes it a viable choice at intersections of major arterial streets. Grade separation of congested arterial streets is an important component of the newly emerging concept of 'super streets', also referred to by traffic engineers as continuous flow boulevard and high flow arterials.

Grade separation has disadvantages that have kept their construction on arterial streets from becoming more widespread. The disadvantage of grade separation most frequently cited by its critics is that it is capital intensive, requiring substantial economic benefits to justify its installation. The other disadvantages are difficulty (both cost and political) associated with acquiring right-of-way in built-up areas, disruption of traffic and businesses during construction (which may take up to two years), and additional road user cost due to diversion of traffic onto alternate routes which increases congestion, delay, pollution and vehicle operating cost.

Grade separation can be achieved by keeping all turning movements on one street at surface level and elevating or depressing the other street. The through movement on one street is carried on an elevated structure (or underpass) while all the other movements (i.e., all the movements of the cross street and the turning movements of the grade separated street) are made at-grade with the help of a signalized intersection (8). The removal of one of the high volume through movement allows reallocation of the grade separated through movement phase to the remaining movements which pass through the signalized intersection.

## CHAPTER II

## LITERATURE REVIEW

Grade separation of an at-grade intersection is necessitated whenever the volumes on the intersecting streets are so high that the at-grade intersection cannot handle the traffic. Installation of an interchange at the intersection of two high-volume streets increases the capacity, efficiency and safety of the intersection by removing the conflicting through traffic on one of the streets. The principal application of grade separation has been for freeways, which by its functional design requires complete control of access and elimination of all at-grade intersections. Use of grade separation at congested at-grade intersections of arterial streets is presently in an evolutionary stage. Some research has been performed to evaluate the potential effectiveness of grade separation of isolated congested intersections on the overall arterial corridor. Arterial corridors are interspersed with signalized intersections which limit its capacity.

To improve the capacity of arterial corridors, super arterials are being developed. The super street was originally conceived by a Los Angeles based architect, James Brown, in the mid 1970s for use on continuous flow boulevards in the Los Angeles area. The original design essentially envisioned a system, similar to a freeway, that provided grade separation at all intersections with major cross streets, and all "left-turn" movements from the boulevard be made with a right turn (i.e a cloverleaf) design (8). Brown's idea was never implemented because of its close similarity to a freeway and critics thought that it would be merely more freeways. The present research is directed towards the development of super streets which will, in terms of operation, be somewhere between a freeway and an arterial street. The proposed salient features of a super street system are (9):

1. Six through lanes.
2. Grade separation of the intersections with other super streets and congested

arterials.

3. Signal coordination for progression of through movement on major streets.
4. No median breaks between intersections.
5. Access restriction along the arterial and especially in the functional area of the intersection.
6. Separate right-turn and dual-left turn lanes at signalized intersections.
7. Grade separation of pedestrian movements.
8. Prohibition of parking.

Various studies have been performed to investigate the benefits of grade separating congested arterial street intersections relative to increases in capacity and reduction in delay, as well as disadvantages in terms of cost, the environment and the economic impacts.

## BENEFITS

In 1982, JEF Engineering (8) used the TRANSYT model to evaluate flyovers for corridor level improvements on arterials streets in Orange County, California. They reported that installing interchange at a congested intersection and coordinating signalization on the remaining at-grade intersections within the arterial corridor results in reductions of 50 percent in delay, 16 percent in fuel consumption and 29 percent in vehicle emission. The authors also remarked that grade separations reduce delay at the downstream intersections due to the dispersion of vehicle platoons; however, the downstream intersections were not considered a part of the network in the analysis performed.

James Witkowski (10) developed a procedure for evaluating user benefits of roadway grade separation at congested intersections. He used the 1985 Highway Capacity Manual's (11) equation for the computation of delay savings, and Dales relationship for fuel and emission savings and accident savings from an actual before-and-after study of an interchange constructed in Phoenix, Arizona. He concluded that grade separation

contributed to a reduction of 73 percent in annual delay, 21 percent in fuel consumption, 40 percent in vehicle emissions and 80 percent in accidents.

In a study for Orange County, California, Parson Brinckerhoff Quade Douglass Inc. (12) reported that the cost of roadway grade separation (which includes the cost of structure, right-of-way, delay and fuel consumption due to diversion of traffic onto alternate routes) is repaid back in three to four years as a result of vehicle-hours saved due to decrease in delay.

Van Dell and Associates, Inc. (13) in a study for the Super Streets Program for Orange County in 1984, found that a grade separation results in significant increase in the level-of-service.

## COST

The cost of a grade separation is a key consideration in justifying its installation at a congested intersection on arterial streets. The costs generally associated with interchanges can be classified as either direct cost or indirect cost. The direct cost comprises purchasing the requisite right-of-way and the structure costs. Direct costs are borne by the agency building the project. Indirect cost stems from adverse affect, albeit temporary, on traffic flow, which forces the drivers to either continue using their normal routes with prolonged delays or divert to more circuitous and lengthy routes on alternate corridors. The diversion increases congestion and delay on alternate corridors. In either case, travel time, fuel consumption and vehicle emissions are increased. Other indirect costs are the adverse effects on property access and sales volumes of the affected businesses. Indirect costs are to be born by the users of the facility, businesses and property owners.

To economize costs, the grade separation is most often accomplished by elevating (or depressing) the through movements for the higher volume facility (depending on the

topography) while the remaining movements occur at grade. Keeping the through movements at grade and elevating (or depressing) the signalized intersection at which all other movements occur is a more expensive option.

The structure cost of a single point diamond interchange, having an elevated six-lane bridge for through movements, while remaining movements take place at-grade, ranges between $ 5 and $ 6 million (16). This does not include the right-of-way and indirect costs.

In a study for Texas Transportation Institute (TTI) in 1987, Bonilla and Urbanik (17) compared the structure and right-of-way cost of conventional and prefabricated flyovers. They also compared the indirect cost, such as delay and diversion costs. The total cost of a conventional flyover structure with at-grade improvements to the intersection ranged between $ 2.3 million and $ 7.0, million depending on the number of lanes, right-of-way, geometrics, etc. The corresponding cost of prefabricated flyovers ranged from $ 4.6 million to $ 16.5 million. The estimated indirect cost, because of delay and diversion, for cast-in-place flyovers ranged from about $ 0.7 million to about $ 2.3 million per interchange. The cost of corresponding prefabricated flyovers was estimated to range from about $ 0.2 million to about $ 0.6 million. Thus, although the estimated construction cost of prefabricated flyovers, was in some cases, more than twice that of conventional flyovers, the shorter time required for construction (six months as opposed to 24 months) resulted in lower estimated total. This may perhaps be the reason for its success in Europe.

## IMPACT OF GRADE SEPARATION

Traditionally, land adjoining major intersections is perceived as a desirable location for gas stations and retail businesses. Consequently, the functional area of congested intersections is invariably commercially developed. Parson Brinckerhoff Quade and Douglas, Inc. (12) evaluated the indirect cost to users and the economic impact to businesses and properties located in the functional area of the congested intersection during

construction of an interchange and after its completion. The research found that during construction, travel time, delay and fuel consumption increased substantially, whereas sales volumes and property values in close proximity to the intersection dropped. After completion of the interchange and restoration of normal traffic, the study reported that travel time, delay and fuel consumption decreased significantly; sales volumes, property values and development density increased significantly.

In 1966, Walker (18) investigated the impact of three Chicago flyovers that were built in developed areas of commercial and industrial land uses with building lines extending up to the edges of sidewalks. His research indicated that the value of land generally declined at the locations of the three flyovers as compared to nearby at-grade intersection locations in the two year period after the construction. The decrease in value at the grade-separated intersections, however, was related to the type of business. For the two locations where commercial land uses were dominant, there was a decline of 30 percent to 33 percent in the value of land, whereas at the location where manufacturing was the main land use, the value of property remained unchanged.

## TYPE OF INTERCHANGE

Selection of the type of arterial interchange is governed by, among other things, the traffic character and demand and the availability of right-of-way (19). Since urban areas are typically densely developed, the availability of right-of-way will generally govern the design. The primary function of the arterial interchange is to accommodate high volumes of traffic safely and efficiently through bottleneck intersections along the urban arterial corridor. In general, arterial interchanges can be grouped into two general types: a) Diamonds and b) Cloverleafs.

Diamond interchanges are a desirable choice where right-of-way is restricted. There are a variety of diamond interchange configurations, such as conventional diamond,

compressed diamond, split diamond, single point diamond, three-level diamond and three level stacked diamond. Of these, single point diamond, also referred to as 'single point urban interchange' (hereinafter referred to as SPUI), is the configuration that is being increasingly applied in urban areas. Their principal advantage is that both off-ramps intersect at a single signalized intersection, thereby SPUI interchange capacity is 40 percent to 100 percent (depending on the proportion of through and turn volumes) greater than an at-grade intersection and from 10 percent to 50 percent more than a tight diamond interchange with two adjacent signalized intersections (15).

Messer and Bonneson (20) evaluated the operational efficiency of SPUIs in NCHRP Project 3-40. The research found that although SPUIs have higher saturation flow rates than conventional diamond interchanges, the all red signal clearance interval at the single-point intersection was thrice that of conventional signalized at-grade intersections. The authors concluded that this negated the capacity advantage of the SPUI over the conventional diamond interchange.

Messer and Bonneson (20) also concluded that the off-ramp, right turn maneuvers from a SPUI pose an operation problem whenever shared lanes are used by the two off-ramp turn movements. The off-ramp right turns are controlled by a yield sign while the left turns are controlled by a signalized intersection. Thus, right-turns cannot be accomplished whenever the off-ramp left-turn phase is operating (they have to yield), and when the red indication is "on", the right-turn traffic is blocked by the left-turn traffic. A solution to this would be to use exclusive lanes for the two turn movements. The study (20) noted that SPUIs are not suitable with continuous frontage roads because of the need for an additional signal phase which may further reduce the capacity.

Although the right-of-way requirement for an SPUI is about three times that of an at-grade intersection, it is less than the area required for a conventional diamond interchange. Right-of-way requirements are minimized due to its provision that the

opposing left-turn lanes on the cross street are offset -- an option not available with conventional diamond interchanges (20). However, preliminary evaluation of the Tight Urban Diamond Interchange (TUDI) indicates that its right-of-way requirements are less than that of the SPUIs. Additional evaluation of TUDIs will be made in subsequent phases of this project since it appears to be a more attractive design for elimination of congested at-grade intersections on existing urban arterial streets. Cloverleafs are not considered a viable type of interchange on urban arterials because of the extremely large right-of-way area requirements (21).

# CHAPTER III

# STUDY OBJECTIVES AND METHODOLOGY

## STUDY OBJECTIVES

The capacity of an urban arterial street system is constrained by the intersections of arterial streets which affect the traffic flow along the arterial corridor and significantly reduce the capacity. These at-grade intersections act as 'bottlenecks' in the system. It is expected that installation of an isolated interchange will substantially increase the capacity on the arterial corridor and eliminate the 'bottleneck'. This research has evaluated replacement of congested intersection of arterial streets with interchanges in terms of reduction in system-wide delays.

Specific objectives of this research are as follows:

1. To calibrate the TRANSYT-7F model in terms of its suitability to simulate interrupted traffic flow conditions.
2. To evaluate the reduction in delay that might be expected by replacing congested intersections with grade separations.
3. To evaluate suitability of the TRANSYT-7F model for the analysis of a congested intersection and its replacement with an interchange.

## STUDY METHODOLOGY

A schematic illustration of a typical study location is shown in Figure 1. A study location consists of the critical intersection of two arterial streets and the first signalized intersection downstream from the critical intersection. The intersection numbering is the same as used by TRANSYT-7F model (i.e., they are numbered first from north to south followed by west to east). The notations for the North-South downstream intersections are

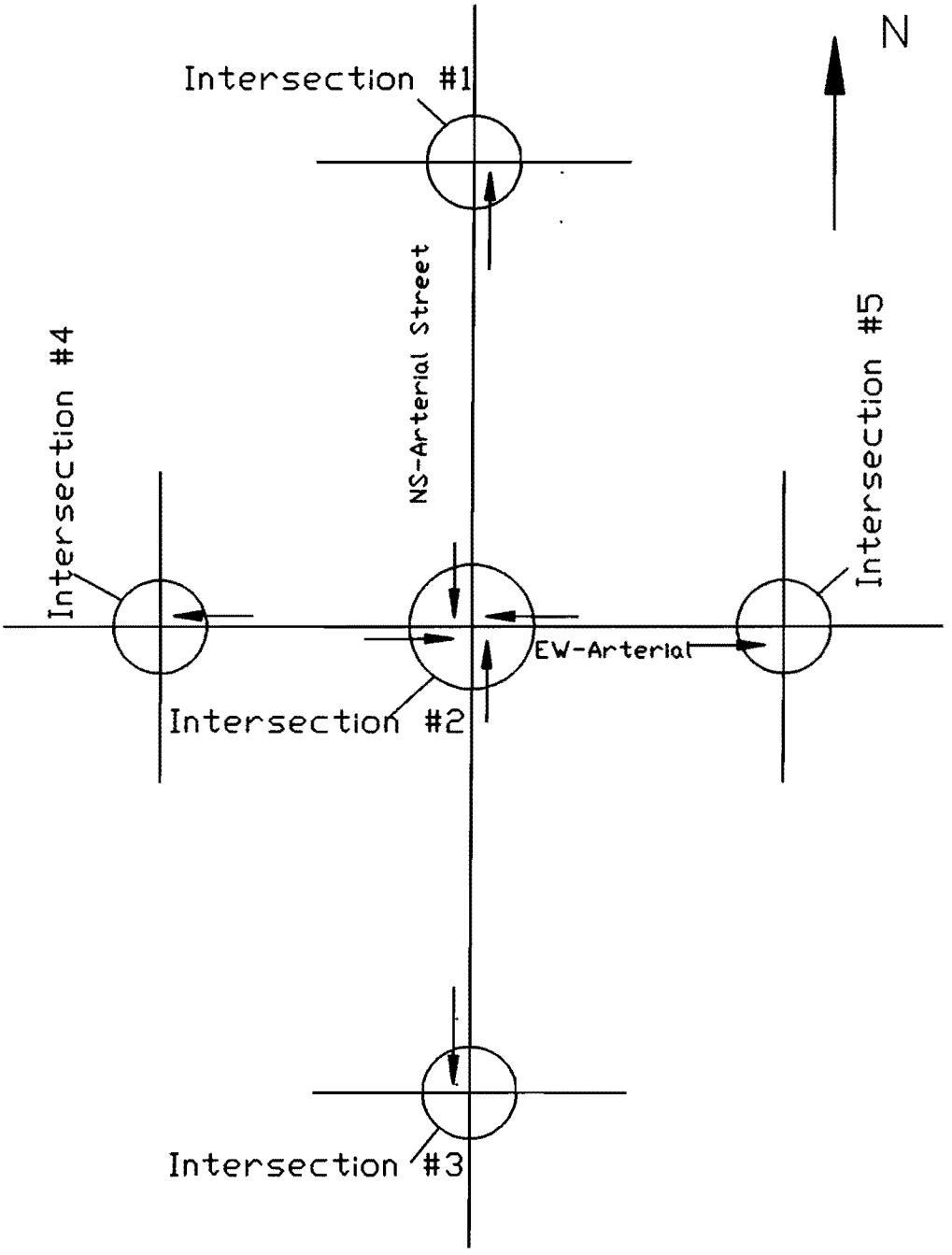



**Figure 1: Schematic Illustration of a Study Site**

1 and 3, and for the East-West downstream intersections, 4 and 5, respectively; the notation for the critical intersection is 2. The 'system' consists of eight approaches -- four approaches at intersection 2 and outbound approach at intersections 1, 3, 4 and 5.

The approaches downstream from the critical intersection have been considered a part of the system because a major concern associated with installation of isolated interchanges on arterial streets is whether the construction of an interchange can be expected to reduce total delay over the system or whether the delay simply shifted to adjacent signalized intersections. This research has addressed this question.

Referring to Figure 1, it can be seen that when there is an at-grade intersection at intersection 2, delay occurs on all the movements of the four approaches. However, after grade separation of the through movement of one of the arterial streets, delay on the grade separated approaches of intersection 2 will be limited to the turn movements, while all the movements on the at-grade approaches will be delayed. It was expected that those movements indicated by an arrow at the downstream intersections will experience increased delay.

This research has looked into system-wide reduction in delay after grade separation. This was arrived at by deducting the sum of simulated delay at eight approaches after grade separation from the sum of simulated delay at the same eight approaches prior to grade separation.

This research utilized data collected at six congested arterial-to-arterial at-grade intersections in the State of Texas. The case study locations were selected with the help of state and city officials on the basis of their severity of congestion. The case study locations will be referred to by the following notation:

Study Site 1: FM 1960 and Kuykendahl in Houston
Study Site 2: Dairy Ashford and Westheimer in Houston

Study Site 3: Preston and Arapaho in Dallas
Study Site 4: FM 1960 and SH 249 in Houston
Study Site 5: Preston and Beltline in Dallas
Study Site 6: Altamesa and FM 731 in Fort Worth

Street names of the five intersections at each study site are presented in Table 3. The layout plans illustrating the lane configuration at the six study locations are presented in Figures A-1 through A-6 of Appendix A.

The critical intersections of the study sites were fairly congested, especially during the a.m. and p.m.-peak periods, as is exhibited by the high v/c ratios at the locations, presented in Table 4. It may be noted that the tabulated v/c ratios illustrated in Table 4 are the total for the intersection. Much larger v/c ratios were observed for individual lane groups and movements. Cyclic failures (inability of the green phase to clear the queues formed during the red phase and arrivals during the green) and spillover of queues from one cycle to another were a common sight during the p.m.-peak periods at these locations.

## STUDY HYPOTHESES AND CRITERIA

The hypotheses for this research are as follows:

1. TRANSYT-7F model is suitable for simulating traffic flow and stop delays at signalized intersections.
2. Grade separation of a congested intersection of two arterial streets will significantly reduce total delay at the critical intersection and will not significantly increase the delay at the downstream intersections.

The criteria used to test the two hypotheses are presented in Table 5 and Table 6 respectively.

The TRANSYT model was calibrated by comparing the observed delays with the delays computed by TRANSYT-7F during traffic simulation using actual turn movement counts. The calibration was performed for two scenarios. The first scenario was based on 15-minute data periods while the second scenario considered an hourly data set. The simulation considered intersection 2 at-grade. The difference between the actual and simulated delays at intersections 1, 2, 3, 4 and 5 by approach and total for the system were compared using criteria presented in Table 5.

**Table 3: List of Study Site Locations**

| Site No | City | Critical Intersec. | Name of Downstream Intersection | | | |
|---|---|---|---|---|---|---|
| | | | North | South | West | East |
| 1. | Houston | Kuyken-dahl - FM 1960 | Kuyken-dahl - Colwell | Kuyken-dahl - Ella Blvd | Sugar Pine- FM 1960 | Fritz - FM 1960 |
| 2. | Houston | Dairy Ashford - Westhe-imer | Dairy Ashford - Whittin-gton | Dairy Ashford - Rich-mond | Brair-west - West-heimer | Old West-heimer - West-heimer |
| 3. | Dallas | Preston - Arapaho | Preston - Cambell | Preston - Beltline | Arapaho - Tollway | Ara-paho - Hill-crest |
| 4. | Houston | SH 249 - FM 1960 | SH 249 - Har-grave | SH 249 - Willow Brook | Center-field - FM 1960 | Mills Road - FM 1960 |
| 5. | Dallas | Preston - Beltline | Preston - Arapaho | Preston - Spring Valley | Beltline - Monfort | Beltline - Hill-crest |
| 6. | Fort-Worth | Alta-mesa - FM 731 | Edgecliff - FM 731 | Syca-more - FM 731 | West Creek - Alta-mesa | I-35 - Alta-mesa |

**Table 4: Volume-to-Capacity Ratios Observed at the Critical Intersection of Study Sites**

| TIME PERIOD | VOLUME-TO-CAPACITY RATIO | | | | | |
|---|---|---|---|---|---|---|
| | SITE 1 | SITE 2 | SITE 3 | SITE 4 | SITE 5 | SITE 6 |
| 6:30 - 6:45 | 0.96 | 0.68 | 0.46 | 0.73 | 0.40 | 0.52 |
| 6:45 - 7:00 | 1.00 | 0.85 | 0.43 | 0.73 | 0.55 | 0.82 |
| 7:00 - 7:15 | 0.92 | 1.01 | 0.74 | 0.81 | 0.77 | 0.86 |
| 7:15 - 7:30 | 1.07 | 1.11 | 0.95 | 0.87 | 0.92 | 0.70 |
| 7:30 - 7:45 | 1.12 | 1.15 | 1.08 | 0.82 | 0.99 | 0.69 |
| 7:45 - 8:00 | 1.14 | 1.09 | 0.93 | 0.79 | 1.00 | 0.63 |
| 8:00 - 8:15 | 0.98 | 1.07 | 0.90 | 0.66 | 1.01 | 0.48 |
| 8:15 - 8:30 | 0.97 | 1.03 | 0.89 | 0.54 | 0.96 | 0.42 |
| 11:00-11:15 | 0.91 | 0.72 | 0.52 | 0.72 | 0.69 | 0.43 |
| 11:15-11:30 | 0.86 | 0.76 | 0.64 | 0.70 | 0.71 | 0.46 |
| 11:30-11:45 | 0.92 | 0.80 | 0.67 | 0.73 | 0.80 | 0.77 |
| 11:45-12:00 | 0.93 | 0.85 | 0.72 | 0.89 | 0.87 | 0.65 |
| 12:00-12:15 | 1.10 | 0.86 | 0.73 | 0.80 | 0.85 | 0.65 |
| 12:15-12:30 | 0.79 | 0.92 | 0.75 | 0.80 | 0.87 | 0.63 |
| 12:30-12:45 | 1.14 | 0.86 | 0.70 | 0.70 | 0.99 | 0.54 |
| 12:45-13:00 | 0.96 | 0.77 | 0.74 | 0.85 | 0.95 | 0.62 |
| 16:30-16:45 | 1.08 | 1.04 | 0.91 | 1.05 | 0.86 | 0.82 |
| 16:45-17:00 | 1.14 | 1.11 | 1.08 | 0.97 | 0.86 | 0.74 |
| 17:00-17:15 | 1.11 | 1.17 | 1.02 | 1.15 | 1.09 | 1.02 |
| 17:15-17:30 | 1.06 | 1.20 | 1.10 | 1.24 | 0.91 | 0.88 |
| 17:30-17:45 | 1.18 | 1.15 | 1.04 | 1.22 | 1.01 | 1.00 |
| 17:45-18:00 | 1.05 | 1.22 | 1.08 | 1.05 | 1.02 | 0.86 |
| 18:00-18:15 | 1.20 | 1.15 | 1.01 | 0.94 | 1.03 | 0.75 |
| 18:15-18:30 | 1.02 | 1.15 | 1.13 | 0.90 | 0.89 | 0.74 |

**Table 5: Criteria For Testing Hypothesis No. 1**

| Type of TRANSYT Delay | Magnitude of Delay/Queue Length | Significance Criteria |
|---|---|---|
| Total Delay (Sum of uniform and random delay) | 0 - 100 vehicle-hr/hr<br>101 and more veh-hr/hr | 10%<br>5% |
| Average delay | 0 and more sec/veh | 5% |

**Table 6: Criteria for Testing Hypothesis No. 2**

| Type of Delay | Increase/Decrease in Delay |
|---|---|
| Total Delay for the system | Decrease by 40% |
| Grade Separated approach of Critical Intersection | Decrease by 70% |
| At-grade approach of Critical Intersection | Decrease by 50% |
| Total Delay at Critical Intersection | Decrease by 60% |
| Delay at grade separated approach of downstream intersection | Increase by 25% |
| Delay at at-grade approach of downstream intersection | Increase by 15% |
| Total delay at downstream intersections | Increase by 20% |

To calibrate the model, a statistical test, Analysis of Variance, was employed to evaluate whether the differences in means between the observed and simulated delays were statistically significant at the five percent significance level. The test was used to compare the six study sites individually, by movement at the eight approaches. The research hypotheses for analysis of variance was as follows:

$H_d$ simulated mean delays are the same.

$H_a$: The observed and simulated mean delays are different.

Test Statistic: $F = s^2_B/s^2_W$

wheres $^2_B = SSB/(t - 1)$

$s^2_W = SSW/(n - t)$

SSB = Sum of squares between samples

SSW = Sum of squares within samples

Acceptance Region: The null hypotheses was accepted if the calculated F was equal to or less than the tabulated F value at the 95% confidence level, and $df_1 = t - 1$, and $df_2 = n - t$

where, df = degree of freedom

n = total sample size

t = number of populations

In the event of significant differences between observed and simulated delays, the model was calibrated by changing the default value of saturation flow rate from 1700 vphg for through movement and 1600 vphg for left and right-turn movements, as well as by observing the effect on the differences.

The analysis for the grade separation was performed for two scenarios. The first scenario assumed that the north-south arterial (refer to Figure 1 for nomenclature) was grade separated and the second scenario assumed the east-west arterial was grade separated. For scenario 1, the turning movements of the north-south arterial and all the movements of the east-west arterial continued through a signalized at-grade intersection (similar to a

single point diamond interchange). The first scenario furnished an estimate of the expected total delay for the system and the delay at intersections 1 through 5 by approach, with grade separation. A comparison of delays when intersection 2 is at-grade, and grade separated, will indicate the reduction in total delay for the system, reduction in delay at intersection 2 by approach, and the increase in delay at intersections 1, 3, 4 and 5. The differences were then compared using the criteria stated in Table 6 to ascertain whether the results were significant.

## DATA COLLECTION

Collection of data on traffic volume and stopped vehicles at the six study locations proved to be an arduous task in view of the manpower requirements to perform the job at the five intersections of a study site simultaneously. Each approach required at least three persons, one to count the turning movements, and two for counting the stopped vehicles at 20- second intervals. Ideally, for reliable data, each approach required a five-member team with two persons for counting turning movements and two for measuring stopped vehicle delay and the fifth member monitoring time and taking notes of the traffic flow conditions. Even with three persons per approach, a study site required 24 people to collect data simultaneously at the five intersections. Non availability of requisite manpower necessitated breaking down data collection at a study site over a few days, collecting data on a few approaches at a time, depending on the personnel available.

Measurements were made in the field at the six study locations during the a.m. (6:30 - 8:30), noon (11:00 - 13:00) and p.m. (16:30 - 18:30) peak hours. The following data were collected:

1. Turn movement counts at all eight approaches of each study site at 15-minute intervals.
2. Stopped vehicle counts at all eight approaches of each study site at 20-second intervals.

The following information was obtained from city, county and state officials having responsibility for the study sites:

1. Layout plan of study sites.
2. Signal timing plan of the intersections.
3. Posted speed on the facilities.

TRANSYT requires an extremely large quantity of user specified data. The data required for this research were:

1. Network data consisting of the number of nodes (intersections), links (streets) and link distances.
2. Signal timing data comprising existing cycle lengths, offsets, interval durations, phase lengths and phase sequence.
3. Saturation flow, start-up lost time, green time extension and number of sneakers (drivers that cross the intersection even after expiration of a yellow signal indication and display of a red signal indication on the approach).
4. Speed data.
5. Traffic volume data.

The actual measurements made in the field and information obtained from public agencies were input into the TRANSYT model to calibrate the model and evaluate the case study locations in terms of reduction in delay after grade separation.

# CHAPTER IV

# CALIBRATION OF THE TRANSYT MODEL

## TRAFFIC VOLUME CHARACTERISTICS

The stopped vehicle and turning movement counts were grouped into 15 minute periods. As traffic volume and delay data were collected for a total of six hours at each location, 24 data points for each movement at the eight approaches of the six study site locations were obtained.

The flow rates measured at the eight approaches (by movement) of the six study sites are presented in Tables B-1 through B-12 of Appendix B. A summary of the number of vehicles entering the critical intersection and the system during each 15-minute data period are presented in Tables 7 and 8 respectively. Figures 2 and 3 illustrate the temporal variation of flow rates at the critical intersection and for the system at the six study sites. It is apparent from these data that the observed flow rates at Study Sites 1 through 5 are very close to one another, although the study sites were located in different cities, having different geometric conditions. Study Site 6 had significantly lower flow rates than the other five sites. The peaking patterns among all the study sites were quite similar.

The a.m. 15-minute peak for the critical intersection at Study Sites 1 and 2 occurred between 7:45 to 8:00 hours, for Study Site 3 and 4, it was observed between 7:30 - 7:45 hours, and for Site 5 & 6 it was between 8:00 - 8:15 and 7:15 - 7:30 hours respectively. The a.m.-peak for the system at Study Sites 1,2,5 and 6 was observed between 7:45 - 8:00 hours, whereas for Study Sites 3 and 4, it was found to occur between 7:30-7:45. The p.m. 15-minute peak for the critical intersection at Study Sites 1, 4 and 5 occurred between 17:30-17:45 hours whereas at Study Sites 2 and 3, the peak occurred between 17:45-18:00 hours. At Study Site 6, pm-peak was observed between 17:00-17:15.

**Table 7: 15-Minute Flow Rates Entering the Critical Intersection**

| | VEH ENTERING THE CRITICAL INTERSECTION (vph) | | | | | |
|---|---|---|---|---|---|---|
| TIME PERIOD | SITE 1 | SITE 2 | SITE 3 | SITE 4 | SITE 5 | SITE 6 |
| 6:30 - 6:45 | 3628 | 3000 | 3000 | 4652 | 2452 | 1876 |
| 6:45 - 7:00 | 4232 | 3384 | 3248 | 4956 | 3492 | 2148 |
| 7:00 - 7:15 | 4288 | 4036 | 4636 | 5148 | 4444 | 2420 |
| 7:15 - 7:30 | 5140 | 5432 | 5848 | 5736 | 5540 | 3336 |
| 7:30 - 7:45 | 5684 | 5776 | 6984 | 5852 | 6216 | 3260 |
| 7:45 - 8:00 | 5804 | 5792 | 6236 | 5648 | 6496 | 3132 |
| 8:00 - 8:15 | 5140 | 5000 | 5988 | 4692 | 6560 | 2360 |
| 8:15 - 8:30 | 4920 | 4424 | 5936 | 4144 | 6248 | 2020 |
| 11:00-11:15 | 4884 | 3380 | 4252 | 4120 | 4200 | 1672 |
| 11:15-11:30 | 4488 | 3888 | 4856 | 4252 | 4424 | 1860 |
| 11:30-11:45 | 4668 | 3996 | 5396 | 4412 | 5280 | 2168 |
| 11:45-12:00 | 5292 | 4408 | 5708 | 5084 | 5188 | 2264 |
| 12:00-12:15 | 5884 | 4496 | 5808 | 4936 | 5436 | 2360 |
| 12:15-12:30 | 5900 | 4524 | 5244 | 4832 | 5352 | 2396 |
| 12:30-12:45 | 5952 | 4236 | 5504 | 4792 | 5764 | 2148 |
| 12:45-13:00 | 5324 | 3956 | 5616 | 5184 | 5860 | 2456 |
| 16:30-16:45 | 6000 | 5428 | 6500 | 6268 | 6260 | 3160 |
| 16:45-17:00 | 6372 | 5996 | 7124 | 5884 | 6356 | 3096 |
| 17:00-17:15 | 6232 | 6480 | 7196 | 6748 | 7184 | 4176 |
| 17:15-17:30 | 6036 | 6288 | 8056 | 7056 | 6552 | 3668 |
| 17:30-17:45 | 6500 | 6060 | 7444 | 7276 | 7280 | 3776 |
| 17:45-18:00 | 6004 | 6660 | 7792 | 6548 | 7004 | 3500 |
| 18:00-18:15 | 6232 | 6228 | 7144 | 6464 | 6932 | 3088 |
| 18:15-18:30 | 6236 | 5812 | 7000 | 5980 | 6268 | 2904 |

**Table 8: 15-Minute Flow Rates Entering the System**

| | VEHICLES ENTERING THE SYSTEM (vph) | | | | | |
|---|---|---|---|---|---|---|
| TIME PERIOD | SITE 1 | SITE 2 | SITE 3 | SITE 4 | SITE 5 | SITE 6 |
| 6:30 - 6:45 | 7452 | 6800 | 6600 | 9788 | 5848 | 4504 |
| 6:45 - 7:00 | 8944 | 7096 | 6780 | 9776 | 6868 | 4480 |
| 7:00 - 7:15 | 9440 | 8908 | 9476 | 10160 | 8356 | 5424 |
| 7:15 - 7:30 | 10960 | 11040 | 11872 | 11364 | 10208 | 6472 |
| 7:30 - 7:45 | 11420 | 11912 | 13624 | 12124 | 12036 | 7148 |
| 7:45 - 8:00 | 11708 | 12104 | 13584 | 11792 | 12136 | 7316 |
| 8:00 - 8:15 | 10388 | 10728 | 12888 | 9124 | 11472 | 5624 |
| 8:15 - 8:30 | 10456 | 9252 | 12460 | 8248 | 10900 | 4480 |
| 11:00-11:15 | 9204 | 6608 | 7772 | 8172 | 8200 | 4244 |
| 11:15-11:30 | 9212 | 7460 | 8344 | 8384 | 8240 | 4316 |
| 11:30-11:45 | 9388 | 7720 | 9556 | 8756 | 9040 | 4344 |
| 11:45-12:00 | 10320 | 8504 | 9716 | 9572 | 9696 | 4496 |
| 12:00-12:15 | 11352 | 8632 | 10328 | 9740 | 9836 | 4888 |
| 12:15-12:30 | 11200 | 8460 | 9368 | 9480 | 9876 | 4852 |
| 12:30-12:45 | 11136 | 8188 | 10144 | 9688 | 10532 | 4824 |
| 12:45-13:00 | 11200 | 8304 | 10564 | 10284 | 10948 | 5272 |
| 16:30-16:45 | 12552 | 10700 | 13000 | 12552 | 11340 | 6284 |
| 16:45-17:00 | 13364 | 11556 | 13320 | 12412 | 12904 | 6180 |
| 17:00-17:15 | 13160 | 12560 | 13756 | 13672 | 13108 | 8016 |
| 17:15-17:30 | 13376 | 12904 | 15240 | 13844 | 13460 | 7356 |
| 17:30-17:45 | 13632 | 12316 | 14548 | 14488 | 13656 | 8060 |
| 17:45-18:00 | 13108 | 13404 | 14844 | 13556 | 13532 | 7780 |
| 18:00-18:15 | 12820 | 12824 | 13676 | 13088 | 13404 | 6792 |
| 18:15-18:30 | 13064 | 11628 | 13500 | 12336 | 12616 | 6304 |

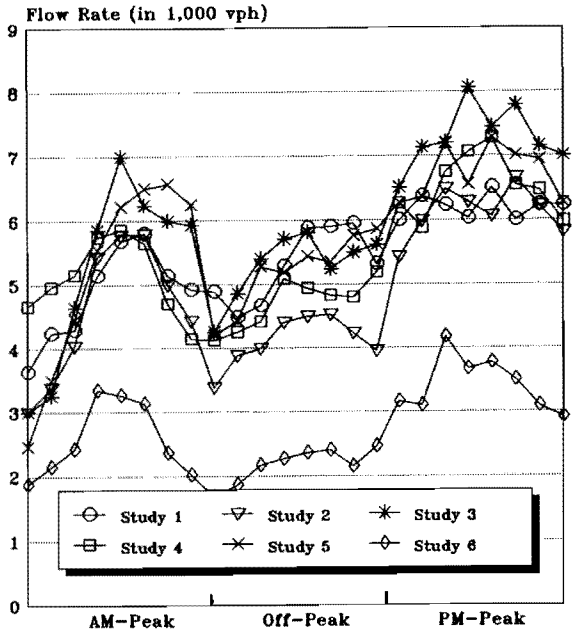



**Figure 2: 15-Minute Flow Rates Entering the Critical Intersection**

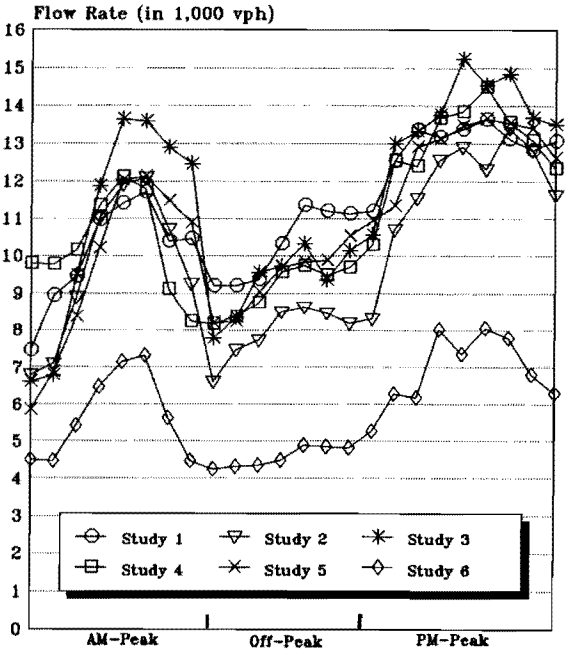



**Figure 3: 15-Minute Flow Rates Entering the System**

The p.m.-peak pattern for the system was observed between 17:30-17:45 hours at Study Sites 1, 4, 5, and 6; for Study Sites 2 and 3, the maximum flow rate was observed between 17:45-18:00 hours. As expected, the maximum 15-minute flow rate occurred during the p.m.-peak period at all the six study sites.

The spatial variation of flow rates, in terms of proportion of inbound and outbound traffic at the study sites was also examined. Figures 4 and 5 illustrate the directional split of traffic at Study Sites 1 through 3, and 4 through 6, respectively. During the a.m.-peak period, the directional split was more pronounced, with 70 to 80 percent of the traffic in the predominant direction. The off-peak pattern followed almost an even directional split at the six study sites, whereas the p.m.-peak was close to a 60/40 split.

## OBSERVED STOPPED DELAYS

The stopped delay at signalized intersections can be measured by a variety of methods, such as use of test-car observations, comparing the arrival and departure volumes on a cycle-by-cycle basis and direct observation of stopped vehicle counts at the intersection. This research used the procedure of measuring stopped delay by direct observation of stopped vehicle counts at the intersections. Vehicles stopped at the five intersections of each study site were measured by movement, at 20 second intervals for each two hour period, during the a.m., p.m. and off-peak periods. The average stopped delay per vehicle was computed using the following equation:

$$Delay = \frac{(\Sigma V_s \times I)}{V}$$

where, $\Sigma V_s$ = sum of the stopped-vehicle counts;

$I$ = interval between stopped-vehicle counts, in seconds; and

$V$ = total volume observed during the study period.

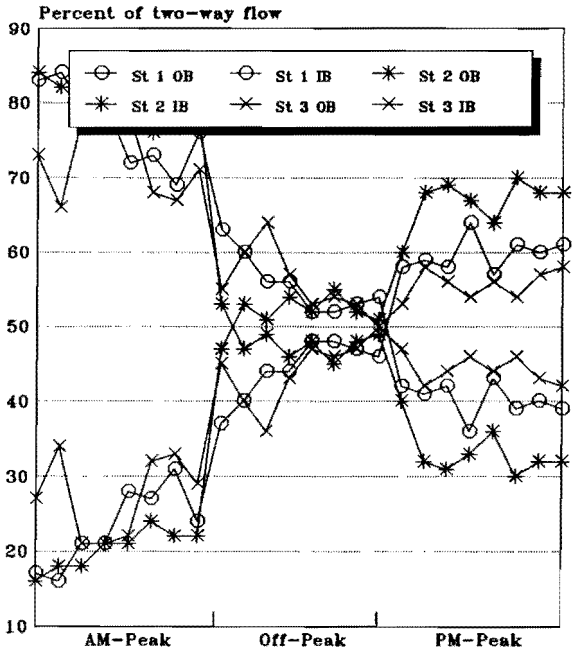



**Figure 4: Directional Split of Traffic at Study Sites 1 Through 3**

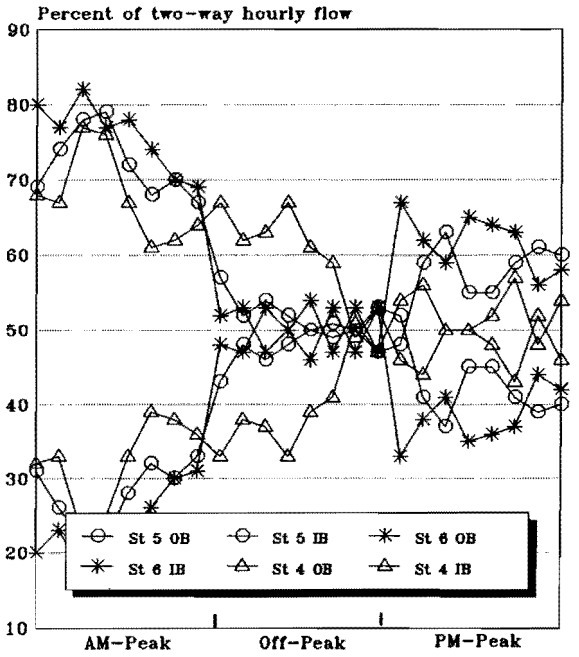



**Figure 5: Directional Split of Traffic at Study Sites 4 Through 6**

The observed stopped delays for the eight approaches, by movement, for the six study sites are presented in Tables C-1 through C-12 of Appendix C. The observed stopped delay at all the study sites followed a similar pattern, that is, the delay initially increased linearly with an increase in flow rate; however, as the flow rate approached capacity, its relationship became non-linear.

## SIMULATED STOPPED DELAY

The turn movement counts collected in the field provided the volume data requirement for the TRANSYT model. Flow rate was input by movement. The traffic signal timing plans obtained from public agencies indicated that nearly all the intersections at the six study sites were operating under fully actuated control, having more than three different timing plans for different times of the day. The number of phases at an intersection varied from site to site; however, at the critical intersections, six phases were generally employed. Most of the controllers in use at the different study sites had NEMA eight-phase dual ring control. The timing plans obtained provided the pertinent information on the number and duration of timing plans, cycle lengths, number of phases, phasing sequence, phase lengths, minimum and maximum greens, offsets, phases skipped, phases on minimum recall, pedestrian phases, and yellow and all red clearance times. At a few of the downstream intersections where the cross street was a minor collector, the minor street phase was optional and was skipped in case of no demand. The information obtained from the timing plan was input into the TRANSYT model. The saturation flow rates used for through movement were 1700 vehicles per hour of green (vphg) and 1600 vphg for left and right turn movements. These values of saturation flow rates were the default values of the TRANSYT model and were considered as representative of normal drivers (22). The distances between the intersections were read from the layout plans. The existing lane configurations at each study site were obtained from the location plans. The start-up lost time used in the analysis was three seconds, reflecting a value adopted for normal drivers (22). The number of sneakers per cycle was assumed to be two.

The calibration of the model was performed for two different scenarios. In the first scenario, the twenty-four, 15-minute volumes were converted to hourly flow rates and input as the traffic volume at each study site. Under the second scenario, the running hourly volumes gathered during data collection were used for analysis, for example, hourly volume from 6:30-7:30, 6:45-7:45 and so on. The second simulation resulted in 15 data points at each study site. Both the scenarios were initially run using the default value of saturation flow rate. Subsequently, a second simulation was performed by increasing the default saturation flow rate to 1800 vphg. Use of the hourly volumes was expected to produce better results than the use of 15-minute flow rates.

The TRANSYT output generates much information not relevant for the purpose of this research; this includes such measures of effectiveness as vehicle miles of travel, total travel time and fuel consumption. The data required for this research consisted of average delay and total delay for the eight approaches of the system.

## CALIBRATION OF THE MODEL

Calibration of the model entailed comparing the observed delay with the delay predicted by TRANSYT. The percent difference was calculated as follows:

$$\text{percent difference} = \frac{(\text{simulated delay} - \text{observed delay})}{\text{observed delay}} * 100$$

Calibration for Scenario 1 (15-minute periods) compared observed and simulated average and total delay by movement. The detailed data are presented in Tables D-1 through D-12 of Appendix D. Comparisons were also separately made for the a.m.-peak, off-peak, p.m.-peak and mean of the three periods. The average percentage differences for different times of the day and for the mean of the three study periods are presented in Tables 9 through 12.

**Table 9:** **A.M.-Peak Calibration Results for 15-Minute Period in Average Percentage Difference Between Observed and Simulated Delay Using Saturation Flow Rate of 1700 vphg**

| Study Site | Critical Intersection | | | | | Downstream Intersections | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | Total | NB | SB | EB | WB |
| 1. | + 14 | +101 | +72.4 | +187 | +93.8 | +1513 | +32.4 | +641 | +301 |
| 2. | +55.1 | +69.3 | +132 | +136 | +96.3 | +144 | +137 | +199 | +13 |
| 3. | - 17.9 | +219 | +88.4 | +47.8 | +90.1 | +260 | +1811 | -86 | +120 |
| 4. | +101 | +70.4 | +43.3 | +26 | +51.1 | +742 | +101 | +26 | 1034 |
| 5. | +259 | +2189 | +117 | +65.5 | +193 | -19.7 | + 812 | +171 | -15.4 |
| 6. | +88.3 | +137 | - 15 | +67.1 | +48.6 | +234 | +40.7 | +672 | +59 |

**Table 10:** **Off-Peak Calibration Results for 15-Minute Period in Average Percentage Difference Between Observed and Simulated Delay Using Saturation Flow Rate of 1700 vphg**

| Study Site | Critical Intersection | | | | | Downstream Intersections | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | Total | NB | SB | EB | WB |
| 1. | +63.3 | +68.1 | - 7.5 | +62.3 | +15.4 | +1513 | +32 | +641 | +301 |
| 2. | +22.3 | - 5.9 | + 51 | +82.1 | +38.8 | +144 | +137 | +200 | +13 |
| 3. | +223 | + 473 | +49.4 | +64.6 | +140 | +63.8 | +389 | - 85.3 | +598 |
| 4. | -29.6 | + 9 | +149 | +138 | +40 | +743 | +101 | +25.8 | 1034 |
| 5. | +60.4 | + 327 | +104 | +10.2 | +82.2 | +139 | + 812 | + 171 | -15.4 |
| 6. | +37.6 | + 116 | +36.4 | +41.2 | +44.6 | +235 | +41 | +672 | +59 |

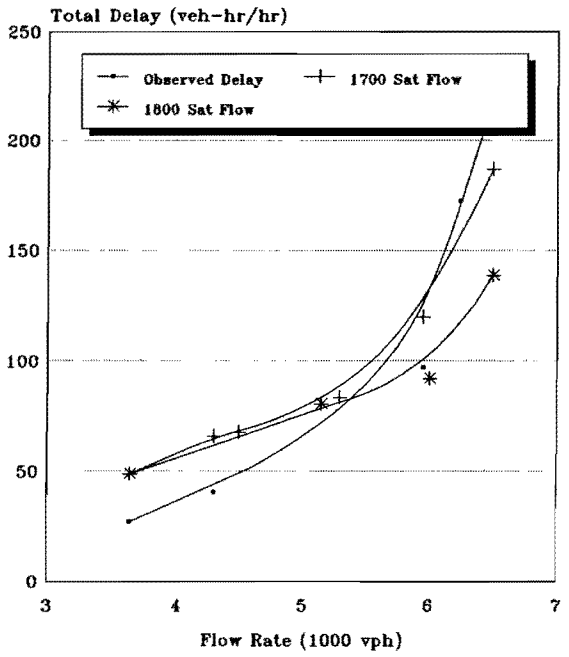
**Table 11: PM-Peak Calibration Results for 15-Minute Period in Average Percentage Difference Between Observed and Simulated Delay Using Saturation Flow Rate of 1700 vphg**

| Study Site | Critical Intersection | | | | | Downstream Intersections | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | Total | NB | SB | EB | WB |
| 1. | -21.6 | -34.9 | - 27.3 | +169 | -9.4 | +438 | +10.2 | +473 | +7.2 |
| 2. | +34.3 | 57.6 | +72.7 | +128 | +77.8 | +99.5 | +21.7 | +150 | +42 |
| 3. | +299 | +46.2 | +17.4 | +188 | +183 | +341 | -27 | -79 | +379 |
| 4. | +9.7 | +133 | +86.2 | +168 | +78 | +471 | +9.9 | +49.6 | +47 |
| 5. | +207 | -12.5 | -34.8 | +8.7 | -4 | +256 | +622 | -67 | +30 |
| 6. | +12.9 | +81.8 | +17.8 | +7.5 | +25.1 | +3 | +29 | +166 | +58 |

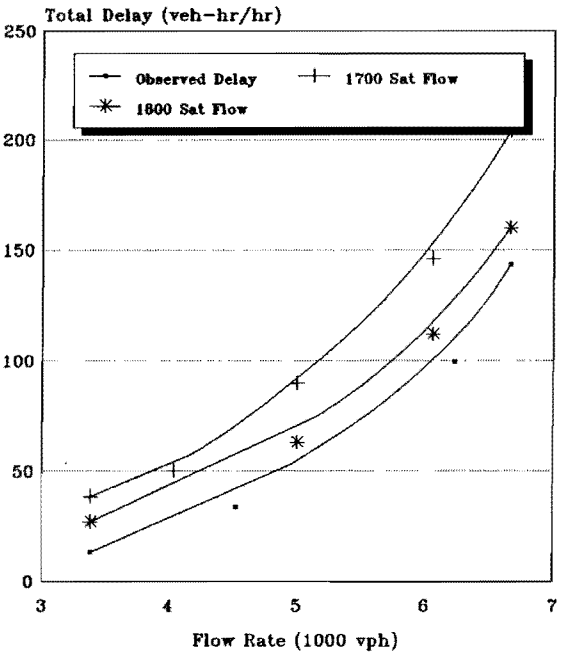
**Table 12: Calibration Results for the Mean of the Three Periods in Average Percentage Difference Between Observed and Simulated Delay Using Saturation Flow Rate of 1700 vphg**

| Study Site | Critical Intersection | | | | | Downstream Intersections | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | Total | NB | SB | EB | WB |
| 1. | +16.6 | +43.7 | +13.4 | +143 | +99 | +882 | +46.4 | +487 | +221 |
| 2. | +37.3 | +40.4 | +86 | +115 | +71 | +115 | +126 | +163 | 0 |
| 3. | +167 | +246 | +52 | +100 | +138 | +214 | +744 | -84 | +388 |
| 4. | +27.2 | +70.9 | +92.9 | +111 | +56.3 | +553 | +26.4 | +24.6 | +331 |
| 5. | +176 | +835 | +62 | +28 | +91 | +125 | +504 | +19 | +26 |
| 6. | +46.3 | +112 | +13.1 | +38.6 | +39.4 | +109 | +17 | +335 | +58 |

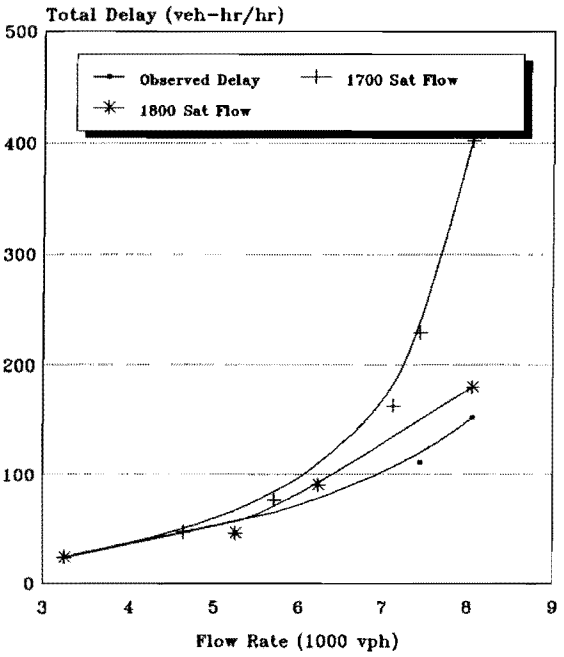
The comparisons of observed and simulated delays indicate the TRANSYT simulated delays were greater than the observed delays. The criteria established to test the hypothesis pertaining to calibration of the model, presented in Table 5, was generally not satisfied. The observed and simulated delays for the critical intersection and for the system at Study Sites 1 through 6 are shown in Figures 6 through 9. These figures indicate that at low flow rates, the simulated delay compares favorably with the observed delays. However, as the flow rate increases and the intersections become saturated, the difference increases rapidly. TRANSYT considers a movement, approach or intersection saturated when the v/c ratio reaches a value of 0.95 or more. The effect of saturation is evident by inspection of Figures 10 through 13 which shows that the simulated delays compare well with the observed delays during the off-peak periods when the flow rates are relatively low and delay increases exponentially at v/c ratios greater than 0.80.



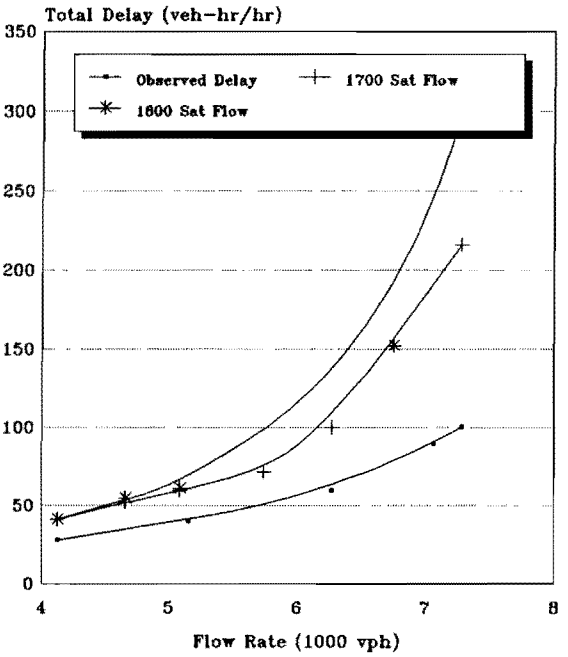

(a) Study Site 1




(b) Study Site 2

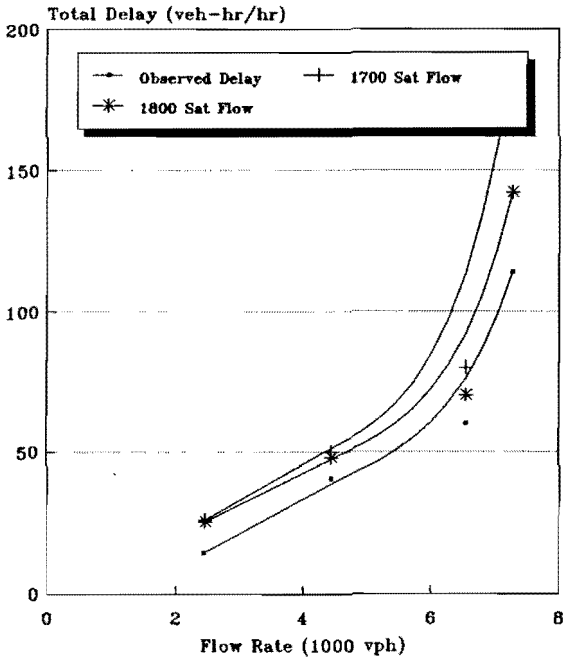



(c) Study Site 3

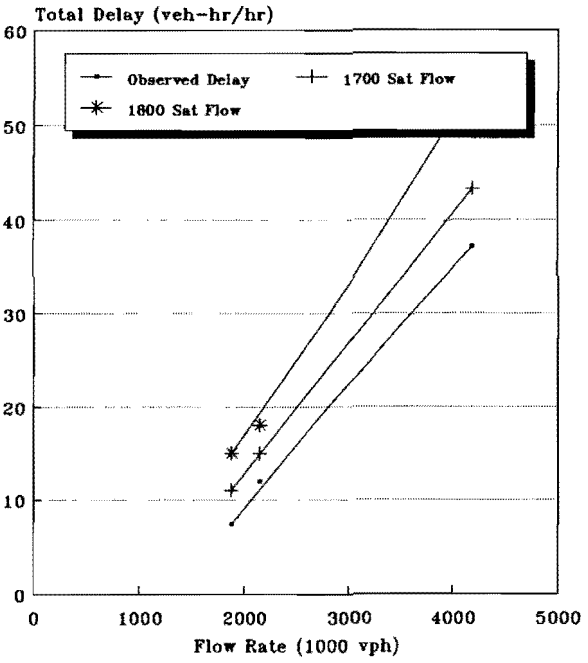



(d) Study Site 4

**Figure 6: Comparison of Observed and Simulated Delay for 15-Minute Period at the Critical Intersection for Study Sites 1 Through 4**

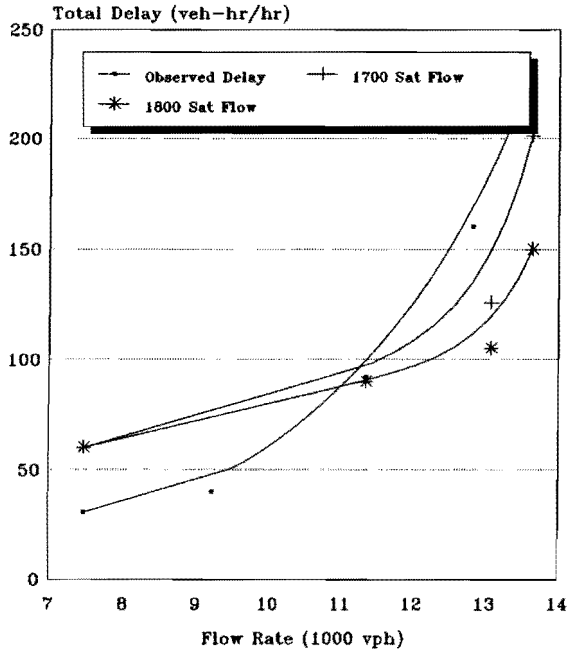



(a) Study Site 5

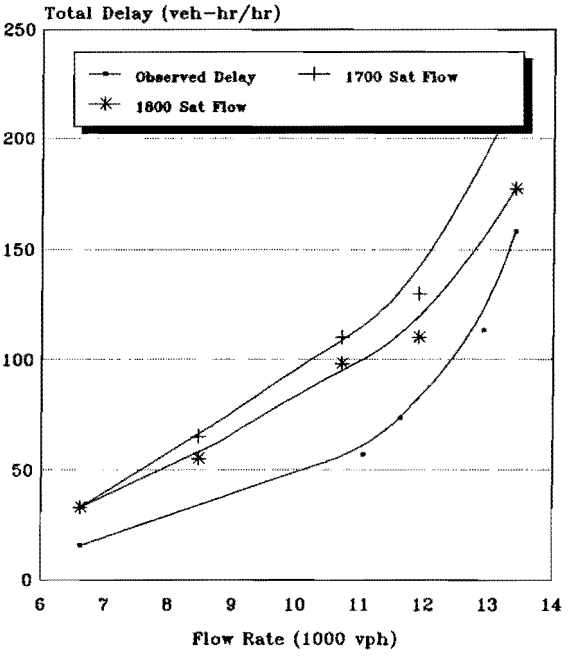



(b) Study Site 6

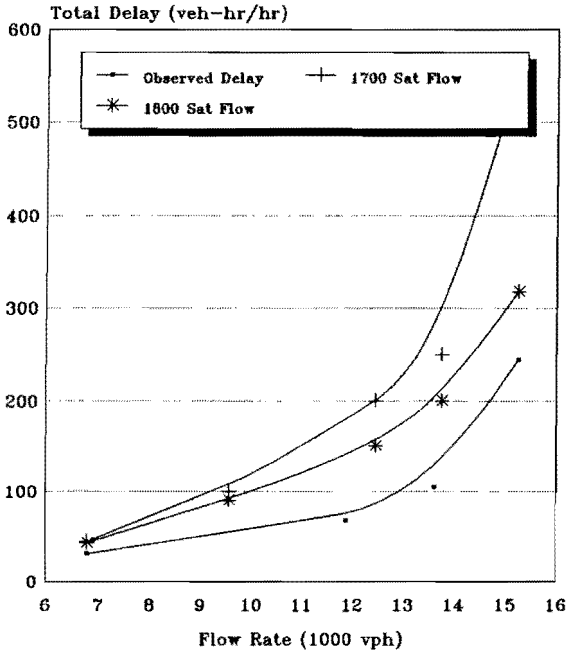
**Figure 7: Comparison of Observed and Simulated Delay for 15-Minute Period at the Critical Intersection for Study Sites 5 and 6**



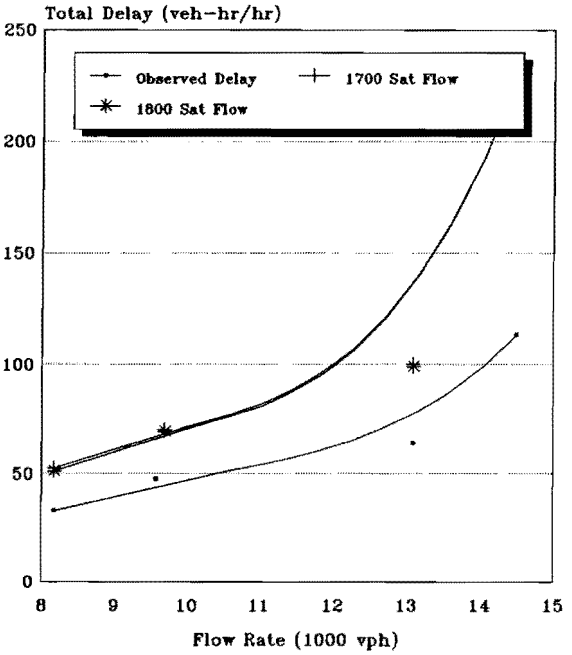

(a) Study Site 1




(b) Study Site 2

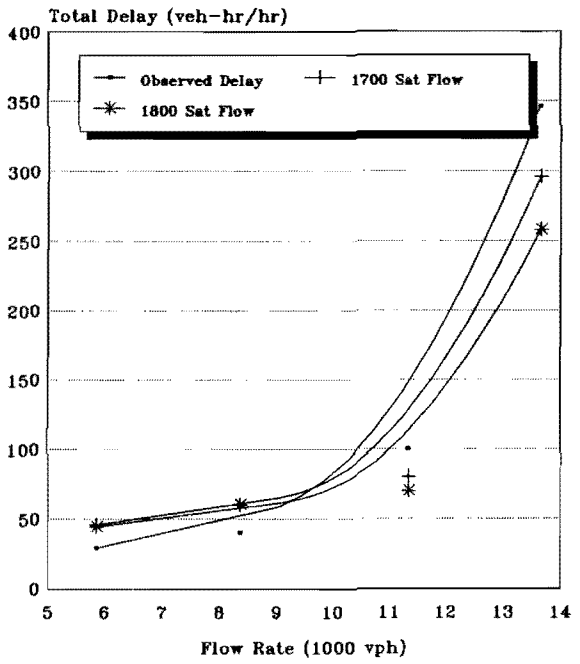



(c) Study Site 3

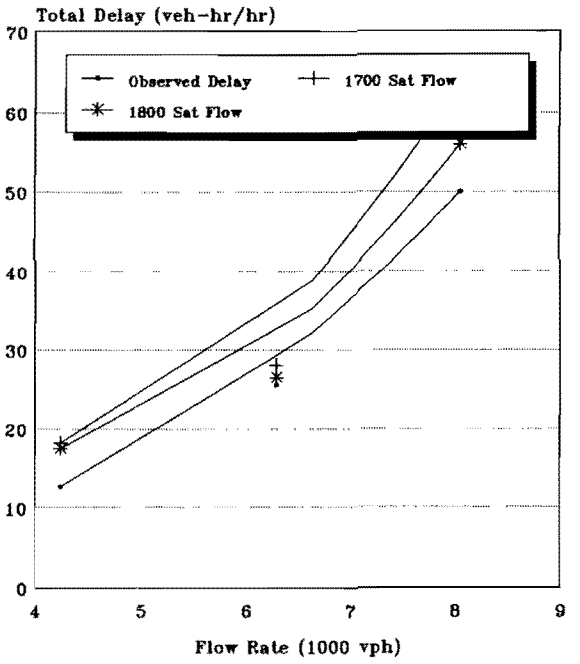



(d) Study Site 4

**Figure 8: Comparison of Observed and Simulated Delay for 15-Minute Period for the System at Study Sites 1 Through 4**

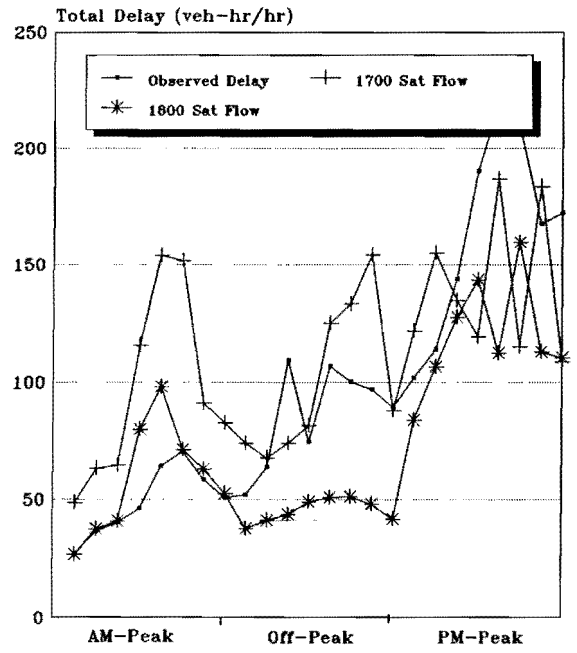



(a) Study Site 5

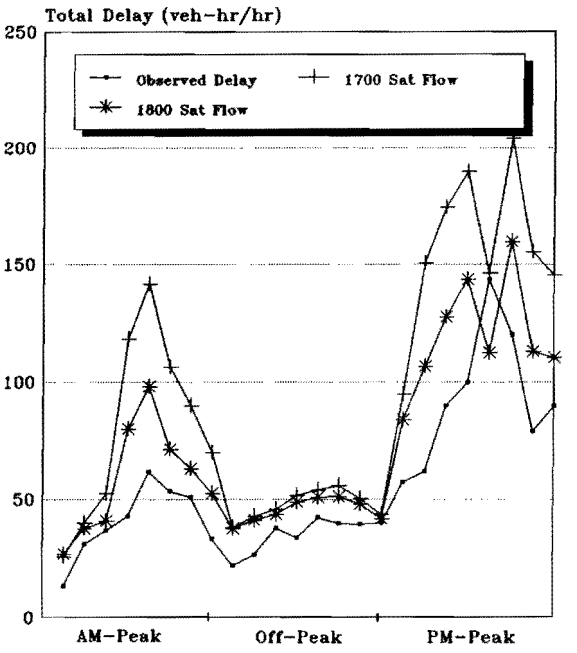



(b) Study Site 6

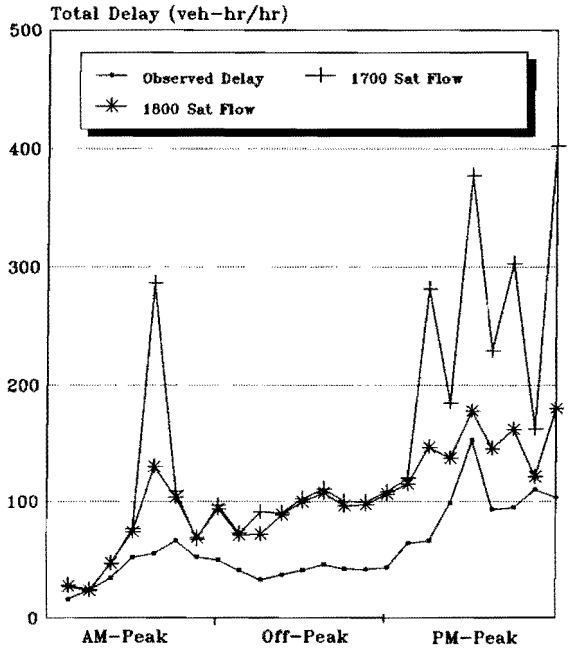
**Figure 9: Comparison of Observed and Simulated Delay for 15-Minute Period for the System at Study Sites 5 and 6**



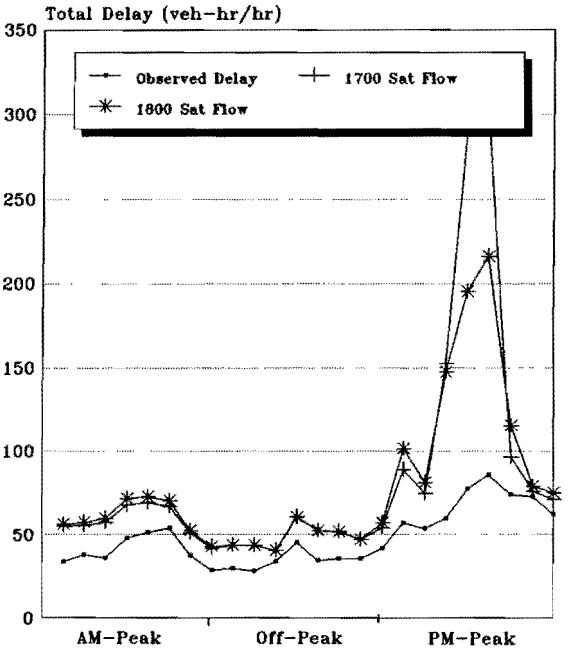

(a) Study Site 1




(b) Study Site 2

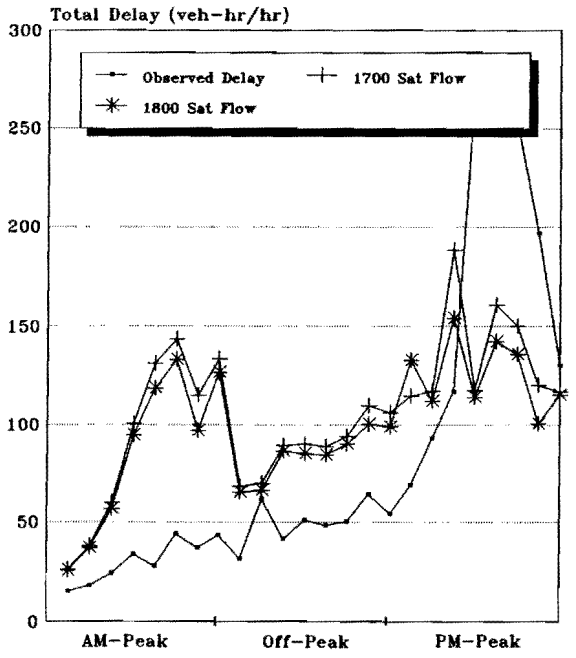



(c) Study Site 3

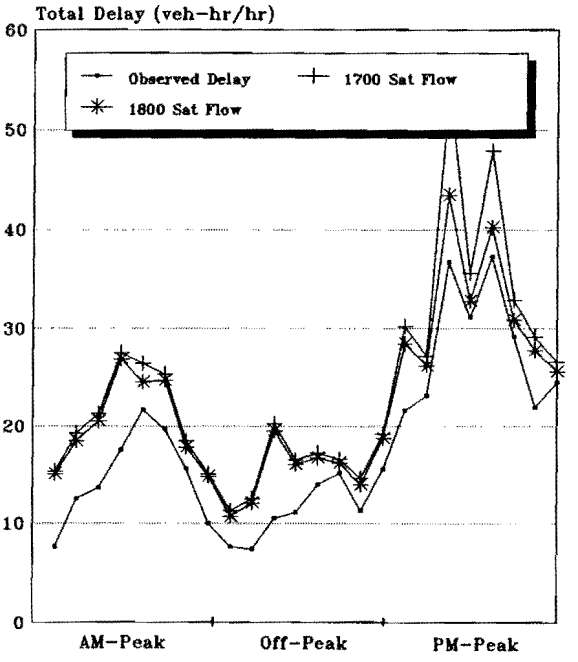



(d) Study Site 4

**Figure 10: Comparison of Observed and Simulated Delay at the Critical Intersection By Time of the Day for Study Sites 1 Through 4**

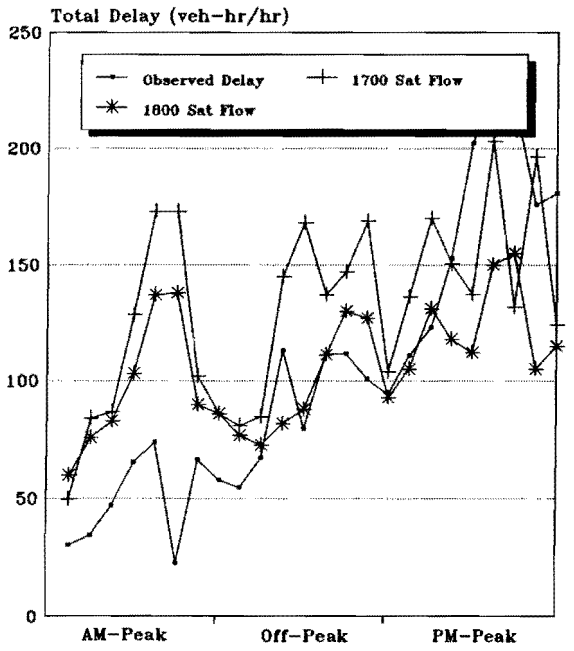



(a) Study Site 5

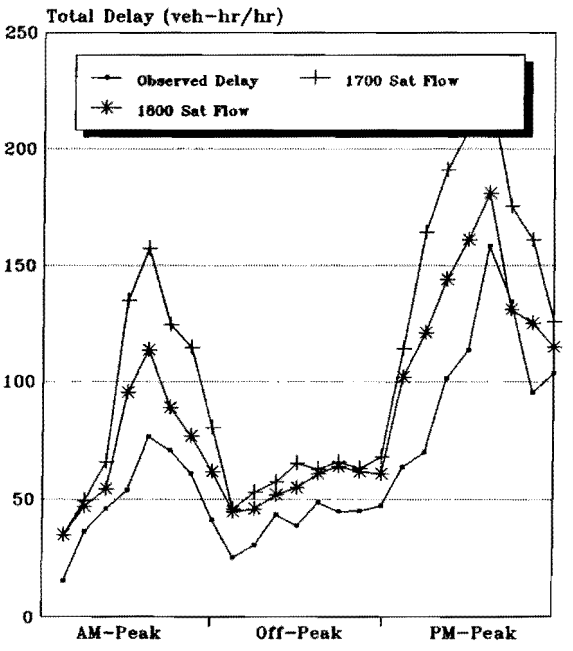



(b) Study Site 6

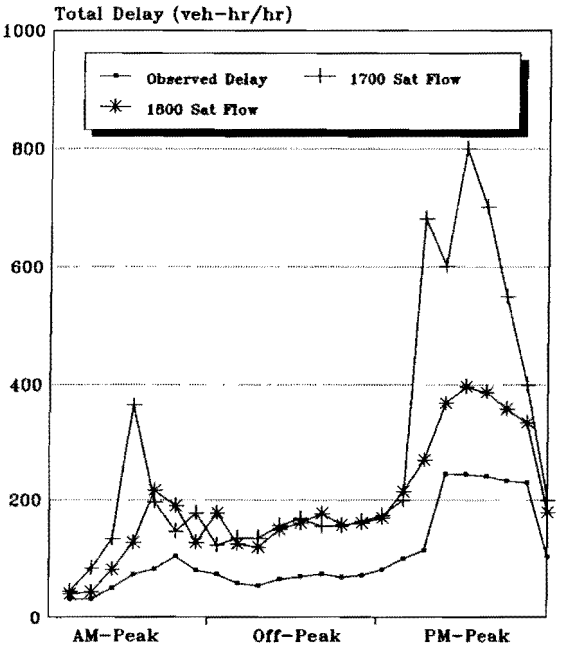
**Figure 11: Comparison of Observed and Simulated Delay at the Critical Intersection By Time of the Day for Study Sites 5 and 6**



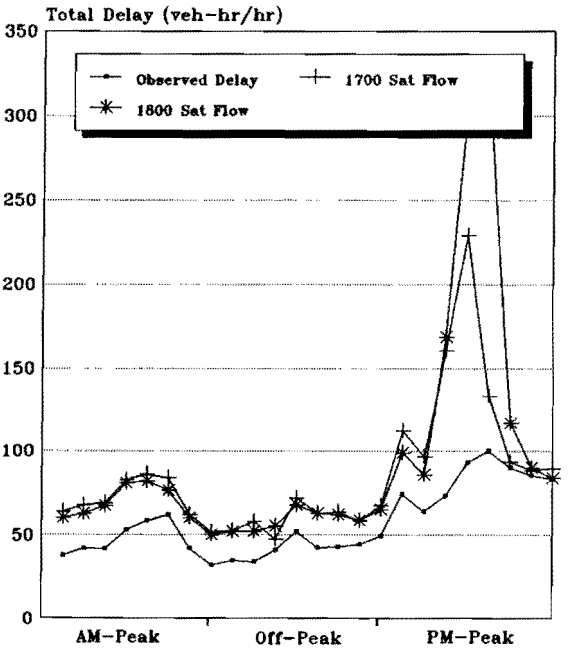

(a) Study Site 1




(b) Study Site 2

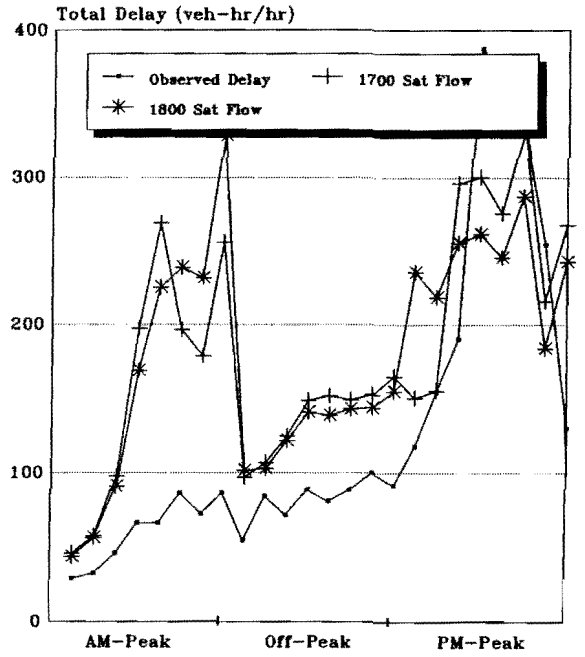



(c) Study Site 3

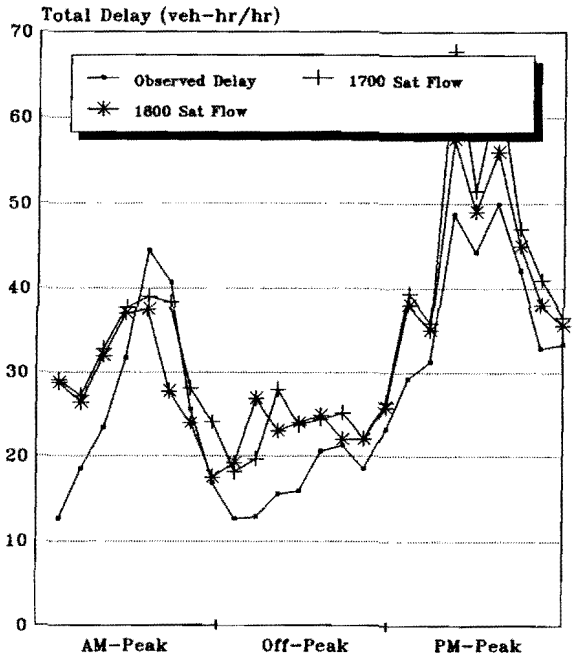



(d) Study Site 4

**Figure 12: Comparison of Observed and Simulated Delay for the System By Time of the Day at Study Sites 1 Through 4**




(a) Study Site 5




(b) Study Site 6

**Figure 13: Comparison of Observed and Simulated Delay for the System By Time of the Day at Study Sites 5 and 6**

To calibrate the model, TRANSYT was rerun using the same 24 15-minute data periods at the six study sites, but with a saturation flow rate of 1800 vphg for the left, right and through movements (detailed data are presented in Tables E-1 through E-12 of Appendix E). A study by Stokes (23) measured saturation flow rates for the left, through and right turn movements at signalized intersections in several cities of Texas. The study indicated that in large cities like Houston and Dallas, the saturation flow rates for all the movements were essentially the same and were close to 1800 vphg. In the course of analyzing the sensitivity of the model, it was discovered that the TRANSYT model is sensitive to the saturation flow rate, start-up lost time and the time period of analyses for saturated conditions. In case of unsaturated conditions, the model as expected did not show any noticeable sensitivity to changes in the start-up lost time, saturation flow rate, platoon dispersion factor, number of sneakers and period of analyses.

The issue of using a lower value of start-up lost time for calibration was explored, but in the end it was abandoned as there was very little justification for using a lower value. A study by Messer, et al. (24) measured start-up lost time at signalized intersections using a tape switch and Zenith PC-microcomputers. The data collection arrangements were very elaborate, and the results were supposedly very accurate. The study did not find any evidence of actual start-up lost time of less than three seconds.

The results obtained from the second calibration for 15-minute data period using a saturation flow rate of 1800 vphg for all movements are presented in Tables 13 through 16.

**Table 13: AM-Peak Calibration Results for 15-Minute Period in Average Percentage Difference Between Observed and Simulated Delay Using Saturation Flow Rate of 1800 vphg**

| Study Site | Critical Intersection | | | | | Downstream Intersection | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | Total | NB | SB | EB | WB |
| 1. | + 6.2 | +56 | +58.8 | +160 | +68.6 | +1487 | +7.1 | +564 | +269 |
| 2. | +22 | +50 | +62 | +124 | +51 | +132 | +129 | +227 | -12 |
| 3. | -20.7 | +206 | +83.8 | +38.9 | +52 | +121 | +1768 | 86 | +101 |
| 4. | +92.8 | +63.6 | +38.9 | +21.6 | +45.6 | +743 | +38 | +26 | 1016 |
| 5. | +249 | +1935 | +103 | +59 | +171 | -21 | +647 | +159 | -15.5 |
| 6. | +86.1 | +127 | -17.2 | +55.3 | +43.8 | +214 | +61.3 | +662 | -59 |

**Table 14: Off-Peak Calibration Results for 15-Minute Period in Average Percentage Difference Between Observed and Simulated Delay Using Saturation Flow Rate of 1800 vphg**

| Study Site | Critical Intersection | | | | | Downstream Intersection | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | Total | NB | SB | EB | WB |
| 1. | +41.9 | +49.8 | - 7.6 | +36.2 | +7.3 | +703 | +93.6 | +368 | +346 |
| 2. | +16.9 | - 10 | +44.4 | +72.9 | +32.4 | +89 | +206 | +126 | +41 |
| 3. | +188 | +451 | +45.7 | +59.3 | +127 | +67.4 | +381 | - 85.3 | +598 |
| 4. | -31 | +7.3 | +147 | +136 | +39 | +445 | +11 | +148 | +4 |
| 5. | +55.9 | +309 | +87.3 | +6 | +72.7 | +138 | +59 | -56.4 | +61 |
| 6. | +34.6 | + 112 | +31.9 | +34.3 | +39.7 | +89 | +40.3 | +157 | -56 |

**Table 15: PM-Peak Calibration Results for 15-Minute Period in Average Percentage Difference Between Observed and Simulated Delay Using Saturation Flow Rate of 1800 vphg**

| Study Site | Critical Intersection | | | | | Downstream Intersection | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | Total | NB | SB | EB | WB |
| 1. | -40.6 | -46.1 | - 36 | +90.8 | -30.9 | +466 | +6.3 | +492 | +1.3 |
| 2. | +16.4 | +14 | +53.5 | +60.4 | +35.2 | +94.3 | +21.5 | +147 | -37.6 |
| 3. | +212 | +38.1 | +0.7 | +154 | +66.4 | +217 | -31.4 | -79.1 | +314 |
| 4. | +2.8 | +177 | +104 | +203 | +98 | +471 | -5.9 | -50.3 | -49.7 |
| 5. | +198 | -6.3 | -39.9 | -6.2 | -8.2 | +171 | +524 | -66 | +29 |
| 6. | +3.2 | +68.2 | +10.5 | -4.7 | +14.2 | -5 | -24.1 | +147 | -57.7 |

**Table 16: Calibration Results for the Mean of the Three Periods in Average Percentage Difference Between Observed and Simulated Delay Using Saturation Flow Rate of 1800 vphg**

| Study Site | Critical Intersection | | | | | Downstream Intersection | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | Total | NB | SB | EB | WB |
| 1. | +2.3 | +18.3 | +2.3 | +12.7 | +8.7 | +885 | +35.7 | +496 | +206 |
| 2. | +18.4 | +18 | +53.2 | +85.8 | +39.6 | +106 | +119 | +167 | -3.1 |
| 3. | +127 | +232 | +43 | +84 | +81.8 | +132 | +726 | -83.8 | +368 |
| 4. | +21.6 | +82.7 | +96.6 | +120 | +61 | +553 | +57 | +23.7 | +324 |
| 5. | +168 | +746 | +50 | +19.4 | +78.6 | +95.8 | +410 | +15 | +25 |
| 6. | +41.3 | +102 | +8.4 | +28.3 | +32.5 | +99.3 | +25.8 | +322 | -57.6 |

Examining Tables 9 through 16 will indicate that by adopting a saturation flow rate of 1800 vphg, the model performed markedly better than with default values. Study Site 1 showed excellent results at the critical intersection and for all practical purposes can be considered to have met the stringent criteria for testing Hypothesis No.1. It was one of the few sites where TRANSYT delay estimates were lower than the observed delay during saturated conditions.

Study Site 2 performed better by using a saturation flow rate of 1800 vphg than with default values. Study Sites 3 and 5 had the largest differences with observed delays than other study sites. A possible explanation to this was that the turn movement and stopped vehicle counts at these study sites were measured separately and may have contributed in these errors. Study Site 4 performed poorly even with higher saturation flow rates. Study Site 6 performed exceptionally well, in fact, at three of the four approaches of the critical intersection. The analysis of variance results showed that the differences were not significant.

The results at the downstream intersections of the six study sites can be treated together. Few features were unique in the analysis of the downstream intersections at each study site. These were:

1. The turn movement and stopped delay at the downstream were only measured on one approach. The turn movement on the remaining approaches of the downstream intersections was considered a constant. This may have contributed in error in simulated delay at the downstream intersections.
2. A few of the downstream intersections were being operated with phase skipping option under fully actuated signal controller. TRANSYT does not have the capability to handle phase skipping operation. This obviously resulted in overestimating delay on the approach of the downstream intersection which was considered a part of the system in this research.

Analysis of variance was performed to determine if the differences between the

simulated and observed delays were statistically significant. The degrees of freedom $df_1$ and $df_2$ for the analysis were 1 and 22 respectively, since there were two rows (simulated and observed delay) and 24 columns (15-minute observations). The critical value of F at the 95% confidence level is 4.3. If the computed F values were greater than 4.3, it was concluded that the differences between observed and simulated delays were statistically significant at the 95% confidence level. However, if the computed F value was less than the tabulated F value, it was inferred that there was no difference between observed and simulated delays at the 95% confidence level. The calculated F values for the eight approaches of each study site using the default value of saturation flow rate and 1800 vphg are presented in Tables 17 and 18 respectively.

The F test demonstrated that at Study Site 1, there was no difference between the means of observed and simulated delay on the north, south and eastbound approaches of the critical intersection. The difference between the means of observed and simulated delays means were statistically significant only on the westbound approach. A possible explanation for this may be that the westbound approach was the most saturated of the four approaches at the critical intersection, as the flow rates for three of the six hours were a third of the total flow rate entering the intersection. Another reason may be that the downstream intersection on the west was located in close proximity to the critical intersection (less than 1000 ft), and as a result, the queues were backing up into the upstream intersection. In addition, since the TRANSYT model apparently does not handle oversaturated conditions very well, the overestimation of simulated delay was not surprising.

At Study Site 2 there were differences between the means of observed and simulated delay on all the four approaches of the critical intersection using the default saturation flow rates. However, when a saturation flow rate of 1800 vphg was employed, the north and southbound approaches showed no differences in the means of observed and simulated delay. However, the east and westbound approaches still showed significant differences. Both the east and westbound approaches were saturated as they had close to two-thirds of the 15-minute flow rates entering the critical intersection throughout the six hours of data collection.

**Table 17: Calculated F Values for 15-Minute Period Using Default Value of Saturation Flow Rate**

| Study Site | Critical Intersection | | | | Downstream Intersection | | | |
|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | NB | SB | EB | WB |
| 1. | 1.41 | .47 | 0.04 | 24.56 | 60 | 11.46 | 70.86 | 30.82 |
| | INSIG | INSIG | INSIG* | SIG** | SIG | SIG | SIG | SIG |
| 2. | 9.93 | 5.21 | 29.8 | 18.06 | 41.45 | 16.75 | 7.25 | 1.47 |
| | SIG | SIG | SIG | SIG | SIG | SIG | SIG | INSIG |
| 3. | 23.37 | 45.64 | 8.94 | 52.83 | 25.66 | 2.26 | 99.71 | 180.8 |
| | SIG | SIG | SIG | SIG | SIG | INSIG | SIG | SIG |
| 4. | 0.04 | 10.75 | 74.23 | 15.36 | 39.99 | .55 | .01 | .31 |
| | INSIG | SIG | SIG | SIG | SIG | INSIG | INSIG | INSIG |
| 5. | 48.96 | 0.88 | 0.06 | 3.44 | 13.36 | 28.94 | 8.47 | .39 |
| | SIG | INSIG | INSIG | INSIG | SIG | SIG | SIG | INSIG |
| 6. | 5.09 | .88 | 0.06 | 3.34 | 9.58 | .38 | 28.06 | 12.34 |
| | SIG | INSIG | INSIG | INSIG | SIG | INSIG | SIG | SIG |

* - not significant at the 95% confidence level

** - significant at the 95 % confidence level

**Table 18: Calculated F Values for 15-Minute Period Using Saturation Flow Rate of 1800 vphg**

| Study Site | Critical Intersection | | | | Downstream Intersection | | | |
|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | NB | SB | EB | WB |
| 1. | 3.51 | 2.75 | 1.15 | 8.66 | 59.4 | 7.72 | 72.7 | 26.1 |
| | INSIG | INSIG | INSIG | SIG | SIG | SIG | SIG | SIG |
| 2. | 3.73 | 0.82 | 27.2 | 13.31 | 35.2 | 15.9 | 6.1 | 3.11 |
| | INSIG | INSIG | SIG | SIG | SIG | SIG | SIG | INSI |
| 3. | 18.6 | 42.4 | 4.8 | 57.4 | 15 | .38 | 128.2 | .66 |
| | SIG | SIG | SIG | SIG | SIG | INSIG | SIG | INSIG |
| 4. | 0.1 | 6.27 | 45.1 | 8.61 | 40 | .28 | 0.1 | .47 |
| | INSIG | SIG | SIG | SIG | SIG | INSIG | INSIG | INSIG |
| 5. | 39.7 | 0.57 | 0.5 | .85 | 12.3 | 30.3 | 8.58 | .47 |
| | SIG | INSIG | INSIG | INSIG | SIG | SIG | SIG | INSIG |
| 6. | 3.87 | 9.37 | 0.05 | 0.2 | 9.24 | 0.05 | 28.2 | 12.3 |
| | INSIG | SIG | INSIG | INSIG | SIG | INSIG | SIG | SIG |

At Study Site 3, the differences at the critical intersection were significant between means of observed and simulated delay on all the approaches of the critical intersection both using a saturation flow rate of 1700 vphg and 1800 vphg. This may be due to measuring turn movement and stopped vehicle counts separately in the field.

At Study Site 4, all the downstream intersections were in close proximity to the critical intersection with queues backing up to these intersections. The result was that the differences were not significant only on the northbound approach; the differences between the means of observed and simulated delay at the remaining three approaches of the critical intersection were significant.

The calculated F values at Study Site 5 indicated that three of the four approaches

at the critical intersection showed no differences between the observed and simulated delays. Only the northbound approaches had significant differences. Turn movement and stopped vehicle counts at Study Site 5 were also measured separately. The lower calculated F values on three of the four approaches may represent similar patterns of flow rate on different days of the week or it may be merely a coincidence.

The calculated F values at the downstream approaches of the six study sites showed that only a third of all approaches had no differences between the means of observed and simulated delays. The low rate of success at the downstream intersections can be attributed to missing data in terms of turn movement counts on three of the four approaches of the downstream intersection.

Calibration for Scenario 2 was performed using hourly running volumes as the input volume in the model and keeping all the other input data unchanged. Initially TRANSYT was run using default values of saturation flow rate. Subsequently, TRANSYT was rerun using a saturation flow rate of 1800 vphg. The results of scenario 2 were more stable and the differences were generally less, especially using a saturation flow rate of 1800 vphg. Detailed data showing the percentage differences using default values of saturation flow rate and a value of 1800 vphg are presented in Tables F-1 through F-12 of Appendix F and Tables G-1 through G-12 of Appendix G respectively. Tables 19 through 22 presents the average percentage differences during the a.m.-peak, off-peak, p.m.-peak and mean of the three periods for scenario 2 using default values of saturation flow rate; Tables 23 through 26 shows the average percentage differences using a saturation flow rate of 1800 vphg.

Analysis of variance was again performed to statistically test the difference between the means. The results using the default value of saturation flow rate and a saturation flow rate of 1800 vphg are presented in Table 27 and 28 respectively. A comparison of Tables 17, 18, 27 and 28 indicates that the 15-minute period simulation performed with default values of saturation flow rates resulted in 10 of the 24 approaches at the critical intersection having no differences between the observed and simulated delays. The second 15-minute

period simulation conducted with a saturation flow rate of 1800 vphg demonstrated that 12 of the 24 approaches at the critical intersection did not have any difference between the simulated and observed delay. The hourly period of analysis performed using a saturation flow rate of 1700 vphg indicated that 9 of the 24 approaches at the critical approach did not have any differences between observed and simulated delays. Increasing the saturation flow rate to 1800 vphg for the hourly period showed that 11 of the 24 approaches at the critical intersection did not have any differences between the observed and simulated delays. The statistical results did not show any improvement using running hourly volumes. However, in terms of percentage difference between observed and simulated delay, the hourly period gave much better results than the 15-minute period.

Figures 14 through 17 compares the observed delays with simulated delays using saturation flow rates of 1700 and 1800 vphg respectively for hourly periods.

**Table 19: AM-Peak Calibration Results for Hourly Period in Average Percentage Difference Between Observed and Simulated Delay Using Default Value of Saturation Flow Rate**

| Study Site | Critical Intersection | | | | | Downstream Intersection | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | Total | NB | SB | EB | WB |
| 1. | +13.9 | +119 | +100 | +216 | +112 | +1061 | +9.6 | +377 | +82 |
| 2. | +205 | +151 | +446 | +200 | +251 | +36.4 | +38.3 | +32.7 | +37 |
| 3. | +8 | +227 | +45.8 | +82.9 | +91 | +264 | +1254 | -92.5 | +120 |
| 4. | +89.2 | +64.4 | +29.5 | +22.6 | +44.6 | +648 | +13 | +8.1 | +257 |
| 5. | +102 | +754 | +39 | +29.4 | +84.5 | +163 | +180 | -10.7 | -6.8 |
| 6. | +29.4 | +107 | +15.5 | +30.8 | +35.6 | +104 | +111 | +292 | -63 |

**Table 20: Off-Peak Calibration Results for Hourly Period in Average Percentage Difference Between Observed and Simulated Delay Using Default Value of Saturation Flow Rate**

| Study Site | Critical Intersection | | | | | Downstream Intersection | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | Total | NB | SB | EB | WB |
| 1. | +53.8 | +80.7 | +78.6 | +78.4 | +75.4 | +441 | +82.6 | +273 | +320 |
| 2. | +24.2 | +3.5 | +47.7 | +78.6 | +37.2 | +90.8 | +207 | +114 | +24 |
| 3. | +199 | +407 | +38.1 | +96.8 | +185 | +49.6 | +360 | -90.2 | +401 |
| 4. | -30.9 | +0.7 | +152 | +159 | +71.3 | +140 | +20.8 | +10.8 | +225 |
| 5. | +62.6 | +304 | +96.5 | -7.6 | +78.9 | +148 | -18 | -59.5 | +40 |
| 6. | +19.4 | +108 | +33.2 | +36.6 | +43.4 | +95.5 | +128 | +144 | -59 |

**Table 21: PM-Peak Calibration Results for Hourly Period in Average Percentage Difference Between Observed and Simulated Delay Using Default Value of Saturation Flow Rate**

| Study Site | Critical Intersection | | | | | Downstream Intersection | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | Total | NB | SB | EB | WB |
| 1. | +66.7 | +60.8 | +15.6 | +15.6 | +37.5 | +171 | +12.7 | +203 | +369 |
| 2. | +129 | +191 | +143 | +354 | +201 | +103 | +9.22 | +1.7 | +51 |
| 3. | +416 | 20.5 | +69.4 | +284 | +189 | +1073 | +44.3 | -89.4 | +310 |
| 4. | +24.7 | +429 | +197 | +506 | +251 | +908 | +14 | -103 | -99 |
| 5. | +75.8 | -27.5 | -50.1 | +14.8 | -21 | +377 | +377 | -71.8 | +10 |
| 6. | +2.5 | +62.4 | +27 | -1.5 | +19.2 | +5.74 | +9.34 | +153 | -60 |

**Table 22: Calibration Results for the Mean of the Three Periods in Percentage Difference Between Observed and Simulated Delay for Hourly Period Using Default Value of Saturation Flow Rate**

| Study Site | Critical Intersection | | | | | Downstream Intersection | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | Total | NB | SB | EB | WB |
| 1. | +39.8 | +2.65 | +8.15 | +57.7 | +27.1 | +577 | +27.6 | +369 | +109 |
| 2. | +181 | +190 | +284 | +394 | +226 | +86.8 | +96.3 | +41.4 | +17 |
| 3. | +190 | +250 | +48.4 | +139 | +160 | +337 | +557 | -90 | +284 |
| 4. | +21.6 | +82.7 | +96.6 | +120 | +61 | +553 | +57 | +23.7 | +324 |
| 5. | +168 | +746 | +50 | +19.4 | +78.6 | +95.8 | +410 | +15 | +25 |
| 6. | +41.3 | +102 | +8.4 | +28.3 | +32.5 | +99.3 | +25.8 | +322 | -57.6 |

**Table 23: AM-Peak Calibration Results for Hourly Period in Average Percentage Difference Between Observed and Simulated Delay Using Saturation Flow Rate of 1800 vphg**

| Study Site | Critical Intersection | | | | | Downstream Intersection | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | Total | NB | SB | EB | WB |
| 1. | +3.2 | +16.8 | - 66 | +114 | +37.7 | +1012 | +1.8 | +386 | +65 |
| 2. | +93.1 | +54.8 | +72.8 | +126 | +79.3 | +33.6 | +36.5 | -34.1 | -37 |
| 3. | -10.1 | +201 | +40.8 | +78.9 | +76.1 | +221 | +1031 | -90.5 | +110 |
| 4. | +82.9 | +59.9 | +28 | +17.6 | +40.1 | +589 | +39.3 | - 47 | +952 |
| 5. | +159 | +1894 | +82 | +73.6 | +195 | - 50 | +133 | +84.8 | -60 |
| 6. | +11.9 | +141 | - 18 | +50.3 | +42.5 | +218 | +61.7 | +571 | -73 |

**Table 24: Off-Peak Calibration Results for Hourly Period in Average Percentage Difference Between Observed and Simulated Delay Using Saturation Flow Rate of 1800 vphg**

| Study Site | Critical Intersection | | | | | Downstream Intersection | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | Total | NB | SB | EB | WB |
| 1. | -74.6 | -61.3 | -82.3 | -80.9 | -54.4 | +436 | +76.8 | +265 | +908 |
| 2. | +20.7 | -8.9 | +69.5 | +70.2 | +30.2 | +81.7 | +199 | +98 | +23 |
| 3. | +190 | +355 | +30.1 | +86.8 | +155 | +59.6 | +320 | -100 | +351 |
| 4. | -35.9 | 5.1 | +112 | +129 | +55.3 | +56 | -10.1 | +225 | +.7 |
| 5. | +62.6 | +304 | +96.5 | -7.6 | +78.9 | +165 | -10 | -59 | +41 |
| 6. | +20.3 | +105 | +29.2 | +30.5 | +40.1 | +90.2 | +36.7 | +137 | -59 |

**Table 25: PM-Peak Calibration Results for Hourly Period in Average Percentage Difference Between Observed and Simulated Delay Using Saturation Flow Rate of 1800 vphg**

| Study Site | Critical Intersection | | | | | Downstream Intersection | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | Total | NB | SB | EB | WB |
| 1. | -86.4 | -86.9 | -81.1 | -56.7 | -79.2 | +212 | +26.7 | +451 | +22 |
| 2. | +42.4 | +80.1 | +86 | +140 | +96.3 | +103 | +9.22 | +1.7 | -55 |
| 3. | +416 | +20.5 | +69.4 | +284 | +189 | +1073 | +44.3 | -89.4 | +310 |
| 4. | -21.7 | +169 | +104 | +174 | +88 | +394 | +21.6 | -49 | -53 |
| 5. | +75.8 | -27.5 | -50.1 | +14.8 | -21.4 | +160 | +316 | -71.5 | +5.3 |
| 6. | -8.2 | +55.2 | +15 | -11.6 | +9.2 | +3.9 | -31.8 | +134 | -60 |

**Table 26: Calibration Results for the Mean of the Three Periods in Percentage Difference Between Observed and Simulated Delay for Hourly Period Using Saturation Flow Rate of 1800 vphg**

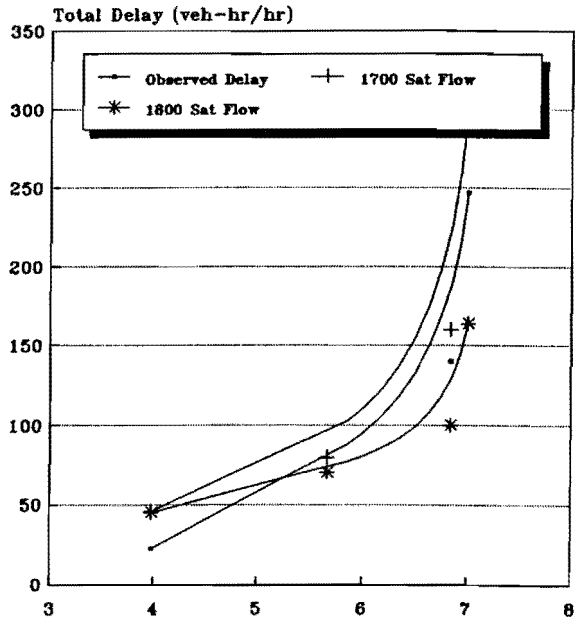
| Study Site | Critical Intersection | | | | | Downstream Intersection | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | Total | NB | SB | EB | WB |
| 1. | -49.2 | -41.1 | -33.3 | +3 | -31.2 | +564 | +21.6 | +378 | +249 |
| 2. | +41.8 | +39.1 | +63.4 | +108 | +60.1 | +80.1 | +90.3 | +39.4 | -18 |
| 3. | +90 | +125 | +8.4 | +69 | +71 | +237 | +357 | -95 | +204 |
| 4. | +7 | +77.7 | +99.5 | +124 | +59.3 | +329 | +15.3 | +8 | +254 |
| 5. | +102 | +754 | +39 | +29.4 | +84.5 | +86.5 | +163 | -12 | -7.7 |
| 6. | +28 | +100 | +8.8 | +23 | +30.6 | +104 | +22.2 | +281 | -64 |

**Table 27: Calculated F Values for Hourly Period Using default Values of Saturation Flow Rate**

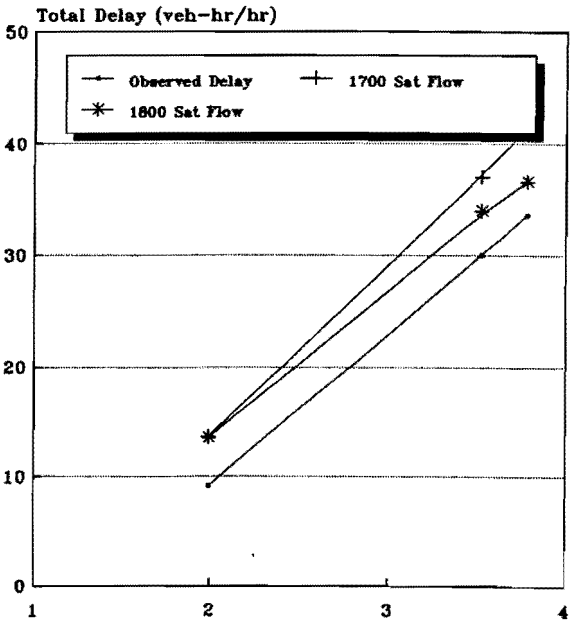
| Study Site | Critical Intersection | | | | Downstream Intersection | | | |
|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | NB | SB | EB | WB |
| 1. | .15 | .56 | 5.68 | 21 | 45.9 | 11.6 | 92.6 | 7.25 |
| | INSI | INSI | SIG | SIG | SIG | SIG | SIG | SIG |
| 2. | 13.07 | 6.45 | 3.51 | 9.21 | 42.35 | 4.87 | 1.73 | 1.47 |
| | SIG | SIG | INSI | SIG | SIG | SIG | INSI | INSI |
| 3. | 12.08 | 39.68 | 9.0 | 40.55 | 4.99 | .55 | 196.2 | 275.3 |
| | SIG | SIG | SIG | SIG | SIG | INSI | SIG | SIG |
| 4. | .18 | 7.36 | 20.86 | 7.8 | 19.68 | 2.34 | .25 | .48 |
| | INSIG | SIG | SIG | SIG | SIG | INSIG | INSIG | INSIG |
| 5. | 30.7 | .3 | .24 | 6.78 | .99 | 12.15 | 7.59 | 1.65 |
| | SIG | INSIG | INSIG | SIG | INSIG | SIG | SIG | INSIG |
| 6. | 2.88 | 8.39 | 1.12 | .34 | 6.25 | 5.39 | 18.55 | 11.11 |
| | INSIG | SIG | INSIG | INSIG | SIG | SIG | SIG | SIG |

**Table 28: Calculated F Values for Hourly Period Using Saturation Flow Rate of 1800 vphg**

| Study Site | Critical Intersection | | | | Downstream Intersection | | | |
|---|---|---|---|---|---|---|---|---|
| | NB | SB | EB | WB | NB | SB | EB | WB |
| 1. | 2.1 | 1.28 | 0.1 | 12.01 | 38.1 | 6.15 | 97.9 | 2.04 |
| | INSIG | INSIG | INSIG | SIG | SIG | SIG | SIG | SIG |
| 2. | 9.24 | 2.71 | 2.52 | 8.1 | 36.3 | 4.45 | 1.59 | 6.47 |
| | SIG | INSIG | INSIG | SIG | SIG | SIG | INSIG | INSI |
| 3. | 11.08 | 32.1 | 7.32 | 36.3 | 4.99 | .55 | 196.2 | 275.3 |
| | SIG | SIG | SIG | SIG | SIG | INSIG | SIG | SIG |
| 4. | .28 | 7.73 | 37.1 | 8.01 | 19.73 | 3.87 | .24 | .59 |
| | INSIG | SIG | SIG | SIG | SIG | INSIG | INSIG | INSIG |
| 5. | 30.7 | .3 | .24 | 6.78 | 5.25 | 15.1 | 7.56 | 2.01 |
| | SIG | INSIG | INSIG | SIG | SIG | SIG | SIG | INSIG |
| 6. | 2.23 | 7.63 | .22 | 0.05 | 5.3 | 0.1 | 19.22 | 12.03 |
| | INSIG | SIG | INSIG | INSIG | SIG | INSIG | SIG | SIG |

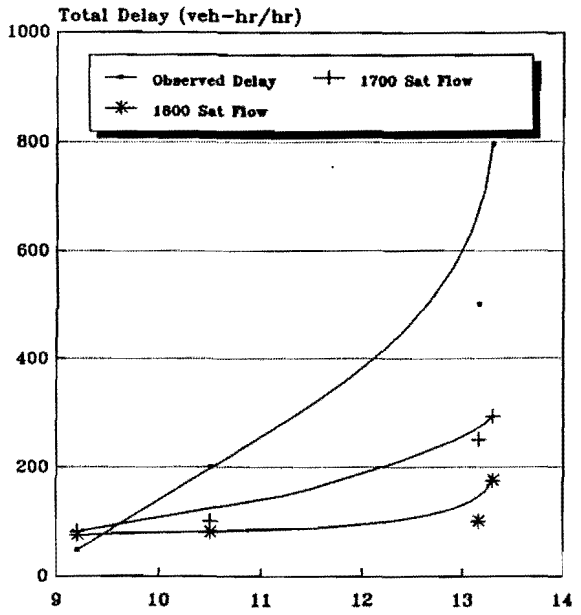



(a) Study Site 5

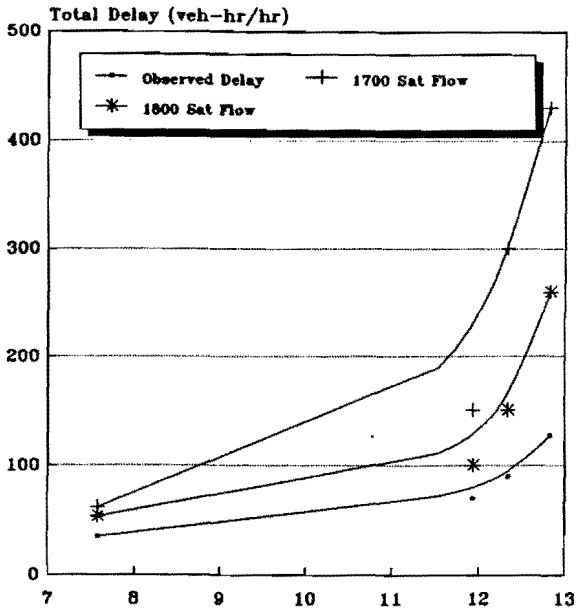



(b) Study Site 6

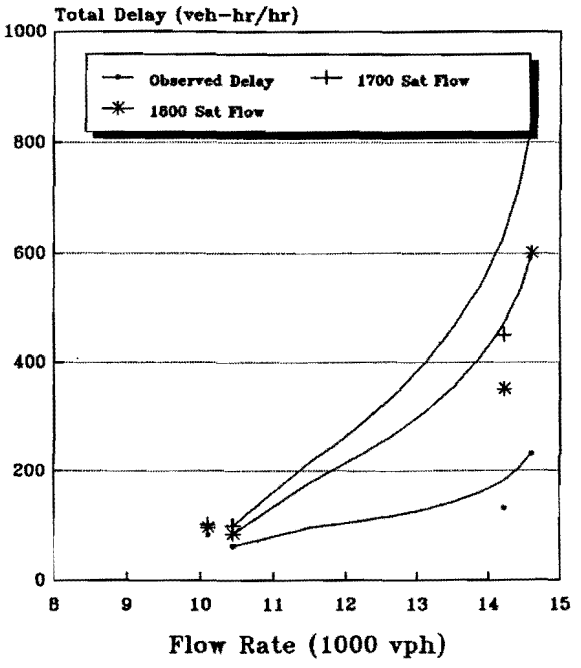
**Figure 15: Comparison of Observed and Simulated Delay for Hourly Period at the Critical Intersection for Study Sites 5 and 6**



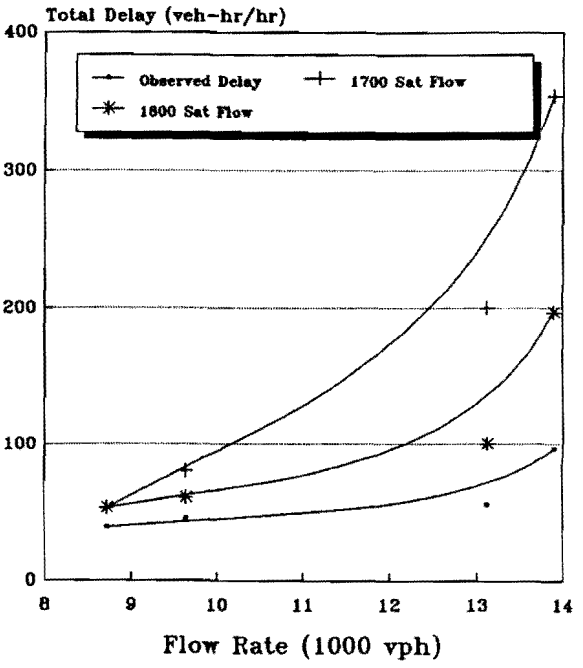

(a) Study Site 1




(b) Study Site 2

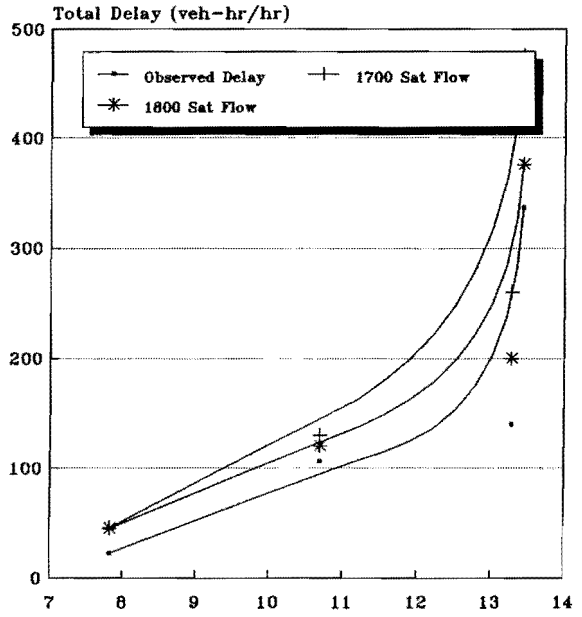



(c) Study Site 3

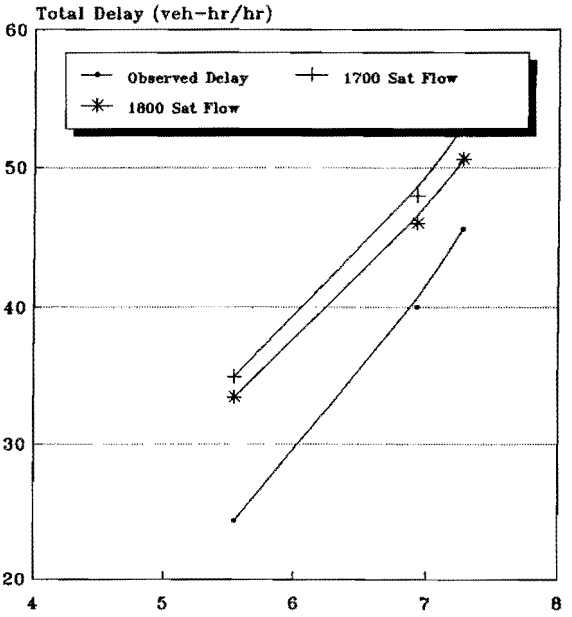



(d) Study Site 4

**Figure 16: Comparison of Observed and Simulated Delay for Hourly Period for the System at Study Sites 1 Through 4**




(a) Study Site 5




(b) Study Site 6

**Figure 17: Comparison of Observed and Simulated Delay for Hourly Period for the System at Study Sites 5 and 6**

## DISCUSSION OF CALIBRATION RESULTS

The simulated delays were found generally to be greater than the observed delays. The differences between observed and simulated delays increased exponentially for saturated conditions. Overestimation of delays using delay models is not unusual. Feng-Bor Lin (24) in a study in New York state compared the observed stopped delays with the delays estimated using the HCM (11) model. The study found that the HCM model overestimated delays for saturated conditions from 10 to 30 percent. A similar study performed by Robertson and Jansen (25) compared the observed stopped delay to the delay estimated using the HCM model for five study site locations in Charlotte, North Carolina. The conclusions of the study were that the HCM model overestimated delay above 100 percent for four cases.

Messer (26) in a paper published in the 1990 ITE Compendium of Technical Papers reviewed the parameters involved in the development of the HCM model. His remarks on overestimation of delay models as compared to observed delays were:

> The prediction of delay at signalized intersection is a complex problem and much remains to be understood by it. In addition there are conflicting needs by various user groups that make interpretation and application of delay more difficult. The HCM delay equation predicts the consequences of decisions for input data conditions existing during a 15-minute time period (a T of 1/4 hours). During oversaturated conditions, the delays that would be measured by a field crew would not be the same as that predicted by any of the above equations. In fact, the overflow delay portion would predict about twice that component measured in the field for the overflow time period. A numerical integration of the demand/capacity curves on a cycle-by-cycle basis would provide the only direct solution to the problem.

The TRANSYT delay function, like HCM delay model, owes its origin to the Websters model and is based on queuing theory. Both these models use a two-term delay function. The first term estimates the uniform delay, and the second term takes into

account the overflow and saturation delay. Such analytical models have proven to generally overestimate delays as compared to observed delays, especially for saturated conditions.

Furthermore, no serious effort has been made to calibrate the Platoon Dispersion Factor (PDF) model used in TRANSYT since it was embedded in the model originally by Robertson in 1969. Only halfhearted attempts have been made to calibrate the PDF model. It has been reported that PDF has been a cause of giving erroneous results in specific situations (27).

## SOURCES OF ERROR

Some of the other possible sources of error responsible for the differences between observed and simulated delay are discussed below:

1. The data collected in the field has an accuracy of plus or minus five percent (11). In the case of measurement of stopped vehicles, the accuracy can be even less due to the following reasons: a) the measurements were made at 20-second intervals for two hours, requiring great alertness for accurate counts; b) when queues extend a long way upstream, it is extremely difficult to accurately estimate the total number of vehicles stopped over six-lane cross-section, and by the time the count can be made, 20 seconds elapses and time for taking the next measurement comes along; c) since a count of stopped vehicles requires counting only those vehicles that are completely stopped, it necessitates distinguishing between vehicles that are slowing down to stop, vehicles that are stopped and vehicles that are rolling to close the headway with the vehicle in front; d) error was expected in monitoring of time since the crew size deployed necessitated that the person recording the number of stopped vehicles was also performing the task of monitoring time. Under these limiting circumstances, the observed delays are at best an estimate.

2. The actuated control phase lengths and sequences used for simulation were based on the timing plan received from public agencies. The actual phase lengths may be quite different from them as the controllers malfunction at times.

3. The TRANSYT models actuated phases on equal degree of saturation on all approaches and do not have the capability to model phase skipping, as was prevalent at a few of the downstream intersections.

4. Saturation flow rates and start up lost time used for analysis was that for normal drivers and based on other studies. Less difference between the observed and simulated delays might be achieved by using start-up lost time and saturation flow rates specifically observed at each site.

5. Since the TRANSYT model simulates only one cycle length and does not carry over queues from one cycle to other, it does not have the capability to model over saturated and breakdown conditions very well.

6. The TRANSYT model does not take into account the queues that were present before the start of the period of analyses. This gives erroneous results especially during the peak periods.

# CHAPTER V

## EVALUATION OF POTENTIAL EFFECTIVENESS OF GRADE SEPARATION

Evaluation of potential effectiveness of grade separation was performed using the same data set for the six study sites which were used for calibration of the model. The data, as before, were grouped into 15-minute periods. Evaluation of grade separation was performed for two scenarios. The first scenario involved simulating traffic with the North-South arterial grade separated, while the second scenario considered the East-West arterial grade separated. The lane configuration for evaluation of grade separation was the same as existing conditions, except that the right-turn on the grade separated approaches was made from a free right turn lane. Since grade separation only removes the through movement on one of the arterials, the remaining movements continue to pass through the at-grade signalized intersection. This research used a single signalized intersection to accomplish the at-grade movements. The number of phases at the at-grade intersection were reduced due to the elimination of the through movement of the grade separated approaches. The cycle length, phase lengths and offsets were optimized by the model to decrease delays to the remaining movements taking place at the at-grade intersection.

The TRANSYT output furnished the average and total delay for every movement of an approach. The data were reduced to the eight approaches considered part of the system. The total delay on each approach of the system was obtained by summing the delay on each movement of the approach. Summation of delay at the four approaches of the critical intersection and for the system provided the total delay at the critical intersection and over the system respectively. Delay on the grade separated and at-grade approaches of the critical intersection was arrived at by adding the delay on the two approaches. Summation of delay at the four downstream intersections provided the total delay at the downstream intersections.

Grade separation was evaluated by comparing the simulated delay when the critical

intersection was at-grade, to the delays simulated from grade separation for the seven situations presented in Table 4. The average percentage reduction in delay for the a.m.-peak, off-peak, p.m.-peak and mean of the three periods for Scenario 1 (north-south arterial grade separated) and Scenario 2 (east-west arterial grade separated) are presented in Tables H-1 through H-4 of Appendix H and Tables J-1 through J-4 of Appendix J respectively. The percentage reduction in delay by movement for the twenty-four, 15-minute data periods resulting from grade separation for the two scenarios are presented in Tables I-1 to I-12 and K-1 to K-12 of Appendix I and K respectively. The scenario which resulted in greater reduction in delay on a study site by study site basis for the a.m.-peak, off-peak, p.m.-peak and average for the three periods are presented in Tables 29 through 32.

Figures 18 through 21 illustrates the relationship between reduction in delay due to grade separation to the flow rate. On examining Tables 29 through 32 and Figures 35 through 38, it is apparent that reduction in delay due to grade separation is related to the flow rate. As expected, the higher the flow rate on the arterial streets, the larger the reduction in delay. Figures 22 and 23 shows the percentage reduction in delay with the time of the day which reinforces this inference. This pattern is very similar to the flow rate pattern observed at the six study sites (i.e. flow rates increases during the am-peak period, then falls to a lower level during the off-peak period. It increases rapidly with the start of the p.m.-peak period until the maximum flow rate for the day is observed at the p.m.-peak).

**Table 29: Scenario Resulting in Greater Average Reduction in Delay During AM-Peak Period**

| Type of Delay | Crit-eria | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 |
|---|---|---|---|---|---|---|---|
| Total delay for the system | - 40 | - 75 | - 69 | - 44 | - 56 | - 33 | - 30 |
| Grade separated approach of critical intersection | - 70 | - 76 | - 86 | - 67 | - 83 | - 91 | - 70 |
| At-grade approach of critical intersection | - 50 | - 62 | - 69 | - 6 | - 33 | - 14 | - 27 |
| Total delay at Critical Intersection | - 60 | - 67 | - 76 | - 66 | - 59 | - 60 | - 46 |
| Grade separated approach of D/S intersection | + 25 | + 74 | - 20 | - 15 | -74 | - 12 | + 12 |
| At-grade approach of D/S intersection | + 15 | + 71 | + 13 | - 15 | + 33 | + 14 | - 1 |
| Total delay at D/S intersections | + 20 | + 56 | - 15 | - 15 | - 40 | - 9 | + 6 |

**Table 30: Scenario Resulting in Greater Average Reduction in Delay During Off-Peak Period**

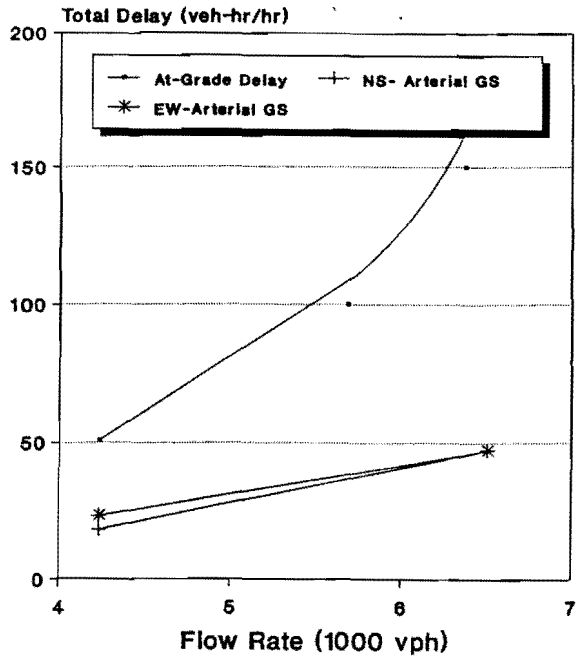
| Type of Delay | Crit-eria | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 |
|---|---|---|---|---|---|---|---|
| Total delay for the system | - 40 | - 74 | - 32 | - 39 | - 60 | - 31 | - 47 |
| Grade separated approach of critical intersection | - 70 | - 93 | - 75 | - 81 | - 90 | - 61 | - 76 |
| At-grade approach of critical intersection | - 50 | - 68 | + 19 | - 8 | - 64 | - 23 | - 33 |
| Total delay at Critical Intersection | - 60 | - 83 | - 41 | - 40 | - 79 | - 40 | - 57 |
| Grade separated approach of D/S intersection | + 25 | + 211 | + 64 | - 22 | + 10 | + 23 | - 10 |
| At-grade approach of D/S intersection | + 15 | + 24 | - 22 | - 38 | +193 | - 22 | + 2 |
| Total delay at D/S intersections | + 20 | +122 | + 8 | - 25 | + 40 | - 9 | - 8 |

**Table 31: Scenario Resulting in Greater Average Reduction in Delay During PM-Peak Period**

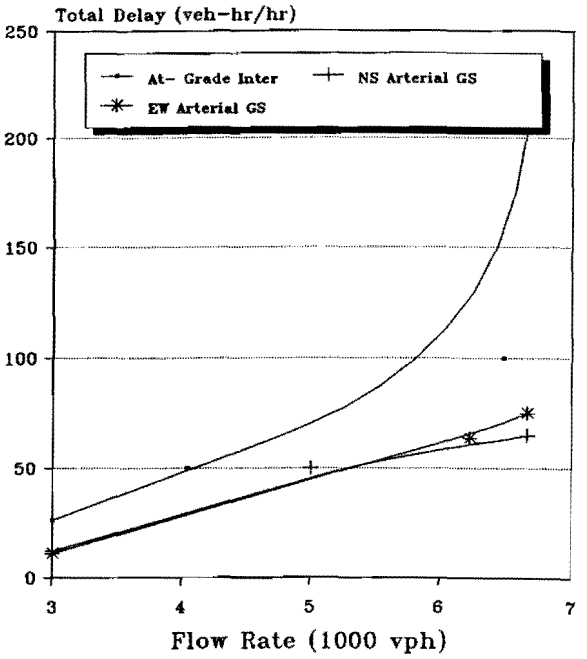
| Type of Delay | Crit-eria | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 |
|---|---|---|---|---|---|---|---|
| Total delay for the system | - 40 | - 87 | - 77 | - 65 | - 54 | - 49 | - 38 |
| Grade separated approach of critical intersection | - 70 | - 83 | - 92 | - 78 | - 86 | - 72 | - 71 |
| At-grade approach of critical intersection | - 50 | - 78 | - 67 | - 52 | - 57 | - 27 | - 26 |
| Total delay at Critical Intersection | - 60 | - 80 | - 84 | - 65 | - 72 | - 48 | - 51 |
| Grade separated approach of D/S intersection | + 25 | + 6 | +159 | 0 | +272 | - 23 | + 6 |
| At-grade approach of D/S intersection | + 15 | + 34 | + 9 | - 4 | + 63 | - 28 | - 12 |
| Total delay at D/S intersections | + 20 | + 14 | + 46 | - 2 | +154 | - 2 | + 8 |

**Table 32: Scenario Resulting in Greater Reduction in Delay for the Mean of the Three Periods**

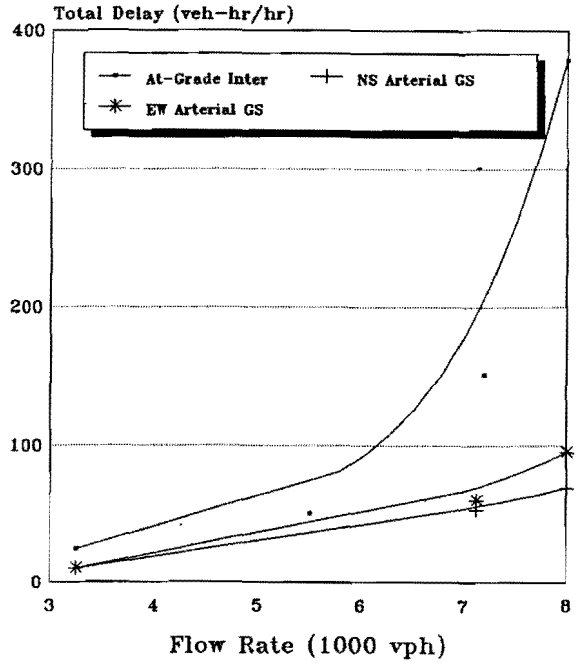
| Type of Delay | Crit-eria | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 |
|---|---|---|---|---|---|---|---|
| Total delay for the system | - 40 | - 78 | - 59 | - 42 | - 51 | - 34 | - 38 |
| Grade separated approach of critical intersection | - 70 | - 75 | - 86 | - 88 | - 78 | - 86 | - 72 |
| At-grade approach of critical intersection | - 50 | - 63 | - 35 | - 26 | - 40 | - 14 | - 29 |
| Total delay at Critical Intersection | - 60 | - 68 | - 67 | - 59 | - 58 | - 55 | - 51 |
| Grade separated approach of D/S intersection | + 25 | + 34 | +154 | - 6 | + 44 | - 18 | + 13 |
| At-grade approach of D/S intersection | + 15 | + 33 | - 7 | - 19 | + 26 | + 10 | - 4 |
| Total delay at D/S intersections | + 20 | +118 | + 30 | - 9 | + 7 | - 12 | - 10 |



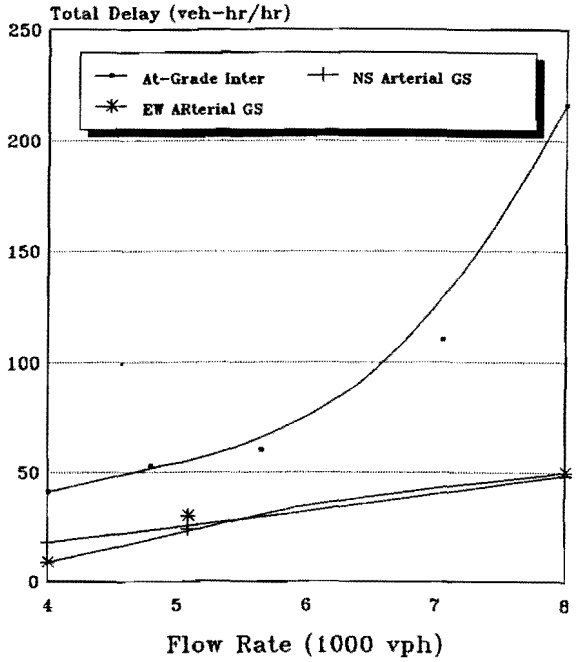

(a) Study Site 1




(b) Study Site 2

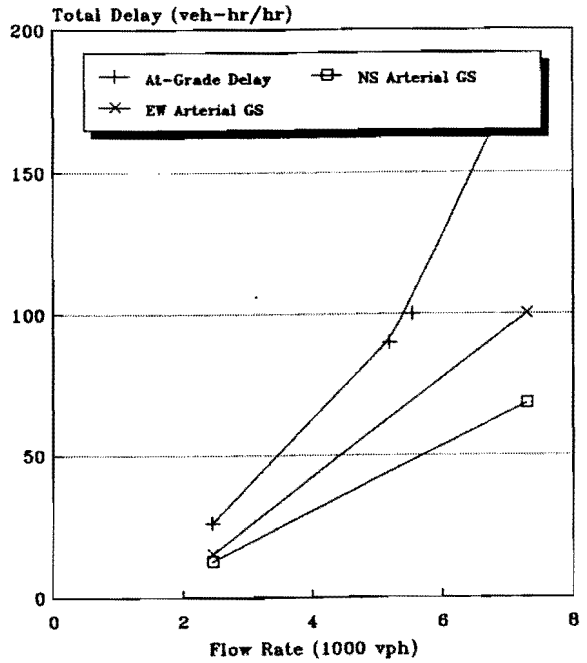



(c) Study Site 3

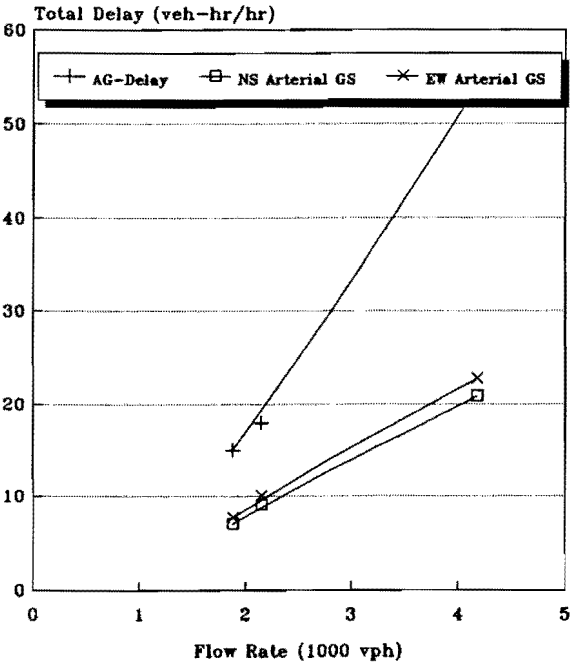



(d) Study Site 4

**Figure 18: Comparison of Delays Between At-Grade Intersection and Grade Separation at the Critical Intersection of Study Sites 1 Through 4**

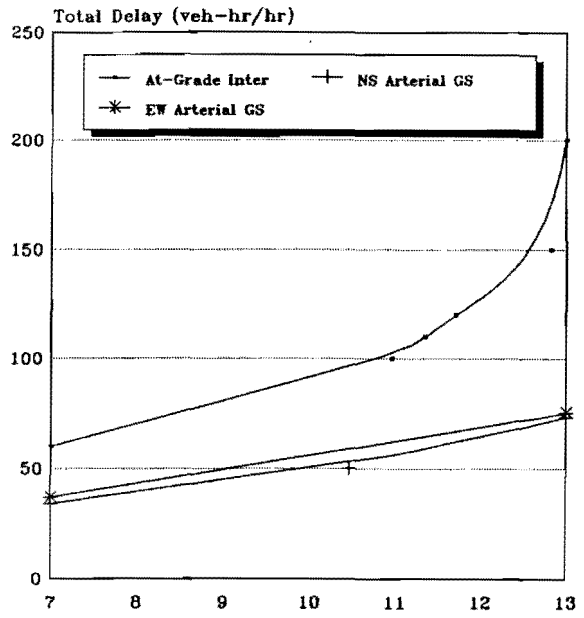



(a) Study Site 5

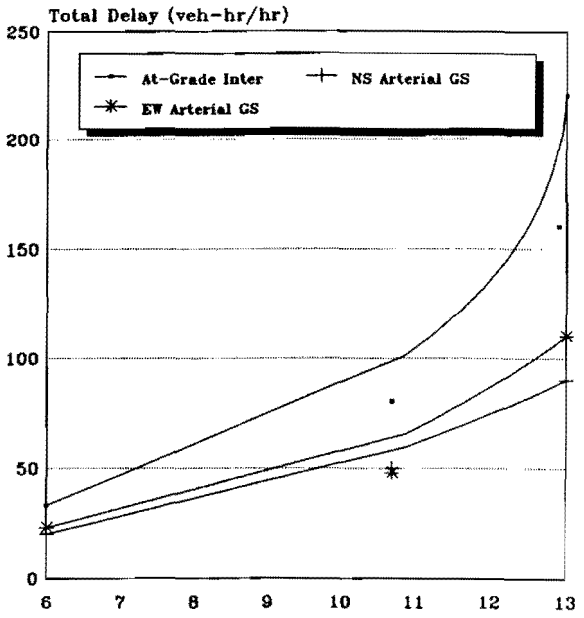



(b) Study Site 6

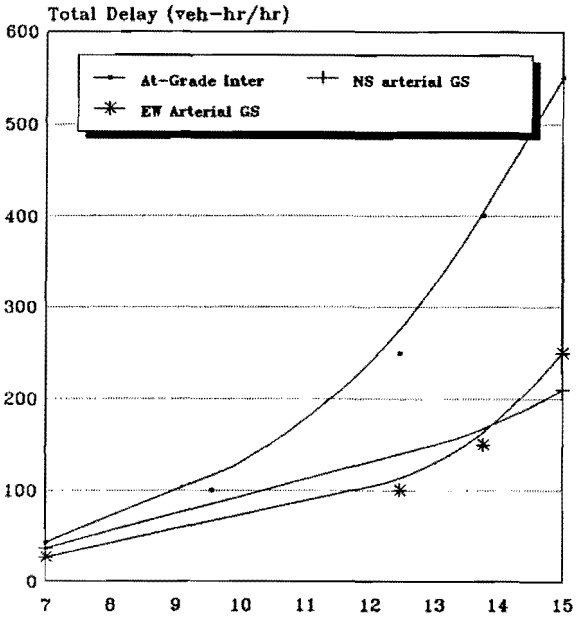
**Figure 19: Comparison of Delays Between At-Grade Intersection and Grade Separation at the Critical Intersection of Study Sites 5 and 6**



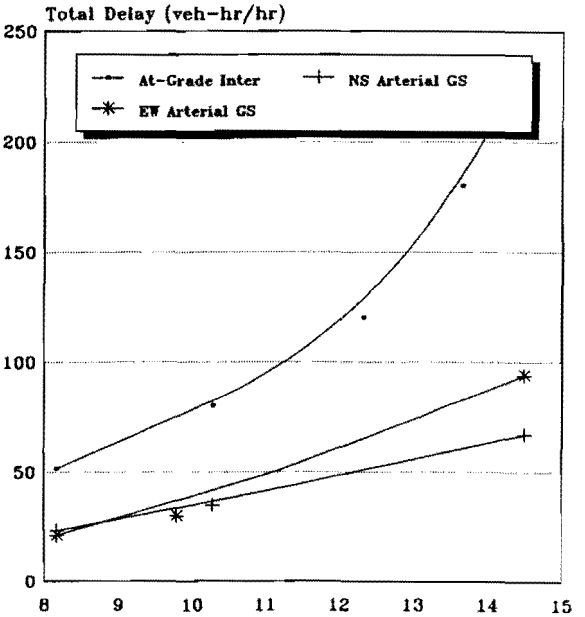

(a) Study Site 1




(b) Study Site 2

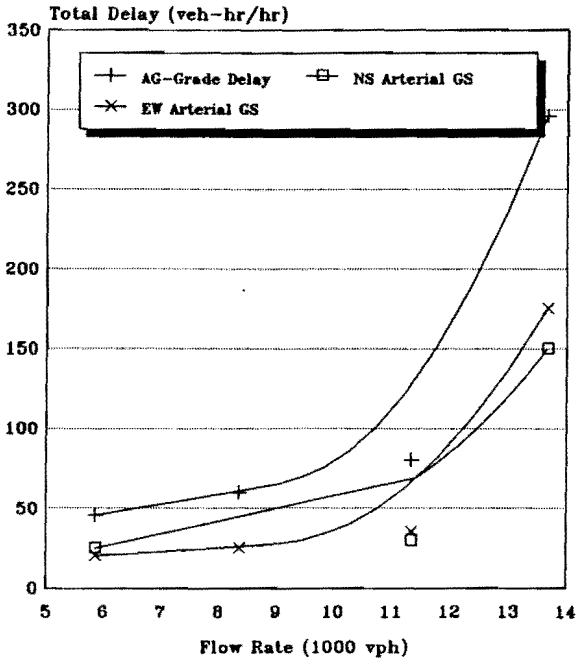



(c) Study Site 3

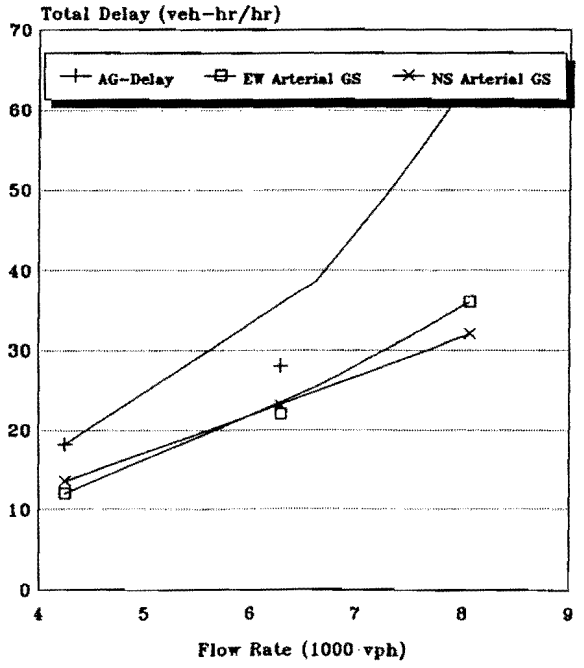



(d) Study Site 4

**Figure 20: Comparison of Delays Between At-Grade Intersection and Grade Separation for the System at Study Sites 1 Through 4**




(a) Study Site 5




(b) Study Site 6

**Figure 21: Comparison of Delays Between At-Grade Intersection and Grade Separation for the System at Study Sites 5 and 6**

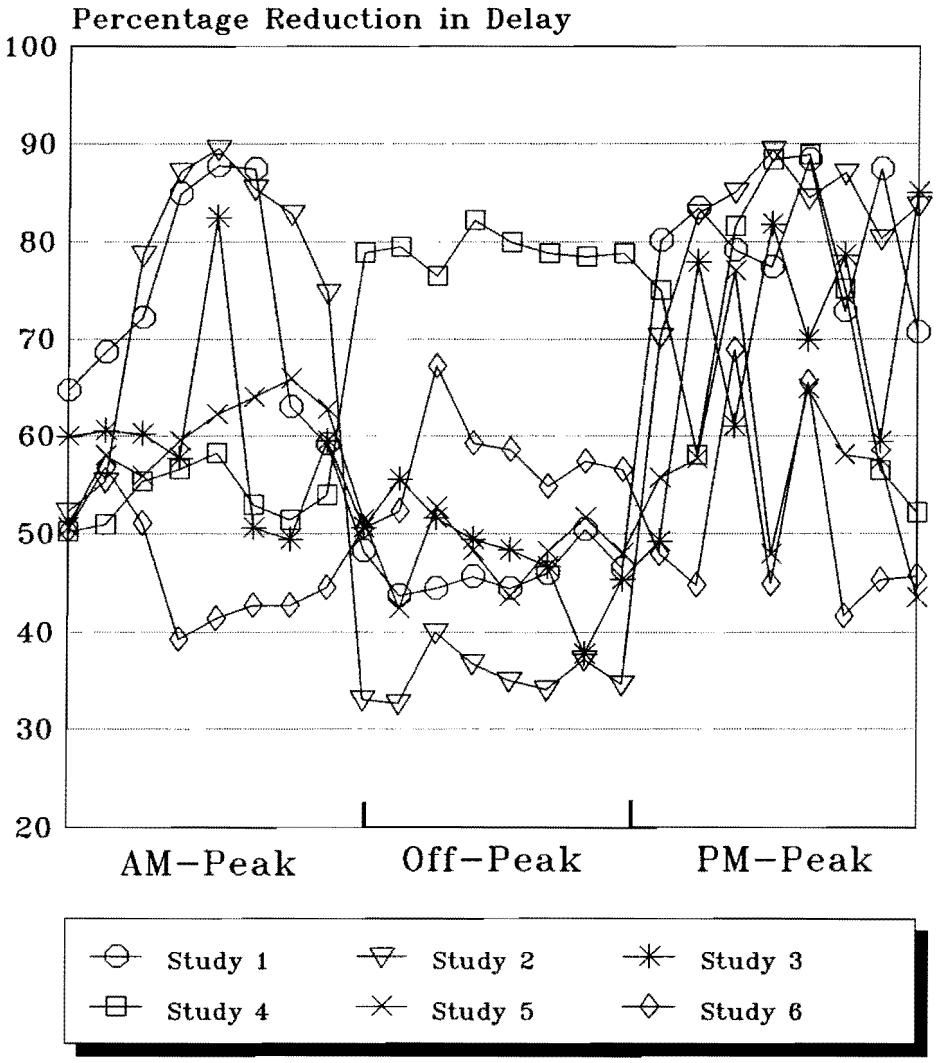



**Figure 22: Percentage Reduction in Delay Due to Grade Separation By Time of the Day at the Critical Intersection**

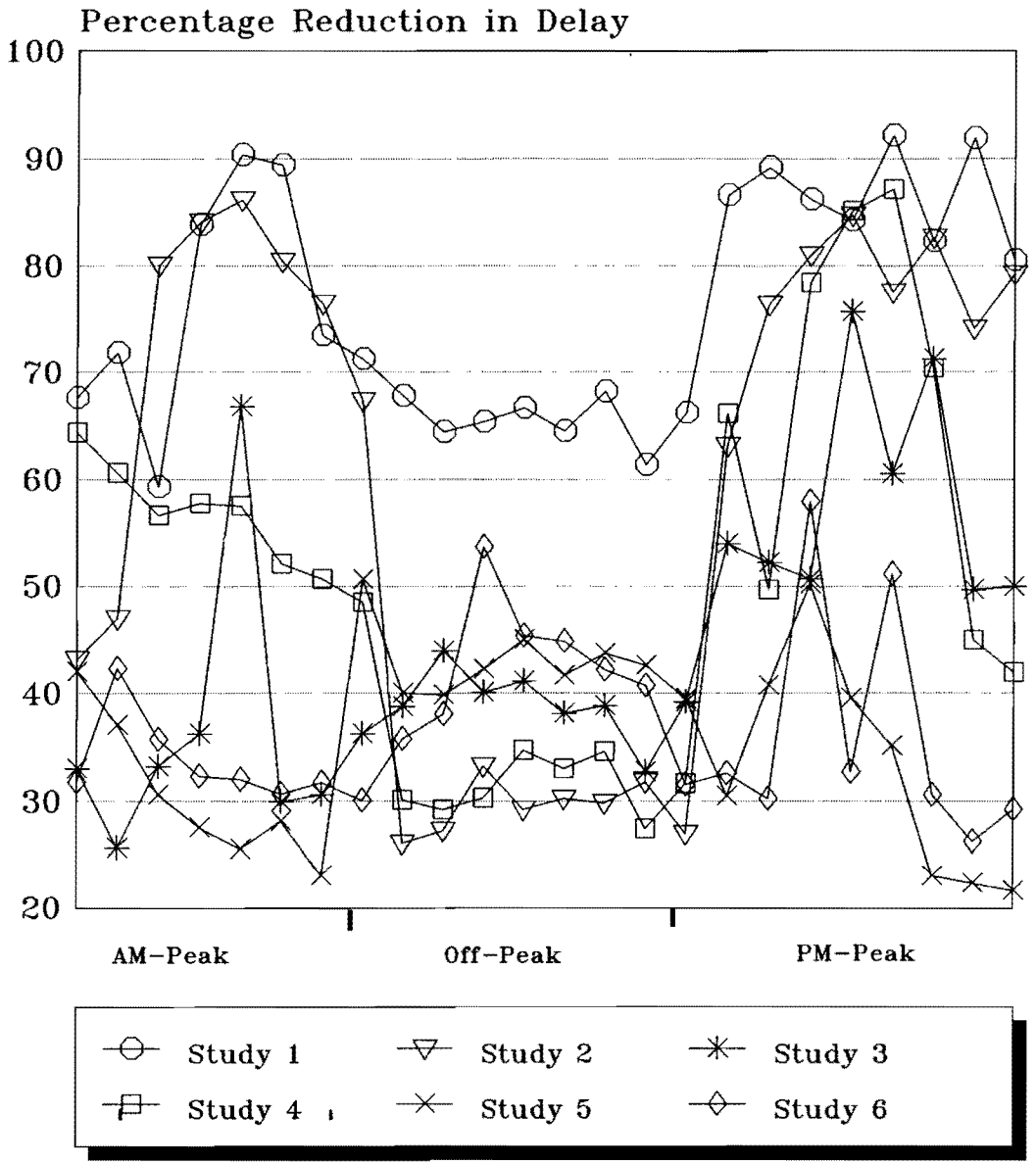



**Figure 23: Percentage Reduction in Delay Due to Grade Separation for the System By Time of the Day**

## DISCUSSION OF GRADE SEPARATION RESULTS

Inspection of Tables 29 through 32 reveals that the criteria for evaluating the potential effectiveness of grade separation in terms of reduction in delay by 40 percent over the system was successfully satisfied by four of the six locations for the average of the three periods. The two study sites that did not meet the criteria, one of them (Study Site 6) was not saturated enough to warrant replacement by an interchange. The other location (Study Site 5) had high type arterial streets as the cross street at the downstream intersection. Although this site had an expected reduction in delay of 55 percent at the critical intersection and no shifting of delays were expected at the downstream intersection, the high proportion of delays at the downstream intersection resulted in delays being understated on the system-wide basis.

The criteria of 70 percent reduction in delay at the grade separated approaches of the critical intersection was met by almost all the six study sites during all the four periods of analyses (that is, a.m.-peak, off-peak, p.m.-peak and mean of the three periods).

The at-grade approaches of the critical intersection was expected to reduce delay by 50 percent. This criteria proved to be very stringent. Only a few study sites were successful in meeting this criterion. A possible explanation to this was the high left-turn volumes on both the intersecting arterial streets which were a significant proportion of the total traffic, up to 40 percent of southbound Dairy Ashford (Study Site 2) and 37 percent on westbound Arapaho (Study Site 3). The high left-turn traffic necessitated a long protected phase at the at-grade intersection, thereby decreasing the reduction in delay.

Total delay at the critical intersection was expected to decrease by 60 percent. This standard met with good results, reflected in the fact that for the average of the three periods, the reduction in delay at the six study site locations ranged between 51 percent to 68 percent. The lowest percentage reduction in delay, not surprisingly, was for Study Site 6 which had relatively low volume.

An important question that this research has tried to address is whether grade separation shifts delays to the downstream intersection from the critical intersection subsequent to grade separation and, if so, by how much. The analyses for grade separation indicate that this is dependent on the spacing, location and the type of cross street at the downstream intersection.

It was found that when the spacing of the downstream intersection from the critical intersection was such that it facilitated progression of traffic on the arterials, no shifting of delays was expected. Examples of such locations are Study Sites 3, 5 and 6. All these sites had an arterial street as the cross street at the downstream intersection. These downstream intersections were spaced in multiples of one-third mile. These features encouraged progression of traffic, and no shifting of delays to the downstream intersection was observed. In fact, at many of these locations, the delay at the downstream intersection was marginally reduced.

However, if the downstream intersections were located out of position, as in case of Study Sites 1, 2 and 4, shifting of delays was expected. As pointed out earlier, many of these out of position intersections were being operated with fully actuated controllers. The cross street phase at these intersections was optional and would get a green phase only in case of demand. In view of the limitation of the TRANSYT model to simulate optional phases, and the fact that TRANSYT distributes delays equally to the main and cross street, the shifting of delays that were estimated at these intersections may be a little inflated.

# CHAPTER VI

## SUMMARY AND CONCLUSIONS

Increasing congestion along the arterial corridor is causing near breakdown conditions at the intersection of two arterial streets. Opinion in favor of grade separation of such intersections to ease congestion is slowly gaining popularity. Historically, much skepticism had existed regarding the ability of grade separation to increase the capacity on a corridor level basis. This uncertainty regarding benefits of installing an interchange stems from the fact that if delay was simply shifted from the problem intersection to the downstream intersections, then not much improvement over the system would be achieved.

The increase in congestion at the intersection of two arterial streets has necessitated traffic engineers to employ delay models that best estimates the prevalent conditions. Towards this end, some studies have been performed to calibrate the existing body of analytical and simulation delay models in order to have an insight into the performance of such models for saturated conditions.

This research dealt with both these issues. The first portion of the thesis was devoted to evaluating the performance of the TRANSYT model in simulating traffic through signalized streets. The second half of the thesis addressed issues relative to reduction of system-wide delay after installation of an interchange at the intersection of two congested arterial streets and especially the effect at the downstream intersections.

The calibration of the TRANSYT model indicated that the simulated delays seemed to be generally higher than the observed delays. During the calibration using default values of saturation flow rate, the model more often than not failed to meet the criteria set to test the hypotheses. The difference between observed and TRANSYT estimated delay were especially significant for saturated conditions. It appeared that the performance of the model for saturated conditions was somewhat erratic. The difference between observed and

estimated delay for unsaturated conditions on the whole were relatively less significant than saturated conditions.

Subsequent calibration of the model using a higher saturation flow rate showed that the model performed better with higher saturation flow rate than with default values. The critical intersection of two of the six study sites successfully satisfied the criteria for testing the first hypothesis.

Sensitivity test were performed on the TRANSYT model to study its behavior by changing the default saturation flow rates, start-up lost time, time period of analyses and platoon dispersion factor. The analysis indicated that the model was sensitive to changes in all these variables for saturated conditions except platoon dispersion factor. For saturated conditions, increasing the saturation flow rate in increments of 100 vphg correspondingly reduced the total delay by 30 to 40 percent for through movements. A similar increase in saturation flow rates for low-volume conditions, did not significantly decrease delay. Changing the start-up lost time from three seconds to two seconds decreased total delay by approximately 40 to 50 percent for saturated conditions. When the time period of analyses (card type 1, field 12 of the TRANSYT model) for saturated conditions was increased from 15 to 60 minutes using 15-minute flow rates, the simulated delays went up by 100 percent to over 300 percent. Increasing the time period of analyses for unsaturated conditions did not significantly increase the delays. Changing the Platoon dispersion factor (card type 10, field 8), used to indicate the lane width, parking along the arterial, type of arterial (high flow suburban) , CBD, did not yield any significant changes in delay estimates.

Some mention needs to be made on the accuracy of manually observed delays for saturated conditions. With limited crew (as in case of this study), it was not humanly possible to accurately measure stopped vehicle counts at 20- second intervals over a six lane cross-section when queues extend beyond 25 vehicles in each lane. The problem was compounded since the observers were required to count only those vehicles that were

completely stopped. Thus they were required to distinguish between completely stopped vehicles and vehicles that were still rolling to close the gap with the vehicle in front. The heavy vehicles in the traffic stream added to the woes of the crew as the vision of vehicles stopped behind the heavy vehicle was blocked.

The analyses to evaluate the potential effectiveness of grade separation indicated that the reduction in delay due to grade separation depended on a number of variables, such as flow rate over the system, the functional classification of the cross street, the prevalent flow rate on the cross street at the downstream intersection and time of the day. The relationship found between percentage reduction in delay from grade separation and flow rate indicated that the higher the flow rate entering the intersection and the system, the greater the expected reduction in delay. The general trend observed in percentage reduction in delay with time of the day showed that maximum reduction in delay was observed during the p.m.-peak period, followed by a.m.-peak period and off-peak period.

The case studys' results showed that grade separation was expected to reduce delay at the critical intersection by almost 60 percent at all the study sites except Study Site 6. To appreciate the reduction in delay over the system, the study sites can be grouped into two categories, with the functional classification of the cross street at the downstream intersection being the boundary. The first group consisted of Study Sites 1, 2 and 4, all of which generally had low-volume collectors or access drives to commercial developments as the cross streets at the downstream intersections. The expected reduction in delay over the system for study sites under group one was more than 50 percent. In fact, Study Site 1 showed a 78 percent reduction of delay over the system. Group two consisted of Study Sites 3, 5 and 6 which had arterial streets as the cross streets on at least three of the four downstream intersections. The results of this group had expected reduction in delay of 41 percent for Study Site 1, 34 percent for Study Site 5 and 38 percent for Study Site 6. A possible reason for study sites of group two showing less expected reduction in delay for the system was the fact that the downstream intersections formed a significant proportion of total delay for the system, and although delay at downstream intersections at these study

sites decreased slightly subsequent to grade separation, it had the effect of pulling down the total reduction in delay for the system by its sheer ratio of the total. A contributing factor peculiar to Study Site 6 only was its significantly lower flow rates as compared to other study sites. This may have been another cause for the lower reduction in delay at Study Site 6 as it has been shown that percentage reduction in delay is directly proportional to the flow rate.

The entering flow rate at an at-grade intersection at which grade separation becomes a viable choice was found to be 5,000 vph. Beyond this flow rate, the delays at an at-grade intersection increase rapidly. Shifting of delays at the downstream intersection was expected to occur whenever a downstream intersection was located out of position. However, if the downstream intersection was well spaced from the critical intersection, no shifting of delays was expected.

This research has clearly indicated that in order to maximize benefits from grade separation, only those intersections which have entering flow rates of at least 5,000 vph need to be selected. Grade separating not so congested intersections does not reduce the delay by a large amount because the delay incurred at an at-grade intersection itself is low. This was evident in case of Study Site 6 which had significantly lower flow rates than the other study sites and consequently did not have as high expected reduction in delay as some of the other congested study sites.

Future research needs to be directed towards calibrating other computer simulation models, such as NETSIM, to see whether they can model saturated conditions better. For accurate measurement of observed delays for saturated conditions, other methods of measuring stopped delays, such as use of test car observation, need to be explored.

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**APPENDIX A**

SCHEMATIC ILLUSTRATION OF STUDY SITES

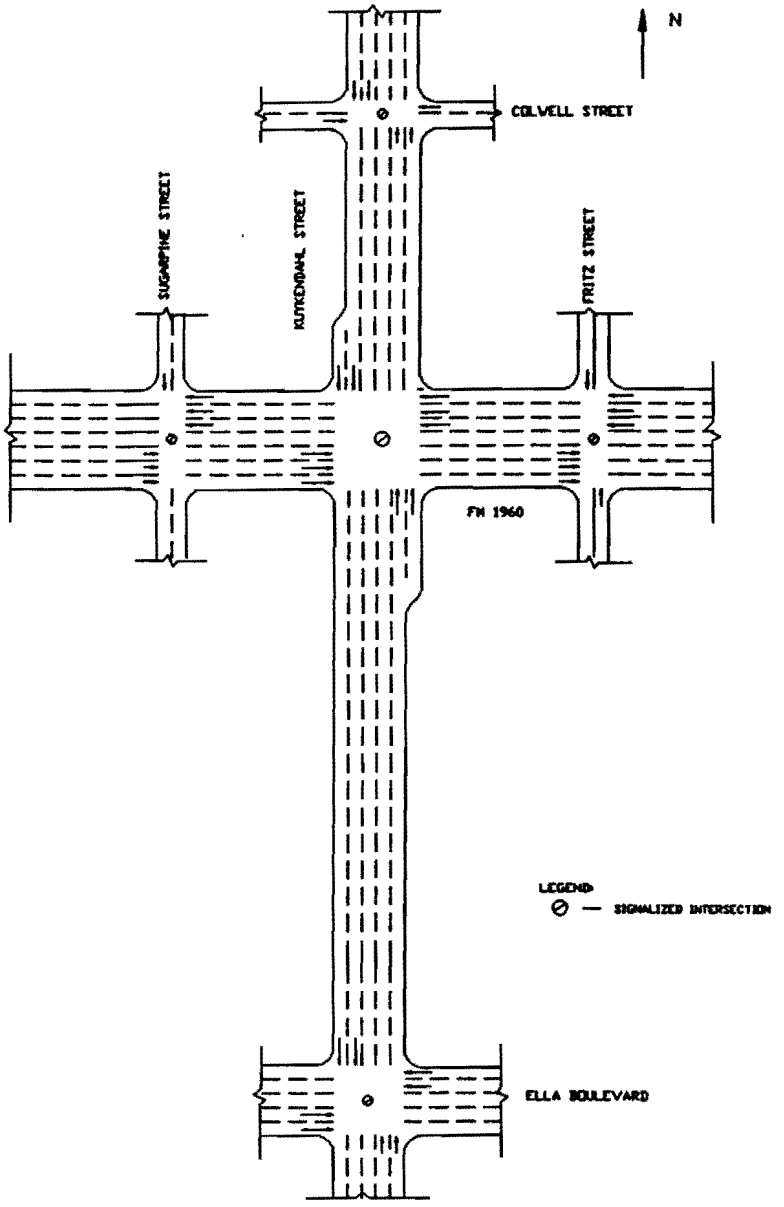


**Figure A-1: Schematic Illustration of Study Site 1**

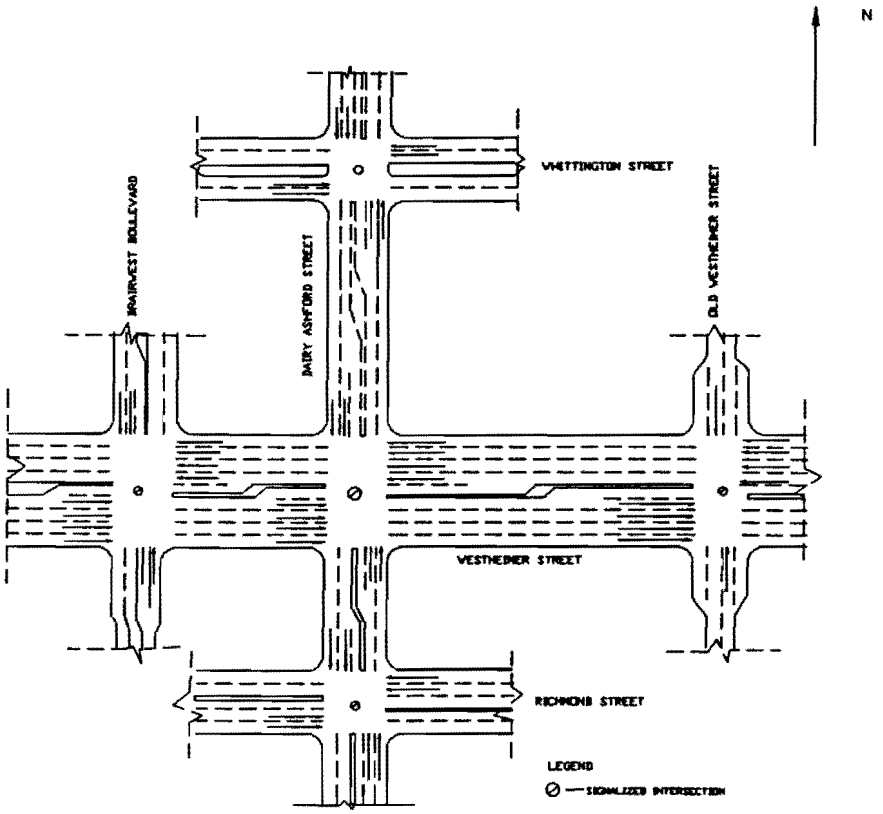


**Figure A-2: Schematic Illustration of Study Site 2**

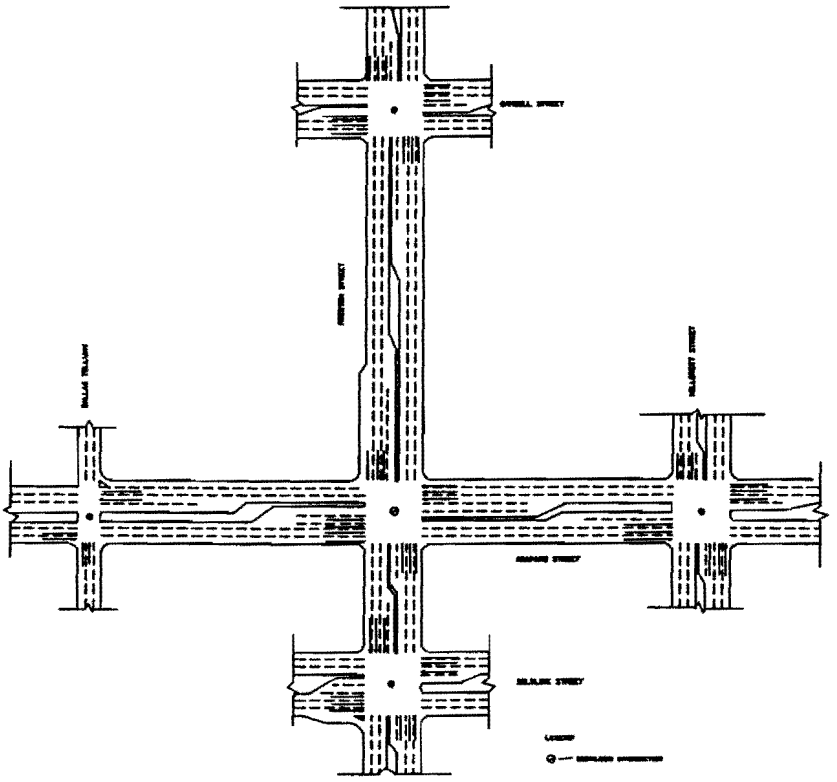

**Figure A-3: Schematic Illustration of Study Site 3**

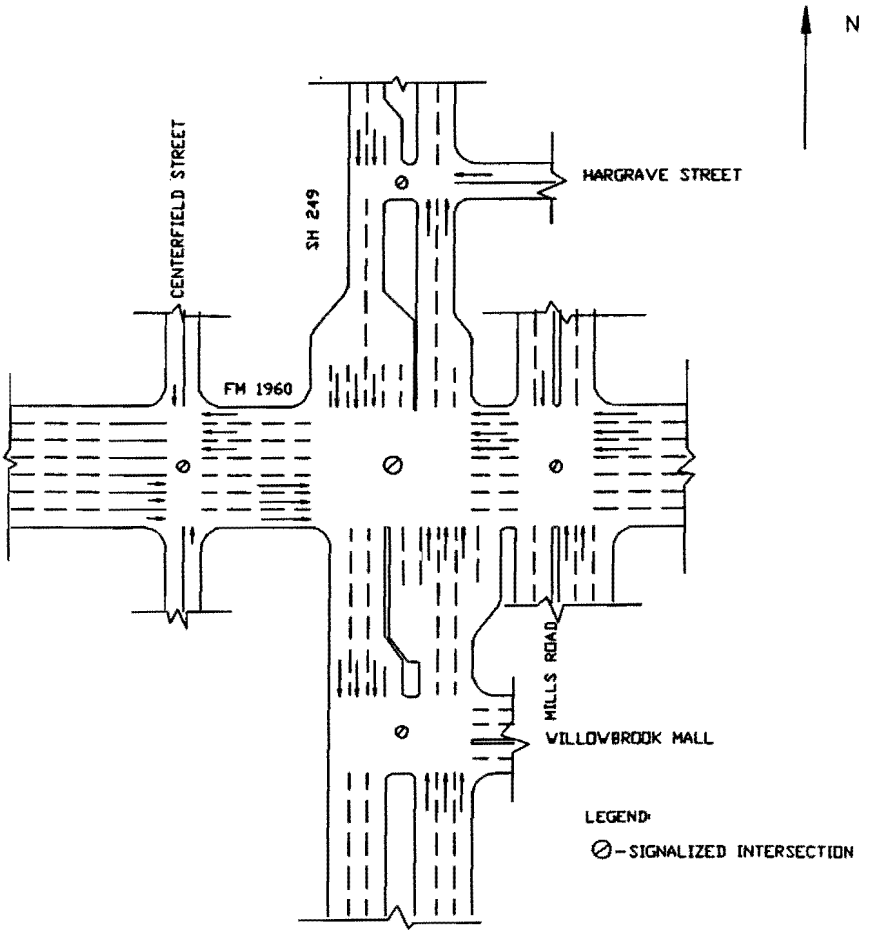


**Figure A-4: Schematic Illustration of Study Site 4**

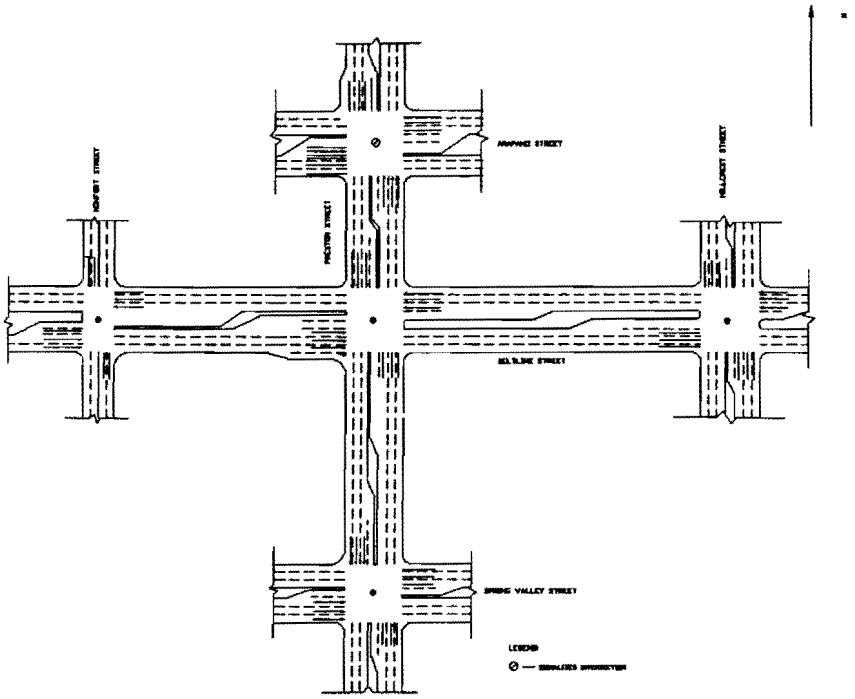

**Figure A-5: Schematic Illustration of Study Site 5**

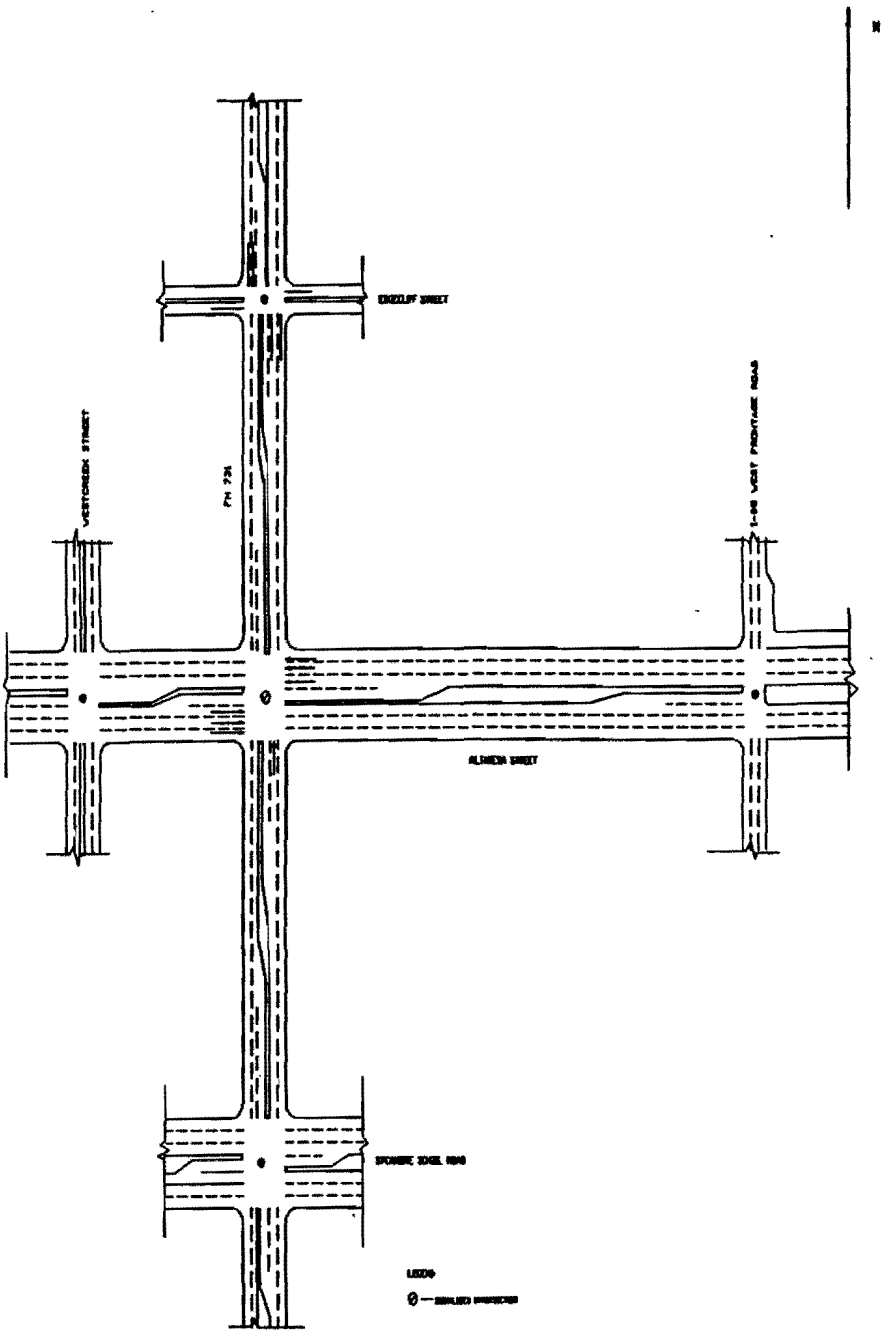

**Figure A-6: Schematic Illustration of Study Site 6**

# APPENDIX B

## 15-MINUTE FLOW RATES OBSERVED AT STUDY SITES

Table B-1: 15-minute Flow Rates observed at the Critical Intersection of Study Site 1

| TIME PERIOD (hours) | FLOW RATE (Vehs per hour) | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | 104 | 196 | 300 | 160 | 1272 | 1432 | 112 | 1076 | 1188 | 80 | 628 | 708 | 3628 |
| 6.45 - 7:00 | 92 | 248 | 340 | 228 | 1544 | 1772 | 148 | 1160 | 1308 | 108 | 704 | 812 | 4232 |
| 7:00 - 7:15 | 144 | 304 | 448 | 168 | 1524 | 1692 | 92 | 1024 | 1116 | 116 | 916 | 1032 | 4288 |
| 7:15 - 7:30 | 200 | 304 | 504 | 192 | 1664 | 1856 | 160 | 1476 | 1636 | 88 | 1056 | 1144 | 5140 |
| 7:30 - 7:45 | 280 | 404 | 684 | 212 | 1584 | 1796 | 204 | 1540 | 1744 | 100 | 1360 | 1460 | 5684 |
| 7:45 - 8:00 | 260 | 408 | 668 | 284 | 1544 | 1828 | 208 | 1520 | 1728 | 124 | 1456 | 1580 | 5804 |
| 8:00 - 8:15 | 268 | 440 | 708 | 248 | 1344 | 1592 | 188 | 1368 | 1556 | 104 | 1180 | 1284 | 5140 |
| 8:15 - 8:30 | 204 | 284 | 488 | 308 | 1244 | 1552 | 180 | 1340 | 1520 | 100 | 1260 | 1360 | 4920 |
| 11:00-11:15 | 216 | 480 | 696 | 372 | 812 | 1184 | 232 | 1288 | 1520 | 120 | 1364 | 1484 | 4884 |
| 11:15-11:30 | 288 | 428 | 716 | 316 | 748 | 1064 | 208 | 1100 | 1308 | 120 | 1280 | 1400 | 4488 |
| 11:30-11:45 | 308 | 604 | 912 | 352 | 800 | 1152 | 276 | 880 | 1156 | 128 | 1320 | 1448 | 4668 |
| 11:45-12:00 | 312 | 568 | 880 | 332 | 784 | 1116 | 268 | 1424 | 1692 | 152 | 1452 | 1604 | 5292 |
| 12:00-12:15 | 384 | 616 | 1000 | 396 | 668 | 1064 | 364 | 1556 | 1920 | 156 | 1744 | 1900 | 5884 |
| 12:30-12:45 | 348 | 564 | 912 | 356 | 680 | 1036 | 384 | 1548 | 1932 | 252 | 1820 | 2072 | 5952 |
| 12:45-13:00 | 316 | 496 | 812 | 352 | 612 | 964 | 364 | 1484 | 1848 | 192 | 1508 | 1700 | 5324 |
| 16:30-16:45 | 372 | 848 | 1220 | 260 | 620 | 880 | 308 | 1512 | 1820 | 100 | 1980 | 2080 | 6000 |
| 16:45-17:00 | 436 | 912 | 1348 | 344 | 612 | 956 | 340 | 1652 | 1992 | 84 | 1992 | 2076 | 6372 |
| 17:00-17:15 | 376 | 916 | 1292 | 288 | 632 | 920 | 360 | 1796 | 2156 | 108 | 1756 | 1864 | 6232 |
| 17:15-17:30 | 400 | 944 | 1344 | 188 | 552 | 740 | 344 | 1780 | 2124 | 92 | 1736 | 1828 | 6036 |
| 17:30-17:45 | 392 | 932 | 1324 | 284 | 700 | 984 | 360 | 1692 | 2052 | 76 | 2064 | 2140 | 6500 |
| 17:45-18:00 | 356 | 972 | 1328 | 180 | 672 | 852 | 312 | 1556 | 1868 | 160 | 1796 | 1956 | 6004 |
| 18:00-18:15 | 412 | 872 | 1284 | 284 | 584 | 868 | 392 | 1456 | 1848 | 100 | 2132 | 2232 | 6232 |
| 18:15:18:30 | 428 | 932 | 1360 | 224 | 636 | 860 | 304 | 1820 | 2124 | 116 | 1776 | 1892 | 6236 |

Table B-2: 15-Minute Flow Rates Observed at Downstream Intersections of Study Site 1

| TIME PERIOD | FLOW RATE (vehicles per hour) | | | | | | | | | | | | TOTAL FOR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| (hours) | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | DS INTER |
| 6:30 - 6:45 | 0 | 356 | 356 | 60 | 1704 | 1764 | 4 | 896 | 900 | 0 | 804 | 804 | 3824 |
| 7:00 - 7:15 | 8 | 444 | 452 | 56 | 1964 | 2020 | 0 | 1328 | 1328 | 16 | 1336 | 1352 | 5152 |
| 7:15 - 7:30 | 12 | 524 | 536 | 116 | 2168 | 2284 | 4 | 1456 | 1460 | 16 | 1524 | 1540 | 5820 |
| 7:30 - 7:45 | 4 | 676 | 680 | 84 | 1728 | 1812 | 20 | 1920 | 1940 | 4 | 1300 | 1304 | 5736 |
| 7:45 - 8:00 | 0 | 672 | 672 | 192 | 1804 | 1996 | 32 | 1780 | 1812 | 16 | 1408 | 1424 | 5904 |
| 8:00 - 8:15 | 8 | 696 | 704 | 68 | 1316 | 1384 | 52 | 1828 | 1880 | 12 | 1268 | 1280 | 5248 |
| 8:15 - 8:30 | 12 | 708 | 720 | 48 | 1352 | 1400 | 24 | 1800 | 1824 | 16 | 1576 | 1592 | 5536 |
| 11:00-11:15 | 0 | 732 | 732 | 68 | 584 | 652 | 0 | 1628 | 1628 | 20 | 1288 | 1308 | 4320 |
| 11:15-11:30 | 8 | 792 | 800 | 44 | 636 | 680 | 4 | 1700 | 1704 | 56 | 1484 | 1540 | 4724 |
| 11:30-11:45 | 12 | 824 | 836 | 72 | 572 | 644 | 12 | 1612 | 1624 | 40 | 1576 | 1616 | 4720 |
| 11:45-12:00 | 0 | 752 | 752 | 76 | 596 | 672 | 4 | 2096 | 2100 | 40 | 1464 | 1504 | 5028 |
| 12:00-12:15 | 12 | 984 | 996 | 120 | 536 | 656 | 24 | 2140 | 2164 | 80 | 1572 | 1652 | 5468 |
| 12:15-12:30 | 28 | 860 | 888 | 88 | 696 | 784 | 20 | 1932 | 1952 | 40 | 1504 | 1544 | 5168 |
| 12:30-12:45 | 4 | 852 | 856 | 76 | 688 | 764 | 28 | 1864 | 1892 | 64 | 1608 | 1672 | 5184 |
| 12:45-13:00 | 12 | 1032 | 1044 | 88 | 716 | 804 | 20 | 1988 | 2008 | 76 | 1944 | 2020 | 5876 |
| 16:30-16:45 | 8 | 1776 | 1784 | 124 | 680 | 804 | 12 | 2108 | 2120 | 92 | 1752 | 1844 | 6552 |
| 16:45-17:00 | 24 | 1820 | 1844 | 140 | 748 | 888 | 8 | 2400 | 2408 | 88 | 1764 | 1852 | 6992 |
| 17:00-17:15 | 28 | 1876 | 1904 | 152 | 664 | 816 | 8 | 2412 | 2420 | 88 | 1700 | 1788 | 6928 |
| 17:15-17:30 | 12 | 1992 | 2004 | 132 | 752 | 884 | 24 | 2524 | 2548 | 140 | 1764 | 1904 | 7340 |
| 17:30-17:45 | 32 | 1872 | 1904 | 108 | 716 | 824 | 4 | 2524 | 2528 | 96 | 1780 | 1876 | 7132 |
| 17:45-18:00 | 28 | 1872 | 1900 | 108 | 612 | 720 | 8 | 2700 | 2708 | 120 | 1656 | 1776 | 7104 |
| 18:00-18:15 | 4 | 1708 | 1712 | 164 | 648 | 812 | 12 | 2244 | 2256 | 104 | 1704 | 1808 | 6588 |
| 18:15:18:30 | 24 | 1860 | 1884 | 124 | 680 | 804 | 12 | 2420 | 2432 | 88 | 1620 | 1708 | 6828 |

Table B-3: 15-Minute Flow Rates Observed at the Critical Intersection of Study Site 2

| TIME PERIOD (hours) | FLOW RATE (vehicles per hour) | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | 64 | 552 | 616 | 172 | 364 | 536 | 100 | 1776 | 1876 | 32 | 324 | 356 | 3384 |
| 6:45 - 7:00 | 108 | 700 | 808 | 260 | 460 | 720 | 100 | 1952 | 2052 | 68 | 388 | 456 | 4036 |
| 7:00 - 7:15 | 60 | 816 | 876 | 296 | 428 | 724 | 128 | 2380 | 2508 | 92 | 468 | 560 | 4668 |
| 7:15 - 7:30 | 76 | 700 | 776 | 360 | 560 | 920 | 196 | 2772 | 2968 | 112 | 656 | 768 | 5432 |
| 7:30 - 7:45 | 136 | 980 | 1116 | 320 | 660 | 980 | 192 | 2708 | 2900 | 96 | 684 | 780 | 5776 |
| 7:45 - 8:00 | 96 | 920 | 1016 | 248 | 568 | 816 | 204 | 2796 | 3000 | 88 | 872 | 960 | 5792 |
| 8:00 - 8:15 | 120 | 1060 | 1180 | 320 | 652 | 972 | 200 | 2008 | 2208 | 104 | 536 | 640 | 5000 |
| 8:15 - 8:30 | 76 | 872 | 948 | 320 | 496 | 816 | 208 | 1876 | 2084 | 176 | 400 | 576 | 4424 |
| 11:00-11:15 | 120 | 448 | 568 | 260 | 468 | 728 | 244 | 864 | 1108 | 124 | 852 | 976 | 3380 |
| 11:15-11:30 | 104 | 428 | 532 | 304 | 544 | 848 | 196 | 972 | 1168 | 136 | 1204 | 1340 | 3888 |
| 11:30-11:45 | 204 | 612 | 816 | 284 | 576 | 860 | 200 | 936 | 1136 | 104 | 1080 | 1184 | 3996 |
| 11:45-12:00 | 164 | 544 | 708 | 280 | 652 | 932 | 244 | 1020 | 1264 | 108 | 1396 | 1504 | 4408 |
| 12:00-12:15 | 172 | 536 | 708 | 320 | 672 | 992 | 248 | 1096 | 1344 | 136 | 1316 | 1452 | 4496 |
| 12:15-12:30 | 108 | 608 | 716 | 380 | 728 | 1108 | 208 | 1004 | 1212 | 136 | 1352 | 1488 | 4524 |
| 12:30-12:45 | 180 | 584 | 764 | 308 | 544 | 852 | 244 | 1024 | 1268 | 132 | 1220 | 1352 | 4236 |
| 12:45-13:00 | 104 | 532 | 636 | 260 | 592 | 852 | 228 | 980 | 1208 | 120 | 1140 | 1260 | 3956 |
| 16:30-16:45 | 228 | 764 | 992 | 288 | 952 | 1240 | 220 | 1044 | 1264 | 156 | 1776 | 1932 | 5428 |
| 16:45-17:00 | 248 | 832 | 1080 | 204 | 816 | 1020 | 240 | 1004 | 1244 | 256 | 2396 | 2652 | 5996 |
| 17:00-17:15 | 244 | 804 | 1048 | 240 | 980 | 1220 | 204 | 1096 | 1300 | 264 | 2648 | 2912 | 6480 |
| 17:15-17:30 | 316 | 956 | 1272 | 188 | 992 | 1180 | 228 | 1024 | 1252 | 204 | 2380 | 2584 | 6288 |
| 17:30-17:45 | 284 | 736 | 1020 | 132 | 888 | 1020 | 260 | 1192 | 1452 | 252 | 2316 | 2568 | 6060 |
| 17:45-18:00 | 308 | 796 | 1104 | 276 | 936 | 1212 | 208 | 1096 | 1304 | 268 | 2772 | 3040 | 6660 |
| 18:00-18:15 | 252 | 776 | 1028 | 268 | 860 | 1128 | 224 | 1072 | 1296 | 240 | 2536 | 2776 | 6228 |
| 18:15:18:30 | 244 | 736 | 980 | 292 | 964 | 1256 | 252 | 884 | 1136 | 252 | 2188 | 2440 | 5812 |

Table B-4: 15-Minute Flow Rates Observed at Downstream Intersections of Study Site 2

| TIME PERIOD (hours) | FLOW RATE (vehicles per hour) | | | | | | | | | | | | TOTAL FOR DS INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | 32 | 640 | 672 | 224 | 356 | 580 | 0 | 304 | 304 | 12 | 2144 | 2156 | 3712 |
| 6:45 - 7:00 | 40 | 768 | 808 | 212 | 504 | 716 | 0 | 440 | 440 | 8 | 2900 | 2908 | 4872 |
| 7:15 - 7:30 | 36 | 956 | 992 | 472 | 500 | 972 | 4 | 408 | 412 | 4 | 3228 | 3232 | 5608 |
| 7:30 - 7:45 | 56 | 992 | 1048 | 460 | 552 | 1012 | 8 | 788 | 796 | 24 | 3256 | 3280 | 6136 |
| 7:45 - 8:00 | 96 | 1256 | 1352 | 428 | 612 | 1040 | 12 | 660 | 672 | 12 | 3236 | 3248 | 6312 |
| 8:00 - 8:15 | 136 | 1188 | 1324 | 392 | 412 | 804 | 8 | 640 | 648 | 16 | 2936 | 2952 | 5728 |
| 8:15 - 8:30 | 112 | 900 | 1012 | 332 | 352 | 684 | 16 | 484 | 500 | 24 | 2608 | 2632 | 4828 |
| 11:00-11:15 | 128 | 820 | 948 | 104 | 320 | 424 | 4 | 636 | 640 | 28 | 1188 | 1216 | 3228 |
| 11:15-11:30 | 116 | 716 | 832 | 92 | 452 | 544 | 12 | 912 | 924 | 28 | 1244 | 1272 | 3572 |
| 11:30-11:45 | 144 | 720 | 864 | 100 | 396 | 496 | 40 | 1064 | 1104 | 32 | 1228 | 1260 | 3724 |
| 11:45-12:00 | 164 | 892 | 1056 | 100 | 520 | 620 | 44 | 1064 | 1108 | 48 | 1264 | 1312 | 4096 |
| 12:00-12:15 | 176 | 1000 | 1176 | 124 | 532 | 656 | 36 | 1112 | 1148 | 36 | 1120 | 1156 | 4136 |
| 12:15-12:30 | 108 | 848 | 956 | 88 | 512 | 600 | 20 | 928 | 948 | 48 | 1384 | 1432 | 3936 |
| 12:30-12:45 | 120 | 796 | 916 | 108 | 356 | 464 | 32 | 1004 | 1036 | 44 | 1492 | 1536 | 3952 |
| 12:45-13:00 | 184 | 808 | 992 | 172 | 496 | 668 | 52 | 1112 | 1164 | 48 | 1476 | 1524 | 4348 |
| 16:30-16:45 | 236 | 1028 | 1264 | 140 | 688 | 828 | 48 | 1972 | 2020 | 28 | 1132 | 1160 | 5272 |
| 16:45-17:00 | 284 | 1068 | 1352 | 140 | 768 | 908 | 48 | 1972 | 2020 | 20 | 1260 | 1280 | 5560 |
| 17:00-17:15 | 248 | 1224 | 1472 | 160 | 756 | 916 | 28 | 2416 | 2444 | 16 | 1232 | 1248 | 6080 |
| 17:15-17:30 | 256 | 1332 | 1588 | 176 | 996 | 1172 | 44 | 2504 | 2548 | 24 | 1284 | 1308 | 6616 |
| 17:30-17:45 | 360 | 1236 | 1596 | 100 | 1008 | 1108 | 60 | 2276 | 2336 | 20 | 1196 | 1216 | 6256 |
| 17:45-18:00 | 324 | 1368 | 1692 | 164 | 892 | 1056 | 28 | 2568 | 2596 | 24 | 1376 | 1400 | 6744 |
| 18:00-18:15 | 308 | 1456 | 1764 | 108 | 836 | 944 | 60 | 2488 | 2548 | 36 | 1304 | 1340 | 6596 |
| 18:15:18:30 | 268 | 916 | 1184 | 96 | 952 | 1048 | 44 | 2116 | 2160 | 32 | 1392 | 1424 | 5816 |

Table B-5: 15-Minute Flow Rates Observed at Critical Intersection of Study Site 3

| TIME PERIOD (hours) | FLOW RATE (vehicles per hour) | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | 12 | 652 | 664 | 12 | 1788 | 1800 | 44 | 196 | 240 | 128 | 296 | 424 | 3128 |
| 6:45 - 7:00 | 12 | 904 | 916 | 16 | 1748 | 1764 | 48 | 132 | 180 | 116 | 272 | 388 | 3248 |
| 7:00 - 7:15 | 24 | 752 | 776 | 12 | 2928 | 2940 | 40 | 212 | 252 | 172 | 496 | 668 | 4636 |
| 7:15 - 7:30 | 48 | 888 | 936 | 28 | 3600 | 3628 | 88 | 244 | 332 | 188 | 764 | 952 | 5848 |
| 7:30 - 7:45 | 88 | 1040 | 1128 | 52 | 4048 | 4100 | 144 | 428 | 572 | 204 | 980 | 1184 | 6984 |
| 7:45 - 8:00 | 132 | 1320 | 1452 | 52 | 3024 | 3076 | 84 | 396 | 480 | 196 | 1032 | 1228 | 6236 |
| 8:00 - 8:15 | 96 | 1372 | 1468 | 88 | 2872 | 2960 | 100 | 320 | 420 | 192 | 948 | 1140 | 5988 |
| 8:15 - 8:30 | 116 | 1176 | 1292 | 80 | 3032 | 3112 | 136 | 428 | 564 | 220 | 748 | 968 | 5936 |
| 11:00-11:15 | 100 | 1208 | 1308 | 104 | 1524 | 1628 | 216 | 512 | 728 | 184 | 404 | 588 | 4252 |
| 11:15-11:30 | 148 | 1180 | 1328 | 108 | 1884 | 1992 | 168 | 564 | 732 | 252 | 552 | 804 | 4856 |
| 11:30-11:45 | 60 | 1176 | 1236 | 160 | 2084 | 2244 | 300 | 736 | 1036 | 284 | 596 | 880 | 5396 |
| 11:45-12:00 | 120 | 1412 | 1532 | 108 | 1940 | 2048 | 276 | 868 | 1144 | 300 | 684 | 984 | 5708 |
| 12:00-12:15 | 192 | 1572 | 1764 | 148 | 1840 | 1988 | 176 | 644 | 820 | 336 | 900 | 1236 | 5808 |
| 12:15-12:30 | 148 | 1412 | 1560 | 160 | 1668 | 1828 | 224 | 660 | 884 | 324 | 648 | 972 | 5244 |
| 12:30-12:45 | 176 | 1380 | 1556 | 108 | 1680 | 1788 | 268 | 776 | 1044 | 336 | 780 | 1116 | 5504 |
| 12:45-13:00 | 188 | 1620 | 1808 | 120 | 1724 | 1844 | 248 | 776 | 1024 | 348 | 592 | 940 | 5616 |
| 16:30-16:45 | 124 | 1836 | 1960 | 148 | 1564 | 1712 | 564 | 972 | 1536 | 188 | 860 | 1048 | 6256 |
| 16:45-17:00 | 144 | 2564 | 2708 | 212 | 1744 | 1956 | 552 | 944 | 1496 | 256 | 708 | 964 | 7124 |
| 17:00-17:15 | 140 | 1944 | 2084 | 172 | 1472 | 1644 | 740 | 1636 | 2376 | 204 | 888 | 1092 | 7196 |
| 17:15-17:30 | 164 | 2612 | 2776 | 192 | 2132 | 2324 | 496 | 1372 | 1868 | 152 | 936 | 1088 | 8056 |
| 17:30-17:45 | 104 | 2036 | 2140 | 128 | 1572 | 1700 | 764 | 1804 | 2568 | 268 | 768 | 1036 | 7444 |
| 17:45-18:00 | 148 | 2376 | 2524 | 208 | 2228 | 2436 | 644 | 1216 | 1860 | 184 | 788 | 972 | 7792 |
| 18:00-18:15 | 176 | 2036 | 2212 | 144 | 1492 | 1636 | 668 | 1560 | 2228 | 300 | 768 | 1068 | 7144 |
| 18:15:18:30 | 192 | 2692 | 2884 | 152 | 1952 | 2104 | 444 | 928 | 1372 | 204 | 648 | 852 | 7212 |

Table B-6: 15-Minute Flow Rates Observed at Downstream Intersection of Study Site 3

| TIME PERIOD (hours) | FLOW RATE (vehicles per hour) | | | | | | | | | | | | TOTAL FOR THE DS INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:45 - 7:00 | 56 | 596 | 652 | 52 | 1888 | 1940 | 464 | 260 | 724 | 28 | 188 | 216 | 3532 |
| 7:00 - 7:15 | 68 | 740 | 808 | 64 | 2488 | 2552 | 820 | 316 | 1136 | 28 | 316 | 344 | 4840 |
| 7:15 - 7:30 | 76 | 880 | 956 | 100 | 2936 | 3036 | 1084 | 424 | 1508 | 56 | 468 | 524 | 6024 |
| 7:30 - 7:45 | 68 | 1100 | 1168 | 176 | 2764 | 2940 | 1192 | 644 | 1836 | 40 | 656 | 696 | 6640 |
| 7:45 - 8:00 | 140 | 1524 | 1664 | 164 | 2596 | 2760 | 1280 | 932 | 2212 | 72 | 640 | 712 | 7348 |
| 8:00 - 8:15 | 96 | 1440 | 1536 | 188 | 2860 | 3048 | 1108 | 652 | 1760 | 32 | 524 | 556 | 6900 |
| 8:15 - 8:30 | 120 | 1396 | 1516 | 192 | 2456 | 2648 | 1048 | 736 | 1784 | 48 | 528 | 576 | 6524 |
| 11:00-11:15 | 108 | 916 | 1024 | 152 | 1348 | 1500 | 268 | 320 | 588 | 84 | 324 | 408 | 3520 |
| 11:15-11:30 | 84 | 904 | 988 | 160 | 1264 | 1424 | 300 | 312 | 612 | 108 | 356 | 464 | 3488 |
| 11:30-11:45 | 36 | 1148 | 1184 | 240 | 1456 | 1696 | 416 | 372 | 788 | 72 | 420 | 492 | 4160 |
| 11:45-12:00 | 80 | 1284 | 1364 | 256 | 1332 | 1588 | 284 | 328 | 612 | 56 | 388 | 444 | 4008 |
| 12:00-12:15 | 132 | 1436 | 1568 | 192 | 1448 | 1640 | 388 | 388 | 776 | 80 | 456 | 536 | 4520 |
| 12:15-12:30 | 116 | 1336 | 1452 | 252 | 1292 | 1544 | 356 | 340 | 696 | 92 | 340 | 432 | 4124 |
| 12:30-12:45 | 152 | 1440 | 1592 | 276 | 1260 | 1536 | 452 | 564 | 1016 | 96 | 400 | 496 | 4640 |
| 12:45-13:00 | 132 | 1452 | 1584 | 232 | 1444 | 1676 | 548 | 676 | 1224 | 64 | 400 | 464 | 4948 |
| 16:45-17:00 | 136 | 2424 | 2560 | 212 | 1148 | 1360 | 296 | 492 | 788 | 192 | 1296 | 1488 | 6196 |
| 17:00-17:15 | 140 | 2644 | 2784 | 216 | 1252 | 1468 | 408 | 576 | 984 | 196 | 1128 | 1324 | 6560 |
| 17:15-17:30 | 132 | 2996 | 3128 | 204 | 1376 | 1580 | 372 | 476 | 848 | 220 | 1408 | 1628 | 7184 |
| 17:30-17:45 | 188 | 2644 | 2832 | 224 | 1724 | 1948 | 356 | 496 | 852 | 264 | 1208 | 1472 | 7104 |
| 17:45-18:00 | 148 | 2856 | 3004 | 220 | 1388 | 1608 | 340 | 564 | 904 | 232 | 1304 | 1536 | 7052 |
| 18:00-18:15 | 140 | 2836 | 2976 | 264 | 1324 | 1588 | 328 | 444 | 772 | 236 | 960 | 1196 | 6532 |

Table B-7: 15-Minute Flow Rates Observed at Critical Intersection of Study Site 4

| TIME PERIOD | FLOW RATE (vehicles per hour) | | | | | | | | | | | | TOTAL FOR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| (hours) | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | THE INTER |
| 6:30 - 6:45 | 92 | 812 | 904 | 188 | 1700 | 1888 | 168 | 624 | 792 | 152 | 916 | 1068 | 4652 |
| 6:45 - 7:00 | 132 | 840 | 972 | 192 | 1760 | 1952 | 172 | 748 | 920 | 172 | 940 | 1112 | 4956 |
| 7:00 - 7:15 | 120 | 504 | 624 | 192 | 1844 | 2036 | 176 | 900 | 1076 | 200 | 1212 | 1412 | 5148 |
| 7:15 - 7:30 | 120 | 596 | 716 | 256 | 1984 | 2240 | 208 | 1064 | 1272 | 216 | 1292 | 1508 | 5736 |
| 7:30 - 7:45 | 148 | 736 | 884 | 228 | 1564 | 1792 | 256 | 1488 | 1744 | 180 | 1252 | 1432 | 5852 |
| 7:45 - 8:00 | 128 | 972 | 1100 | 396 | 1356 | 1752 | 240 | 1340 | 1580 | 168 | 1048 | 1216 | 5648 |
| 8:00 - 8:15 | 124 | 696 | 820 | 248 | 1084 | 1332 | 232 | 1132 | 1364 | 148 | 1028 | 1176 | 4692 |
| 8:15 - 8:30 | 100 | 580 | 680 | 220 | 1004 | 1224 | 172 | 1104 | 1276 | 96 | 868 | 964 | 4144 |
| 11:00-11:15 | 164 | 476 | 640 | 508 | 788 | 1296 | 156 | 992 | 1148 | 96 | 940 | 1036 | 4120 |
| 11:15-11:30 | 148 | 548 | 696 | 432 | 728 | 1160 | 136 | 1120 | 1256 | 104 | 1036 | 1140 | 4252 |
| 11:30-11:45 | 192 | 548 | 740 | 500 | 748 | 1248 | 108 | 1104 | 1212 | 80 | 1132 | 1212 | 4412 |
| 11:45-12:00 | 232 | 612 | 844 | 652 | 1032 | 1684 | 188 | 1280 | 1468 | 88 | 1000 | 1088 | 5084 |
| 12:00-12:15 | 188 | 692 | 880 | 488 | 872 | 1360 | 176 | 1220 | 1396 | 112 | 1188 | 1300 | 4936 |
| 12:15-12:30 | 204 | 692 | 896 | 500 | 800 | 1300 | 184 | 1172 | 1356 | 112 | 1168 | 1280 | 4832 |
| 12:30-12:45 | 276 | 816 | 1092 | 396 | 648 | 1044 | 140 | 1156 | 1296 | 104 | 1256 | 1360 | 4792 |
| 12:45-13:00 | 272 | 824 | 1096 | 440 | 792 | 1232 | 248 | 1332 | 1580 | 140 | 1136 | 1276 | 5184 |
| 16:30-16:45 | 216 | 1208 | 1424 | 432 | 772 | 1204 | 360 | 1552 | 1912 | 80 | 1648 | 1728 | 6268 |
| 16:45-17:00 | 224 | 1252 | 1476 | 392 | 760 | 1152 | 324 | 1420 | 1744 | 100 | 1412 | 1512 | 5884 |
| 17:00-17:15 | 348 | 1324 | 1672 | 552 | 1128 | 1680 | 328 | 1376 | 1704 | 104 | 1588 | 1692 | 6748 |
| 17:15-17:30 | 376 | 1228 | 1604 | 444 | 1192 | 1636 | 468 | 1508 | 1976 | 128 | 1712 | 1840 | 7056 |
| 17:30-17:45 | 264 | 1536 | 1800 | 480 | 1176 | 1656 | 432 | 1668 | 2100 | 100 | 1620 | 1720 | 7276 |
| 17:45-18:00 | 292 | 1464 | 1756 | 348 | 972 | 1320 | 372 | 1452 | 1824 | 116 | 1532 | 1648 | 6548 |
| 18:00-18:15 | 272 | 1156 | 1428 | 364 | 1168 | 1532 | 332 | 1576 | 1908 | 124 | 1472 | 1596 | 6464 |
| 18:15:18:30 | 276 | 1172 | 1448 | 408 | 844 | 1252 | 276 | 1444 | 1720 | 116 | 1444 | 1560 | 5980 |

Table B-8: 15-Minute Flow Rates Observed at Downstream Intersection of Study Site 4

| TIME PERIOD (hours) | FLOW RATE (vehicles per hour) | | | | | | | | | | | | TOTAL FOR THE DS INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:45 - 7:00 | 0 | 1144 | 1144 | 4 | 1612 | 1616 | 16 | 1200 | 1216 | 8 | 836 | 844 | 4820 |
| 7:00 - 7:15 | 0 | 924 | 924 | 4 | 1720 | 1724 | 4 | 1416 | 1420 | 4 | 940 | 944 | 5012 |
| 7:15 - 7:30 | 0 | 1184 | 1184 | 8 | 1728 | 1736 | 20 | 1536 | 1556 | 4 | 1148 | 1152 | 5628 |
| 7:30 - 7:45 | 0 | 1272 | 1272 | 8 | 1856 | 1864 | 24 | 1540 | 1564 | 12 | 1560 | 1572 | 6272 |
| 7:45 - 8:00 | 0 | 1592 | 1592 | 8 | 1292 | 1300 | 16 | 1656 | 1672 | 12 | 1568 | 1580 | 6144 |
| 8:00 - 8:15 | 0 | 1140 | 1140 | 40 | 988 | 1028 | 24 | 932 | 956 | 8 | 1300 | 1308 | 4432 |
| 8:15 - 8:30 | 0 | 976 | 976 | 40 | 876 | 916 | 12 | 1084 | 1096 | 4 | 1112 | 1116 | 4104 |
| 11:00-11:15 | 0 | 928 | 928 | 84 | 624 | 708 | 24 | 1068 | 1092 | 4 | 1320 | 1324 | 4052 |
| 11:15-11:30 | 0 | 928 | 928 | 104 | 588 | 692 | 12 | 1012 | 1024 | 20 | 1468 | 1488 | 4132 |
| 11:30-11:45 | 0 | 972 | 972 | 84 | 552 | 636 | 12 | 1168 | 1180 | 8 | 1548 | 1556 | 4344 |
| 11:45-12:00 | 0 | 1032 | 1032 | 136 | 688 | 824 | 0 | 1140 | 1140 | 8 | 1484 | 1492 | 4488 |
| 12:00-12:15 | 0 | 1088 | 1088 | 120 | 628 | 748 | 28 | 1164 | 1192 | 44 | 1732 | 1776 | 4804 |
| 12:15-12:30 | 0 | 1328 | 1328 | 108 | 584 | 692 | 24 | 984 | 1008 | 16 | 1604 | 1620 | 4648 |
| 12:30-12:45 | 0 | 1416 | 1416 | 92 | 528 | 620 | 44 | 1168 | 1212 | 32 | 1616 | 1648 | 4896 |
| 12:45-13:00 | 0 | 1648 | 1648 | 100 | 576 | 676 | 16 | 1096 | 1112 | 20 | 1644 | 1664 | 5100 |
| 16:30-16:45 | 0 | 1880 | 1880 | 132 | 672 | 804 | 24 | 1920 | 1944 | 28 | 1628 | 1656 | 6284 |
| 16:45-17:00 | 0 | 1936 | 1936 | 140 | 688 | 828 | 8 | 1968 | 1976 | 32 | 1756 | 1788 | 6528 |
| 17:00-17:15 | 0 | 2228 | 2228 | 112 | 940 | 1052 | 20 | 1792 | 1812 | 36 | 1796 | 1832 | 6924 |
| 17:15-17:30 | 0 | 2264 | 2264 | 108 | 968 | 1076 | 28 | 1536 | 1564 | 56 | 1828 | 1884 | 6788 |
| 17:30-17:45 | 0 | 2268 | 2268 | 116 | 1052 | 1168 | 40 | 1616 | 1656 | 40 | 2080 | 2120 | 7212 |
| 17:45-18:00 | 0 | 2452 | 2452 | 104 | 760 | 864 | 16 | 1752 | 1768 | 36 | 1888 | 1924 | 7008 |
| 18:00-18:15 | 0 | 2280 | 2280 | 92 | 776 | 868 | 12 | 1612 | 1624 | 56 | 1796 | 1852 | 6624 |
| 18:15:18:30 | 0 | 2184 | 2184 | 128 | 700 | 828 | 12 | 1468 | 1480 | 68 | 1796 | 1864 | 6356 |

Table B-9: 15-Minute Flow Rates Observed at Critical Intersection of Study Site 5

| TIME PERIOD (hours) | FLOW RATE (vehicles per hour) | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | 104 | 472 | 576 | 48 | 1212 | 1260 | 60 | 196 | 256 | 20 | 340 | 360 | 2452 |
| 6:45 - 7:00 | 56 | 612 | 668 | 52 | 1888 | 1940 | 88 | 188 | 276 | 60 | 548 | 608 | 3492 |
| 7:00 - 7:15 | 96 | 632 | 728 | 64 | 2488 | 2552 | 84 | 236 | 320 | 76 | 768 | 844 | 4444 |
| 7:15 - 7:30 | 140 | 688 | 828 | 100 | 2936 | 3036 | 92 | 448 | 540 | 64 | 1072 | 1136 | 5540 |
| 7:30 - 7:45 | 168 | 956 | 1124 | 176 | 2764 | 2940 | 136 | 648 | 784 | 44 | 1324 | 1368 | 6216 |
| 7:45 - 8:00 | 148 | 1144 | 1292 | 164 | 2596 | 2760 | 172 | 644 | 816 | 68 | 1560 | 1628 | 6496 |
| 8:00 - 8:15 | 140 | 1136 | 1276 | 188 | 2860 | 3048 | 204 | 688 | 892 | 64 | 1280 | 1344 | 6560 |
| 8:15 - 8:30 | 180 | 1152 | 1332 | 192 | 2456 | 2648 | 188 | 704 | 892 | 80 | 1296 | 1376 | 6248 |
| 11:00-11:15 | 260 | 864 | 1124 | 152 | 1348 | 1500 | 280 | 680 | 960 | 84 | 648 | 732 | 4316 |
| 11:15-11:30 | 348 | 984 | 1332 | 160 | 1264 | 1424 | 204 | 700 | 904 | 68 | 696 | 764 | 4424 |
| 11:30-11:45 | 320 | 1124 | 1444 | 240 | 1456 | 1696 | 336 | 808 | 1144 | 152 | 844 | 996 | 5280 |
| 11:45-12:00 | 360 | 1128 | 1488 | 256 | 1332 | 1588 | 376 | 888 | 1264 | 104 | 744 | 848 | 5188 |
| 12:00-12:15 | 368 | 1300 | 1668 | 192 | 1448 | 1640 | 340 | 896 | 1236 | 160 | 732 | 892 | 5436 |
| 12:15-12:30 | 348 | 1228 | 1576 | 252 | 1292 | 1544 | 384 | 948 | 1332 | 116 | 784 | 900 | 5352 |
| 12:30-12:45 | 364 | 1196 | 1560 | 276 | 1260 | 1536 | 456 | 1216 | 1672 | 124 | 872 | 996 | 5764 |
| 12:45-13:00 | 340 | 1152 | 1492 | 232 | 1444 | 1676 | 440 | 1232 | 1672 | 140 | 880 | 1020 | 5860 |
| 16:30-16:45 | 208 | 1552 | 1760 | 228 | 1644 | 1872 | 576 | 1328 | 1904 | 80 | 644 | 724 | 6260 |
| 16:45-17:00 | 300 | 1620 | 1920 | 212 | 1148 | 1360 | 704 | 1412 | 2116 | 76 | 884 | 960 | 6356 |
| 17:00-17:15 | 388 | 2148 | 2536 | 216 | 1252 | 1468 | 756 | 1552 | 2308 | 52 | 820 | 872 | 7184 |
| 17:15-17:30 | 328 | 1572 | 1900 | 204 | 1376 | 1580 | 628 | 1524 | 2152 | 64 | 856 | 920 | 6552 |
| 17:30-17:45 | 388 | 2012 | 2400 | 224 | 1724 | 1948 | 628 | 1400 | 2028 | 56 | 848 | 904 | 7280 |
| 17:45-18:00 | 364 | 1940 | 2304 | 220 | 1388 | 1608 | 652 | 1460 | 2112 | 108 | 872 | 980 | 7004 |
| 18:00-18:15 | 412 | 2044 | 2456 | 264 | 1324 | 1588 | 512 | 1520 | 2032 | 60 | 796 | 856 | 6932 |
| 18:15:18:30 | 344 | 1800 | 2144 | 156 | 1252 | 1408 | 612 | 1356 | 1968 | 112 | 636 | 748 | 6268 |

Table B-10: 15-Minute Flow Rates Observed at Downstream Intersections of Study Site 5

| TIME PERIOD (hours) | FLOW RATE (vehicles per hour) | | | | | | | | | | | | TOTAL FOR THE DS INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | 12 | 652 | 664 | 8 | 2172 | 2180 | 12 | 376 | 388 | 4 | 160 | 164 | 3396 |
| 6:45 - 7:00 | 12 | 904 | 916 | 4 | 1612 | 1616 | 28 | 568 | 596 | 8 | 240 | 248 | 3376 |
| 7:00 - 7:15 | 24 | 752 | 776 | 4 | 1720 | 1724 | 92 | 1040 | 1132 | 20 | 260 | 280 | 3912 |
| 7:15 - 7:30 | 48 | 888 | 936 | 8 | 1728 | 1736 | 112 | 1420 | 1532 | 16 | 448 | 464 | 4668 |
| 7:30 - 7:45 | 88 | 1040 | 1128 | 8 | 1856 | 1864 | 220 | 2096 | 2316 | 32 | 480 | 512 | 5820 |
| 7:45 - 8:00 | 132 | 1320 | 1452 | 8 | 1292 | 1300 | 116 | 2212 | 2328 | 24 | 536 | 560 | 5640 |
| 8:00 - 8:15 | 96 | 1372 | 1468 | 40 | 988 | 1028 | 140 | 1720 | 1860 | 20 | 536 | 556 | 4912 |
| 8:15 - 8:30 | 116 | 1176 | 1292 | 40 | 876 | 916 | 120 | 1756 | 1876 | 16 | 552 | 568 | 4652 |
| 11:15-11:30 | 148 | 1180 | 1328 | 104 | 588 | 692 | 176 | 916 | 1092 | 40 | 664 | 704 | 3816 |
| 11:30-11:45 | 60 | 1176 | 1236 | 84 | 552 | 636 | 128 | 948 | 1076 | 68 | 744 | 812 | 3760 |
| 11:45-12:00 | 120 | 1412 | 1532 | 136 | 688 | 824 | 240 | 1004 | 1244 | 60 | 848 | 908 | 4508 |
| 12:00-12:15 | 192 | 1572 | 1764 | 120 | 628 | 748 | 228 | 904 | 1132 | 52 | 704 | 756 | 4400 |
| 12:15-12:30 | 148 | 1412 | 1560 | 108 | 584 | 692 | 284 | 1044 | 1328 | 40 | 904 | 944 | 4524 |
| 12:30-12:45 | 176 | 1380 | 1556 | 92 | 528 | 620 | 320 | 1276 | 1596 | 76 | 920 | 996 | 4768 |
| 12:45-13:00 | 188 | 1620 | 1808 | 100 | 576 | 676 | 300 | 1192 | 1492 | 84 | 1028 | 1112 | 5088 |
| 16:30-16:45 | 124 | 1836 | 1960 | 132 | 672 | 804 | 144 | 872 | 1016 | 76 | 1224 | 1300 | 5080 |
| 16:45-17:00 | 144 | 2564 | 2708 | 140 | 688 | 828 | 268 | 1524 | 1792 | 68 | 1152 | 1220 | 6548 |
| 17:00-17:15 | 140 | 1944 | 2084 | 112 | 940 | 1052 | 228 | 1240 | 1468 | 104 | 1216 | 1320 | 5924 |
| 17:15-17:30 | 164 | 2612 | 2776 | 108 | 968 | 1076 | 180 | 1420 | 1600 | 152 | 1304 | 1456 | 6908 |
| 17:30-17:45 | 104 | 2036 | 2140 | 116 | 1052 | 1168 | 292 | 1172 | 1464 | 132 | 1472 | 1604 | 6376 |
| 17:45-18:00 | 148 | 2376 | 2524 | 104 | 760 | 864 | 264 | 1252 | 1516 | 152 | 1472 | 1624 | 6528 |
| 18:00-18:15 | 176 | 2036 | 2212 | 92 | 776 | 868 | 312 | 1224 | 1536 | 152 | 1704 | 1856 | 6472 |
| 18:15:18:30 | 192 | 2692 | 2884 | 128 | 700 | 828 | 280 | 920 | 1200 | 144 | 1292 | 1436 | 6348 |

Table B-11: 15-Minute Flow Rates Observed at Critical Intersection of Study Site 6

| TIME PERIOD (hours) | FLOW RATE (vehicles per hour) | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | 144 | 636 | 780 | 64 | 132 | 196 | 116 | 540 | 656 | 24 | 220 | 244 | 1876 |
| 6:45 - 7:00 | 180 | 700 | 880 | 60 | 208 | 268 | 92 | 560 | 652 | 44 | 304 | 348 | 2148 |
| 7:00 - 7:15 | 172 | 968 | 1140 | 60 | 196 | 256 | 120 | 564 | 684 | 36 | 304 | 340 | 2420 |
| 7:15 - 7:30 | 188 | 1184 | 1372 | 96 | 316 | 412 | 220 | 824 | 1044 | 40 | 468 | 508 | 3336 |
| 7:30 - 7:45 | 160 | 1132 | 1292 | 88 | 280 | 368 | 188 | 864 | 1052 | 24 | 524 | 548 | 3260 |
| 7:45 - 8:00 | 264 | 992 | 1256 | 80 | 368 | 448 | 100 | 748 | 848 | 72 | 508 | 580 | 3132 |
| 8:00 - 8:15 | 164 | 624 | 788 | 80 | 260 | 340 | 148 | 620 | 768 | 48 | 416 | 464 | 2360 |
| 8:15 - 8:30 | 168 | 476 | 644 | 64 | 228 | 292 | 96 | 592 | 688 | 44 | 352 | 396 | 2020 |
| 11:00-11:15 | 132 | 228 | 360 | 64 | 264 | 328 | 132 | 432 | 564 | 32 | 388 | 420 | 1672 |
| 11:15-11:30 | 164 | 280 | 444 | 60 | 332 | 392 | 104 | 456 | 560 | 36 | 428 | 464 | 1860 |
| 11:30-11:45 | 176 | 260 | 436 | 60 | 424 | 484 | 124 | 600 | 724 | 44 | 480 | 524 | 2168 |
| 11:45-12:00 | 200 | 252 | 452 | 68 | 384 | 452 | 124 | 540 | 664 | 56 | 640 | 696 | 2264 |
| 12:00-12:15 | 184 | 248 | 432 | 72 | 432 | 504 | 160 | 576 | 736 | 44 | 644 | 688 | 2360 |
| 12:15-12:30 | 236 | 252 | 488 | 48 | 380 | 428 | 152 | 732 | 884 | 48 | 548 | 596 | 2396 |
| 12:30-12:45 | 120 | 276 | 396 | 52 | 388 | 440 | 136 | 640 | 776 | 52 | 484 | 536 | 2148 |
| 12:45-13:00 | 256 | 328 | 584 | 108 | 420 | 528 | 160 | 688 | 848 | 52 | 444 | 496 | 2456 |
| 16:30-16:45 | 164 | 288 | 452 | 108 | 804 | 912 | 164 | 708 | 872 | 96 | 828 | 924 | 3160 |
| 16:45-17:00 | 216 | 304 | 520 | 52 | 808 | 860 | 92 | 612 | 704 | 164 | 848 | 1012 | 3096 |
| 17:00-17:15 | 260 | 484 | 744 | 96 | 996 | 1092 | 212 | 776 | 988 | 172 | 1180 | 1352 | 4176 |
| 17:15-17:30 | 212 | 364 | 576 | 68 | 996 | 1064 | 156 | 776 | 932 | 128 | 968 | 1096 | 3668 |
| 17:30-17:45 | 256 | 356 | 612 | 88 | 1008 | 1096 | 244 | 612 | 856 | 200 | 1012 | 1212 | 3776 |
| 17:45-18:00 | 224 | 360 | 584 | 112 | 888 | 1000 | 140 | 668 | 808 | 160 | 948 | 1108 | 3500 |
| 18:00-18:15 | 244 | 360 | 604 | 76 | 704 | 780 | 116 | 572 | 688 | 148 | 868 | 1016 | 3088 |
| 18:15:18:30 | 236 | 312 | 548 | 68 | 684 | 752 | 108 | 520 | 628 | 124 | 852 | 976 | 2904 |

Table B-12: 15-Minute Flow Rates Observed at Downstream Intersections of Study Site 6

| TIME PERIOD (hours) | FLOW RATE (vehicles per hour) | | | | | | | | | | | | TOTAL FOR THE DS INTERS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | TH | RT | TOTAL | |
| 6:30 - 6:45 | 40 | 672 | 712 | 48 | 212 | 260 | 8 | 384 | 392 | 840 | 148 | 988 | 2352 |
| 6:45 - 7:00 | 68 | 860 | 928 | 20 | 140 | 160 | 8 | 412 | 420 | 700 | 176 | 876 | 2384 |
| 7:00 - 7:15 | 160 | 960 | 1120 | 40 | 216 | 256 | 40 | 540 | 580 | 900 | 184 | 1084 | 3040 |
| 7:15 - 7:30 | 124 | 1204 | 1328 | 40 | 208 | 248 | 8 | 320 | 328 | 1016 | 264 | 1280 | 3184 |
| 7:30 - 7:45 | 112 | 1516 | 1628 | 40 | 184 | 224 | 32 | 800 | 832 | 1140 | 276 | 1416 | 4100 |
| 7:45 - 8:00 | 128 | 1192 | 1320 | 56 | 340 | 396 | 40 | 756 | 796 | 1104 | 392 | 1496 | 4008 |
| 8:00 - 8:15 | 60 | 784 | 844 | 40 | 244 | 284 | 36 | 576 | 612 | 900 | 284 | 1184 | 2924 |
| 8:15 - 8:30 | 72 | 712 | 784 | 40 | 156 | 196 | 24 | 592 | 616 | 688 | 136 | 824 | 2420 |
| 11:00-11:15 | 32 | 276 | 308 | 68 | 220 | 288 | 24 | 636 | 660 | 588 | 224 | 812 | 2068 |
| 11:15-11:30 | 48 | 264 | 312 | 72 | 220 | 292 | 44 | 712 | 756 | 528 | 176 | 704 | 2064 |
| 11:30-11:45 | 44 | 336 | 380 | 28 | 284 | 312 | 56 | 864 | 920 | 316 | 156 | 472 | 2084 |
| 11:45-12:00 | 20 | 360 | 380 | 56 | 236 | 292 | 60 | 928 | 988 | 320 | 156 | 476 | 2136 |
| 12:00-12:15 | 28 | 364 | 392 | 92 | 300 | 392 | 56 | 744 | 800 | 468 | 200 | 668 | 2252 |
| 12:15-12:30 | 40 | 336 | 376 | 84 | 256 | 340 | 80 | 836 | 916 | 384 | 216 | 600 | 2232 |
| 12:30-12:45 | 40 | 416 | 456 | 84 | 296 | 380 | 56 | 784 | 840 | 476 | 252 | 728 | 2404 |
| 12:45-13:00 | 36 | 372 | 408 | 88 | 268 | 356 | 56 | 868 | 924 | 468 | 300 | 768 | 2456 |
| 16:30-16:45 | 28 | 368 | 396 | 104 | 500 | 604 | 124 | 1100 | 1224 | 460 | 188 | 648 | 2872 |
| 16:45-17:00 | 28 | 376 | 404 | 104 | 620 | 724 | 120 | 984 | 1104 | 432 | 196 | 628 | 2860 |
| 17:00-17:15 | 88 | 440 | 528 | 168 | 792 | 960 | 172 | 1204 | 1376 | 452 | 300 | 752 | 3616 |
| 17:15-17:30 | 96 | 448 | 544 | 128 | 608 | 736 | 256 | 1352 | 1608 | 388 | 284 | 672 | 3560 |
| 17:30-17:45 | 80 | 428 | 508 | 176 | 808 | 984 | 236 | 1304 | 1540 | 600 | 280 | 880 | 3912 |
| 17:45-18:00 | 56 | 416 | 472 | 148 | 700 | 848 | 212 | 1260 | 1472 | 568 | 412 | 980 | 3772 |
| 18:00-18:15 | 44 | 324 | 368 | 204 | 624 | 828 | 148 | 1192 | 1340 | 460 | 308 | 768 | 3304 |
| 18:15:18:30 | 36 | 380 | 416 | 148 | 612 | 760 | 124 | 972 | 1096 | 508 | 264 | 772 | 3044 |

# APPENDIX C

## OBSERVED DELAY AT THE STUDY SITES

Table C-1: Observed Average Total Stopped Delay (veh-hr/hr) at the Critical Intersection of Study Site 1

| TIME PERIOD (hours) | Measured Average Total Delay (veh-hr/hr) | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & R | TOTAL | LT | TH & R | TOTAL | LT | TH & R | TOTAL | LT | TH & R | TOTAL | |
| 6:30 - 6:45 | 1.89 | 1.29 | 3.18 | 2.18 | 5.69 | 7.87 | 1.49 | 7.93 | 9.42 | 1.38 | 5.11 | 6.49 | 26.96 |
| 6.45 - 7:00 | 1.47 | 1.56 | 3.02 | 2.84 | 11.78 | 14.62 | 1.84 | 10.00 | 11.84 | 1.40 | 5.80 | 7.20 | 36.69 |
| 7:00 - 7:15 | 1.78 | 1.89 | 3.67 | 2.16 | 14.36 | 16.51 | 0.78 | 9.98 | 10.76 | 1.69 | 7.80 | 9.49 | 40.42 |
| 7:15 - 7:30 | 3.27 | 1.87 | 5.13 | 2.40 | 12.60 | 15.00 | 2.16 | 14.76 | 16.91 | 1.22 | 7.96 | 9.18 | 46.22 |
| 7:30 - 7:45 | 5.02 | 3.87 | 8.89 | 2.93 | 18.49 | 21.42 | 3.91 | 13.24 | 17.16 | 1.27 | 15.53 | 16.80 | 64.27 |
| 7:45 - 8:00 | 7.24 | 3.60 | 10.84 | 3.78 | 19.36 | 23.13 | 4.69 | 20.93 | 25.62 | 1.09 | 9.67 | 10.76 | 70.36 |
| 8:00 - 8:15 | 5.42 | 3.62 | 9.04 | 2.58 | 8.87 | 11.44 | 3.27 | 13.49 | 16.76 | 2.31 | 18.93 | 21.24 | 58.49 |
| 8:15 - 8:30 | 6.29 | 2.93 | 9.22 | 4.00 | 6.84 | 10.84 | 3.29 | 15.36 | 18.64 | 1.33 | 10.84 | 12.18 | 50.89 |
| 11:00-11:15 | 3.89 | 3.67 | 7.56 | 3.98 | 4.93 | 8.91 | 6.40 | 12.71 | 19.11 | 1.87 | 14.44 | 16.31 | 51.89 |
| 11:15-11:30 | 6.20 | 4.62 | 10.82 | 4.18 | 5.67 | 9.84 | 10.58 | 11.02 | 21.60 | 6.47 | 15.07 | 21.53 | 63.80 |
| 11:30-11:45 | 10.00 | 6.71 | 16.71 | 2.93 | 3.69 | 6.62 | 12.49 | 16.22 | 28.71 | 4.16 | 53.27 | 57.42 | 109.47 |
| 11:45-12:00 | 7.24 | 6.04 | 13.29 | 3.71 | 4.31 | 8.02 | 8.87 | 13.36 | 22.22 | 2.47 | 28.44 | 30.91 | 74.44 |
| 12:00-12:15 | 7.76 | 4.82 | 12.58 | 6.27 | 13.47 | 19.73 | 12.58 | 15.16 | 27.73 | 2.20 | 44.78 | 46.98 | 107.02 |
| 12:30-12:45 | 3.93 | 6.16 | 10.09 | 7.64 | 34.49 | 42.13 | 9.07 | 14.27 | 23.33 | 5.42 | 16.04 | 21.47 | 97.02 |
| 12:45-13:00 | 3.11 | 4.49 | 7.60 | 9.67 | 33.24 | 42.91 | 7.67 | 9.60 | 17.27 | 2.73 | 18.93 | 21.67 | 89.44 |
| 16:30-16:45 | 5.82 | 13.47 | 19.29 | 6.18 | 18.80 | 24.98 | 17.87 | 14.04 | 31.91 | 2.56 | 23.29 | 25.84 | 102.02 |
| 16:45-17:00 | 5.51 | 12.76 | 18.27 | 7.47 | 15.38 | 22.84 | 18.04 | 10.93 | 28.98 | 3.89 | 40.13 | 44.02 | 114.11 |
| 17:00-17:15 | 12.53 | 45.09 | 57.62 | 5.78 | 15.07 | 20.84 | 18.91 | 14.20 | 33.11 | 2.16 | 29.93 | 32.09 | 143.67 |
| 17:15-17:30 | 7.98 | 66.20 | 74.18 | 7.04 | 26.18 | 33.22 | 21.87 | 12.47 | 34.33 | 1.53 | 46.84 | 48.38 | 190.11 |
| 17:30-17:45 | 9.27 | 69.27 | 78.53 | 5.24 | 41.53 | 46.78 | 22.87 | 12.16 | 35.02 | 1.87 | 56.73 | 58.60 | 218.93 |
| 17:45-18:00 | 8.69 | 63.82 | 72.51 | 9.91 | 48.60 | 58.51 | 23.24 | 12.31 | 35.56 | 2.07 | 40.31 | 42.38 | 208.96 |
| 18:00-18:15 | 8.80 | 70.24 | 79.04 | 11.24 | 32.02 | 43.27 | 23.04 | 13.02 | 36.07 | 0.91 | 8.16 | 9.07 | 167.44 |
| 18:15:18:30 | 9.36 | 65.76 | 75.11 | 10.29 | 44.58 | 54.87 | 18.60 | 11.18 | 29.78 | 1.96 | 10.47 | 12.42 | 172.18 |

Table D-1: Percentage Difference Between Observed and Simulated Average Delay at the Critical Intersection of Study Site 1

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | -4.71 | 1.64 | -2.13 | 71.28 | 63.48 | 65.64 | 29.63 | 85.55 | 76.71 | 72.74 | 162.37 | 143.34 | 80.22 |
| 6:45 - 7:00 | 2.95 | 2.21 | 2.57 | 113.05 | 14.45 | 33.63 | 50.18 | 87.40 | 81.60 | 156.43 | 169.31 | 166.81 | 72.70 |
| 7:00 - 7:15 | 52.44 | 5.35 | 28.18 | 100.41 | -4.08 | 9.56 | 186.71 | 68.88 | 77.40 | 122.63 | 142.31 | 138.81 | 59.64 |
| 7:15 - 7:30 | 57.35 | 27.50 | 46.49 | 132.08 | 162.38 | 157.53 | 90.21 | 154.07 | 145.93 | 152.82 | 213.24 | 205.19 | 150.42 |
| 7:30 - 7:45 | 96.53 | 3.45 | 56.04 | 73.18 | 158.86 | 147.13 | 69.01 | 107.63 | 98.83 | 174.74 | 217.96 | 214.70 | 139.30 |
| 7:45 - 8:00 | -0.48 | 13.33 | 4.11 | 208.12 | 153.16 | 162.13 | 48.22 | 21.53 | 26.41 | 288.47 | 448.48 | 432.28 | 129.65 |
| 8:00 - 8:15 | -0.59 | 25.34 | 9.79 | 120.34 | 98.72 | 103.59 | 53.67 | 55.16 | 54.87 | 44.09 | 51.43 | 50.63 | 55.89 |
| 8:15 - 8:30 | -48.96 | 1.25 | -32.99 | 96.75 | 148.38 | 129.33 | 30.44 | 14.68 | 17.46 | 101.75 | 149.62 | 144.38 | 62.53 |
| 11:00-11:15 | -34.17 | 80.55 | 21.50 | 68.94 | 144.05 | 110.52 | -26.09 | 8.33 | -3.20 | 58.57 | 70.17 | 68.84 | 42.57 |
| 11:15-11:30 | -31.94 | 31.97 | -4.64 | 40.03 | 89.00 | 68.22 | -57.65 | -3.83 | -30.19 | -55.62 | 50.93 | 18.93 | 5.91 |
| 11:30-11:45 | -54.00 | 35.15 | -18.20 | 144.77 | 230.99 | 192.80 | -58.04 | -47.29 | -51.97 | -28.53 | -54.68 | -52.79 | -32.44 |
| 11:45-12:00 | -30.43 | 45.42 | 4.07 | 71.65 | 193.66 | 137.22 | -41.47 | 10.44 | -10.27 | 53.24 | -11.44 | -6.28 | 9.84 |
| 12:00-12:15 | 27.26 | 126.66 | 65.37 | -28.67 | 87.35 | 50.51 | -19.06 | -4.79 | -11.26 | 77.73 | 21.27 | 23.91 | 24.57 |
| 12:30-12:45 | 165.17 | 52.06 | 96.16 | -62.46 | -19.86 | -27.59 | 41.40 | 23.22 | 30.29 | 23.93 | 315.97 | 242.20 | 58.89 |
| 12:45-13:00 | 73.25 | 92.92 | 278.82 | -17.97 | -66.55 | -54.77 | -11.30 | 48.85 | 23.76 | 74.88 | 53.80 | 141.20 | -1.51 |
| 16:30-16:45 | 26.76 | 58.99 | 49.26 | 26.10 | -38.19 | -22.29 | -46.77 | -15.55 | -33.03 | -8.43 | 114.35 | 102.21 | 19.42 |
| 16:45-17:00 | 72.74 | 98.89 | 91.00 | 52.01 | -20.27 | 3.35 | -38.21 | 17.26 | -17.28 | -48.57 | 75.69 | 64.71 | 35.81 |
| 17:00-17:15 | -47.82 | -36.99 | -39.35 | 55.25 | -24.80 | -2.61 | -41.89 | 8.38 | -20.33 | 35.00 | 66.94 | 64.79 | -6.37 |
| 17:15-17:30 | -23.16 | -65.45 | -60.90 | 1.36 | -65.54 | -51.36 | -58.98 | 18.07 | -31.00 | 60.43 | 2.47 | 4.30 | -37.24 |
| 17:30-17:45 | -2.66 | -48.30 | -42.92 | 116.42 | -51.34 | -32.53 | -45.99 | 3.24 | -28.90 | -1.43 | 47.39 | 45.84 | -14.70 |
| 17:45-18:00 | -24.85 | -70.53 | -65.05 | -49.35 | -74.28 | -70.06 | -66.92 | 20.54 | -36.63 | 95.00 | 13.69 | 17.66 | -44.84 |
| 18:00-18:15 | 2.27 | -47.58 | -42.03 | 1.38 | -49.82 | -36.51 | -33.69 | -20.14 | -28.80 | 149.15 | 908.51 | 832.21 | 9.58 |
| 18:15:18:30 | -3.80 | -71.56 | -63.12 | -65.30 | -67.79 | -67.32 | -62.20 | 42.87 | -22.76 | 58.01 | 253.60 | 222.81 | -36.85 |

Table C-2: Observed Average Total Stopped Delay (veh-hr/hr) at Downstream Intersections of Study Site 1

| TIME PERIOD (hours) | Measured Average Total Stopped Delay (veh-hr/hr) | | | | | | | | | | | | TOTAL FOR DS INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | 0.00 | 0.04 | 0.04 | 1.02 | 2.18 | 3.20 | 0.02 | 0.00 | 0.02 | 0.00 | 0.18 | 0.18 | 3.44 |
| 7:00 - 7:15 | 0.02 | 0.09 | 0.11 | 1.47 | 4.87 | 6.33 | 0.00 | 0.09 | 0.09 | 0.00 | 0.24 | 0.24 | 6.77 |
| 7:15 - 7:30 | 0.02 | 0.09 | 0.11 | 2.22 | 15.02 | 17.24 | 0.00 | 0.07 | 0.07 | 0.09 | 1.78 | 1.87 | 19.29 |
| 7:30 - 7:45 | 0.00 | 0.02 | 0.02 | 2.07 | 6.36 | 8.42 | 0.02 | 0.22 | 0.24 | 0.22 | 0.67 | 0.89 | 9.57 |
| 7:45 - 8:00 | 0.00 | 0.13 | 0.13 | 2.76 | 7.27 | 10.02 | 0.02 | 0.82 | 0.84 | 0.20 | 1.13 | 1.33 | 12.32 |
| 8:00 - 8:15 | 0.00 | 0.13 | 0.13 | 1.96 | 4.38 | 6.33 | 0.00 | 0.38 | 0.38 | 0.13 | 1.09 | 1.22 | 8.06 |
| 8:15 - 8:30 | 0.07 | 0.13 | 0.20 | 3.24 | 2.67 | 5.91 | 0.02 | 0.31 | 0.33 | 0.22 | 0.60 | 0.82 | 7.26 |
| 11:00-11:15 | 0.00 | 0.20 | 0.20 | 0.53 | 1.20 | 1.73 | 0.00 | 0.33 | 0.36 | 0.13 | 0.40 | 0.53 | 2.82 |
| 11:15-11:30 | 0.02 | 0.22 | 0.24 | 0.58 | 1.60 | 2.18 | 0.02 | 0.07 | 0.09 | 0.56 | 0.64 | 1.20 | 3.71 |
| 11:30-11:45 | 0.07 | 0.11 | 0.18 | 0.44 | 1.56 | 2.00 | 0.02 | 0.36 | 0.38 | 0.29 | 0.67 | 0.96 | 3.52 |
| 11:45-12:00 | 0.00 | 0.18 | 0.18 | 1.27 | 1.62 | 2.89 | 0.04 | 0.51 | 0.56 | 0.56 | 1.22 | 1.78 | 5.41 |
| 12:00-12:15 | 0.00 | 0.27 | 0.27 | 0.76 | 1.82 | 2.58 | 0.00 | 0.36 | 0.36 | 0.82 | 0.56 | 1.38 | 4.59 |
| 12:15-12:30 | 0.02 | 0.18 | 0.20 | 0.62 | 1.53 | 2.16 | 0.04 | 0.31 | 0.36 | 0.49 | 0.62 | 1.11 | 3.83 |
| 12:30-12:45 | 0.00 | 0.31 | 0.31 | 0.51 | 1.07 | 1.58 | 0.04 | 0.58 | 0.62 | 0.56 | 0.82 | 1.38 | 3.89 |
| 12:45-13:00 | 0.04 | 0.02 | 0.07 | 0.64 | 1.56 | 2.20 | 0.22 | 0.58 | 0.80 | 0.96 | 0.76 | 1.71 | 4.78 |
| 16:30-16:45 | 0.02 | 0.60 | 0.62 | 1.60 | 3.44 | 5.04 | 0.16 | 0.38 | 0.53 | 1.38 | 1.20 | 2.58 | 8.77 |
| 16:45-17:00 | 0.04 | 0.33 | 0.38 | 1.87 | 4.20 | 6.07 | 0.02 | 0.33 | 0.36 | 0.91 | 1.09 | 2.00 | 8.81 |
| 17:00-17:15 | 0.04 | 1.02 | 1.07 | 2.16 | 3.20 | 5.36 | 0.00 | 0.38 | 0.38 | 1.13 | 1.09 | 2.22 | 9.03 |
| 17:15-17:30 | 0.00 | 4.49 | 4.56 | 1.62 | 2.51 | 4.13 | 0.02 | 0.11 | 0.13 | 1.96 | 1.16 | 3.11 | 11.93 |
| 17:30-17:45 | 0.09 | 3.18 | 3.27 | 0.96 | 3.44 | 4.40 | 0.00 | 0.31 | 0.31 | 1.16 | 1.18 | 2.33 | 10.31 |
| 17:45-18:00 | 0.11 | 1.49 | 1.60 | 1.51 | 3.24 | 4.76 | 0.07 | 0.36 | 0.42 | 1.22 | 0.76 | 1.98 | 8.76 |
| 18:00-18:15 | 0.00 | 1.11 | 1.11 | 1.78 | 3.11 | 4.89 | 0.02 | 0.49 | 0.51 | 0.91 | 0.87 | 1.78 | 8.29 |
| 18:15:18:30 | 0.04 | 1.18 | 1.22 | 1.40 | 2.84 | 4.24 | 0.00 | 0.73 | 0.73 | 1.38 | 1.07 | 2.44 | 8.63 |

Table C-3: Observed Average Total Stopped Delay (veh-hr/hr) at Critical Intersection of Study Site 2

| TIME PERIOD (hours) | Measured Average Total Stopped Delay (veh-hr/hr) | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | 0.96 | 4.20 | 5.16 | 1.87 | 1.27 | 3.13 | 1.47 | 2.31 | 3.78 | 0.36 | 0.98 | 1.33 | 13.40 |
| 6:45 - 7:00 | 2.42 | 6.04 | 8.47 | 3.49 | 3.04 | 6.53 | 2.56 | 11.04 | 13.60 | 1.13 | 1.44 | 2.58 | 31.18 |
| 7:00 - 7:15 | 0.89 | 7.02 | 7.91 | 3.76 | 3.20 | 6.96 | 2.82 | 11.22 | 14.04 | 1.98 | 1.84 | 3.82 | 32.73 |
| 7:15 - 7:30 | 1.29 | 5.73 | 7.02 | 6.02 | 3.02 | 9.04 | 2.98 | 19.53 | 22.51 | 1.40 | 2.91 | 4.31 | 42.89 |
| 7:30 - 7:45 | 1.91 | 10.18 | 12.09 | 6.22 | 6.11 | 12.33 | 4.42 | 27.38 | 31.80 | 1.49 | 3.89 | 5.38 | 61.60 |
| 7:45 - 8:00 | 1.47 | 12.44 | 13.91 | 3.87 | 3.89 | 7.76 | 3.64 | 21.49 | 25.13 | 1.42 | 5.27 | 6.69 | 53.49 |
| 8:00 - 8:15 | 1.80 | 14.60 | 16.40 | 5.98 | 3.93 | 9.91 | 4.07 | 15.64 | 19.71 | 1.40 | 3.60 | 5.00 | 51.02 |
| 8:15 - 8:30 | 1.04 | 8.36 | 9.40 | 4.62 | 2.58 | 7.20 | 3.04 | 10.73 | 13.78 | 0.53 | 2.56 | 3.09 | 33.47 |
| 11:00-11:15 | 1.11 | 3.27 | 4.38 | 3.51 | 3.13 | 6.64 | 2.51 | 3.27 | 5.78 | 1.44 | 3.80 | 5.24 | 22.04 |
| 11:15-11:30 | 1.64 | 4.51 | 6.16 | 3.60 | 3.07 | 6.67 | 2.82 | 4.00 | 6.82 | 1.62 | 5.58 | 7.20 | 26.84 |
| 11:30-11:45 | 2.58 | 5.42 | 8.00 | 7.73 | 4.07 | 11.80 | 2.80 | 5.33 | 8.13 | 1.49 | 8.62 | 10.11 | 38.04 |
| 11:45-12:00 | 1.96 | 4.89 | 6.84 | 4.96 | 4.91 | 9.87 | 2.53 | 4.53 | 7.07 | 1.49 | 8.49 | 9.98 | 33.76 |
| 12:00-12:15 | 2.73 | 5.07 | 7.80 | 6.00 | 4.89 | 10.89 | 5.27 | 6.51 | 11.78 | 2.64 | 9.20 | 11.84 | 42.31 |
| 12:15-12:30 | 1.62 | 5.78 | 7.40 | 7.04 | 4.51 | 11.56 | 4.13 | 4.93 | 9.07 | 1.76 | 10.27 | 12.02 | 40.04 |
| 12:30-12:45 | 2.80 | 6.87 | 9.67 | 6.60 | 4.49 | 11.09 | 3.20 | 5.71 | 8.91 | 1.87 | 8.04 | 9.91 | 39.58 |
| 12:45-13:00 | 2.07 | 5.91 | 7.98 | 4.96 | 4.22 | 9.18 | 3.78 | 4.53 | 8.31 | 3.18 | 11.42 | 14.60 | 40.07 |
| 16:30-16:45 | 4.62 | 8.09 | 12.71 | 4.38 | 13.29 | 17.67 | 2.71 | 7.07 | 9.78 | 4.84 | 12.29 | 17.13 | 57.29 |
| 16:45-17:00 | 5.42 | 10.16 | 15.58 | 3.67 | 9.47 | 13.13 | 3.80 | 8.09 | 11.89 | 4.82 | 16.49 | 21.31 | 61.91 |
| 17:00-17:15 | 6.49 | 13.98 | 20.47 | 4.27 | 15.82 | 20.09 | 3.89 | 6.64 | 10.53 | 7.67 | 31.27 | 38.93 | 90.02 |
| 17:15-17:30 | 5.51 | 10.51 | 16.02 | 5.24 | 28.60 | 33.84 | 6.11 | 7.29 | 13.40 | 6.16 | 30.29 | 36.44 | 99.71 |
| 17:30-17:45 | 7.07 | 8.67 | 15.73 | 3.09 | 25.98 | 29.07 | 3.24 | 9.20 | 12.44 | 10.42 | 75.87 | 86.29 | 143.53 |
| 17:45-18:00 | 7.42 | 9.33 | 16.76 | 5.56 | 23.71 | 29.27 | 5.02 | 7.13 | 12.16 | 9.09 | 52.78 | 61.87 | 120.04 |
| 18:00-18:15 | 7.16 | 11.24 | 18.40 | 6.78 | 9.31 | 16.09 | 3.07 | 6.31 | 9.38 | 5.44 | 29.73 | 35.18 | 79.04 |
| 18:15:18:30 | 6.98 | 10.62 | 17.60 | 6.47 | 11.69 | 18.16 | 5.40 | 6.22 | 11.62 | 9.51 | 32.69 | 42.20 | 89.58 |

Table C-4: Observed Total Average Stopped Delay (veh-hr/hr) at Downstream Intersections of Study Site 2

| TIME PERIOD (hours) | Measured Average Total Stopped Delay (veh-hr/hr) | | | | | | | | | | | | TOTAL FOR THE DS INTERS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH& RT | TOTAL | LT | TH& RT | TOTAL | LT | TH& RT | TOTAL | LT | TH& RT | TOTAL | |
| 6:30 - 6:45 | 0.13 | 0.09 | 0.22 | 0.87 | 0.18 | 1.04 | 0.00 | 0.20 | 0.20 | 0.18 | 0.51 | 0.69 | 2.16 |
| 6:45 - 7:00 | 0.42 | 0.82 | 1.24 | 1.53 | 0.22 | 1.76 | 0.00 | 0.44 | 0.44 | 0.02 | 1.62 | 1.64 | 5.09 |
| 7:15 - 7:30 | 0.49 | 1.93 | 2.42 | 5.40 | 0.29 | 5.69 | 0.02 | 0.22 | 0.24 | 0.02 | 2.78 | 2.80 | 11.16 |
| 7:30 - 7:45 | 0.53 | 1.38 | 1.91 | 7.98 | 0.24 | 8.22 | 0.09 | 0.87 | 0.96 | 0.13 | 3.91 | 4.04 | 15.13 |
| 7:45 - 8:00 | 0.84 | 4.87 | 5.71 | 8.02 | 0.24 | 8.27 | 0.09 | 1.00 | 1.09 | 0.11 | 2.16 | 2.27 | 17.33 |
| 8:00 - 8:15 | 0.96 | 2.16 | 3.11 | 2.98 | 0.16 | 3.13 | 0.00 | 0.42 | 0.42 | 0.16 | 3.33 | 3.49 | 10.16 |
| 8:15 - 8:30 | 1.04 | 1.82 | 2.87 | 1.84 | 0.38 | 2.22 | 0.18 | 0.22 | 0.40 | 0.33 | 1.91 | 2.24 | 7.73 |
| 11:00-11:15 | 0.67 | 0.84 | 1.51 | 0.51 | 0.18 | 0.69 | 0.00 | 0.31 | 0.31 | 0.22 | 0.58 | 0.80 | 3.31 |
| 11:15-11:30 | 0.56 | 1.04 | 1.60 | 0.67 | 0.18 | 0.84 | 0.11 | 0.51 | 0.62 | 0.24 | 0.47 | 0.71 | 3.78 |
| 11:30-11:45 | 1.07 | 1.02 | 2.09 | 0.44 | 0.27 | 0.71 | 0.16 | 0.82 | 0.98 | 0.29 | 1.42 | 1.71 | 5.49 |
| 11:45-12:00 | 1.18 | 0.78 | 1.96 | 0.36 | 0.40 | 0.76 | 0.18 | 0.71 | 0.89 | 0.42 | 1.07 | 1.49 | 5.09 |
| 12:00-12:15 | 1.36 | 1.62 | 2.98 | 0.60 | 0.44 | 1.04 | 0.20 | 0.96 | 1.16 | 0.49 | 0.62 | 1.11 | 6.29 |
| 12:15-12:30 | 1.22 | 1.24 | 2.47 | 0.29 | 0.27 | 0.56 | 0.16 | 0.78 | 0.93 | 0.27 | 0.71 | 0.98 | 4.93 |
| 12:30-12:45 | 0.76 | 1.00 | 1.76 | 0.51 | 0.42 | 0.93 | 0.36 | 1.00 | 1.36 | 0.51 | 1.13 | 1.64 | 5.69 |
| 12:45-13:00 | 1.47 | 0.98 | 2.44 | 0.96 | 0.53 | 1.49 | 0.47 | 0.91 | 1.38 | 0.51 | 1.42 | 1.93 | 7.24 |
| 16:30-16:45 | 1.87 | 0.96 | 2.82 | 0.84 | 0.98 | 1.82 | 0.13 | 0.38 | 0.51 | 0.56 | 0.87 | 1.42 | 6.58 |
| 16:45-17:00 | 2.60 | 1.18 | 3.78 | 0.93 | 1.47 | 2.40 | 0.18 | 0.56 | 0.73 | 0.24 | 1.16 | 1.40 | 8.31 |
| 17:00-17:15 | 2.47 | 2.44 | 4.91 | 1.38 | 1.16 | 2.53 | 0.22 | 1.47 | 1.69 | 0.29 | 2.07 | 2.36 | 11.49 |
| 17:15-17:30 | 2.36 | 2.64 | 5.00 | 1.00 | 2.56 | 3.56 | 0.16 | 2.58 | 2.73 | 0.62 | 1.80 | 2.42 | 13.71 |
| 17:30-17:45 | 3.71 | 1.84 | 5.56 | 0.62 | 2.89 | 3.51 | 0.38 | 3.40 | 3.78 | 0.38 | 1.36 | 1.73 | 14.58 |
| 17:45-18:00 | 2.80 | 1.38 | 4.18 | 0.93 | 1.71 | 2.64 | 0.40 | 5.09 | 5.49 | 0.31 | 1.58 | 1.89 | 14.20 |
| 18:00-18:15 | 2.16 | 2.93 | 5.09 | 0.69 | 2.00 | 2.69 | 0.53 | 5.67 | 6.20 | 0.53 | 1.73 | 2.27 | 16.24 |
| 18:15:18:30 | 3.04 | 2.69 | 5.73 | 0.62 | 1.60 | 2.22 | 0.31 | 4.22 | 4.53 | 0.36 | 1.20 | 1.56 | 14.04 |

Table C-5: Observed Average Total Stopped Delay (veh-hr/hr) at the Critical Intersection of Study Site 3

| TIME PERIOD (hours) | Measured Average Total Delay (veh-hr/hr) | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & R | TOTAL | LT | TH & R | TOTAL | LT | TH & R | TOTAL | LT | TH & R | TOTAL | |
| 6:30 - 6:45 | 0.33 | 9.62 | 9.96 | 0.58 | 2.93 | 3.51 | 0.76 | 0.64 | 1.40 | 2.71 | 4.16 | 6.87 | 21.73 |
| 6.45 - 7:00 | 0.93 | 8.56 | 9.49 | 0.31 | 3.33 | 3.64 | 0.60 | 1.24 | 1.84 | 2.91 | 6.11 | 9.02 | 24.00 |
| 7:00 - 7:15 | 1.20 | 11.93 | 13.13 | 0.42 | 5.42 | 5.84 | 1.80 | 2.76 | 4.56 | 4.07 | 6.93 | 11.00 | 34.53 |
| 7:15 - 7:30 | 1.11 | 14.60 | 15.71 | 0.69 | 13.36 | 14.04 | 2.29 | 4.02 | 6.31 | 3.11 | 12.67 | 15.78 | 51.84 |
| 7:30 - 7:45 | 2.11 | 10.62 | 12.73 | 0.51 | 14.20 | 14.71 | 3.07 | 5.84 | 8.91 | 5.27 | 13.73 | 19.00 | 55.36 |
| 7:45 - 8:00 | 2.78 | 13.16 | 15.93 | 0.73 | 11.40 | 12.13 | 3.00 | 7.64 | 10.64 | 3.31 | 24.02 | 27.33 | 66.04 |
| 8:00 - 8:15 | 1.98 | 12.91 | 14.89 | 1.56 | 10.04 | 11.60 | 2.53 | 4.31 | 6.84 | 3.13 | 15.13 | 18.27 | 51.60 |
| 8:15 - 8:30 | 1.73 | 12.82 | 14.56 | 0.69 | 7.33 | 8.02 | 2.38 | 4.53 | 6.91 | 3.36 | 16.80 | 20.16 | 49.64 |
| 11:00-11:15 | 2.33 | 12.29 | 14.62 | 2.73 | 2.36 | 5.09 | 3.51 | 5.51 | 9.02 | 4.47 | 7.62 | 12.09 | 40.82 |
| 11:15-11:30 | 1.13 | 5.64 | 6.78 | 2.24 | 2.64 | 4.89 | 3.11 | 6.36 | 9.47 | 4.42 | 6.98 | 11.40 | 32.53 |
| 11:30-11:45 | 1.58 | 6.31 | 7.89 | 2.24 | 2.33 | 4.58 | 4.27 | 8.49 | 12.76 | 3.56 | 8.38 | 11.93 | 37.16 |
| 11:45-12:00 | 2.27 | 7.78 | 10.04 | 2.73 | 2.40 | 5.13 | 3.38 | 8.02 | 11.40 | 3.71 | 10.40 | 14.11 | 40.69 |
| 12:00-12:15 | 2.58 | 7.64 | 10.22 | 2.93 | 2.64 | 5.58 | 7.00 | 8.20 | 15.20 | 4.58 | 10.44 | 15.02 | 46.02 |
| 12:15-12:30 | 1.80 | 6.24 | 8.04 | 0.00 | 0.00 | 4.64 | 5.76 | 8.98 | 14.73 | 5.27 | 9.53 | 14.80 | 42.22 |
| 12:30-12:45 | 2.24 | 5.42 | 7.67 | 2.40 | 3.00 | 5.40 | 6.44 | 8.44 | 14.89 | 3.49 | 9.98 | 13.47 | 41.42 |
| 12:45-13:00 | 2.13 | 6.47 | 8.60 | 1.78 | 2.93 | 4.71 | 5.33 | 7.51 | 12.84 | 4.36 | 12.69 | 17.04 | 43.20 |
| 16:30-16:45 | 2.29 | 10.67 | 12.96 | 2.56 | 11.93 | 14.49 | 7.82 | 10.69 | 18.51 | 2.11 | 7.89 | 10.00 | 55.96 |
| 16:45-17:00 | 3.53 | 10.60 | 14.13 | 2.98 | 10.78 | 13.76 | 9.04 | 15.53 | 24.58 | 3.78 | 10.13 | 13.91 | 66.38 |
| 17:00-17:15 | 2.51 | 15.27 | 17.78 | 6.22 | 15.09 | 21.31 | 14.91 | 35.73 | 50.64 | 3.04 | 5.84 | 8.89 | 98.62 |
| 17:15-17:30 | 2.78 | 20.60 | 23.38 | 7.62 | 26.58 | 34.20 | 18.27 | 62.91 | 81.18 | 4.11 | 9.13 | 13.24 | 152.00 |
| 17:30-17:45 | 3.67 | 15.36 | 19.02 | 6.91 | 12.89 | 19.80 | 13.02 | 25.18 | 38.20 | 4.42 | 11.56 | 15.98 | 93.00 |
| 17:45-18:00 | 4.71 | 21.91 | 26.62 | 4.73 | 12.44 | 17.18 | 12.73 | 17.36 | 30.09 | 5.60 | 15.13 | 20.73 | 94.62 |
| 18:00-18:15 | 3.44 | 8.22 | 11.67 | 5.20 | 17.40 | 22.60 | 16.91 | 45.44 | 62.36 | 4.47 | 9.16 | 13.62 | 110.24 |
| 18:15:18:30 | 3.84 | 9.62 | 13.47 | 4.11 | 14.78 | 18.89 | 13.71 | 26.58 | 40.29 | 3.18 | 8.71 | 11.89 | 84.53 |

Table C-6: Observed Average Total Stopped Delay (veh-hr/hr) at Downstream Intersections of Study Site 3

| TIME PERIOD | Measured Average Total Stopped Delay (veh-hr/hr) | | | | | | | | | | | | TOTAL FOR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| (hours) | LT | TH & R | TOTAL | LT | TH& RT | TOTAL | LT | TH & R | TOTAL | LT | TH & R | TOTAL | DS INTER |
| 6:45 - 7:00 | 0.51 | 2.49 | 3.00 | 0.07 | 0.53 | 0.60 | 0.00 | 1.62 | 1.62 | 0.20 | 1.62 | 1.82 | 7.04 |
| 7:00 - 7:15 | 0.76 | 2.27 | 3.02 | 0.18 | 0.27 | 0.44 | 5.96 | 1.58 | 7.53 | 0.18 | 3.29 | 3.47 | 14.47 |
| 7:15 - 7:30 | 0.76 | 2.87 | 3.62 | 0.49 | 0.98 | 1.47 | 10.67 | 2.42 | 13.09 | 0.33 | 2.78 | 3.11 | 21.29 |
| 7:30 - 7:45 | 1.89 | 5.62 | 7.51 | 1.11 | 1.18 | 2.29 | 10.00 | 3.02 | 13.02 | 0.36 | 3.91 | 4.27 | 27.09 |
| 7:45 - 8:00 | 1.89 | 4.98 | 6.87 | 1.22 | 2.24 | 3.47 | 18.60 | 7.04 | 25.64 | 0.44 | 2.16 | 2.60 | 38.58 |
| 8:00 - 8:15 | 1.18 | 7.96 | 9.13 | 1.24 | 1.22 | 2.47 | 9.93 | 3.47 | 13.40 | 0.27 | 3.33 | 3.60 | 28.60 |
| 8:15 - 8:30 | 0.58 | 5.82 | 6.40 | 1.11 | 1.36 | 2.47 | 9.51 | 3.96 | 13.47 | 0.44 | 1.91 | 2.36 | 24.69 |
| 11:00-11:15 | 1.36 | 7.16 | 8.51 | 1.89 | 1.64 | 3.53 | 1.71 | 2.49 | 4.20 | 0.53 | 0.58 | 1.11 | 17.36 |
| 11:15-11:30 | 1.53 | 8.11 | 9.64 | 2.60 | 4.31 | 6.91 | 1.78 | 2.24 | 4.02 | 0.64 | 0.47 | 1.11 | 21.69 |
| 11:30-11:45 | 2.20 | 12.78 | 14.98 | 3.91 | 2.02 | 5.93 | 3.18 | 2.69 | 5.87 | 0.29 | 1.42 | 1.71 | 28.49 |
| 11:45-12:00 | 1.87 | 17.04 | 18.91 | 3.78 | 0.96 | 4.73 | 1.76 | 2.22 | 3.98 | 0.27 | 1.07 | 1.33 | 28.96 |
| 12:00-12:15 | 1.47 | 14.84 | 16.31 | 3.64 | 1.84 | 5.49 | 1.76 | 2.91 | 4.67 | 0.51 | 0.62 | 1.13 | 27.60 |
| 12:15-12:30 | 2.33 | 13.40 | 15.73 | 3.91 | 1.58 | 5.49 | 1.71 | 2.31 | 4.02 | 0.56 | 0.71 | 1.27 | 26.51 |
| 12:30-12:45 | 1.38 | 14.73 | 16.11 | 4.27 | 1.40 | 5.67 | 2.84 | 4.51 | 7.36 | 0.67 | 1.13 | 1.80 | 30.93 |
| 12:45-13:00 | 2.91 | 19.80 | 22.71 | 3.49 | 2.00 | 5.49 | 4.00 | 4.49 | 8.49 | 0.49 | 1.42 | 1.91 | 38.60 |
| 16:45-17:00 | 2.00 | 14.84 | 16.84 | 4.18 | 18.73 | 22.91 | 4.22 | 1.33 | 5.56 | 2.20 | 1.16 | 3.36 | 48.67 |
| 17:00-17:15 | 1.53 | 20.71 | 22.24 | 3.89 | 19.33 | 23.22 | 5.07 | 2.13 | 7.20 | 2.11 | 2.07 | 4.18 | 56.84 |
| 17:15-17:30 | 1.82 | 37.69 | 39.51 | 5.33 | 31.31 | 36.64 | 6.40 | 2.58 | 8.98 | 5.71 | 1.80 | 7.51 | 92.64 |
| 17:30-17:45 | 1.47 | 36.42 | 37.89 | 7.53 | 84.38 | 91.91 | 12.11 | 3.47 | 15.58 | 4.82 | 1.36 | 6.18 | 151.56 |
| 17:45-18:00 | 1.56 | 22.07 | 23.62 | 8.44 | 100.93 | 109.38 | 5.67 | 1.78 | 7.44 | 3.93 | 1.58 | 5.51 | 145.96 |
| 18:00-18:15 | 1.62 | 31.29 | 32.91 | 9.40 | 70.13 | 79.53 | 4.13 | 1.49 | 5.62 | 3.71 | 1.73 | 5.44 | 123.51 |

Table C-7: Observed Average Total Stopped Delay (veh-hr/hr) at Critical Intersection of Study Site 4

| TIME PERIOD (hours) | Measured Average Total Stopped Delay (veh-hr/hr) | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & R | TOTAL | LT | TH& RT | TOTAL | LT | TH & R | TOTAL | LT | TH & R | TOTAL | |
| 6:30 - 6:45 | 1.29 | 4.87 | 6.16 | 1.73 | 9.29 | 11.02 | 2.13 | 5.47 | 7.60 | 2.42 | 4.36 | 6.78 | 31.56 |
| 6:45 - 7:00 | 1.22 | 5.44 | 6.67 | 1.58 | 8.62 | 10.20 | 2.98 | 6.00 | 8.98 | 2.42 | 9.47 | 11.89 | 37.73 |
| 7:00 - 7:15 | 1.44 | 2.27 | 3.71 | 1.84 | 8.82 | 10.67 | 2.27 | 5.27 | 7.53 | 2.64 | 11.33 | 13.98 | 35.89 |
| 7:15 - 7:30 | 1.38 | 2.69 | 4.07 | 3.40 | 12.31 | 15.71 | 4.84 | 7.73 | 12.58 | 3.87 | 11.73 | 15.60 | 47.96 |
| 7:30 - 7:45 | 1.64 | 5.04 | 6.69 | 2.53 | 12.20 | 14.73 | 3.67 | 13.16 | 16.82 | 2.42 | 10.58 | 13.00 | 51.24 |
| 7:45 - 8:00 | 1.42 | 6.93 | 8.36 | 4.13 | 6.29 | 10.42 | 7.29 | 12.36 | 19.64 | 3.33 | 12.27 | 15.60 | 54.02 |
| 8:00 - 8:15 | 1.91 | 5.20 | 7.11 | 2.96 | 6.27 | 9.22 | 4.09 | 4.96 | 9.04 | 1.80 | 10.24 | 12.04 | 37.42 |
| 8:15 - 8:30 | 1.16 | 2.76 | 3.91 | 2.51 | 6.13 | 8.64 | 1.96 | 6.20 | 8.16 | 1.58 | 6.31 | 7.89 | 28.60 |
| 11:00-11:15 | 1.96 | 4.49 | 6.44 | 5.24 | 6.38 | 11.62 | 3.89 | 3.93 | 7.82 | 1.20 | 2.87 | 4.07 | 29.96 |
| 11:15-11:30 | 1.91 | 5.64 | 7.56 | 4.76 | 6.49 | 11.24 | 1.29 | 3.96 | 5.24 | 0.98 | 3.11 | 4.09 | 28.13 |
| 11:30-11:45 | 1.82 | 5.78 | 7.60 | 6.76 | 7.31 | 14.07 | 2.93 | 4.73 | 7.67 | 1.89 | 2.96 | 4.84 | 34.18 |
| 11:45-12:00 | 2.69 | 7.96 | 10.64 | 10.29 | 9.58 | 19.87 | 4.13 | 5.22 | 9.36 | 0.89 | 4.29 | 5.18 | 45.04 |
| 12:00-12:15 | 1.67 | 9.04 | 10.71 | 4.42 | 6.33 | 10.76 | 2.33 | 4.91 | 7.24 | 1.47 | 4.20 | 5.67 | 34.38 |
| 12:15-12:30 | 1.82 | 9.07 | 10.89 | 5.40 | 7.38 | 12.78 | 1.73 | 4.22 | 5.96 | 1.56 | 4.42 | 5.98 | 35.60 |
| 12:30-12:45 | 3.49 | 10.11 | 13.60 | 4.20 | 4.87 | 9.07 | 2.04 | 5.13 | 7.18 | 1.44 | 4.33 | 5.78 | 35.62 |
| 12:45-13:00 | 3.00 | 11.47 | 14.47 | 5.58 | 7.24 | 12.82 | 3.44 | 6.33 | 9.78 | 1.62 | 2.84 | 4.47 | 41.53 |
| 16:30-16:45 | 1.80 | 13.36 | 15.16 | 5.47 | 6.58 | 12.04 | 5.04 | 10.24 | 15.29 | 1.27 | 13.22 | 14.49 | 56.98 |
| 16:45-17:00 | 1.22 | 13.44 | 14.67 | 9.76 | 6.62 | 16.38 | 3.71 | 7.40 | 11.11 | 1.31 | 10.02 | 11.33 | 53.49 |
| 17:00-17:15 | 3.27 | 18.69 | 21.96 | 9.71 | 7.49 | 17.20 | 3.91 | 5.60 | 9.51 | 1.33 | 9.87 | 11.20 | 59.87 |
| 17:15-17:30 | 4.33 | 16.33 | 20.67 | 8.58 | 10.76 | 19.33 | 10.29 | 6.04 | 16.33 | 1.80 | 19.07 | 20.87 | 77.20 |
| 17:30-17:45 | 2.09 | 36.51 | 38.60 | 7.96 | 9.29 | 17.24 | 5.73 | 7.80 | 13.53 | 1.67 | 14.76 | 16.42 | 85.80 |
| 17:45-18:00 | 2.60 | 23.31 | 25.91 | 4.49 | 8.07 | 12.56 | 3.98 | 9.16 | 13.13 | 1.98 | 20.27 | 22.24 | 73.84 |
| 18:00-18:15 | 2.82 | 34.56 | 37.38 | 4.44 | 9.29 | 13.73 | 7.44 | 5.40 | 12.84 | 1.47 | 7.29 | 8.76 | 72.71 |
| 18:15:18:30 | 2.47 | 59.62 | 62.09 | 3.96 | 5.71 | 9.67 | 11.24 | 8.82 | 20.07 | 1.64 | 7.00 | 8.64 | 100.47 |

Table C-8: Observed Total Average Stopped Delay (veh-hr/hr) at Downstream Intersections of Study Site 4

| TIME PERIOD (hours) | Measured Average Total Stopped Delay (veh-hr/hr) | | | | | | | | | | | | TOTAL FOR THE DS INTERS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH& RT | TOTAL | LT | TH& RT | TOTAL | LT | TH& RT | TOTAL | LT | TH& RT | TOTAL | |
| 6:45 - 7:00 | 0.00 | 0.44 | 0.44 | 0.09 | 0.67 | 0.76 | 0.00 | 2.60 | 2.69 | 0.02 | 0.47 | 0.49 | 4.38 |
| 7:00 - 7:15 | 0.00 | 0.36 | 0.36 | 0.22 | 2.22 | 2.44 | 0.04 | 2.76 | 2.80 | 0.16 | 0.04 | 0.20 | 5.80 |
| 7:15 - 7:30 | 0.00 | 0.13 | 0.13 | 0.13 | 1.36 | 1.49 | 0.38 | 3.00 | 3.38 | 0.02 | 0.04 | 0.07 | 5.07 |
| 7:30 - 7:45 | 0.00 | 0.87 | 0.87 | 0.11 | 1.76 | 1.87 | 0.36 | 3.80 | 4.16 | 0.04 | 0.02 | 0.07 | 6.96 |
| 7:45 - 8:00 | 0.00 | 1.00 | 1.00 | 0.18 | 1.31 | 1.49 | 0.04 | 5.18 | 5.22 | 0.16 | 0.09 | 0.24 | 7.96 |
| 8:00 - 8:15 | 0.00 | 0.78 | 0.78 | 0.76 | 0.91 | 1.67 | 0.13 | 1.89 | 2.02 | 0.00 | 0.07 | 0.07 | 4.53 |
| 8:15 - 8:30 | 0.00 | 0.56 | 0.56 | 0.36 | 0.76 | 1.11 | 0.13 | 1.62 | 1.76 | 0.00 | 0.11 | 0.11 | 3.53 |
| 11:00-11:15 | 0.00 | 0.47 | 0.47 | 0.69 | 0.11 | 0.80 | 0.16 | 1.53 | 1.69 | 0.02 | 1.93 | 1.96 | 4.91 |
| 11:15-11:30 | 0.00 | 0.02 | 0.02 | 1.00 | 0.13 | 1.13 | 0.02 | 1.16 | 1.18 | 0.18 | 3.18 | 3.36 | 5.69 |
| 11:30-11:45 | 0.00 | 0.51 | 0.51 | 0.69 | 0.11 | 0.80 | 0.07 | 2.33 | 2.40 | 0.11 | 2.82 | 2.93 | 6.64 |
| 11:45-12:00 | 0.00 | 0.09 | 0.09 | 1.29 | 0.07 | 1.36 | 0.00 | 2.62 | 2.62 | 0.07 | 2.80 | 2.87 | 6.93 |
| 12:00-12:15 | 0.00 | 0.69 | 0.69 | 1.07 | 0.13 | 1.20 | 0.49 | 1.58 | 2.07 | 0.42 | 3.73 | 4.16 | 8.11 |
| 12:15-12:30 | 0.00 | 0.60 | 0.60 | 1.31 | 0.11 | 1.42 | 0.31 | 1.31 | 1.62 | 0.07 | 3.71 | 3.78 | 7.42 |
| 12:30-12:45 | 0.00 | 0.42 | 0.42 | 0.76 | 0.07 | 0.82 | 0.44 | 2.82 | 3.27 | 0.20 | 4.02 | 4.22 | 8.73 |
| 12:45-13:00 | 0.00 | 0.42 | 0.42 | 0.67 | 0.09 | 0.76 | 0.24 | 2.38 | 2.62 | 0.29 | 3.78 | 4.07 | 7.87 |
| 16:30-16:45 | 0.00 | 1.22 | 1.22 | 1.49 | 0.04 | 1.53 | 0.69 | 8.76 | 9.44 | 0.29 | 4.98 | 5.27 | 17.47 |
| 16:45-17:00 | 0.00 | 0.51 | 0.51 | 1.42 | 0.02 | 1.44 | 0.33 | 3.38 | 3.71 | 0.42 | 4.47 | 4.89 | 10.56 |
| 17:00-17:15 | 0.00 | 1.69 | 1.69 | 1.56 | 0.07 | 1.62 | 0.22 | 5.00 | 5.22 | 0.24 | 4.69 | 4.93 | 13.47 |
| 17:15-17:30 | 0.00 | 1.84 | 1.84 | 1.13 | 0.04 | 1.18 | 0.38 | 7.62 | 8.00 | 0.42 | 4.67 | 5.09 | 16.11 |
| 17:30-17:45 | 0.00 | 1.36 | 1.36 | 1.36 | 0.04 | 1.40 | 0.51 | 4.49 | 5.00 | 0.60 | 5.78 | 6.38 | 14.13 |
| 17:45-18:00 | 0.00 | 2.04 | 2.04 | 1.16 | 0.02 | 1.18 | 0.29 | 5.71 | 6.00 | 0.42 | 6.73 | 7.16 | 16.38 |
| 18:00-18:15 | 0.00 | 0.91 | 0.91 | 1.42 | 0.04 | 1.47 | 0.09 | 5.84 | 5.93 | 0.69 | 3.98 | 4.67 | 12.98 |
| 18:15:18:30 | 0.00 | 0.80 | 0.80 | 1.20 | 0.04 | 1.24 | 0.13 | 5.71 | 5.84 | 0.62 | 4.24 | 4.87 | 12.76 |

Table C-9: Observed Average Total Stopped Delay (veh-hr/hr) at Critical Intersection of Study Site 5

| TIME PERIOD (hours) | Measured Average Total Stopped Delay (veh-hr/hr) | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & R | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & R | TOTAL | |
| 6:30 - 6:45 | 0.64 | 1.58 | 2.22 | 0.07 | 1.93 | 2.00 | 1.40 | 3.98 | 5.38 | 0.49 | 5.00 | 5.49 | 15.09 |
| 6:45 - 7:00 | 2.02 | 2.89 | 4.91 | 0.07 | 0.53 | 0.60 | 2.02 | 5.38 | 7.40 | 0.76 | 4.24 | 5.00 | 17.91 |
| 7:00 - 7:15 | 1.02 | 2.07 | 3.09 | 0.18 | 0.27 | 0.44 | 3.62 | 6.67 | 10.29 | 1.56 | 8.98 | 10.53 | 24.36 |
| 7:15 - 7:30 | 2.44 | 2.93 | 5.38 | 0.49 | 0.98 | 1.47 | 5.07 | 6.71 | 11.78 | 1.82 | 13.38 | 15.20 | 33.82 |
| 7:30 - 7:45 | 3.11 | 2.91 | 6.02 | 1.11 | 1.18 | 2.29 | 1.04 | 2.58 | 3.62 | 0.96 | 14.84 | 15.80 | 27.73 |
| 7:45 - 8:00 | 4.33 | 3.02 | 7.36 | 1.22 | 2.24 | 3.47 | 0.87 | 1.91 | 2.78 | 1.18 | 29.24 | 30.42 | 44.02 |
| 8:00 - 8:15 | 2.11 | 2.18 | 4.29 | 1.24 | 1.22 | 2.47 | 4.38 | 5.62 | 10.00 | 1.04 | 18.98 | 20.02 | 36.78 |
| 8:15 - 8:30 | 6.20 | 2.60 | 8.80 | 1.11 | 1.36 | 2.47 | 4.93 | 6.47 | 11.40 | 1.84 | 18.87 | 20.71 | 43.38 |
| 11:00-11:15 | 7.22 | 7.84 | 15.07 | 1.89 | 1.64 | 3.53 | 2.89 | 5.73 | 8.62 | 0.60 | 3.58 | 4.18 | 31.40 |
| 11:15-11:30 | 10.33 | 6.22 | 16.56 | 2.60 | 4.31 | 6.91 | 4.36 | 10.96 | 15.31 | 0.96 | 22.16 | 23.11 | 61.89 |
| 11:30-11:45 | 6.87 | 3.18 | 10.04 | 3.91 | 2.02 | 5.93 | 3.71 | 10.36 | 14.07 | 1.38 | 10.24 | 11.62 | 41.67 |
| 11:45-12:00 | 13.89 | 10.49 | 24.38 | 3.78 | 0.96 | 4.73 | 3.33 | 6.64 | 9.98 | 1.00 | 10.93 | 11.93 | 51.02 |
| 12:00-12:15 | 10.53 | 4.62 | 15.16 | 3.64 | 1.84 | 5.49 | 4.27 | 11.91 | 16.18 | 1.38 | 10.24 | 11.62 | 48.44 |
| 12:15-12:30 | 7.09 | 8.47 | 15.56 | 3.91 | 1.58 | 5.49 | 4.60 | 11.27 | 15.87 | 1.22 | 12.22 | 13.44 | 50.36 |
| 12:30-12:45 | 13.13 | 8.49 | 21.62 | 4.27 | 1.40 | 5.67 | 7.20 | 10.71 | 17.91 | 1.58 | 17.69 | 19.27 | 64.47 |
| 12:45-13:00 | 10.96 | 7.20 | 18.16 | 3.36 | 2.00 | 5.36 | 6.11 | 9.58 | 15.69 | 1.69 | 13.40 | 15.09 | 54.29 |
| 16:30-16:45 | 3.00 | 1.98 | 4.98 | 4.16 | 15.24 | 19.40 | 10.87 | 17.16 | 28.02 | 1.18 | 15.22 | 16.40 | 68.80 |
| 16:45-17:00 | 6.02 | 4.69 | 10.71 | 4.18 | 18.73 | 22.91 | 16.73 | 23.82 | 40.56 | 1.49 | 17.29 | 18.78 | 92.96 |
| 17:00-17:15 | 7.93 | 7.76 | 15.69 | 3.89 | 19.33 | 23.22 | 15.98 | 45.11 | 61.09 | 0.73 | 16.22 | 16.96 | 116.96 |
| 17:15-17:30 | 25.69 | 23.09 | 48.78 | 5.33 | 31.31 | 36.64 | 17.33 | 150.84 | 168.18 | 2.22 | 17.20 | 19.42 | 273.02 |
| 17:30-17:45 | 22.58 | 16.80 | 39.38 | 7.53 | 84.38 | 91.91 | 17.44 | 95.93 | 113.38 | 1.76 | 19.51 | 21.27 | 265.93 |
| 17:45-18:00 | 15.36 | 12.27 | 27.62 | 8.44 | 100.93 | 109.38 | 18.47 | 75.84 | 94.31 | 2.60 | 17.89 | 20.49 | 251.80 |
| 18:00-18:15 | 15.56 | 11.33 | 26.89 | 9.40 | 70.13 | 79.53 | 14.27 | 59.13 | 73.40 | 2.73 | 14.38 | 17.11 | 196.93 |
| 18:15:18:30 | 5.24 | 4.29 | 9.53 | 5.56 | 33.44 | 39.00 | 15.07 | 51.80 | 66.87 | 1.64 | 13.04 | 14.69 | 130.09 |

Table C-10: Observed Average Total Stopped Delay (veh-hr/hr) at Downstream Intersections of Study Site 5

| TIME PERIOD (hours) | Measured Average Total Stopped Delay (veh-hr/hr) | | | | | | | | | | | | TOTAL FOR DS INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & R | TOTAL | LT | TH& RT | TOTAL | LT | TH & R | TOTAL | LT | TH & R | TOTAL | |
| 6:30 - 6:45 | 0.33 | 9.62 | 9.96 | 0.13 | 2.78 | 2.91 | 0.00 | 0.36 | 0.53 | 0.00 | 0.51 | 0.62 | 14.02 |
| 6:45 - 7:00 | 0.93 | 8.56 | 9.49 | 0.20 | 1.49 | 1.69 | 0.00 | 0.38 | 1.00 | 0.33 | 2.20 | 2.53 | 14.71 |
| 7:00 - 7:15 | 1.20 | 11.93 | 13.13 | 0.42 | 3.36 | 3.78 | 1.09 | 0.51 | 1.60 | 0.11 | 3.29 | 3.40 | 21.91 |
| 7:15 - 7:30 | 1.11 | 14.60 | 15.71 | 0.87 | 7.36 | 8.22 | 1.78 | 1.40 | 3.18 | 0.09 | 5.73 | 5.82 | 32.93 |
| 7:30 - 7:45 | 2.11 | 10.62 | 12.73 | 1.84 | 12.56 | 14.40 | 2.64 | 1.53 | 4.18 | 0.16 | 7.53 | 7.69 | 39.00 |
| 7:45 - 8:00 | 2.78 | 13.16 | 15.93 | 1.24 | 10.98 | 12.22 | 2.11 | 3.44 | 5.56 | 0.44 | 12.49 | 12.93 | 46.64 |
| 8:00 - 8:15 | 1.98 | 12.91 | 14.89 | 1.18 | 6.47 | 7.64 | 1.71 | 0.53 | 2.24 | 0.20 | 11.09 | 11.29 | 36.07 |
| 8:15 - 8:30 | 1.73 | 12.82 | 14.56 | 1.71 | 9.62 | 11.33 | 2.91 | 2.24 | 5.16 | 0.44 | 11.64 | 12.09 | 43.13 |
| 11:15-11:30 | 1.13 | 5.64 | 6.78 | 0.31 | 6.84 | 7.16 | 2.31 | 5.44 | 7.76 | 0.13 | 1.82 | 1.96 | 23.64 |
| 11:30-11:45 | 1.58 | 6.31 | 7.89 | 1.44 | 7.96 | 9.40 | 2.27 | 5.78 | 8.04 | 0.38 | 4.36 | 4.73 | 30.07 |
| 11:45-12:00 | 2.27 | 7.78 | 10.04 | 0.73 | 9.24 | 9.98 | 0.00 | 5.24 | 10.76 | 0.40 | 4.22 | 4.62 | 35.40 |
| 12:00-12:15 | 2.58 | 7.64 | 10.22 | 1.24 | 8.11 | 9.36 | 4.40 | 9.31 | 13.71 | 0.40 | 4.02 | 4.42 | 37.71 |
| 12:15-12:30 | 1.80 | 6.24 | 8.04 | 1.11 | 7.27 | 8.38 | 4.58 | 8.22 | 12.80 | 0.16 | 2.98 | 3.13 | 32.36 |
| 12:30-12:45 | 2.24 | 5.42 | 7.67 | 2.09 | 9.27 | 11.36 | 4.62 | 9.89 | 14.51 | 0.33 | 4.49 | 4.82 | 38.36 |
| 12:45-13:00 | 2.13 | 6.47 | 8.60 | 1.42 | 9.84 | 11.27 | 4.80 | 6.18 | 10.98 | 0.31 | 4.71 | 5.02 | 35.87 |
| 16:30-16:45 | 2.29 | 10.67 | 12.96 | 2.24 | 3.60 | 5.84 | 2.71 | 6.04 | 8.76 | 0.62 | 9.07 | 9.69 | 37.24 |
| 16:45-17:00 | 3.53 | 10.60 | 14.13 | 2.62 | 5.00 | 7.62 | 3.44 | 10.16 | 13.60 | 0.89 | 12.80 | 13.69 | 49.04 |
| 17:00-17:15 | 2.51 | 15.27 | 17.78 | 3.38 | 4.11 | 7.49 | 5.89 | 14.31 | 20.20 | 1.96 | 14.18 | 16.13 | 61.60 |
| 17:15-17:30 | 2.78 | 20.60 | 23.38 | 3.16 | 2.93 | 6.09 | 4.09 | 19.33 | 23.42 | 2.07 | 18.36 | 20.42 | 73.31 |
| 17:30-17:45 | 3.67 | 15.36 | 19.02 | 4.07 | 3.11 | 7.18 | 3.64 | 46.13 | 49.78 | 1.47 | 37.04 | 38.51 | 114.49 |
| 17:45-18:00 | 4.71 | 21.91 | 26.62 | 2.71 | 5.87 | 8.58 | 3.51 | 38.96 | 42.47 | 2.73 | 26.87 | 29.60 | 107.27 |
| 18:00-18:15 | 3.44 | 8.22 | 11.67 | 2.82 | 7.47 | 10.29 | 3.58 | 39.29 | 42.87 | 2.96 | 15.60 | 18.56 | 83.38 |
| 18:15:18:30 | 3.84 | 9.62 | 13.47 | 3.60 | 3.69 | 7.29 | 6.00 | 16.49 | 22.49 | 1.91 | 12.62 | 14.53 | 57.78 |

Table C-11: Observed Stopped Average Total Delay (veh-hr/hr) at the Critical Intersection of Study Site 6

| TIME PERIOD (hours) | Measured Average Total Delay (veh-hr/hr) | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & R | TOTAL | LT | TH & R | TOTAL | LT | TH & R | TOTAL | LT | TH & R | TOTAL | |
| 6:30 - 6:45 | 0.89 | 0.89 | 1.78 | 0.51 | 0.62 | 1.13 | 0.91 | 2.58 | 3.49 | 0.20 | 0.98 | 1.18 | 7.57 |
| 6.45 - 7:00 | 1.87 | 2.69 | 4.56 | 0.80 | 0.76 | 1.56 | 1.16 | 2.93 | 4.09 | 0.47 | 1.87 | 2.33 | 12.53 |
| 7:00 - 7:15 | 1.38 | 3.56 | 4.93 | 0.56 | 0.82 | 1.38 | 1.20 | 3.98 | 5.18 | 0.33 | 1.84 | 2.18 | 13.67 |
| 7:15 - 7:30 | 1.73 | 3.44 | 5.18 | 0.71 | 1.11 | 1.82 | 2.29 | 5.58 | 7.87 | 0.60 | 2.09 | 2.69 | 17.56 |
| 7:30 - 7:45 | 1.82 | 6.62 | 8.44 | 0.73 | 1.60 | 2.33 | 2.20 | 5.56 | 7.76 | 0.13 | 2.98 | 3.11 | 21.64 |
| 7:45 - 8:00 | 2.69 | 4.44 | 7.13 | 1.24 | 1.49 | 2.73 | 1.71 | 4.64 | 6.36 | 0.91 | 2.53 | 3.44 | 19.67 |
| 8:00 - 8:15 | 1.64 | 2.80 | 4.44 | 0.62 | 1.33 | 1.96 | 2.20 | 4.07 | 6.27 | 0.53 | 2.38 | 2.91 | 15.58 |
| 8:15 - 8:30 | 1.31 | 1.76 | 3.07 | 0.44 | 0.62 | 1.07 | 0.84 | 3.11 | 3.96 | 0.33 | 1.60 | 1.93 | 10.02 |
| 11:00-11:15 | 1.02 | 0.67 | 1.69 | 0.40 | 0.96 | 1.36 | 0.64 | 1.44 | 2.09 | 0.38 | 2.07 | 2.44 | 7.58 |
| 11:15-11:30 | 1.22 | 0.67 | 1.89 | 0.53 | 0.84 | 1.38 | 0.76 | 1.09 | 1.84 | 0.33 | 1.89 | 2.22 | 7.33 |
| 11:30-11:45 | 1.22 | 0.71 | 1.93 | 0.44 | 1.56 | 2.00 | 1.07 | 2.47 | 3.53 | 0.38 | 2.69 | 3.07 | 10.53 |
| 11:45-12:00 | 1.91 | 0.93 | 2.84 | 0.60 | 0.82 | 1.42 | 0.98 | 2.47 | 3.44 | 0.51 | 2.84 | 3.36 | 11.07 |
| 12:00-12:15 | 1.82 | 0.84 | 2.67 | 0.98 | 1.78 | 2.76 | 1.60 | 1.76 | 3.36 | 0.49 | 3.73 | 4.22 | 13.00 |
| 12:15-12:30 | 2.09 | 1.87 | 3.96 | 0.33 | 1.53 | 1.87 | 1.00 | 3.22 | 4.22 | 0.62 | 4.47 | 5.09 | 15.13 |
| 12:30-12:45 | 1.44 | 1.02 | 2.47 | 0.47 | 1.40 | 1.87 | 0.84 | 2.87 | 3.71 | 0.58 | 2.58 | 3.16 | 11.20 |
| 12:45-13:00 | 1.44 | 1.16 | 2.60 | 1.29 | 1.64 | 2.93 | 2.07 | 4.64 | 6.71 | 0.56 | 2.76 | 3.31 | 15.56 |
| 16:30-16:45 | 1.67 | 0.80 | 2.47 | 1.22 | 4.24 | 5.47 | 2.73 | 3.62 | 6.36 | 2.07 | 5.29 | 7.36 | 21.64 |
| 16:45-17:00 | 2.96 | 1.31 | 4.27 | 0.53 | 3.47 | 4.00 | 1.60 | 3.82 | 5.42 | 2.07 | 7.33 | 9.40 | 23.09 |
| 17:00-17:15 | 2.71 | 2.82 | 5.53 | 0.98 | 9.87 | 10.84 | 3.07 | 4.60 | 7.67 | 2.13 | 10.64 | 12.78 | 36.82 |
| 17:15-17:30 | 3.40 | 2.42 | 5.82 | 0.60 | 5.18 | 5.78 | 1.69 | 4.40 | 6.09 | 2.84 | 10.60 | 13.44 | 31.13 |
| 17:30-17:45 | 3.93 | 2.29 | 6.22 | 1.27 | 6.87 | 8.13 | 2.24 | 4.58 | 6.82 | 3.44 | 12.71 | 16.16 | 37.33 |
| 17:45-18:00 | 2.40 | 1.93 | 4.33 | 1.42 | 5.49 | 6.91 | 1.93 | 5.24 | 7.18 | 2.40 | 8.31 | 10.71 | 29.13 |
| 18:00-18:15 | 3.22 | 1.51 | 4.73 | 0.84 | 2.87 | 3.71 | 1.18 | 3.09 | 4.27 | 1.93 | 7.27 | 9.20 | 21.91 |
| 18:15:18:30 | 2.53 | 1.87 | 4.40 | 0.78 | 4.02 | 4.80 | 2.09 | 4.47 | 6.56 | 1.76 | 6.96 | 8.71 | 24.47 |

Table C-12: Observed Total Average Stopped Delay (veh-hr/hr) at Downstream Intersections of Study Site 6

| TIME PERIOD (hours) | Measured Average Total Stopped Delay (veh-hr/hr) | | | | | | | | | | | | TOTAL FOR THE DS INTERS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH& RT | TOTAL | LT | TH& RT | TOTAL | LT | TH& RT | TOTAL | LT | TH& RT | TOTAL | |
| 6:30 - 6:45 | 0.20 | 0.51 | 0.71 | 0.27 | 0.29 | 0.56 | 0.07 | 0.18 | 0.24 | 2.53 | 1.00 | 3.53 | 5.04 |
| 6:45 - 7:00 | 0.20 | 0.71 | 0.91 | 0.27 | 0.51 | 0.78 | 0.07 | 0.13 | 0.20 | 3.02 | 1.09 | 4.11 | 6.00 |
| 7:00 - 7:15 | 0.49 | 1.24 | 1.73 | 0.33 | 0.38 | 0.71 | 0.07 | 0.40 | 0.47 | 4.42 | 2.38 | 6.80 | 9.71 |
| 7:15 - 7:30 | 0.58 | 2.31 | 2.89 | 0.13 | 0.51 | 0.64 | 0.11 | 0.11 | 0.22 | 6.93 | 3.53 | 10.47 | 14.22 |
| 7:30 - 7:45 | 0.42 | 1.58 | 2.00 | 0.36 | 0.47 | 0.82 | 0.16 | 0.42 | 0.58 | 10.51 | 8.93 | 19.44 | 22.84 |
| 7:45 - 8:00 | 0.49 | 1.27 | 1.76 | 0.29 | 0.73 | 1.02 | 0.16 | 0.40 | 0.56 | 8.89 | 8.78 | 17.67 | 21.00 |
| 8:00 - 8:15 | 0.24 | 1.36 | 1.60 | 0.24 | 0.82 | 1.07 | 0.16 | 0.18 | 0.33 | 4.20 | 2.96 | 7.16 | 10.16 |
| 8:15 - 8:30 | 0.38 | 1.09 | 1.47 | 0.31 | 0.27 | 0.58 | 0.11 | 0.24 | 0.36 | 3.16 | 1.27 | 4.42 | 6.82 |
| 11:00-11:15 | 0.11 | 0.56 | 0.67 | 0.29 | 0.38 | 0.67 | 0.07 | 0.56 | 0.62 | 2.96 | 0.16 | 3.11 | 5.07 |
| 11:15-11:30 | 0.20 | 0.69 | 0.89 | 0.36 | 0.60 | 0.96 | 0.18 | 1.31 | 1.49 | 2.16 | 0.09 | 2.24 | 5.58 |
| 11:30-11:45 | 0.13 | 0.58 | 0.71 | 0.24 | 0.33 | 0.58 | 0.22 | 1.27 | 1.49 | 2.04 | 0.16 | 2.20 | 4.98 |
| 11:45-12:00 | 0.11 | 0.33 | 0.44 | 0.24 | 0.36 | 0.60 | 0.00 | 1.16 | 1.82 | 1.87 | 0.13 | 2.00 | 4.87 |
| 12:00-12:15 | 0.20 | 0.60 | 0.80 | 0.42 | 0.40 | 0.82 | 0.53 | 1.24 | 1.78 | 3.04 | 0.16 | 3.20 | 6.60 |
| 12:15-12:30 | 0.22 | 0.44 | 0.67 | 0.47 | 0.58 | 1.04 | 0.58 | 1.24 | 1.82 | 2.42 | 0.11 | 2.53 | 6.07 |
| 12:30-12:45 | 0.11 | 0.89 | 1.00 | 0.78 | 0.31 | 1.09 | 0.31 | 1.09 | 1.40 | 3.36 | 0.42 | 3.78 | 7.27 |
| 12:45-13:00 | 0.04 | 0.71 | 0.76 | 0.49 | 0.33 | 0.82 | 0.38 | 1.18 | 1.56 | 4.13 | 0.42 | 4.56 | 7.69 |
| 16:30-16:45 | 0.18 | 1.29 | 1.47 | 0.64 | 0.87 | 1.51 | 0.96 | 0.98 | 1.93 | 2.47 | 0.20 | 2.67 | 7.58 |
| 16:45-17:00 | 0.13 | 1.42 | 1.56 | 0.73 | 1.56 | 2.29 | 0.87 | 0.82 | 1.69 | 2.53 | 0.16 | 2.69 | 8.22 |
| 17:00-17:15 | 0.93 | 1.02 | 1.96 | 1.51 | 1.27 | 2.78 | 1.24 | 1.42 | 2.67 | 3.87 | 0.60 | 4.47 | 11.87 |
| 17:15-17:30 | 0.78 | 1.47 | 2.24 | 1.09 | 2.13 | 3.22 | 2.27 | 2.91 | 5.18 | 2.09 | 0.36 | 2.44 | 13.09 |
| 17:30-17:45 | 0.60 | 1.33 | 1.93 | 1.56 | 2.98 | 4.53 | 1.04 | 2.22 | 3.27 | 2.42 | 0.47 | 2.89 | 12.62 |
| 17:45-18:00 | 0.40 | 1.22 | 1.62 | 1.69 | 2.56 | 4.24 | 1.60 | 2.09 | 3.69 | 2.67 | 0.73 | 3.40 | 12.96 |
| 18:00-18:15 | 0.18 | 1.22 | 1.40 | 1.53 | 1.87 | 3.40 | 0.78 | 1.73 | 2.51 | 3.27 | 0.40 | 3.67 | 10.98 |
| 18:15:18:30 | 0.20 | 0.82 | 1.02 | 1.18 | 1.36 | 2.53 | 0.73 | 1.56 | 2.29 | 2.84 | 0.20 | 3.04 | 8.89 |

# APPENDIX D

## COMPARISON OF OBSERVED AND SIMULATED DELAYS FOR 15-MINUTE PERIODS USING DEFAULT VALUES OF SATURATION FLOW RATES

Table D-2: Percentage Difference Between Observed and Simulated Average Total Stopped Delay at the Downstream Intersections of Study Site 1

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:30 - 6:45 | 0.00 | 1025.00 | 1150.00 | 90.76 | 188.83 | 157.50 | 0.00 | 0.00 | 2250.00 | 0.00 | 1058.75 | 1044.44 |
| 6:45 - 7:00 | 530.00 | 530.00 | 536.36 | 38.41 | 57.40 | 53.08 | 0.00 | 316.25 | 522.22 | 0.00 | 607.73 | 691.67 |
| 7:15 - 7:30 | 665.00 | 766.25 | 754.55 | 93.95 | -2.74 | 9.74 | 0.00 | 500.00 | 771.43 | 68.75 | -26.31 | -21.93 |
| 7:30 - 7:45 | 0.00 | 5570.00 | 6950.00 | 7.42 | -11.57 | -6.89 | 1610.00 | 156.50 | 295.83 | -64.00 | 188.00 | 124.72 |
| 7:45 - 8:00 | 0.00 | 822.50 | 846.15 | 82.18 | 29.36 | 43.91 | 2600.00 | -33.11 | 36.90 | -25.00 | 87.94 | 71.43 |
| 8:00 - 8:15 | 0.00 | 897.50 | 1046.15 | -11.02 | -4.06 | -6.16 | 0.00 | 95.88 | 371.05 | -25.00 | 91.02 | 78.69 |
| 8:15 - 8:30 | 200.00 | 620.00 | 480.00 | -59.01 | 33.50 | -17.26 | 2420.00 | 86.43 | 245.45 | -55.00 | 440.00 | 307.32 |
| 11:00-11:15 | 0.00 | 150.00 | 150.00 | 205.63 | 89.17 | 125.43 | 0.00 | 92.00 | 77.78 | 65.00 | 962.50 | 743.40 |
| 11:15-11:30 | 1340.00 | 201.50 | 312.50 | 97.31 | 31.88 | 49.08 | 800.00 | 1565.00 | 1355.56 | -13.60 | 703.79 | 371.67 |
| 11:30-11:45 | 455.00 | 467.00 | 455.56 | 305.00 | 27.93 | 89.50 | 1070.00 | 178.44 | 228.95 | 31.54 | 861.50 | 607.29 |
| 11:45-12:00 | 0.00 | 265.63 | 261.11 | 50.79 | 18.36 | 32.53 | 282.50 | 205.22 | 208.93 | -24.40 | 233.82 | 152.81 |
| 12:00-12:15 | 0.00 | 353.75 | 485.19 | 144.85 | 50.91 | 78.29 | 0.00 | 170.00 | 300.00 | -5.14 | 476.00 | 188.41 |
| 12:15-12:30 | 3680.00 | 456.87 | 815.00 | 263.21 | 86.52 | 137.04 | 935.00 | 568.57 | 605.56 | -20.23 | 525.18 | 285.59 |
| 12:30-12:45 | 0.00 | 243.93 | 345.16 | 25.22 | 172.81 | 124.68 | 1070.00 | 5.58 | 82.26 | 26.00 | 308.65 | 194.20 |
| 12:45-13:00 | 1272.50 | 6065.00 | 2728.57 | 238.28 | 92.86 | 135.45 | 93.50 | 40.19 | 55.00 | -19.42 | 661.03 | 281.29 |
| 16:30-16:45 | 1025.00 | 665.00 | 680.65 | 86.88 | -39.03 | 0.99 | 28.57 | 151.47 | 116.98 | -25.97 | 2.50 | -12.79 |
| 16:45-17:00 | 1250.00 | 1286.00 | 1273.68 | 81.07 | -39.52 | -2.47 | 755.00 | 335.00 | 355.56 | 8.66 | 18.47 | 14.00 |
| 17:00-17:15 | 1542.50 | 423.37 | 468.22 | 73.04 | -30.00 | 11.38 | 0.00 | 339.41 | 384.21 | -25.00 | 26.73 | 0.45 |
| 17:15-17:30 | 0.00 | 46.58 | 50.44 | 101.58 | 0.75 | 40.44 | 2060.00 | 1709.00 | 1815.38 | -40.68 | 17.69 | -18.97 |
| 17:30-17:45 | 878.75 | 57.34 | 79.51 | 158.49 | -42.23 | 1.36 | 0.00 | 288.93 | 332.26 | -10.00 | 7.83 | -0.86 |
| 17:45-18:00 | 629.00 | 295.60 | 318.75 | 76.69 | -46.37 | -7.35 | 185.00 | 499.06 | 452.38 | -10.82 | 95.88 | 29.80 |
| 18:00-18:15 | 0.00 | 172.70 | 194.59 | 110.94 | -32.18 | 19.84 | 800.00 | 127.05 | 156.86 | 36.10 | 62.69 | 48.88 |
| 18:15-18:30 | 1452.50 | 399.25 | 438.52 | 115.00 | -30.39 | 17.69 | 0.00 | 141.36 | 169.86 | -37.58 | 41.56 | -2.87 |

Table D-3: Percentage Difference Between Observed and Simulated Average Delay at the Critical Intersection of Study Site 2

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | -48.72 | 15.95 | 3.97 | 21.07 | 203.16 | 94.68 | -44.77 | 338.32 | 189.59 | 85.63 | 193.52 | 164.75 | 93.51 |
| 6:45 - 7:00 | -62.43 | 22.76 | -1.61 | 16.66 | 64.56 | 38.98 | -56.96 | 43.87 | 24.93 | 54.41 | 185.92 | 128.10 | 29.19 |
| 7:00 - 7:15 | -29.13 | 63.05 | 52.70 | 83.20 | 44.69 | 65.48 | -56.06 | 77.59 | 50.74 | 41.07 | 173.80 | 105.12 | 60.69 |
| 7:15 - 7:30 | -39.48 | 167.73 | 129.70 | 71.53 | 167.68 | 103.66 | -25.11 | 259.13 | 221.53 | 169.29 | 157.29 | 161.19 | 175.57 |
| 7:30 - 7:45 | 26.63 | 175.11 | 151.64 | 84.50 | 28.45 | 56.73 | -47.99 | 185.89 | 153.36 | 114.93 | 107.00 | 109.19 | 129.82 |
| 7:45 - 8:00 | -1.82 | 59.51 | 53.04 | 109.74 | 62.26 | 85.93 | -26.46 | 160.23 | 133.16 | 72.97 | 83.42 | 81.20 | 98.98 |
| 8:00 - 8:15 | -29.44 | 21.30 | 15.73 | 37.51 | 54.32 | 44.18 | -43.20 | 182.34 | 135.81 | 124.29 | 93.61 | 102.20 | 76.12 |
| 8:15 - 8:30 | -33.94 | 44.57 | 35.85 | 50.36 | 91.25 | 65.00 | -33.98 | 204.84 | 152.07 | 880.63 | 100.74 | 235.40 | 108.39 |
| 11:00-11:15 | -18.10 | 101.73 | 71.32 | -8.58 | 10.74 | 0.54 | 16.28 | 159.59 | 97.31 | 15.62 | 193.68 | 144.64 | 74.24 |
| 11:15-11:30 | -25.81 | 22.36 | 9.49 | -4.44 | 44.13 | 17.90 | 2.40 | 107.50 | 64.02 | 20.21 | 170.36 | 136.53 | 59.51 |
| 11:30-11:45 | 2.41 | 41.64 | 29.00 | -56.81 | 14.34 | -32.29 | 13.21 | 58.25 | 42.75 | 6.12 | 67.82 | 58.74 | 20.83 |
| 11:45-12:00 | 21.70 | 49.52 | 41.57 | -18.68 | 26.86 | 3.99 | 59.47 | 80.22 | 72.78 | -1.94 | 113.10 | 95.94 | 53.19 |
| 12:00-12:15 | -19.51 | 39.93 | 19.10 | -22.17 | 32.75 | 2.49 | -24.05 | 51.13 | 17.51 | -27.77 | 91.30 | 64.72 | 27.15 |
| 12:15-12:30 | -13.70 | 52.48 | 37.97 | -23.91 | 25.25 | -4.72 | -10.48 | 85.07 | 41.51 | 25.89 | 89.84 | 80.50 | 39.22 |
| 12:30-12:45 | -9.29 | 9.22 | -23.03 | -32.58 | 4.26 | -25.33 | 21.56 | 62.49 | 32.42 | 1.79 | 100.26 | 64.26 | 27.22 |
| 12:45-13:00 | -33.23 | 2.52 | -6.74 | -27.35 | 10.84 | -9.78 | -9.74 | 85.07 | 41.98 | -46.82 | 27.73 | 11.51 | 9.32 |
| 16:30-16:45 | -35.96 | 1.74 | -11.97 | 74.06 | 16.64 | 30.87 | 126.48 | 94.72 | 103.52 | -54.38 | 211.58 | 136.38 | 65.32 |
| 16:45-17:00 | 12.68 | 106.29 | 73.71 | 18.64 | 96.58 | 74.82 | 129.74 | 12.62 | 50.06 | -39.86 | 383.17 | 287.45 | 142.98 |
| 17:00-17:15 | 35.31 | -24.31 | -5.41 | 121.25 | 90.62 | 97.12 | 82.83 | 69.31 | 74.30 | -50.17 | 197.92 | 149.07 | 93.61 |
| 17:15-17:30 | 119.01 | 155.25 | 142.79 | -42.22 | 10.73 | 2.53 | 38.27 | 50.23 | 44.78 | -52.08 | 209.78 | 165.55 | 90.33 |
| 17:30-17:45 | 29.62 | 19.88 | 24.26 | -27.81 | -5.19 | -7.59 | 207.29 | 37.39 | 81.69 | -65.17 | -2.95 | -10.46 | 1.91 |
| 17:45-18:00 | 69.63 | 72.18 | 71.05 | 73.52 | 49.76 | 54.27 | 79.80 | 65.42 | 71.36 | -57.53 | 99.80 | 76.69 | 69.90 |
| 18:00-18:15 | -8.18 | 7.96 | 1.68 | 47.10 | 122.74 | 90.88 | 170.65 | 65.26 | 99.73 | -36.45 | 180.46 | 146.89 | 96.09 |
| 18:15:18:30 | -34.51 | -13.20 | -21.65 | 82.32 | 137.75 | 118.00 | 60.00 | 52.20 | 55.82 | -61.31 | 114.87 | 75.17 | 62.32 |

Table D-4: Percentage Difference Between Observed and Simulated Average Delay at the Downstream Intersections of Study Site 2

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:30 - 6:45 | 125.00 | 1441.25 | 651.50 | 366.15 | 226.25 | 342.34 | 0.00 | 0.00 | -30.00 | -38.13 | 101.52 | 65.48 |
| 6:45 - 7:00 | -10.00 | 148.11 | 94.46 | 119.13 | 210.50 | 130.70 | 0.00 | 0.00 | -39.25 | 485.00 | -2.60 | 3.99 |
| 7:15 - 7:30 | -20.23 | 6.55 | 1.15 | 48.52 | 93.85 | 50.82 | 0.00 | -32.50 | 63.64 | 530.00 | -40.96 | -36.43 |
| 7:30 - 7:45 | -0.62 | 87.26 | 62.73 | 5.92 | 108.64 | 8.97 | 158.75 | -66.54 | -45.58 | 5.00 | -58.07 | -55.99 |
| 7:45 - 8:00 | 3.03 | -31.37 | -26.28 | -0.03 | 165.91 | 4.88 | 237.50 | -73.00 | -47.65 | 116.00 | -20.67 | -13.97 |
| 8:00 - 8:15 | 15.12 | 140.77 | 102.18 | 123.32 | 247.14 | 129.47 | 0.00 | 65.79 | 117.89 | 2.86 | -53.50 | -50.99 |
| 8:15 - 8:30 | -22.45 | 130.49 | 74.77 | 200.36 | 74.71 | 179.00 | 102.50 | 89.00 | 95.00 | -46.00 | -2.15 | -8.66 |
| 11:00-11:15 | 24.50 | 230.39 | 139.56 | 363.70 | 125.00 | 302.10 | 0.00 | 179.64 | 250.36 | -5.50 | 211.54 | 151.25 |
| 11:15-11:30 | 36.80 | 102.02 | 79.38 | 155.00 | 310.62 | 187.76 | 170.00 | 66.30 | 84.82 | 22.73 | 157.14 | 110.94 |
| 11:30-11:45 | -18.44 | 170.00 | 73.78 | 262.25 | 95.00 | 199.53 | 523.57 | 112.84 | 178.18 | 21.15 | -23.36 | -15.84 |
| 11:45-12:00 | -10.85 | 365.43 | 138.81 | 380.94 | 32.50 | 196.47 | 496.25 | 89.84 | 171.13 | -14.74 | 6.87 | 0.75 |
| 12:00-12:15 | -14.43 | 149.66 | 74.96 | 236.67 | 48.50 | 156.60 | 340.00 | 61.16 | 109.42 | 20.68 | 46.25 | 35.00 |
| 12:15-12:30 | -29.64 | 80.00 | 25.68 | 419.23 | 200.00 | 314.00 | 189.29 | 64.57 | 85.36 | 61.25 | 46.25 | 50.34 |
| 12:30-12:45 | 7.21 | 159.00 | 93.67 | 258.04 | 11.32 | 146.43 | 110.94 | 5.00 | 32.79 | 9.57 | 5.00 | 6.42 |
| 12:45-13:00 | -25.00 | 268.18 | 92.27 | 221.28 | 12.50 | 146.49 | 165.71 | 64.63 | 98.87 | -8.04 | -13.52 | -12.07 |
| 16:30-16:45 | -5.71 | 367.79 | 120.75 | 147.50 | -17.16 | 59.15 | 815.00 | 370.65 | 486.57 | -8.20 | 38.46 | 20.23 |
| 16:45-17:00 | -21.92 | 436.60 | 121.03 | 137.86 | -39.32 | 29.58 | 1238.75 | 674.00 | 810.91 | 39.09 | -31.63 | -19.29 |
| 17:00-17:15 | -20.14 | 129.91 | 54.55 | 76.37 | -28.17 | 28.68 | 174.50 | 20.68 | 40.92 | -61.92 | -84.52 | -81.75 |
| 17:15-17:30 | -22.74 | 173.40 | 81.00 | 144.00 | -56.57 | -0.16 | 555.71 | -31.34 | 2.07 | -67.86 | -64.44 | -65.32 |
| 17:30-17:45 | -23.20 | 367.89 | 106.64 | 145.89 | -53.96 | -18.54 | 254.71 | -46.76 | -16.62 | -10.00 | -43.93 | -36.54 |
| 17:45-18:00 | -4.29 | 447.26 | 144.63 | 147.50 | -39.81 | 26.30 | 52.50 | -71.11 | -62.11 | -19.64 | -60.07 | -53.41 |
| 18:00-18:15 | 22.94 | 197.27 | 123.43 | 148.23 | -47.50 | 2.64 | 164.38 | -59.41 | -40.16 | -38.12 | -50.96 | -47.94 |
| 18:15-18:30 | -32.01 | 41.32 | 2.38 | 133.04 | 10.00 | 44.45 | 224.64 | -65.66 | -45.74 | 60.31 | -39.17 | -16.43 |

Table D-5: Percentage Difference Between Observed and Simulated Average Delay at the Critical Intersection of Study Site 3

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | -22.00 | -74.95 | -73.18 | -37.69 | 250.45 | 203.04 | 19.12 | 539.31 | 258.57 | 14.71 | 59.06 | 41.55 | 29.06 |
| 6:45 - 7:00 | -71.07 | -80.60 | -79.66 | 44.64 | 180.50 | 168.90 | 75.00 | 132.23 | 113.61 | -5.19 | -2.96 | -3.68 | 1.50 |
| 7:00 - 7:15 | -50.00 | -79.30 | -76.62 | -12.37 | 252.81 | 233.65 | -51.67 | 78.91 | 27.32 | 15.82 | 93.13 | 64.55 | 34.71 |
| 7:15 - 7:30 | 47.60 | -58.42 | -50.93 | -5.65 | 141.25 | 134.04 | -10.44 | 49.67 | 27.87 | 61.68 | 72.74 | 70.56 | 48.10 |
| 7:30 - 7:45 | 43.05 | 30.86 | 32.88 | 117.17 | 397.39 | 387.66 | 8.59 | 170.17 | 114.56 | 5.57 | 216.89 | 158.32 | 417.62 |
| 7:45 - 8:00 | 44.72 | 43.21 | 43.47 | 75.91 | 207.54 | 199.59 | -38.67 | 40.49 | 18.18 | 48.89 | 25.72 | 28.52 | 64.96 |
| 8:00 - 8:15 | 13.76 | 15.71 | 15.46 | 2.86 | 113.25 | 98.45 | -7.63 | 102.73 | 61.88 | -33.30 | -13.83 | -17.17 | 30.19 |
| 8:15 - 8:30 | 80.58 | 40.15 | 44.96 | 183.06 | 336.91 | 323.70 | 20.28 | 119.93 | 85.64 | 81.49 | 31.61 | 39.91 | 94.93 |
| 11:00-11:15 | -12.14 | 69.83 | 56.75 | 27.32 | 611.08 | 297.53 | 20.47 | 61.49 | 45.53 | 33.21 | 38.15 | 36.32 | 78.29 |
| 11:15-11:30 | 173.53 | 260.35 | 245.84 | 54.16 | 942.56 | 534.70 | 19.25 | 70.87 | 53.91 | 76.83 | 95.91 | 88.51 | 178.39 |
| 11:30-11:45 | -18.87 | 214.68 | 167.97 | 111.63 | 986.00 | 557.31 | 40.86 | 50.67 | 47.39 | 114.59 | 58.51 | 75.22 | 143.54 |
| 11:45-12:00 | 16.47 | 229.40 | 181.35 | 22.93 | 1057.08 | 506.43 | 67.86 | 84.61 | 79.65 | 116.11 | 38.37 | 58.81 | 151.52 |
| 12:00-12:15 | 66.81 | 300.16 | 241.32 | 69.43 | 983.78 | 502.93 | -38.57 | 50.98 | 9.74 | 76.29 | 66.98 | 69.82 | 140.80 |
| 12:15-12:30 | 68.33 | 322.62 | 265.72 | 258.14 | 413.85 | 575.65 | -13.30 | 43.91 | 21.56 | 56.08 | 40.66 | 46.15 | 137.81 |
| 12:30-12:45 | 75.99 | 364.57 | 280.09 | 42.08 | 671.00 | 391.48 | -10.78 | 59.51 | 29.09 | 124.14 | 46.63 | 66.71 | 139.94 |
| 12:45-13:00 | 102.50 | 403.66 | 343.72 | 128.37 | 801.70 | 417.50 | -6.25 | 89.19 | 108.34 | 113.06 | -0.07 | 75.54 | 151.50 |
| 16:30-16:45 | 14.47 | 233.19 | 194.55 | 98.00 | 61.90 | 68.27 | 55.07 | 36.87 | 44.56 | 81.42 | 230.72 | 199.20 | 114.58 |
| 16:45-17:00 | -11.98 | 651.42 | 485.57 | 165.30 | 49.29 | 74.40 | 100.01 | 27.02 | 53.88 | 94.82 | 185.20 | 160.65 | 323.62 |
| 17:00-17:15 | 11.90 | 178.19 | 154.70 | 10.57 | 7.43 | 8.35 | 33.12 | -18.84 | -3.54 | 86.24 | 457.62 | 330.43 | 88.08 |
| 17:15-17:30 | 41.48 | 330.83 | 296.44 | 30.15 | -16.81 | -6.35 | -9.12 | -42.82 | -35.24 | 22.35 | 361.50 | 256.22 | 148.42 |
| 17:30-17:45 | -41.09 | 236.88 | 183.30 | -18.83 | 30.97 | 13.59 | 20.95 | 80.83 | 60.42 | 81.13 | 119.46 | 108.85 | 146.52 |
| 17:45-18:00 | -29.74 | 240.28 | 192.50 | 109.58 | 119.46 | 116.73 | 56.99 | 30.62 | 41.78 | -9.64 | 136.17 | 96.78 | 219.98 |
| 18:00-18:15 | 18.74 | 246.26 | 179.09 | 3.65 | 14.89 | 12.30 | -21.06 | -28.77 | -26.68 | 97.01 | 166.61 | 143.79 | 46.86 |
| 18:15:18:30 | 21.99 | 955.89 | 689.28 | 85.35 | 81.96 | 82.70 | -44.72 | 29.54 | 4.27 | 79.69 | 259.66 | 211.55 | 375.53 |

Table D-6: Percentage Difference Between Observed and Simulated Average Delay at the Downstream Intersections of Study Site 3

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:45 - 7:00 | 191.52 | 104.51 | 119.33 | 1610.00 | 1081.25 | 1140.00 | 0.00 | -59.93 | -58.70 | 185.00 | 135.48 | 140.91 |
| 7:00 - 7:15 | 352.65 | 220.29 | 253.38 | 580.62 | 5945.00 | 3799.25 | -99.83 | -65.14 | -92.57 | 164.38 | 46.86 | 52.88 |
| 7:15 - 7:30 | 527.35 | 316.16 | 360.21 | 253.86 | 2790.23 | 1944.77 | -99.91 | -74.82 | -95.26 | 155.00 | 95.84 | 102.18 |
| 7:30 - 7:45 | 74.71 | 201.30 | 169.47 | 171.80 | 3342.92 | 1803.54 | -99.90 | -72.54 | -93.55 | 80.00 | 97.13 | 95.70 |
| 7:45 - 8:00 | 301.29 | 459.89 | 416.26 | 152.00 | 1752.57 | 1188.27 | -99.89 | -86.23 | -96.14 | 163.25 | 191.80 | 186.92 |
| 8:00 - 8:15 | 344.06 | 80.88 | 114.82 | 252.77 | 1969.18 | 1103.24 | -96.88 | -4.23 | -72.91 | 278.75 | 23.00 | 41.94 |
| 8:15 - 8:30 | 860.58 | 339.01 | 386.09 | 233.00 | 2899.51 | 1698.38 | -99.79 | -83.31 | -94.95 | 73.25 | 253.20 | 219.25 |
| 11:00-11:15 | 55.66 | 137.16 | 124.18 | 86.88 | 1191.01 | 600.75 | -98.25 | -76.70 | -85.48 | 351.88 | 1191.15 | 788.30 |
| 11:15-11:30 | 7.61 | 97.51 | 83.21 | 31.15 | 318.45 | 210.37 | -97.75 | -67.92 | -81.10 | 371.72 | 1166.43 | 705.50 |
| 11:30-11:45 | -67.73 | 51.67 | 34.13 | 63.38 | 1023.02 | 390.45 | -99.37 | -84.01 | -92.33 | 706.54 | 463.20 | 504.29 |
| 11:45-12:00 | -23.93 | 26.49 | 21.52 | 79.47 | 2115.47 | 490.49 | -98.86 | -78.85 | -87.68 | 612.50 | 622.81 | 620.75 |
| 12:00-12:15 | 62.95 | 85.46 | 83.43 | 15.24 | 936.63 | 324.86 | -98.29 | -68.05 | -79.43 | 410.65 | 1082.86 | 779.71 |
| 12:15-12:30 | -5.29 | 78.96 | 66.46 | 61.34 | 1120.07 | 365.67 | -98.25 | -71.01 | -82.60 | 404.00 | 711.41 | 576.58 |
| 12:30-12:45 | 106.85 | 74.91 | 77.64 | 83.52 | 1086.43 | 331.29 | -98.95 | -78.05 | -86.13 | 374.00 | 444.41 | 418.33 |
| 12:45-13:00 | -16.53 | 24.95 | 19.63 | 60.51 | 979.00 | 395.18 | -99.00 | -77.05 | -87.40 | 327.50 | 409.06 | 388.20 |
| 16:45-17:00 | 49.50 | 242.89 | 219.93 | 37.63 | -8.83 | -0.35 | -97.87 | -23.50 | -80.02 | 117.73 | 1688.75 | 658.74 |
| 17:00-17:15 | 65.00 | 674.90 | 632.86 | 95.43 | 62.52 | 68.03 | -97.04 | -54.53 | -84.44 | 173.79 | 889.03 | 527.61 |
| 17:15-17:30 | 14.70 | 385.98 | 368.86 | -6.81 | -32.87 | -29.08 | -97.19 | -23.97 | -76.16 | -16.65 | 1048.33 | 238.57 |
| 17:30-17:45 | 120.91 | 271.15 | 265.33 | 1.02 | -61.71 | -56.57 | -99.17 | -76.35 | -94.09 | 19.86 | 1137.13 | 265.02 |
| 17:45-18:00 | 53.00 | 546.50 | 514.00 | -20.66 | -78.63 | -74.15 | -95.94 | 18.69 | -68.57 | 40.59 | 1228.45 | 380.67 |
| 18:00-18:15 | 36.23 | 207.84 | 199.38 | -41.49 | -74.15 | -70.29 | -96.85 | 0.75 | -71.01 | 89.70 | 880.19 | 341.37 |

Table D-7: Percentage Difference Between Observed and Simulated Average Delay at the Critical Intersection of Study Site 4

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | 38.88 | 147.19 | 124.51 | 73.65 | 55.13 | 58.04 | 42.50 | 55.85 | 52.11 | -3.81 | 127.53 | 80.59 | 74.42 |
| 6:45 - 7:00 | 107.00 | 47.49 | 58.40 | 85.70 | 74.78 | 76.47 | 6.79 | 75.50 | 52.71 | 20.14 | 8.06 | 10.52 | 46.85 |
| 7:00 - 7:15 | 64.77 | 128.09 | 103.44 | 46.39 | 96.10 | 87.50 | 42.94 | 114.75 | 93.14 | 24.41 | 7.38 | 10.60 | 60.38 |
| 7:15 - 7:30 | 94.52 | 146.20 | 128.69 | 4.12 | 60.02 | 47.92 | -18.67 | 71.34 | 36.67 | 4.22 | 21.19 | 16.99 | 41.76 |
| 7:30 - 7:45 | 80.61 | 83.17 | 82.54 | 41.71 | 36.64 | 37.51 | 9.36 | 19.34 | 17.17 | 75.87 | 21.76 | 31.85 | 35.27 |
| 7:45 - 8:00 | 70.16 | 77.98 | 76.65 | 53.39 | 102.74 | 83.17 | -50.47 | 18.41 | -7.15 | 13.70 | -7.47 | -2.95 | 24.45 |
| 8:00 - 8:15 | 17.73 | 60.77 | 49.20 | 34.66 | 80.00 | 65.47 | -28.83 | 93.12 | 37.99 | 55.00 | -5.22 | 3.78 | 35.88 |
| 8:15 - 8:30 | 49.71 | 148.23 | 119.12 | 38.98 | 58.15 | 52.58 | 8.92 | 34.35 | 28.26 | 38.80 | 17.10 | 21.44 | 46.15 |
| 11:00-11:15 | -34.03 | -23.14 | -26.45 | -2.94 | 12.74 | 5.66 | -23.63 | 236.86 | 107.36 | 60.83 | 189.88 | 151.80 | 45.15 |
| 11:15-11:30 | -33.02 | -32.32 | -32.50 | -7.69 | 4.64 | -0.57 | 96.29 | 265.81 | 224.15 | 120.91 | 160.36 | 150.92 | 54.76 |
| 11:30-11:45 | -20.98 | -23.67 | -23.03 | -27.76 | 1.35 | -12.63 | -37.27 | 123.73 | 62.13 | -11.59 | 186.24 | 109.11 | 19.08 |
| 11:45-12:00 | -18.93 | -48.97 | -41.38 | -30.99 | 9.21 | -11.61 | -1.53 | 260.19 | 144.56 | 152.00 | 180.03 | 175.21 | 35.27 |
| 12:00-12:15 | 3.80 | -44.05 | -36.61 | 27.09 | 33.26 | 30.72 | 50.00 | 222.13 | 166.69 | 65.00 | 136.19 | 117.76 | 52.74 |
| 12:15-12:30 | -5.61 | -33.71 | -29.01 | 4.07 | 12.23 | 8.78 | 104.81 | 250.76 | 208.28 | 46.57 | 119.35 | 100.41 | 45.98 |
| 12:30-12:45 | -24.62 | -31.96 | -26.84 | 4.52 | 12.81 | 39.52 | 30.60 | 195.52 | 167.35 | 50.92 | 76.31 | 109.60 | 32.08 |
| 12:45-13:00 | -16.33 | -35.12 | -31.22 | -8.21 | 3.94 | -1.34 | 15.55 | 140.16 | 96.26 | 68.90 | 229.41 | 171.12 | 29.78 |
| 16:30-16:45 | 30.00 | 46.01 | 44.11 | 76.52 | 94.29 | 86.23 | 77.22 | 17.62 | 37.29 | 75.26 | 63.82 | 64.82 | 56.45 |
| 16:45-17:00 | 93.91 | 18.04 | 24.36 | -15.95 | 67.47 | 17.78 | 53.59 | 64.73 | 61.01 | 99.07 | 67.73 | 71.35 | 39.92 |
| 17:00-17:15 | 16.02 | -8.02 | -4.44 | 111.92 | 315.15 | 200.41 | 241.08 | 157.68 | 191.97 | 114.50 | 402.20 | 367.95 | 155.28 |
| 17:15-17:30 | 6.38 | -0.88 | 0.65 | 211.27 | 630.97 | 444.76 | 265.64 | 132.61 | 216.41 | 80.56 | 489.20 | 453.95 | 280.04 |
| 17:30-17:45 | 46.49 | 79.29 | 77.51 | 301.86 | 620.32 | 473.40 | 360.29 | 116.03 | 219.51 | 73.40 | 466.91 | 426.97 | 246.36 |
| 17:45-18:00 | 11.15 | -0.82 | 0.38 | 71.31 | 81.86 | 78.09 | 126.76 | 40.90 | 66.90 | 54.21 | 14.42 | 17.96 | 30.72 |
| 18:00-18:15 | 47.05 | -55.29 | -47.56 | 25.33 | 42.21 | 36.75 | -25.18 | 144.63 | 46.21 | 118.18 | 111.28 | 112.44 | 4.19 |
| 18:15:18:30 | 51.62 | -77.51 | -72.38 | 79.24 | 79.65 | 79.48 | -56.87 | 55.18 | -7.61 | 93.38 | 117.00 | 112.51 | -28.92 |

Table D-8: Percentage Difference Between Observed and Simulated Average Delay at the Downstream Intersections of Study Site 4

| TIME PERIOD | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| (hours) | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:45 - 7:00 | 0.00 | 649.25 | 649.25 | 12.50 | 116.00 | 103.82 | 0.00 | 0.00 | -28.60 | -100.00 | 86.43 | 77.95 |
| 7:00 - 7:15 | 0.00 | 293.75 | 293.75 | -59.50 | 6.20 | 0.23 | 0.00 | -26.69 | -20.00 | -3.57 | 2150.00 | 475.00 |
| 7:15 - 7:30 | 0.00 | 1917.50 | 1917.50 | -17.50 | 98.44 | 88.06 | 0.00 | -34.33 | -27.17 | 575.00 | 3027.50 | 2210.00 |
| 7:30 - 7:45 | 0.00 | 512.69 | 512.69 | -1.00 | 125.57 | 118.04 | 71.56 | -53.42 | -42.73 | 282.50 | 4625.00 | 1730.00 |
| 7:45 - 8:00 | 0.00 | 651.00 | 651.00 | -38.13 | 9.83 | 4.10 | 800.00 | -72.77 | -65.34 | 2.86 | 2161.25 | 787.73 |
| 8:00 - 8:15 | 0.00 | 510.71 | 510.71 | -70.88 | 28.41 | -16.60 | 0.00 | -43.88 | -17.42 | 0.00 | 1730.00 | 1910.00 |
| 8:15 - 8:30 | 0.00 | 627.20 | 627.20 | -43.75 | 29.71 | 6.20 | 117.50 | 29.45 | 36.14 | 0.00 | 746.00 | 872.00 |
| 11:00-11:15 | 0.00 | 37.14 | 37.14 | 111.94 | -64.00 | 87.50 | 0.00 | 188.26 | 183.03 | 305.00 | 33.45 | 36.53 |
| 11:15-11:30 | 0.00 | 2735.00 | 2735.00 | -40.00 | -77.50 | -44.41 | 665.00 | 240.96 | 248.96 | 1.25 | -12.20 | -11.49 |
| 11:30-11:45 | 0.00 | 21.30 | 21.30 | 29.19 | -82.00 | 13.75 | 245.00 | 322.57 | 320.42 | -10.00 | 8.43 | 7.73 |
| 11:45-12:00 | 0.00 | 293.75 | 293.75 | -44.14 | -70.00 | -45.41 | ERR | 21.27 | 21.27 | 35.00 | -6.07 | -5.12 |
| 12:00-12:15 | 0.00 | 7.42 | 7.42 | -25.94 | -77.50 | -31.67 | -16.14 | 208.03 | 155.00 | -7.63 | 11.43 | 9.49 |
| 12:15-12:30 | 0.00 | 53.33 | 53.33 | -16.86 | -73.00 | -21.25 | 6.07 | 193.64 | 157.67 | 95.00 | 10.21 | 11.71 |
| 12:30-12:45 | 0.00 | 172.37 | 172.37 | 40.29 | -70.00 | 31.35 | 41.75 | 67.60 | 64.08 | 70.00 | -24.92 | -20.42 |
| 12:45-13:00 | 0.00 | 243.42 | 243.42 | 119.00 | -55.00 | 98.53 | -14.09 | 34.58 | 30.04 | -44.62 | 7.47 | 3.77 |
| 16:30-16:45 | 0.00 | 161.82 | 161.82 | -18.06 | -77.50 | -19.78 | -21.61 | -73.39 | -69.61 | 55.77 | -59.42 | -53.10 |
| 16:45-17:00 | 0.00 | 845.00 | 845.00 | -31.80 | -55.00 | -32.15 | -25.00 | -28.06 | -27.78 | 16.05 | -58.36 | -51.93 |
| 17:00-17:15 | 0.00 | 361.25 | 361.25 | 19.57 | -85.00 | 15.27 | 93.50 | -40.40 | -34.70 | 145.45 | -61.40 | -51.15 |
| 17:15-17:30 | 0.00 | 268.13 | 268.13 | 21.76 | -55.00 | 18.87 | 61.47 | -71.40 | -65.13 | 96.58 | -61.00 | -47.93 |
| 17:30-17:45 | 0.00 | 292.46 | 292.46 | 34.26 | -55.00 | 31.43 | 80.00 | -54.55 | -40.80 | 5.00 | -67.12 | -60.33 |
| 17:45-18:00 | 0.00 | 414.08 | 414.08 | 30.67 | -55.00 | 29.06 | 21.15 | -59.20 | -55.33 | 30.26 | -68.81 | -62.97 |
| 18:00-18:15 | 0.00 | 713.29 | 713.29 | -45.16 | 35.00 | -42.73 | 192.50 | -62.36 | -58.54 | 10.32 | -44.44 | -36.36 |
| 18:15-18:30 | 0.00 | 712.50 | 712.50 | -51.67 | 80.00 | -46.96 | 95.00 | -54.12 | -50.72 | 52.68 | -46.52 | -33.84 |

Table D-9: Percentage Difference Between Observed and Simulated Average Delay at the Critical Intersection of Study Site 5

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | 205.69 | 118.66 | 143.90 | 1445.00 | 322.59 | 360.00 | 17.14 | 3.83 | 7.29 | -30.45 | 6.00 | 2.75 | 72.51 |
| 6:45 - 7:00 | -2.58 | 174.15 | 101.38 | 1550.00 | 1739.38 | 1718.33 | 17.69 | -22.83 | -11.76 | 37.65 | 124.53 | 111.40 | 111.60 |
| 7:00 - 7:15 | 210.11 | 231.94 | 224.71 | 614.38 | 8067.50 | 5086.25 | -19.94 | -5.20 | -10.39 | -2.93 | 80.11 | 67.85 | 146.27 |
| 7:15 - 7:30 | 136.86 | 289.66 | 220.21 | 288.64 | 4182.16 | 2884.32 | -38.42 | 32.76 | 2.14 | -23.17 | 94.73 | 80.59 | 197.05 |
| 7:30 - 7:45 | 137.54 | 540.31 | 332.23 | 187.10 | 4180.09 | 2241.75 | 399.79 | 403.15 | 402.18 | 0.47 | 119.00 | 111.84 | 373.40 |
| 7:45 - 8:00 | 47.46 | 555.48 | 256.19 | 184.73 | 2463.66 | 1660.19 | 540.38 | 386.10 | 434.24 | 10.38 | 38.08 | 37.01 | 226.52 |
| 8:00 - 8:15 | 187.53 | 894.59 | 546.55 | 294.55 | 2471.55 | 1373.24 | 44.37 | 94.94 | 72.80 | 27.34 | 69.09 | 66.91 | 212.06 |
| 8:15 - 8:30 | 17.90 | 798.85 | 248.64 | 263.60 | 3774.43 | 2192.97 | 5.41 | 67.16 | 40.44 | -15.96 | 51.48 | 45.48 | 207.48 |
| 11:00-11:15 | -20.80 | 60.75 | 21.66 | 33.94 | 945.95 | 458.40 | 102.50 | 150.12 | 134.16 | 56.67 | 154.07 | 140.08 | 117.45 |
| 11:15-11:30 | -34.68 | 120.02 | 23.46 | -3.85 | 273.45 | 169.13 | 3.09 | 40.84 | 30.10 | -7.91 | -54.50 | -52.58 | 12.98 |
| 11:30-11:45 | 2.52 | 478.39 | 153.08 | 25.28 | 934.01 | 335.00 | 98.05 | 49.87 | 62.58 | 52.42 | 27.97 | 30.87 | 114.34 |
| 11:45-12:00 | -36.14 | 67.99 | 8.66 | 41.88 | 1777.44 | 392.25 | 147.20 | 203.56 | 184.73 | 13.00 | -0.76 | 0.39 | 76.75 |
| 12:00-12:15 | -19.02 | 321.23 | 84.75 | -11.92 | 839.04 | 274.03 | 78.36 | 66.99 | 69.99 | 77.10 | 2.49 | 11.34 | 83.65 |
| 12:15-12:30 | 20.19 | 150.75 | 91.25 | 30.40 | 933.73 | 290.06 | 73.91 | 95.98 | 89.58 | 8.82 | -5.66 | -4.35 | 86.87 |
| 12:30-12:45 | -18.98 | 156.22 | 37.03 | 57.50 | 982.14 | 337.47 | 51.94 | 192.97 | 114.45 | -12.54 | -33.18 | -31.54 | 70.29 |
| 12:45-13:00 | -15.84 | 183.47 | 63.20 | 35.00 | 913.00 | 362.88 | 59.87 | 199.03 | 144.82 | -1.71 | -13.96 | -12.58 | 95.29 |
| 16:30-16:45 | 101.67 | 1477.53 | 648.33 | 41.74 | 26.87 | 30.05 | 48.34 | 10.46 | 25.15 | -31.23 | 6.69 | 3.96 | 66.57 |
| 16:45-17:00 | 14.74 | 601.66 | 271.67 | 40.98 | 3.24 | 10.12 | -3.67 | -20.45 | -13.53 | -45.60 | -6.07 | -9.20 | 26.04 |
| 17:00-17:15 | 22.65 | 577.32 | 296.84 | 125.26 | 99.03 | 103.43 | 72.24 | -42.34 | -12.37 | 90.91 | 46.28 | 48.21 | 60.88 |
| 17:15-17:30 | -69.09 | 22.27 | -25.85 | 0.87 | -17.82 | -15.10 | -25.75 | -85.74 | -79.56 | -32.95 | -16.98 | -18.80 | -56.99 |
| 17:30-17:45 | -53.36 | 143.15 | 30.48 | 7.26 | -53.26 | -48.30 | 0.43 | -75.09 | -63.47 | -21.96 | -0.98 | -2.71 | -39.45 |
| 17:45-18:00 | -45.04 | 239.29 | 81.23 | -17.22 | -74.97 | -70.52 | -0.31 | -63.37 | -51.02 | 10.38 | 5.60 | 6.20 | -40.33 |
| 18:00-18:15 | -78.27 | 82.82 | -10.37 | -38.30 | -72.82 | -68.74 | -18.62 | -42.33 | -37.72 | 17.44 | 54.68 | 48.73 | -39.00 |
| 18:15:18:30 | 64.17 | 730.75 | 364.06 | -26.20 | -43.34 | -40.90 | -20.29 | -53.76 | -46.22 | 46.55 | -13.45 | -6.73 | -10.10 |

Table D-10: Percentage Difference Between Observed and Simulated Average Total Stopped Delay at the Downstream Intersections of Study Site 5

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:30 - 6:45 | 0.00 | -79.32 | -77.50 | 372.50 | 264.68 | 269.62 | 0.00 | 1016.56 | 674.38 | 0.00 | 330.43 | 282.50 |
| 6:45 - 7:00 | 0.00 | -88.66 | -86.72 | 605.00 | 661.64 | 654.93 | 0.00 | 940.29 | 321.00 | -52.00 | -5.91 | -11.97 |
| 7:00 - 7:15 | 0.00 | -87.09 | -83.48 | 252.89 | 738.91 | 684.59 | -65.10 | 627.83 | 156.25 | 206.00 | -51.35 | -42.94 |
| 7:15 - 7:30 | 0.00 | -56.44 | -48.70 | 137.69 | 990.20 | 900.34 | -65.13 | 163.57 | 35.63 | 248.75 | -61.80 | -57.06 |
| 7:30 - 7:45 | 0.00 | 32.46 | 34.29 | 76.75 | 783.35 | 692.85 | -66.34 | 104.13 | -3.78 | 330.71 | -75.04 | -66.84 |
| 7:45 - 8:00 | 0.00 | 42.68 | 43.03 | 267.23 | 944.56 | 875.60 | -53.58 | 78.26 | 28.16 | 32.75 | -82.22 | -78.27 |
| 8:00 - 8:15 | 0.00 | 18.19 | 15.46 | 228.58 | 1969.69 | 1701.44 | 0.00 | 743.75 | 143.71 | 0.00 | -76.10 | -72.89 |
| 8:15 - 8:30 | 0.00 | 40.85 | 45.72 | 168.25 | 819.95 | 721.56 | -66.68 | 120.99 | 15.02 | 0.00 | -77.41 | -75.68 |
| 11:15-11:30 | 0.00 | 163.44 | 154.51 | 446.43 | 27.84 | 46.04 | -4.81 | -67.12 | -48.55 | 395.00 | 182.07 | 196.59 |
| 11:30-11:45 | 0.00 | 133.71 | 100.41 | 77.92 | 1.44 | 13.19 | -10.44 | -67.63 | -51.52 | 185.88 | -16.66 | -0.49 |
| 11:45-12:00 | 0.00 | 143.90 | 109.37 | 358.18 | 148.58 | 163.99 | ERR | -69.11 | -58.90 | 130.00 | 24.82 | 33.92 |
| 12:00-12:15 | 0.00 | 195.38 | 153.27 | 26.16 | 134.37 | 119.98 | -31.82 | -79.70 | -64.34 | 107.50 | 10.64 | 19.40 |
| 12:15-12:30 | 0.00 | 218.84 | 177.21 | 103.40 | 160.23 | 152.69 | -40.80 | -79.20 | -65.47 | 343.57 | 97.80 | 110.00 |
| 12:30-12:45 | 0.00 | 242.48 | 182.00 | 16.33 | -11.29 | -6.21 | -42.24 | -77.96 | -66.58 | 275.00 | 19.41 | 37.07 |
| 12:45-13:00 | 0.00 | 280.10 | 225.12 | 71.56 | 59.79 | 61.27 | -27.92 | -60.67 | -46.35 | 324.29 | 23.54 | 42.17 |
| 16:30-16:45 | 0.00 | 498.50 | 413.29 | 157.97 | 962.78 | 653.71 | -71.23 | 14.32 | -12.17 | 145.89 | 89.38 | 93.00 |
| 16:45-17:00 | 0.00 | 502.26 | 370.52 | 119.66 | 665.20 | 477.52 | -33.81 | -38.75 | -37.50 | 72.12 | 34.14 | 36.61 |
| 17:00-17:15 | 0.00 | 61.99 | 52.38 | 101.91 | 1087.76 | 643.10 | -67.40 | -80.30 | -76.53 | -2.84 | 36.76 | 31.96 |
| 17:15-17:30 | 0.00 | 236.80 | 210.81 | 17.89 | 2383.52 | 1157.54 | -56.47 | -73.72 | -70.71 | 38.39 | 26.39 | 27.61 |
| 17:30-17:45 | 0.00 | 161.27 | 120.16 | 161.15 | 916.04 | 488.34 | -38.26 | -94.91 | -90.76 | 80.68 | -36.86 | -32.38 |
| 17:45-18:00 | 0.00 | 187.84 | 148.14 | 84.43 | 1253.24 | 883.82 | -38.48 | -91.99 | -87.57 | 10.85 | -11.71 | -9.63 |
| 18:00-18:15 | 0.00 | 194.32 | 126.54 | 244.06 | 242.99 | 243.28 | 125.84 | -96.89 | -78.30 | 65.79 | 29.87 | 35.59 |
| 18:15:18:30 | 0.00 | 839.39 | 603.59 | 44.72 | 800.27 | 427.10 | -61.50 | -87.26 | -80.39 | 30.29 | 64.63 | 60.11 |

Table D-11: Percentage Difference Between Observed and Simulated Average Stopped Delay at the Critical Intersection of Study Site 6

| TIME PERIOD (hours) | Percent Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | 17.00 | 469.25 | 243.13 | 27.17 | 179.64 | 110.88 | -35.24 | 33.06 | 15.22 | -35.00 | 178.18 | 141.98 | 102.70 |
| 6:45 - 7:00 | 16.79 | 196.40 | 122.80 | 43.75 | 310.29 | 173.21 | 13.37 | -53.30 | -34.46 | 54.29 | -20.18 | -5.29 | 53.91 |
| 7:00 - 7:15 | 18.31 | 188.28 | 140.81 | 103.40 | 193.11 | 156.94 | 60.83 | -57.26 | -29.89 | 65.00 | -7.29 | 3.78 | 55.93 |
| 7:15 - 7:30 | -21.54 | 134.00 | 81.93 | 81.41 | 216.80 | 163.96 | 3.98 | -6.95 | -3.77 | 3.33 | 142.71 | 111.61 | 56.59 |
| 7:30 - 7:45 | -34.15 | 24.13 | 11.55 | 78.64 | 89.37 | 86.00 | -4.55 | -11.08 | -9.23 | 147.50 | 75.30 | 78.39 | 21.74 |
| 7:45 - 8:00 | -23.76 | 50.75 | 22.66 | -8.39 | 194.85 | 102.32 | -33.38 | -11.29 | -17.24 | 14.15 | 86.71 | 67.52 | 28.69 |
| 8:00 - 8:15 | -24.59 | 61.79 | 29.83 | 36.61 | 117.50 | 91.76 | -29.09 | -28.20 | -28.51 | 23.75 | 61.92 | 54.92 | 18.82 |
| 8:15 - 8:30 | -10.00 | 101.65 | 53.91 | 44.00 | 333.93 | 213.13 | 39.74 | -25.75 | -11.77 | 74.00 | 86.25 | 84.14 | 50.76 |
| 11:00-11:15 | -9.02 | 98.00 | 33.22 | 65.00 | 123.95 | 106.56 | 148.28 | 3.85 | 48.40 | -7.35 | 34.52 | 28.05 | 48.86 |
| 11:15-11:30 | -1.00 | 126.50 | 44.00 | 12.50 | 205.53 | 130.81 | 72.06 | 60.71 | 65.36 | 29.00 | 66.76 | 61.10 | 70.86 |
| 11:30-11:45 | 41.55 | 137.66 | 76.90 | 98.00 | 146.86 | 136.00 | 5.94 | 139.59 | 99.25 | -62.94 | 82.98 | 65.00 | 92.15 |
| 11:45-12:00 | -4.77 | 67.14 | 18.83 | 36.67 | 305.00 | 191.80 | 63.64 | -28.65 | -2.45 | 58.48 | 69.10 | 67.48 | 49.19 |
| 12:00-12:15 | -7.26 | 63.42 | 15.13 | 6.36 | 105.31 | 70.20 | 38.12 | 8.23 | 22.48 | 16.59 | 28.30 | 26.95 | 32.54 |
| 12:15-12:30 | -10.48 | -23.39 | -16.57 | 32.00 | 106.74 | 93.39 | 107.00 | -18.38 | 11.32 | 1.25 | -2.84 | -2.34 | 9.56 |
| 12:30-12:45 | -32.15 | 48.70 | 69.05 | 37.14 | 121.43 | 142.68 | 110.79 | -12.44 | 58.98 | 9.04 | 34.22 | 45.14 | 30.54 |
| 12:45-13:00 | 95.92 | 15.96 | 60.38 | 35.78 | 69.05 | 54.43 | -48.71 | 4.21 | -12.09 | 22.40 | 41.53 | 38.32 | 23.30 |
| 16:30-16:45 | -24.40 | 122.50 | 23.24 | 35.00 | 90.13 | 77.80 | 12.32 | 57.91 | 38.30 | -60.32 | 44.26 | 14.88 | 38.60 |
| 16:45-17:00 | -31.99 | 37.29 | -10.70 | 10.62 | 121.54 | 106.75 | 13.75 | 0.99 | 4.75 | -14.84 | 4.32 | 0.11 | 17.68 |
| 17:00-17:15 | 95.49 | -2.56 | 45.48 | 171.02 | 32.97 | 45.42 | 67.93 | 7.61 | 31.74 | -25.94 | 72.95 | 56.44 | 46.41 |
| 17:15-17:30 | -10.00 | -20.32 | -14.29 | 155.00 | 86.95 | 94.02 | 93.03 | 10.23 | 33.19 | -58.52 | -3.87 | -15.43 | 14.60 |
| 17:30-17:45 | 21.27 | -11.75 | 9.13 | 62.63 | 102.57 | 96.35 | 147.72 | -13.50 | 39.54 | -48.61 | 9.04 | -3.25 | 28.33 |
| 17:45-18:00 | -12.92 | 11.21 | -2.15 | 25.16 | 67.06 | 58.44 | 41.72 | -25.25 | -7.21 | -35.00 | 15.87 | 4.47 | 13.41 |
| 18:00-18:15 | 18.24 | 57.50 | 30.77 | -1.71 | 152.91 | 117.72 | 85.94 | 6.51 | 28.44 | -23.45 | 8.58 | 1.85 | 32.90 |
| 18:15:18:30 | 36.97 | 1.79 | 22.05 | 0.29 | 69.06 | 57.92 | -7.61 | -35.30 | -26.47 | -33.92 | 9.84 | 1.02 | 8.60 |

Table D-12: Percentage Difference Between Observed and Simulated Average Total Stopped Delay at the Downstream Intersections of Study Site 6

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:30 - 6:45 | 135.00 | 1216.74 | 912.50 | 83.75 | 131.92 | 108.80 | -28.57 | 1334.38 | 963.64 | -94.08 | -28.00 | -21.60 |
| 6:45 - 7:00 | 455.00 | 160.16 | 224.88 | 8.75 | 19.35 | 15.71 | 35.00 | 1355.00 | 915.00 | -95.04 | -33.88 | -49.89 |
| 7:00 - 7:15 | 380.68 | 116.16 | 190.77 | 68.00 | 32.35 | 49.06 | 425.00 | 595.00 | 570.71 | -96.61 | -56.68 | -66.18 |
| 7:15 - 7:30 | 195.96 | 47.55 | 77.23 | 260.00 | 5.65 | 58.28 | -46.00 | 944.00 | 449.00 | -97.84 | -59.81 | -73.15 |
| 7:30 - 7:45 | 323.95 | 110.42 | 155.50 | 37.81 | 24.29 | 30.14 | 41.43 | 575.00 | 431.35 | -98.48 | -88.13 | -82.67 |
| 7:45 - 8:00 | 272.27 | 134.47 | 172.85 | 111.15 | -26.36 | 12.50 | 80.00 | 780.00 | 584.00 | -98.31 | -77.44 | -81.55 |
| 8:00 - 8:15 | 231.36 | 37.95 | 67.50 | 71.82 | -31.89 | -8.13 | 0.00 | 1334.38 | 734.00 | 0.00 | -56.69 | -54.72 |
| 8:15 - 8:30 | 151.47 | 48.78 | 75.23 | 25.36 | 98.75 | 59.23 | 35.00 | 1045.45 | 729.69 | 0.00 | -22.63 | -41.66 |
| 11:00-11:15 | 134.00 | 94.40 | 101.00 | -3.08 | 90.59 | 50.00 | 0.00 | 431.00 | 396.61 | -96.95 | 1558.57 | -55.00 |
| 11:15-11:30 | 90.00 | 48.06 | 57.50 | -10.00 | 13.33 | 4.65 | 51.88 | 141.78 | 131.04 | -91.65 | 3038.75 | -43.86 |
| 11:30-11:45 | 215.00 | 50.58 | 81.41 | -22.27 | 107.00 | 52.31 | 80.00 | 217.37 | 196.87 | -95.11 | 1867.14 | -45.45 |
| 11:45-12:00 | 71.00 | 182.00 | 154.25 | 22.73 | 105.31 | 71.67 | 0.00 | 208.08 | 118.41 | -95.18 | 1872.50 | -53.50 |
| 12:00-12:15 | 35.00 | 66.67 | 58.75 | -12.37 | 97.50 | 41.08 | -34.38 | 159.55 | 101.38 | -87.19 | 2574.29 | -62.50 |
| 12:15-12:30 | 53.00 | 179.00 | 137.00 | -22.86 | 50.58 | 17.77 | -20.38 | 243.12 | 159.57 | -94.63 | 3581.00 | -57.37 |
| 12:30-12:45 | 224.00 | 47.37 | 67.00 | -57.57 | 160.36 | 4.69 | 18.93 | 184.69 | 147.86 | -89.87 | 615.26 | -67.44 |
| 12:45-13:00 | 260.00 | 82.81 | 93.24 | -65.23 | 278.00 | 73.92 | 95.88 | 75.75 | 80.64 | -95.89 | 923.16 | -64.22 |
| 16:30-16:45 | 175.62 | -58.88 | -30.45 | -13.10 | 8.46 | -0.74 | -13.14 | 389.89 | 190.69 | -81.35 | 990.00 | -62.13 |
| 16:45-17:00 | 252.50 | -62.73 | -35.71 | -12.73 | -40.86 | -31.84 | -8.85 | 399.86 | 190.13 | -80.26 | 1192.14 | -54.63 |
| 17:00-17:15 | 59.64 | -11.96 | 22.22 | -24.56 | -9.21 | -17.56 | -19.64 | 390.08 | 198.88 | -83.97 | 221.67 | -72.69 |
| 17:15-17:30 | 108.29 | -39.32 | 11.83 | -25.61 | -53.13 | -43.83 | -29.85 | 200.23 | 99.51 | -59.31 | 445.62 | -53.77 |
| 17:30-17:45 | 131.67 | -46.00 | 9.14 | -37.00 | -66.75 | -56.54 | 27.34 | 316.70 | 224.18 | -73.17 | 339.29 | -51.88 |
| 17:45-18:00 | 137.50 | -45.18 | -0.14 | -52.04 | -54.22 | -53.35 | -22.50 | 259.04 | 136.93 | -80.13 | 216.36 | -52.06 |
| 18:00-18:15 | 282.50 | -55.00 | -12.14 | -56.30 | 14.11 | -17.65 | 24.71 | 216.15 | 156.86 | -77.04 | 497.50 | -62.09 |
| 18:15:18:30 | 175.00 | -28.24 | 11.52 | -49.91 | 18.03 | -13.55 | 6.36 | 185.43 | 128.06 | -68.01 | 1140.00 | -52.37 |

# APPENDIX E

## COMPARISON OF OBSERVED AND SIMULATED DELAYS FOR 15-MINUTE PERIODS USING SATURATION FLOW RATE OF 1800 VPHG

Table E-1: Percentage Difference Between Observed and Simulated Average Delay at the Critical Intersection of Study Site 1

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | -4.71 | 1.64 | -2.13 | 71.28 | 63.48 | 65.64 | 29.63 | 85.55 | 76.71 | 72.74 | 162.37 | 143.34 | 80.22 |
| 6:45 - 7:00 | 2.95 | 2.21 | 2.57 | 113.05 | 14.45 | 33.63 | 50.18 | 87.40 | 81.60 | 156.43 | 169.31 | 166.81 | 72.70 |
| 7:00 - 7:15 | 55.25 | -1.53 | 26.00 | 101.80 | -19.75 | -3.88 | 153.29 | 64.77 | 71.17 | 93.62 | 143.46 | 134.59 | 51.30 |
| 7:15 - 7:30 | 59.49 | 17.86 | 44.35 | 134.58 | 45.24 | 59.53 | 63.30 | 93.15 | 89.34 | 159.36 | 203.44 | 197.57 | 96.16 |
| 7:30 - 7:45 | 38.38 | -3.02 | 20.38 | 60.57 | 47.82 | 49.56 | 75.40 | 87.25 | 84.55 | 174.74 | 154.29 | 155.83 | 82.65 |
| 7:45 - 8:00 | -24.08 | 11.39 | -12.31 | 128.44 | 67.60 | 77.54 | 27.32 | 13.22 | 15.80 | 224.18 | 335.62 | 324.34 | 78.93 |
| 8:00 - 8:15 | -6.31 | 21.47 | 4.82 | 109.87 | 62.63 | 73.27 | 38.37 | 35.89 | 36.37 | 25.48 | 34.21 | 33.26 | 37.58 |
| 8:15 - 8:30 | -49.12 | -2.84 | -34.40 | 70.00 | 106.30 | 92.91 | 21.93 | 12.92 | 14.51 | 97.25 | 128.87 | 125.41 | 48.89 |
| 11:00-11:15 | -30.31 | 75.36 | 20.97 | 74.97 | 120.34 | 100.09 | -33.59 | -2.68 | -13.03 | 54.82 | 40.82 | 42.42 | 28.77 |
| 11:15-11:30 | -33.55 | 31.11 | -5.93 | 34.28 | 79.12 | 60.09 | -60.86 | -7.82 | -33.80 | -56.86 | 24.31 | -0.06 | -3.20 |
| 11:30-11:45 | -55.70 | 31.72 | -20.59 | 126.02 | 196.02 | 165.02 | -62.05 | -47.97 | -54.09 | -29.73 | -58.59 | -56.50 | -36.99 |
| 11:45-12:00 | -31.95 | 41.95 | 1.66 | 66.80 | 158.63 | 116.15 | -47.56 | 4.30 | -16.39 | 48.38 | -22.13 | -16.50 | 1.07 |
| 12:00-12:15 | 8.57 | 115.25 | 49.47 | -27.71 | 20.74 | 5.35 | -38.46 | -10.59 | -23.23 | 71.82 | -19.83 | -15.53 | -6.04 |
| 12:30-12:45 | 132.63 | 50.92 | 82.78 | -62.33 | -38.47 | -42.80 | 7.76 | 16.71 | 13.23 | 12.32 | 154.79 | 118.80 | 19.49 |
| 12:45-13:00 | 55.25 | 89.36 | 200.39 | -31.93 | -69.29 | -61.85 | -19.00 | 40.73 | 8.01 | 69.76 | 23.54 | 56.78 | -12.94 |
| 16:30-16:45 | 4.94 | 24.16 | 18.36 | -6.28 | -43.72 | -34.46 | -58.47 | -20.04 | -41.56 | -9.61 | 35.94 | 31.44 | -10.00 |
| 16:45-17:00 | 33.55 | 32.33 | 32.70 | 29.51 | -28.99 | -9.87 | -52.40 | 10.85 | -28.53 | -49.09 | 20.17 | 14.06 | 1.44 |
| 17:00-17:15 | -50.61 | -58.28 | -56.61 | 38.98 | -33.69 | -13.55 | -56.22 | 3.87 | -30.45 | 24.33 | 11.35 | 12.22 | -28.96 |
| 17:15-17:30 | -26.17 | -75.42 | -70.13 | -25.76 | -69.25 | -60.03 | -67.30 | 16.79 | -36.77 | 57.83 | -23.36 | -20.79 | -49.78 |
| 17:30-17:45 | -16.26 | -58.68 | -53.68 | 43.20 | -67.26 | -54.87 | -52.68 | -2.68 | -35.33 | -3.04 | -5.80 | -5.72 | -38.16 |
| 17:45-18:00 | -30.72 | -74.88 | -69.59 | -58.83 | -77.94 | -74.71 | -72.94 | 10.06 | -44.20 | 92.58 | -22.35 | -16.75 | -55.99 |
| 18:00-18:15 | -10.57 | -62.53 | -56.75 | -5.11 | -64.46 | -49.04 | -48.23 | -24.13 | -39.53 | 143.66 | 618.16 | 570.48 | -17.08 |
| 18:15:18:30 | -16.84 | -76.82 | -69.35 | -62.87 | -74.79 | -72.55 | -68.17 | 33.12 | -30.15 | 52.39 | 158.34 | 141.66 | -48.37 |

Table E-2: Percentage Difference Between Observed and Simulated Average Total Stopped Delay at the Downstream Intersections of Study Site 1

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:30 - 6:45 | 0.00 | 1025.00 | 1150.00 | 90.76 | 188.83 | 157.50 | 0.00 | 0.00 | 2250.00 | 0.00 | 1058.75 | 1044.44 |
| 6:45 - 7:00 | 530.00 | 530.00 | 536.36 | 38.41 | 57.40 | 53.08 | 0.00 | 316.25 | 522.22 | 0.00 | 607.73 | 691.67 |
| 7:15 - 7:30 | 665.00 | 766.25 | 754.55 | 93.95 | -2.74 | 9.74 | 0.00 | 500.00 | 771.43 | 68.75 | -26.31 | -21.93 |
| 7:30 - 7:45 | 0.00 | 5570.00 | 6950.00 | 7.42 | -11.57 | -6.89 | 1610.00 | 156.50 | 295.83 | -64.00 | 188.00 | 124.72 |
| 7:45 - 8:00 | 0.00 | 822.50 | 846.15 | 82.18 | 29.36 | 43.91 | 2600.00 | -33.11 | 36.90 | -25.00 | 87.94 | 71.43 |
| 8:00 - 8:15 | 0.00 | 897.50 | 1046.15 | -11.02 | -4.06 | -6.16 | 0.00 | 95.88 | 371.05 | -25.00 | 91.02 | 78.69 |
| 8:15 - 8:30 | 200.00 | 620.00 | 480.00 | -59.01 | 33.50 | -17.26 | 2420.00 | 86.43 | 245.45 | -55.00 | 440.00 | 307.32 |
| 11:00-11:15 | 0.00 | 150.00 | 150.00 | 205.63 | 89.17 | 125.43 | 0.00 | 92.00 | 77.78 | 65.00 | 962.50 | 743.40 |
| 11:15-11:30 | 1340.00 | 201.50 | 312.50 | 97.31 | 31.88 | 49.08 | 800.00 | 1565.00 | 1355.56 | -13.60 | 703.79 | 371.67 |
| 11:30-11:45 | 455.00 | 467.00 | 455.56 | 305.00 | 27.93 | 89.50 | 1070.00 | 178.44 | 228.95 | 31.54 | 861.50 | 607.29 |
| 11:45-12:00 | 0.00 | 265.63 | 261.11 | 50.79 | 18.36 | 32.53 | 282.50 | 205.22 | 208.93 | -24.40 | 233.82 | 152.81 |
| 12:00-12:15 | 0.00 | 353.75 | 485.19 | 144.85 | 50.91 | 78.29 | 0.00 | 170.00 | 300.00 | -5.14 | 476.00 | 188.41 |
| 12:15-12:30 | 3680.00 | 456.87 | 815.00 | 263.21 | 86.52 | 137.04 | 935.00 | 568.57 | 605.56 | -20.23 | 525.18 | 285.59 |
| 12:30-12:45 | 0.00 | 243.93 | 345.16 | 25.22 | 172.81 | 124.68 | 1070.00 | 5.58 | 82.26 | 26.00 | 308.65 | 194.20 |
| 12:45-13:00 | 1272.50 | 6065.00 | 2728.57 | 238.28 | 92.86 | 135.45 | 93.50 | 40.19 | 55.00 | -19.42 | 661.03 | 281.29 |
| 16:30-16:45 | 1025.00 | 665.00 | 680.65 | 86.88 | -39.03 | 0.99 | 28.57 | 151.47 | 116.98 | -25.97 | 2.50 | -12.79 |
| 16:45-17:00 | 1250.00 | 1286.00 | 1273.68 | 81.07 | -39.52 | -2.47 | 755.00 | 335.00 | 355.56 | 8.66 | 18.47 | 14.00 |
| 17:00-17:15 | 1542.50 | 423.37 | 468.22 | 73.04 | -30.00 | 11.38 | 0.00 | 339.41 | 384.21 | -25.00 | 26.73 | 0.45 |
| 17:15-17:30 | 0.00 | 46.58 | 50.44 | 101.58 | 0.75 | 40.44 | 2060.00 | 1709.00 | 1815.38 | -40.68 | 17.69 | -18.97 |
| 17:30-17:45 | 878.75 | 57.34 | 79.51 | 158.49 | -42.23 | 1.36 | 0.00 | 288.93 | 332.26 | -10.00 | 7.83 | -0.86 |
| 17:45-18:00 | 629.00 | 295.60 | 318.75 | 76.69 | -46.37 | -7.35 | 185.00 | 499.06 | 452.38 | -10.82 | 95.88 | 29.80 |
| 18:00-18:15 | 0.00 | 172.70 | 194.59 | 110.94 | -32.18 | 19.84 | 800.00 | 127.05 | 156.86 | 36.10 | 62.69 | 48.88 |
| 18:15:18:30 | 1452.50 | 399.25 | 438.52 | 115.00 | -30.39 | 17.69 | 0.00 | 141.36 | 169.86 | -37.58 | 41.56 | -2.87 |

**Table E-3: Percentage Difference Between Observed and Simulated Average Delay at the Critical Intersection of Study Site 2**

| TIME PERIOD (hours) | Simulated Average Total Stopped Delay (veh-hr/hr) | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | -36.16 | 15.48 | 5.91 | 23.75 | 200.79 | 95.32 | -35.23 | 360.38 | 206.79 | 54.69 | 234.43 | 186.50 | 101.42 |
| 6:45 - 7:00 | -59.54 | 10.02 | -9.88 | 11.78 | 58.65 | 33.62 | -55.78 | 32.83 | 16.18 | 42.06 | 171.38 | 114.53 | 20.89 |
| 7:00 - 7:15 | -33.63 | 31.58 | 24.26 | 48.31 | 40.00 | 44.49 | -55.00 | 13.73 | -0.08 | 12.75 | 165.66 | 86.54 | 25.39 |
| 7:15 - 7:30 | -37.93 | 102.67 | 76.87 | 28.03 | 159.74 | 72.04 | -24.78 | 102.63 | 85.77 | 105.00 | 149.05 | 134.74 | 86.34 |
| 7:30 - 7:45 | 25.06 | 76.95 | 68.75 | 47.70 | 21.42 | 34.68 | -49.80 | 73.75 | 56.57 | 133.06 | 100.31 | 109.38 | 59.19 |
| 7:45 - 8:00 | -10.68 | 15.96 | 13.15 | 41.21 | 59.17 | 50.21 | -30.30 | 35.93 | 26.33 | 84.92 | 81.33 | 82.09 | 33.34 |
| 8:00 - 8:15 | -29.44 | -12.33 | -14.21 | 8.07 | 48.73 | 24.20 | -46.15 | 59.80 | 37.94 | 82.14 | 87.22 | 85.80 | 23.20 |
| 8:15 - 8:30 | -37.77 | 17.05 | 10.96 | 21.80 | 85.82 | 44.72 | -37.59 | 93.60 | 64.61 | 661.25 | 94.87 | 192.66 | 57.08 |
| 11:00-11:15 | -19.90 | 97.76 | 67.89 | -15.13 | 10.43 | -3.08 | 12.30 | 155.31 | 93.15 | 15.62 | 189.47 | 141.59 | 70.66 |
| 11:15-11:30 | -22.77 | 21.48 | 9.66 | -5.56 | 47.07 | 18.65 | 0.63 | 92.50 | 54.50 | 17.12 | 152.61 | 122.08 | 53.44 |
| 11:30-11:45 | -3.41 | 35.18 | 22.75 | -59.40 | 10.66 | -35.25 | 5.00 | 52.44 | 36.11 | 4.78 | 59.70 | 51.62 | 15.29 |
| 11:45-12:00 | 15.06 | 40.52 | 33.25 | -25.54 | 20.95 | -2.40 | 55.92 | 71.62 | 65.99 | -3.28 | 99.55 | 84.21 | 44.75 |
| 12:00-12:15 | -26.10 | 35.79 | 14.10 | -32.33 | 30.50 | -4.12 | -26.71 | 43.14 | 11.91 | -29.29 | 80.11 | 55.68 | 20.44 |
| 12:15-12:30 | -15.55 | 37.25 | 25.68 | -33.71 | 20.59 | -12.51 | -18.47 | 76.35 | 33.13 | 21.90 | 72.11 | 64.78 | 28.08 |
| 12:30-12:45 | -19.29 | 4.27 | -26.86 | -41.36 | 3.59 | -27.95 | 12.19 | 61.44 | 25.80 | 1.79 | 94.42 | 56.69 | 22.01 |
| 12:45-13:00 | -37.10 | -2.39 | -11.38 | -32.40 | 9.89 | -12.94 | -14.76 | 76.25 | 34.88 | -48.39 | 21.61 | 6.37 | 4.33 |
| 16:30-16:45 | -38.34 | 123.27 | 64.50 | 43.22 | -6.61 | 5.74 | 67.83 | 74.91 | 72.94 | -56.24 | 104.49 | 59.05 | 46.19 |
| 16:45-17:00 | -9.63 | 33.33 | 18.37 | 7.18 | 26.55 | 21.14 | 95.79 | 11.02 | 38.11 | -41.94 | 222.17 | 162.41 | 72.33 |
| 17:00-17:15 | 12.81 | -35.11 | -19.92 | 84.69 | 25.96 | 38.43 | 61.49 | 66.15 | 64.43 | -53.30 | 99.93 | 69.75 | 41.75 |
| 17:15-17:30 | 43.89 | 99.79 | 80.56 | -46.99 | -11.96 | -17.39 | 23.38 | 41.59 | 33.28 | -52.89 | 116.91 | 88.23 | 43.77 |
| 17:30-17:45 | 4.43 | 4.88 | 4.68 | -27.16 | -39.91 | -38.56 | 120.07 | 33.48 | 56.05 | -67.09 | -27.25 | -32.07 | -21.71 |
| 17:45-18:00 | 42.14 | 18.07 | 28.73 | 40.40 | 6.70 | 13.10 | 33.41 | 57.43 | 47.50 | -59.51 | 58.12 | 40.84 | 33.06 |
| 18:00-18:15 | -27.33 | -5.20 | -13.80 | 18.92 | 70.87 | 48.98 | 98.59 | 59.56 | 72.32 | -41.59 | 80.54 | 61.64 | 42.77 |
| 18:15:18:30 | -49.70 | -20.92 | -32.33 | 20.77 | 51.43 | 40.51 | 36.11 | 49.95 | 43.52 | -62.68 | 61.52 | 33.53 | 23.30 |

Table E-4: Percentage Difference Between Observed and Simulated Average Delay at the Downstream Intersections of Study Site 2

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:30 - 6:45 | 125.00 | 1441.25 | 651.50 | 366.15 | 226.25 | 342.34 | 0.00 | 0.00 | -30.00 | -38.13 | 101.52 | 65.48 |
| 6:45 - 7:00 | -10.00 | 148.11 | 94.46 | 119.13 | 210.50 | 130.70 | 0.00 | 0.00 | -39.25 | 485.00 | -2.60 | 3.99 |
| 7:15 - 7:30 | -20.23 | 6.55 | 1.15 | 48.52 | 93.85 | 50.82 | 0.00 | -32.50 | 63.64 | 530.00 | -40.96 | -36.43 |
| 7:30 - 7:45 | -0.62 | 87.26 | 62.73 | 5.92 | 108.64 | 8.97 | 158.75 | -66.54 | -45.58 | 5.00 | -58.07 | -55.99 |
| 7:45 - 8:00 | 3.03 | -31.37 | -26.28 | -0.03 | 165.91 | 4.88 | 237.50 | -73.00 | -47.65 | 116.00 | -20.67 | -13.97 |
| 8:00 - 8:15 | 15.12 | 140.77 | 102.18 | 123.32 | 247.14 | 129.47 | 0.00 | 65.79 | 117.89 | 2.86 | -53.50 | -50.99 |
| 8:15 - 8:30 | -22.45 | 130.49 | 74.77 | 200.36 | 74.71 | 179.00 | 102.50 | 89.00 | 95.00 | -46.00 | -2.15 | -8.66 |
| 11:00-11:15 | 24.50 | 230.39 | 139.56 | 363.70 | 125.00 | 302.10 | 0.00 | 179.64 | 250.36 | -5.50 | 211.54 | 151.25 |
| 11:15-11:30 | 36.80 | 102.02 | 79.38 | 155.00 | 310.62 | 187.76 | 170.00 | 66.30 | 84.82 | 22.73 | 157.14 | 110.94 |
| 11:30-11:45 | -18.44 | 170.00 | 73.78 | 262.25 | 95.00 | 199.53 | 523.57 | 112.84 | 178.18 | 21.15 | -23.36 | -15.84 |
| 11:45-12:00 | -10.85 | 365.43 | 138.81 | 380.94 | 32.50 | 196.47 | 496.25 | 89.84 | 171.13 | -14.74 | 6.87 | 0.75 |
| 12:00-12:15 | -14.43 | 149.66 | 74.96 | 236.67 | 48.50 | 156.60 | 340.00 | 61.16 | 109.42 | 20.68 | 46.25 | 35.00 |
| 12:15-12:30 | -29.64 | 80.00 | 25.68 | 419.23 | 200.00 | 314.00 | 189.29 | 64.57 | 85.36 | 61.25 | 46.25 | 50.34 |
| 12:30-12:45 | 7.21 | 159.00 | 93.67 | 258.04 | 11.32 | 146.43 | 110.94 | 5.00 | 32.79 | 9.57 | 5.00 | 6.42 |
| 12:45-13:00 | -25.00 | 268.18 | 92.27 | 221.28 | 12.50 | 146.49 | 165.71 | 64.63 | 98.87 | -8.04 | -13.52 | -12.07 |
| 16:30-16:45 | -5.71 | 367.79 | 120.75 | 147.50 | -17.16 | 59.15 | 815.00 | 370.65 | 486.57 | -8.20 | 38.46 | 20.23 |
| 16:45-17:00 | -21.92 | 436.60 | 121.03 | 137.86 | -39.32 | 29.58 | 1238.75 | 674.00 | 810.91 | 39.09 | -31.63 | -19.29 |
| 17:00-17:15 | -20.14 | 129.91 | 54.55 | 76.37 | -28.17 | 28.68 | 174.50 | 20.68 | 40.92 | -61.92 | -84.52 | -81.75 |
| 17:15-17:30 | -22.74 | 173.40 | 81.00 | 144.00 | -56.57 | -0.16 | 555.71 | -31.34 | 2.07 | -67.86 | -64.44 | -65.32 |
| 17:30-17:45 | -23.20 | 367.89 | 106.64 | 145.89 | -53.96 | -18.54 | 254.71 | -46.76 | -16.62 | -10.00 | -43.93 | -36.54 |
| 17:45-18:00 | -4.29 | 447.26 | 144.63 | 147.50 | -39.81 | 26.30 | 52.50 | -71.11 | -62.11 | -19.64 | -60.07 | -53.41 |
| 18:00-18:15 | 22.94 | 197.27 | 123.43 | 148.23 | -47.50 | 2.64 | 164.38 | -59.41 | -40.16 | -38.12 | -50.96 | -47.94 |
| 18:15-18:30 | -32.01 | 41.32 | 2.38 | 133.04 | 10.00 | 44.45 | 224.64 | -65.66 | -45.74 | 60.31 | -39.17 | -16.43 |

Table E-5: Percentage Difference Between Observed and Simulated Average Delay at the Critical Intersection of Study Site 3

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | -25.00 | -75.58 | -73.88 | -39.42 | 224.20 | 180.82 | 19.12 | 537.76 | 257.86 | 16.56 | 60.75 | 43.30 | 25.66 |
| 6:45 - 7:00 | -72.14 | -80.95 | -80.08 | 44.64 | 158.90 | 149.15 | 76.67 | 131.43 | 113.61 | -5.53 | -3.13 | -3.90 | -1.75 |
| 7:00 - 7:15 | -52.50 | -82.15 | -79.44 | -5.26 | 273.28 | 253.16 | -51.67 | 76.01 | 25.56 | 16.07 | 92.84 | 64.45 | 36.53 |
| 7:15 - 7:30 | 26.90 | -60.96 | -54.75 | 0.16 | 134.73 | 128.13 | -10.00 | 53.90 | 30.72 | 60.07 | 68.87 | 67.13 | 42.29 |
| 7:30 - 7:45 | 40.68 | 33.31 | 34.53 | 138.70 | 291.69 | 286.37 | 4.67 | 130.65 | 87.29 | 6.71 | 142.77 | 105.05 | 134.16 |
| 7:45 - 8:00 | 36.44 | 33.10 | 33.68 | 82.73 | 206.23 | 198.76 | -39.00 | 31.73 | 11.80 | 48.89 | 22.22 | 25.45 | 57.08 |
| 8:00 - 8:15 | 7.19 | 22.45 | 20.43 | 6.71 | 147.80 | 128.88 | -10.39 | 105.52 | 62.61 | -41.91 | -25.53 | -28.34 | 33.14 |
| 8:15 - 8:30 | 72.50 | 29.15 | 34.31 | 203.39 | 331.18 | 320.21 | 19.02 | 113.09 | 80.72 | 82.09 | 29.46 | 38.22 | 88.56 |
| 11:00-11:15 | -12.14 | 64.29 | 52.10 | 26.59 | 572.03 | 279.06 | 19.05 | 60.58 | 44.42 | 31.87 | 36.31 | 34.67 | 73.53 |
| 11:15-11:30 | 171.76 | 257.34 | 3.28 | 52.38 | 884.33 | 502.39 | 17.00 | 62.06 | 47.25 | 73.22 | 91.46 | 84.39 | 119.50 |
| 11:30-11:45 | -18.24 | 214.52 | 167.97 | 110.30 | 920.00 | 523.01 | 38.05 | 48.31 | 44.88 | 110.09 | 53.74 | 70.53 | 138.16 |
| 11:45-12:00 | 11.62 | 223.10 | 175.38 | 22.56 | 1015.83 | 486.95 | 64.90 | 81.12 | 76.32 | 109.64 | 33.27 | 53.35 | 144.61 |
| 12:00-12:15 | 65.26 | 296.10 | 237.89 | 67.39 | 941.81 | 481.95 | -41.71 | 46.10 | 5.66 | 67.77 | 59.61 | 62.09 | 133.39 |
| 12:15-12:30 | 62.78 | 309.32 | 254.16 | 252.11 | 376.93 | 536.24 | -13.65 | 38.34 | 18.03 | 48.48 | 34.37 | 39.39 | 127.51 |
| 12:30-12:45 | 74.21 | 371.58 | 284.52 | 40.83 | 700.67 | 407.41 | -12.48 | 56.79 | 26.81 | 118.12 | 41.41 | 61.29 | 135.33 |
| 12:45-13:00 | 98.75 | 401.80 | 329.53 | 126.69 | 775.45 | 392.24 | -7.56 | 85.06 | 102.19 | 102.04 | -5.51 | 68.74 | 145.42 |
| 16:30-16:45 | 14.03 | 221.84 | 185.13 | 90.17 | 53.60 | 60.05 | 47.91 | 34.72 | 40.29 | 79.53 | 216.52 | 187.60 | 105.27 |
| 16:45-17:00 | -11.70 | 443.49 | 329.69 | 129.03 | 44.65 | 62.92 | 47.38 | 20.52 | 30.40 | 75.24 | 142.86 | 124.50 | 120.59 |
| 17:00-17:15 | 16.68 | 161.94 | 141.43 | 2.21 | -11.52 | -7.51 | 2.47 | -27.88 | -18.94 | 57.66 | 385.42 | 273.16 | 38.76 |
| 17:15-17:30 | 37.88 | 191.99 | 173.68 | 14.27 | -12.90 | -6.84 | -27.08 | -54.46 | -48.30 | 21.86 | 282.23 | 201.41 | 16.93 |
| 17:30-17:45 | -41.36 | 186.80 | 142.82 | -32.14 | 31.82 | 9.49 | 14.57 | 25.75 | 21.94 | 61.46 | 102.15 | 90.89 | 55.86 |
| 17:45-18:00 | -30.80 | 138.78 | 108.77 | 85.92 | 113.99 | 106.25 | 30.84 | 25.55 | 27.79 | -11.96 | 81.45 | 56.22 | 71.05 |
| 18:00-18:15 | 19.90 | 161.97 | 120.03 | -3.27 | 11.95 | 8.45 | -24.07 | -40.43 | -36.00 | 74.63 | 154.49 | 128.30 | 9.93 |
| 18:15:18:30 | 19.13 | 685.79 | 495.47 | 68.81 | 72.49 | 71.69 | -46.32 | 5.80 | -11.94 | 71.82 | 201.11 | 166.55 | 112.69 |

Table E-6: Percentage Difference Between Observed and Simulated Average Delay at the Downstream Intersections of Study Site 3

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:45 - 7:00 | 168.04 | 82.41 | 97.00 | 1580.00 | 1056.88 | 1115.00 | 0.00 | -66.71 | -65.48 | 0.00 | 4.40 | 3.81 |
| 7:00 - 7:15 | 253.38 | 173.97 | 193.82 | 625.63 | 6376.25 | 4076.00 | -99.83 | -62.61 | -92.04 | 170.00 | 48.38 | 54.62 |
| 7:15 - 7:30 | 391.03 | 298.37 | 317.70 | 274.32 | 2765.68 | 1935.23 | -99.91 | -79.36 | -96.10 | 155.00 | 103.04 | 108.61 |
| 7:30 - 7:45 | 89.00 | 187.61 | 162.81 | 190.70 | 3143.40 | 1710.05 | -99.90 | -70.55 | -93.09 | 88.44 | 104.80 | 103.44 |
| 7:45 - 8:00 | 198.06 | 437.19 | 371.41 | 166.73 | 1727.18 | 1177.02 | -99.95 | -89.78 | -97.15 | 5.75 | 506.34 | 420.77 |
| 8:00 - 8:15 | 257.45 | 61.02 | 86.35 | 292.95 | 1146.91 | 716.08 | -96.48 | 0.96 | -71.27 | 297.50 | 2.90 | 24.72 |
| 8:15 - 8:30 | 585.38 | 314.45 | 338.91 | 250.10 | 2795.49 | 1648.92 | -99.89 | -83.57 | -95.10 | 75.50 | 263.14 | 227.74 |
| 11:00-11:15 | 52.70 | 128.21 | 116.19 | 87.41 | 1180.68 | 596.23 | -98.83 | -82.72 | -89.29 | 353.75 | 1194.62 | 791.00 |
| 11:15-11:30 | 6.96 | 92.08 | 78.55 | 31.92 | 319.85 | 211.53 | -98.31 | -76.39 | -86.08 | 371.72 | 1164.29 | 704.60 |
| 11:30-11:45 | -68.64 | 46.58 | 29.66 | 61.34 | 1018.57 | 387.58 | -99.37 | -84.01 | -92.33 | 710.00 | 456.17 | 499.03 |
| 11:45-12:00 | -23.39 | 22.74 | 18.18 | 73.12 | 2095.58 | 481.41 | -98.86 | -79.30 | -87.93 | 616.25 | 622.81 | 621.50 |
| 12:00-12:15 | 62.27 | 77.44 | 76.08 | 15.79 | 911.14 | 316.66 | -98.29 | -73.89 | -83.07 | 414.57 | 1055.54 | 766.47 |
| 12:15-12:30 | -6.57 | 76.57 | 64.24 | 54.69 | 1078.87 | 349.09 | -98.83 | -79.66 | -87.82 | 400.40 | 683.28 | 559.21 |
| 12:30-12:45 | 103.23 | 67.65 | 70.69 | 69.69 | 1125.71 | 330.59 | -98.95 | -81.16 | -88.04 | 375.50 | 433.82 | 412.22 |
| 12:45-13:00 | -17.90 | 21.67 | 16.59 | 56.50 | 931.00 | 375.14 | -99.25 | -79.73 | -88.93 | 331.59 | 397.81 | 380.87 |
| 16:45-17:00 | 57.00 | 168.05 | 154.86 | 27.10 | -9.68 | -2.97 | -97.87 | -28.75 | -81.28 | 870.91 | 1683.56 | 781.72 |
| 17:00-17:15 | 67.61 | 547.24 | 514.18 | 72.54 | 46.07 | 50.50 | -97.43 | -59.22 | -86.11 | 704.79 | 711.45 | 496.47 |
| 17:15-17:30 | 15.79 | 323.49 | 309.30 | -11.69 | -33.79 | -30.58 | -97.19 | -32.11 | -78.50 | 297.82 | 1065.00 | 676.02 |
| 17:30-17:45 | 119.55 | 197.84 | 194.81 | -13.98 | -64.50 | -60.36 | -99.26 | -77.50 | -94.42 | 283.85 | 1153.36 | 391.01 |
| 17:45-18:00 | 56.21 | 450.38 | 424.42 | -28.83 | -78.63 | -74.78 | -95.76 | 7.44 | -71.12 | 440.00 | 1185.99 | 595.64 |
| 18:00-18:15 | 36.23 | 100.07 | 96.92 | -36.06 | -74.72 | -70.15 | -97.10 | -8.66 | -73.68 | 241.41 | 605.00 | 293.21 |

Table E-7: Percentage Difference Between Observed and Simulated Average Delay at the Critical Intersection of Study Site 4

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | 46.64 | 159.11 | 135.56 | 76.54 | 63.21 | 65.30 | 40.16 | 48.90 | 46.45 | -3.39 | 131.43 | 83.25 | 78.32 |
| 6:45 - 7:00 | 120.09 | 45.65 | 59.30 | 88.24 | 75.36 | 77.35 | 15.19 | 86.00 | 62.51 | 19.72 | 16.94 | 17.50 | 51.78 |
| 7:00 - 7:15 | 77.23 | 146.18 | 119.34 | 44.76 | 107.88 | 96.97 | 51.76 | 115.32 | 96.19 | 30.84 | 10.29 | 14.18 | 66.88 |
| 7:15 - 7:30 | 155.48 | 158.84 | 157.70 | 3.53 | 66.44 | 52.82 | -12.06 | 79.48 | 44.22 | 7.59 | 27.84 | 22.82 | 49.70 |
| 7:30 - 7:45 | 97.64 | 85.35 | 88.37 | 44.47 | 40.74 | 41.38 | 16.73 | 26.87 | 24.66 | 70.92 | 33.96 | 40.85 | 41.89 |
| 7:45 - 8:00 | 68.05 | 82.60 | 80.12 | 62.34 | 114.66 | 93.91 | -48.00 | 25.45 | -1.80 | 20.00 | -2.99 | 1.92 | 30.41 |
| 8:00 - 8:15 | 16.16 | 65.96 | 52.58 | 34.66 | 95.16 | 75.77 | -25.65 | 100.78 | 43.62 | 46.67 | -3.75 | 3.78 | 40.42 |
| 8:15 - 8:30 | 47.12 | 148.95 | 118.86 | 38.58 | 67.77 | 59.29 | 9.94 | 36.61 | 30.22 | 43.24 | 19.00 | 23.85 | 49.37 |
| 11:00-11:15 | -34.03 | -23.14 | -26.45 | -2.94 | 12.74 | 5.66 | -23.63 | 236.86 | 107.36 | 60.83 | 189.88 | 151.80 | 45.15 |
| 11:15-11:30 | -33.02 | -32.32 | -32.50 | -7.69 | 4.64 | -0.57 | 96.29 | 265.81 | 224.15 | 120.91 | 160.36 | 150.92 | 54.76 |
| 11:30-11:45 | -20.98 | -23.67 | -23.03 | -27.76 | 1.35 | -12.63 | -37.27 | 123.73 | 62.13 | -11.59 | 186.24 | 109.11 | 19.08 |
| 11:45-12:00 | -18.93 | -48.97 | -41.38 | -31.87 | 8.69 | -12.32 | -5.40 | 258.85 | 142.10 | 139.62 | 176.53 | 170.19 | 33.87 |
| 12:00-12:15 | 3.80 | -44.05 | -36.61 | 26.18 | 33.26 | 30.35 | 47.00 | 222.13 | 165.72 | 62.95 | 135.71 | 116.88 | 52.28 |
| 12:15-12:30 | -5.61 | -33.71 | -29.01 | 3.52 | 11.82 | 8.31 | 101.92 | 250.76 | 207.44 | 45.93 | 119.35 | 100.24 | 45.65 |
| 12:30-12:45 | -24.62 | -31.96 | -21.47 | 4.52 | 12.81 | 48.46 | 29.62 | 195.52 | 180.03 | 49.54 | 76.31 | 119.12 | 31.97 |
| 12:45-13:00 | -14.67 | -29.19 | -26.18 | -3.19 | 11.26 | 4.97 | 27.45 | 148.05 | 105.57 | 80.00 | 242.42 | 183.43 | 37.00 |
| 16:30-16:45 | 30.00 | 65.02 | 60.87 | 122.62 | 106.00 | 113.54 | 31.83 | 23.87 | 26.50 | 76.05 | 127.19 | 122.72 | 78.51 |
| 16:45-17:00 | 93.91 | 36.04 | 40.86 | -12.67 | 76.68 | 23.46 | 72.72 | 69.19 | 70.37 | 107.46 | 86.98 | 89.35 | 51.94 |
| 17:00-17:15 | 16.94 | 4.77 | 6.58 | 76.81 | 362.55 | 201.22 | 224.20 | 172.14 | 193.55 | 110.75 | 324.26 | 298.84 | 146.88 |
| 17:15-17:30 | 9.62 | 5.55 | 6.40 | 122.55 | 308.72 | 226.12 | 85.15 | 146.18 | 107.73 | 85.00 | 284.13 | 266.95 | 153.29 |
| 17:30-17:45 | 39.31 | 41.08 | 40.98 | 132.04 | 402.43 | 277.69 | 204.19 | 136.67 | 165.27 | 74.00 | 292.80 | 270.60 | 152.11 |
| 17:45-18:00 | 14.23 | 36.89 | 34.61 | 106.06 | 108.88 | 107.88 | 150.64 | 47.78 | 78.93 | 51.18 | 37.96 | 39.14 | 56.32 |
| 18:00-18:15 | 47.40 | -51.18 | -43.74 | 76.85 | 2.06 | 26.26 | -15.37 | 153.15 | 55.48 | 129.09 | 136.94 | 135.62 | 8.61 |
| 18:15:18:30 | 50.41 | -74.04 | -69.09 | 95.17 | 85.43 | 89.41 | -54.64 | 50.53 | -8.41 | 87.30 | 130.86 | 122.57 | -25.23 |

Table E-8: Percentage Difference Between Observed and Simulated Average Delay at the Downstream Intersections of Study Site 4

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:45 - 7:00 | 0.00 | 649.25 | 649.25 | 12.50 | 116.00 | 103.82 | 0.00 | 0.00 | -28.60 | -100.00 | 86.43 | 77.95 |
| 7:00 - 7:15 | 0.00 | 293.75 | 293.75 | -59.50 | 6.20 | 0.23 | 0.00 | -26.69 | -20.00 | -3.57 | 2150.00 | 475.00 |
| 7:15 - 7:30 | 0.00 | 1917.50 | 1917.50 | -17.50 | 98.44 | 88.06 | 0.00 | -34.33 | -27.17 | 575.00 | 3027.50 | 2210.00 |
| 7:30 - 7:45 | 0.00 | 512.69 | 512.69 | -1.00 | 125.57 | 118.04 | 71.56 | -53.42 | -42.73 | 282.50 | 4625.00 | 1730.00 |
| 7:45 - 8:00 | 0.00 | 651.00 | 651.00 | -38.13 | 9.83 | 4.10 | 800.00 | -72.77 | -65.34 | 2.86 | 2161.25 | 787.73 |
| 8:00 - 8:15 | 0.00 | 510.71 | 510.71 | -70.88 | 28.41 | -16.60 | 0.00 | -43.88 | -17.42 | 0.00 | 1730.00 | 1910.00 |
| 8:15 - 8:30 | 0.00 | 627.20 | 627.20 | -43.75 | 29.71 | 6.20 | 117.50 | 29.45 | 36.14 | 0.00 | 746.00 | 872.00 |
| 11:00-11:15 | 0.00 | 37.14 | 37.14 | 111.94 | -64.00 | 87.50 | 0.00 | 188.26 | 183.03 | 305.00 | 33.45 | 36.53 |
| 11:15-11:30 | 0.00 | 2735.00 | 2735.00 | -40.00 | -77.50 | -44.41 | 665.00 | 240.96 | 248.96 | 1.25 | -12.20 | -11.49 |
| 11:30-11:45 | 0.00 | 21.30 | 21.30 | 29.19 | -82.00 | 13.75 | 245.00 | 322.57 | 320.42 | -10.00 | 8.43 | 7.73 |
| 11:45-12:00 | 0.00 | 293.75 | 293.75 | -44.14 | -70.00 | -45.41 | ERR | 21.27 | 21.27 | 35.00 | -6.07 | -5.12 |
| 12:00-12:15 | 0.00 | 7.42 | 7.42 | -25.94 | -77.50 | -31.67 | -16.14 | 208.03 | 155.00 | -7.63 | 11.43 | 9.49 |
| 12:15-12:30 | 0.00 | 53.33 | 53.33 | -16.86 | -73.00 | -21.25 | 6.07 | 193.64 | 157.67 | 95.00 | 10.21 | 11.71 |
| 12:30-12:45 | 0.00 | 172.37 | 172.37 | 40.29 | -70.00 | 31.35 | 41.75 | 67.60 | 64.08 | 70.00 | -24.92 | -20.42 |
| 12:45-13:00 | 0.00 | 243.42 | 243.42 | 119.00 | -55.00 | 98.53 | -14.09 | 34.58 | 30.04 | -44.62 | 7.47 | 3.77 |
| 16:30-16:45 | 0.00 | 161.82 | 161.82 | -18.06 | -77.50 | -19.78 | -21.61 | -73.39 | -69.61 | 55.77 | -59.42 | -53.10 |
| 16:45-17:00 | 0.00 | 845.00 | 845.00 | -31.80 | -55.00 | -32.15 | -25.00 | -28.06 | -27.78 | 16.05 | -58.36 | -51.93 |
| 17:00-17:15 | 0.00 | 361.25 | 361.25 | 19.57 | -85.00 | 15.27 | 93.50 | -40.40 | -34.70 | 145.45 | -61.40 | -51.15 |
| 17:15-17:30 | 0.00 | 268.13 | 268.13 | 21.76 | -55.00 | 18.87 | 61.47 | -71.40 | -65.13 | 96.58 | -61.00 | -47.93 |
| 17:30-17:45 | 0.00 | 292.46 | 292.46 | 34.26 | -55.00 | 31.43 | 80.00 | -54.55 | -40.80 | 5.00 | -67.12 | -60.33 |
| 17:45-18:00 | 0.00 | 414.08 | 414.08 | 30.67 | -55.00 | 29.06 | 21.15 | -59.20 | -55.33 | 30.26 | -68.81 | -62.97 |
| 18:00-18:15 | 0.00 | 713.29 | 713.29 | -45.16 | 35.00 | -42.73 | 192.50 | -62.36 | -58.54 | 10.32 | -44.44 | -36.36 |
| 18:15-18:30 | 0.00 | 712.50 | 712.50 | -51.67 | 80.00 | -46.96 | 95.00 | -54.12 | -50.72 | 52.68 | -46.52 | -33.84 |

Table E-9: Percentage Difference Between Observed and Simulated Average Delay at the Critical Intersection of Study Site 5

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | 38.88 | 147.19 | 124.51 | 73.65 | 55.13 | 58.04 | 42.50 | 55.85 | 52.11 | -3.81 | 127.53 | 80.59 | 74.42 |
| 6:45 - 7:00 | 107.00 | 47.49 | 58.40 | 85.70 | 74.78 | 76.47 | 6.79 | 75.50 | 52.71 | 20.14 | 8.06 | 10.52 | 46.85 |
| 7:00 - 7:15 | 64.77 | 128.09 | 103.44 | 46.39 | 96.10 | 87.50 | 42.94 | 114.75 | 93.14 | 24.41 | 7.38 | 10.60 | 60.38 |
| 7:15 - 7:30 | 94.52 | 146.20 | 128.69 | 4.12 | 60.02 | 47.92 | -18.67 | 71.34 | 36.67 | 4.22 | 21.19 | 16.99 | 41.76 |
| 7:30 - 7:45 | 80.61 | 83.17 | 82.54 | 41.71 | 36.64 | 37.51 | 9.36 | 19.34 | 17.17 | 75.87 | 21.76 | 31.85 | 35.27 |
| 7:45 - 8:00 | 70.16 | 77.98 | 76.65 | 53.39 | 102.74 | 83.17 | -50.47 | 18.41 | -7.15 | 13.70 | -7.47 | -2.95 | 24.45 |
| 8:00 - 8:15 | 17.73 | 60.77 | 49.20 | 34.66 | 80.00 | 65.47 | -28.83 | 93.12 | 37.99 | 55.00 | -5.22 | 3.78 | 35.88 |
| 8:15 - 8:30 | 49.71 | 148.23 | 119.12 | 38.98 | 58.15 | 52.58 | 8.92 | 34.35 | 28.26 | 38.80 | 17.10 | 21.44 | 46.15 |
| 11:00-11:15 | -34.03 | -23.14 | -26.45 | -2.94 | 12.74 | 5.66 | -23.63 | 236.86 | 107.36 | 60.83 | 189.88 | 151.80 | 45.15 |
| 11:15-11:30 | -33.02 | -32.32 | -32.50 | -7.69 | 4.64 | -0.57 | 96.29 | 265.81 | 224.15 | 120.91 | 160.36 | 150.92 | 54.76 |
| 11:30-11:45 | -20.98 | -23.67 | -23.03 | -27.76 | 1.35 | -12.63 | -37.27 | 123.73 | 62.13 | -11.59 | 186.24 | 109.11 | 19.08 |
| 11:45-12:00 | -18.93 | -48.97 | -41.38 | -30.99 | 9.21 | -11.61 | -1.53 | 260.19 | 144.56 | 152.00 | 180.03 | 175.21 | 35.27 |
| 12:00-12:15 | 3.80 | -44.05 | -36.61 | 27.09 | 33.26 | 30.72 | 50.00 | 222.13 | 166.69 | 65.00 | 136.19 | 117.76 | 52.74 |
| 12:15-12:30 | -5.61 | -33.71 | -29.01 | 4.07 | 12.23 | 8.78 | 104.81 | 250.76 | 208.28 | 46.57 | 119.35 | 100.41 | 45.98 |
| 12:30-12:45 | -24.62 | -31.96 | -26.84 | 4.52 | 12.81 | 39.52 | 30.60 | 195.52 | 167.35 | 50.92 | 76.31 | 109.60 | 32.08 |
| 12:45-13:00 | -16.33 | -35.12 | -31.22 | -8.21 | 3.94 | -1.34 | 15.55 | 140.16 | 96.26 | 68.90 | 229.41 | 171.12 | 29.78 |
| 16:30-16:45 | 30.00 | 46.01 | 44.11 | 76.52 | 94.29 | 86.23 | 77.22 | 17.62 | 37.29 | 75.26 | 63.82 | 64.82 | 56.45 |
| 16:45-17:00 | 93.91 | 18.04 | 24.36 | -15.95 | 67.47 | 17.78 | 53.59 | 64.73 | 61.01 | 99.07 | 67.73 | 71.35 | 39.92 |
| 17:00-17:15 | 16.02 | -8.02 | -4.44 | 111.92 | 315.15 | 200.41 | 241.08 | 157.68 | 191.97 | 114.50 | 402.20 | 367.95 | 155.28 |
| 17:15-17:30 | 6.38 | -0.88 | 0.65 | 211.27 | 630.97 | 444.76 | 265.64 | 132.61 | 216.41 | 80.56 | 489.20 | 453.95 | 280.04 |
| 17:30-17:45 | 46.49 | 79.29 | 77.51 | 301.86 | 620.32 | 473.40 | 360.29 | 116.03 | 219.51 | 73.40 | 466.91 | 426.97 | 246.36 |
| 17:45-18:00 | 11.15 | -0.82 | 0.38 | 71.31 | 81.86 | 78.09 | 126.76 | 40.90 | 66.90 | 54.21 | 14.42 | 17.96 | 30.72 |
| 18:00-18:15 | 47.05 | -55.29 | -47.56 | 25.33 | 42.21 | 36.75 | -25.18 | 144.63 | 46.21 | 118.18 | 111.28 | 112.44 | 4.19 |
| 18:15:18:30 | 51.62 | -77.51 | -72.38 | 79.24 | 79.65 | 79.48 | -56.87 | 55.18 | -7.61 | 93.38 | 117.00 | 112.51 | -28.92 |

Table E-10: Percentage Difference Between Observed and Simulated Average Total Stopped Delay at the Downstream Intersections of Study Site 5

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:30 - 6:45 | 0.00 | -79.32 | -77.50 | 372.50 | 264.68 | 269.62 | 0.00 | 1016.56 | 674.38 | 0.00 | 330.43 | 282.50 |
| 6:45 - 7:00 | 0.00 | -88.66 | -86.72 | 605.00 | 661.64 | 654.93 | 0.00 | 940.29 | 321.00 | -52.00 | -5.91 | -11.97 |
| 7:00 - 7:15 | 0.00 | -87.09 | -83.48 | 252.89 | 738.91 | 684.59 | -65.10 | 627.83 | 156.25 | 206.00 | -51.35 | -42.94 |
| 7:15 - 7:30 | 0.00 | -56.44 | -48.70 | 137.69 | 990.20 | 900.34 | -65.13 | 163.57 | 35.63 | 248.75 | -61.80 | -57.06 |
| 7:30 - 7:45 | 0.00 | 32.46 | 34.29 | 76.75 | 783.35 | 692.85 | -66.34 | 104.13 | -3.78 | 330.71 | -75.04 | -66.84 |
| 7:45 - 8:00 | 0.00 | 42.68 | 43.03 | 267.23 | 944.56 | 875.60 | -53.58 | 78.26 | 28.16 | 32.75 | -82.22 | -78.27 |
| 8:00 - 8:15 | 0.00 | 18.19 | 15.46 | 228.58 | 1969.69 | 1701.44 | 0.00 | 743.75 | 143.71 | 0.00 | -76.10 | -72.89 |
| 8:15 - 8:30 | 0.00 | 40.85 | 45.72 | 168.25 | 819.95 | 721.56 | -66.68 | 120.99 | 15.02 | 0.00 | -77.41 | -75.68 |
| 11:15-11:30 | 0.00 | 163.44 | 154.51 | 446.43 | 27.84 | 46.04 | -4.81 | -67.12 | -48.55 | 395.00 | 182.07 | 196.59 |
| 11:30-11:45 | 0.00 | 133.71 | 100.41 | 77.92 | 1.44 | 13.19 | -10.44 | -67.63 | -51.52 | 185.88 | -16.66 | -0.49 |
| 11:45-12:00 | 0.00 | 143.90 | 109.37 | 358.18 | 148.58 | 163.99 | ERR | -69.11 | -58.90 | 130.00 | 24.82 | 33.92 |
| 12:00-12:15 | 0.00 | 195.38 | 153.27 | 26.16 | 134.37 | 119.98 | -31.82 | -79.70 | -64.34 | 107.50 | 10.64 | 19.40 |
| 12:15-12:30 | 0.00 | 218.84 | 177.21 | 103.40 | 160.23 | 152.69 | -40.80 | -79.20 | -65.47 | 343.57 | 97.80 | 110.00 |
| 12:30-12:45 | 0.00 | 242.48 | 182.00 | 16.33 | -11.29 | -6.21 | -42.24 | -77.96 | -66.58 | 275.00 | 19.41 | 37.07 |
| 12:45-13:00 | 0.00 | 280.10 | 225.12 | 71.56 | 59.79 | 61.27 | -27.92 | -60.67 | -46.35 | 324.29 | 23.54 | 42.17 |
| 16:30-16:45 | 0.00 | 498.50 | 413.29 | 157.97 | 962.78 | 653.71 | -71.23 | 14.32 | -12.17 | 145.89 | 89.38 | 93.00 |
| 16:45-17:00 | 0.00 | 502.26 | 370.52 | 119.66 | 665.20 | 477.52 | -33.81 | -38.75 | -37.50 | 72.12 | 34.14 | 36.61 |
| 17:00-17:15 | 0.00 | 61.99 | 52.38 | 101.91 | 1087.76 | 643.10 | -67.40 | -80.30 | -76.53 | -2.84 | 36.76 | 31.96 |
| 17:15-17:30 | 0.00 | 236.80 | 210.81 | 17.89 | 2383.52 | 1157.54 | -56.47 | -73.72 | -70.71 | 38.39 | 26.39 | 27.61 |
| 17:30-17:45 | 0.00 | 161.27 | 120.16 | 161.15 | 916.04 | 488.34 | -38.26 | -94.91 | -90.76 | 80.68 | -36.86 | -32.38 |
| 17:45-18:00 | 0.00 | 187.84 | 148.14 | 84.43 | 1253.24 | 883.82 | -38.48 | -91.99 | -87.57 | 10.85 | -11.71 | -9.63 |
| 18:00-18:15 | 0.00 | 194.32 | 126.54 | 244.06 | 242.99 | 243.28 | 125.84 | -96.89 | -78.30 | 65.79 | 29.87 | 35.59 |
| 18:15:18:30 | 0.00 | 839.39 | 603.59 | 44.72 | 800.27 | 427.10 | -61.50 | -87.26 | -80.39 | 30.29 | 64.63 | 60.11 |

Table E-11: Percentage Difference Between Observed and Simulated Average Stopped Delay at the Critical Intersection of Study Site 6

| TIME PERIOD (hours) | Percent Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | 27.12 | 458.00 | 242.56 | 31.09 | 163.57 | 103.82 | -37.44 | 26.47 | 9.78 | -35.00 | 176.14 | 140.28 | 98.74 |
| 6:45 - 7:00 | 10.36 | 187.48 | 114.90 | 25.00 | 286.47 | 152.00 | 10.77 | -53.64 | -35.43 | 43.57 | -20.18 | -7.43 | 47.69 |
| 7:00 - 7:15 | 14.68 | 173.66 | 129.26 | 76.40 | 187.03 | 142.42 | 55.00 | -56.26 | -30.47 | 56.00 | -7.83 | 1.94 | 49.78 |
| 7:15 - 7:30 | -17.50 | 131.10 | 81.35 | 68.75 | 205.10 | 151.89 | -1.26 | -9.82 | -7.33 | -3.33 | 138.40 | 106.78 | 52.83 |
| 7:30 - 7:45 | -31.95 | 21.26 | 9.78 | 62.27 | 83.75 | 77.00 | -1.36 | -13.78 | -10.26 | 147.50 | 27.61 | 32.75 | 13.15 |
| 7:45 - 8:00 | -21.53 | 50.30 | 23.22 | -18.84 | 182.09 | 90.61 | -29.87 | -17.11 | -20.54 | 17.44 | 79.61 | 63.16 | 25.44 |
| 8:00 - 8:15 | -23.99 | 67.14 | 33.42 | 43.04 | 114.50 | 91.76 | -27.27 | -32.13 | -30.43 | 18.13 | 33.32 | 30.53 | 14.52 |
| 8:15 - 8:30 | -6.95 | 100.51 | 54.57 | 39.50 | 322.68 | 204.69 | 43.29 | -27.68 | -12.53 | 71.00 | 75.00 | 74.31 | 47.87 |
| 11:00-11:15 | -10.98 | 98.00 | 32.04 | 57.50 | 122.91 | 103.61 | 140.52 | -0.31 | 43.14 | -10.00 | 16.13 | 12.09 | 41.47 |
| 11:15-11:30 | -1.00 | 117.50 | 40.82 | 12.50 | 193.68 | 123.55 | 62.79 | 55.20 | 58.31 | 23.00 | 59.88 | 54.35 | 64.86 |
| 11:30-11:45 | 32.55 | 136.25 | 70.69 | 80.00 | 139.79 | 126.50 | 4.06 | 131.08 | 92.74 | -62.94 | 75.91 | 58.80 | 85.22 |
| 11:45-12:00 | -2.67 | 68.21 | 20.59 | 45.00 | 298.92 | 191.80 | 58.52 | -31.49 | -5.94 | 44.78 | 58.55 | 56.46 | 45.21 |
| 12:00-12:15 | -12.74 | 62.24 | 11.00 | -3.86 | 102.50 | 64.76 | 33.12 | 6.52 | 19.21 | 8.41 | 25.36 | 23.39 | 28.54 |
| 12:15-12:30 | -10.00 | -21.79 | -15.56 | 38.00 | 103.48 | 91.79 | 103.00 | -21.17 | 8.24 | -5.18 | -8.21 | -7.84 | 6.92 |
| 12:30-12:45 | -33.54 | 41.85 | 62.97 | 39.29 | 110.00 | 141.07 | 106.05 | -13.84 | 54.40 | 3.85 | 23.36 | 41.97 | 24.91 |
| 12:45-13:00 | 84.15 | 17.69 | 54.62 | 31.12 | 70.88 | 53.41 | -52.10 | 2.06 | -14.62 | 13.40 | 39.72 | 35.30 | 20.41 |
| 16:30-16:45 | -27.40 | 121.25 | 20.81 | 20.27 | 84.48 | 70.12 | 6.46 | 43.56 | 27.60 | -60.81 | 35.57 | 8.49 | 31.07 |
| 16:45-17:00 | -32.33 | 36.53 | -11.17 | 14.37 | 116.92 | 103.25 | 8.75 | -4.51 | -0.59 | -16.29 | -2.36 | -5.43 | 13.47 |
| 17:00-17:15 | 34.63 | -2.91 | 15.48 | 110.68 | 13.41 | 22.18 | 53.91 | 0.65 | 21.96 | -27.81 | 21.28 | 13.09 | 17.97 |
| 17:15-17:30 | -25.59 | -20.32 | -23.40 | 113.33 | 78.84 | 82.42 | 85.33 | 0.68 | 24.16 | -59.22 | -13.58 | -23.24 | 5.61 |
| 17:30-17:45 | -14.83 | -12.18 | -13.86 | 31.84 | 56.41 | 52.58 | 123.66 | -15.68 | 30.16 | -48.32 | -7.01 | -15.82 | 7.81 |
| 17:45-18:00 | -14.17 | 6.55 | -4.92 | 28.67 | 56.50 | 50.77 | 42.76 | -31.93 | -11.81 | -35.42 | 1.79 | -6.55 | 6.00 |
| 18:00-18:15 | 17.31 | 50.22 | 27.82 | 3.03 | 141.05 | 109.64 | 69.81 | 1.01 | 20.00 | -26.55 | 1.70 | -4.24 | 26.69 |
| 18:15:18:30 | 24.74 | 0.71 | 14.55 | -2.29 | 65.58 | 54.58 | -4.26 | -37.76 | -27.08 | -31.65 | 2.80 | -4.15 | 4.59 |

Table E-12 Percentage Difference Between Observed and Simulated Average Total Stopped Delay at the Downstream Intersections of Study Site 6

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH & RT | TOTAL | LT | TH& RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:30 - 6:45 | 135.00 | 1216.74 | 912.50 | 83.75 | 131.92 | 108.80 | -28.57 | 1334.38 | 963.64 | -94.08 | -28.00 | -21.60 |
| 6:45 - 7:00 | 455.00 | 160.16 | 224.88 | 8.75 | 19.35 | 15.71 | 35.00 | 1355.00 | 915.00 | -95.04 | -33.88 | -49.89 |
| 7:00 - 7:15 | 380.68 | 116.16 | 190.77 | 68.00 | 32.35 | 49.06 | 425.00 | 595.00 | 570.71 | -96.61 | -56.68 | -66.18 |
| 7:15 - 7:30 | 195.96 | 47.55 | 77.23 | 260.00 | 5.65 | 58.28 | -46.00 | 944.00 | 449.00 | -97.84 | -59.81 | -73.15 |
| 7:30 - 7:45 | 323.95 | 110.42 | 155.50 | 37.81 | 24.29 | 30.14 | 41.43 | 575.00 | 431.35 | -98.48 | -88.13 | -82.67 |
| 7:45 - 8:00 | 272.27 | 134.47 | 172.85 | 111.15 | -26.36 | 12.50 | 80.00 | 780.00 | 584.00 | -98.31 | -77.44 | -81.55 |
| 8:00 - 8:15 | 231.36 | 37.95 | 67.50 | 71.82 | -31.89 | -8.13 | 0.00 | 1334.38 | 734.00 | 0.00 | -56.69 | -54.72 |
| 8:15 - 8:30 | 151.47 | 48.78 | 75.23 | 25.36 | 98.75 | 59.23 | 35.00 | 1045.45 | 729.69 | 0.00 | -22.63 | -41.66 |
| 11:00-11:15 | 134.00 | 94.40 | 101.00 | -3.08 | 90.59 | 50.00 | 0.00 | 431.00 | 396.61 | -96.95 | 1558.57 | -55.00 |
| 11:15-11:30 | 90.00 | 48.06 | 57.50 | -10.00 | 13.33 | 4.65 | 51.88 | 141.78 | 131.04 | -91.65 | 3038.75 | -43.86 |
| 11:30-11:45 | 215.00 | 50.58 | 81.41 | -22.27 | 107.00 | 52.31 | 80.00 | 217.37 | 196.87 | -95.11 | 1867.14 | -45.45 |
| 11:45-12:00 | 71.00 | 182.00 | 154.25 | 22.73 | 105.31 | 71.67 | 0.00 | 208.08 | 118.41 | -95.18 | 1872.50 | -53.50 |
| 12:00-12:15 | 35.00 | 66.67 | 58.75 | -12.37 | 97.50 | 41.08 | -34.38 | 159.55 | 101.38 | -87.19 | 2574.29 | -62.50 |
| 12:15-12:30 | 53.00 | 179.00 | 137.00 | -22.86 | 50.58 | 17.77 | -20.38 | 243.12 | 159.57 | -94.63 | 3581.00 | -57.37 |
| 12:30-12:45 | 224.00 | 47.37 | 67.00 | -57.57 | 160.36 | 4.69 | 18.93 | 184.69 | 147.86 | -89.87 | 615.26 | -67.44 |
| 12:45-13:00 | 260.00 | 82.81 | 93.24 | -65.23 | 278.00 | 73.92 | 95.88 | 75.75 | 80.64 | -95.89 | 923.16 | -64.22 |
| 16:30-16:45 | 175.62 | -58.88 | -30.45 | -13.10 | 8.46 | -0.74 | -13.14 | 389.89 | 190.69 | -81.35 | 990.00 | -62.13 |
| 16:45-17:00 | 252.50 | -62.73 | -35.71 | -12.73 | -40.86 | -31.84 | -8.85 | 399.86 | 190.13 | -80.26 | 1192.14 | -54.63 |
| 17:00-17:15 | 59.64 | -11.96 | 22.22 | -24.56 | -9.21 | -17.56 | -19.64 | 390.08 | 198.88 | -83.97 | 221.67 | -72.69 |
| 17:15-17:30 | 108.29 | -39.32 | 11.83 | -25.61 | -53.13 | -43.83 | -29.85 | 200.23 | 99.51 | -59.31 | 445.62 | -53.77 |
| 17:30-17:45 | 131.67 | -46.00 | 9.14 | -37.00 | -66.75 | -56.54 | 27.34 | 316.70 | 224.18 | -73.17 | 339.29 | -51.88 |
| 17:45-18:00 | 137.50 | -45.18 | -0.14 | -52.04 | -54.22 | -53.35 | -22.50 | 259.04 | 136.93 | -80.13 | 216.36 | -52.06 |
| 18:00-18:15 | 282.50 | -55.00 | -12.14 | -56.30 | 14.11 | -17.65 | 24.71 | 216.15 | 156.86 | -77.04 | 497.50 | -62.09 |
| 18:15:18:30 | 175.00 | -28.24 | 11.52 | -49.91 | 18.03 | -13.55 | 6.36 | 185.43 | 128.06 | -68.01 | 1140.00 | -52.37 |

# APPENDIX F

## COMPARISON OF OBSERVED AND SIMULATED DELAYS FOR HOURLY PERIODS USING DEFAULT VALUES OF SATURATION FLOW RATES

Table F-1: Percentage Difference Between Observed and Simulated Total Delay for Hourly Volume at the Critical Intersection of Study Site 1

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | |
| 6:30 - 7:30 | 16.67 | 9.09 | 13.33 | 142.65 | 33.18 | 52.59 | 69.15 | 68.56 | 68.64 | 210.08 | 173.45 | 179.89 | 81.30 |
| 6:45 - 7:45 | 46.71 | 0.68 | 26.31 | 205.03 | 60.50 | 82.61 | 82.30 | 138.78 | 130.12 | 303.03 | 160.02 | 178.72 | 112.60 |
| 7:00 - 8:00 | 59.20 | 8.71 | 39.35 | 144.97 | 194.44 | 187.12 | 109.13 | 224.76 | 205.83 | 227.34 | 371.93 | 355.45 | 209.18 |
| 7:15 - 8:15 | 79.62 | 13.62 | 54.40 | 145.70 | 312.00 | 284.62 | 187.26 | 151.38 | 157.97 | 300.08 | 379.49 | 371.42 | 232.57 |
| 7:30 - 8:30 | -59.34 | -72.26 | -64.11 | 10.62 | -16.14 | -10.82 | -46.03 | -65.09 | -61.40 | -27.83 | -4.00 | -6.34 | -34.20 |
| 11:00-12:00 | -85.88 | -65.83 | -77.16 | -53.24 | -33.92 | -42.49 | -87.58 | -78.28 | -82.17 | -79.27 | -79.27 | -79.27 | -75.71 |
| 11:15-12:15 | -83.17 | -60.14 | -73.60 | -56.70 | -51.87 | -53.73 | -86.88 | -78.50 | -82.22 | -78.28 | -81.81 | -81.47 | -77.04 |
| 11:30-12:30 | -76.12 | -57.95 | -67.93 | -47.31 | -71.85 | -65.26 | -79.00 | -77.29 | -78.01 | -70.73 | -75.07 | -74.67 | -72.78 |
| 16:30-17:30 | -77.14 | -67.71 | -69.48 | -35.62 | -85.06 | -72.21 | -70.83 | -73.24 | -71.80 | -76.02 | -18.49 | -22.37 | -57.65 |
| 16:45-17:45 | -78.21 | -71.33 | -72.39 | -22.14 | -86.83 | -73.47 | -71.44 | -71.88 | -71.61 | -75.44 | -16.14 | -19.20 | -57.83 |
| 17:00-18:00 | -80.61 | -79.06 | -79.27 | -59.97 | -90.55 | -85.18 | -77.01 | -71.66 | -75.03 | -62.48 | -31.54 | -32.84 | -68.68 |
| 17:15-18:15 | -75.24 | -73.71 | -73.88 | -67.56 | -88.54 | -84.68 | -73.93 | -73.56 | -73.80 | -59.08 | -14.29 | -16.10 | -64.71 |
| 17:15-18:30 | -59.07 | -74.28 | -72.48 | -60.23 | -90.00 | -84.63 | -72.31 | -72.65 | -72.43 | -59.12 | -0.08 | -3.36 | -64.66 |

Table F-2: Percentage Difference Between Observed and Simulated Delay for Hourly Volume at the Downstream Intersections of Study Site 1

| TIME PERIOD (hours) | SIMULATED TOTAL AVERAGE STOPPED DELAY (veh-hr/hr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL |
| 6:30 - 7:30 | 1160.00 | 594.29 | 665.00 | 28.83 | 17.53 | 19.76 | 3680.00 | 620.00 | 1002.50 | -14.74 | 92.66 | 78.78 |
| 6:45 - 7:45 | 1160.00 | 980.00 | 1004.00 | 35.26 | 3.17 | 9.52 | 3680.00 | 323.53 | 510.00 | -37.93 | 82.40 | 62.91 |
| 7:00 - 8:00 | 1160.00 | 1316.00 | 1297.65 | 48.98 | 3.01 | 12.32 | 2510.00 | 33.33 | 121.79 | -26.88 | 91.51 | 72.94 |
| 7:15 - 8:15 | 2600.00 | 1191.76 | 1270.00 | 35.11 | -10.00 | -0.34 | 1610.00 | 15.52 | 61.74 | -31.72 | 62.00 | 50.63 |
| 7:30 - 8:30 | 860.00 | 1103.16 | 1070.00 | 2.97 | 21.45 | 6.62 | 3740.00 | 50.00 | 186.67 | -43.43 | 184.33 | 142.81 |
| 11:00-12:00 | 1340.00 | 293.75 | 410.00 | 119.69 | 77.99 | 91.36 | 656.00 | 250.53 | 283.23 | 1.74 | 585.91 | 385.37 |
| 11:15-12:15 | 1295.00 | 275.43 | 380.00 | 156.20 | 20.61 | 63.41 | 890.00 | 281.72 | 320.97 | -1.00 | 528.06 | 306.69 |
| 11:30-12:30 | 1655.00 | 407.27 | 542.16 | 191.37 | 46.33 | 92.89 | 1016.00 | 155.65 | 213.78 | -7.22 | 462.17 | 268.43 |
| 16:30-17:30 | 1556.00 | 230.21 | 252.68 | 83.87 | -32.61 | 8.35 | 300.00 | 446.67 | 425.71 | -23.39 | 20.88 | -3.14 |
| 16:45-17:45 | 1295.00 | 126.11 | 148.70 | 98.79 | -24.23 | 16.46 | 1610.00 | 521.18 | 562.26 | -15.43 | 18.82 | 0.55 |
| 17:00-18:00 | 963.64 | 118.12 | 137.95 | 97.94 | -35.16 | 9.42 | 755.00 | 530.00 | 546.07 | -24.63 | 44.57 | 5.35 |
| 17:15-18:15 | 820.00 | 93.64 | 107.52 | 113.41 | -31.77 | 15.09 | 620.00 | 342.11 | 364.52 | -12.29 | 35.51 | 8.26 |
| 17:15-18:30 | 832.73 | 188.12 | 210.00 | 109.21 | -32.30 | 14.17 | 755.00 | 177.41 | 203.37 | -13.43 | 36.55 | 9.22 |

Table F-3: Percentage Difference Between Observed and Simulated Delay for Hourly Volume at the Critical Intersection of Study Site 2

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | |
| 7:15 - 8:15 | -17.73 | 240.26 | 206.50 | 204.04 | 60.66 | 141.78 | -34.09 | 650.08 | 545.81 | 387.47 | 106.04 | 181.23 | 352.80 |
| 7:30 - 8:30 | -18.36 | 233.85 | 203.55 | 247.24 | 50.20 | 159.78 | -38.33 | 423.95 | 346.35 | 599.36 | 98.03 | 218.52 | 261.60 |
| 11:00-12:00 | 4.27 | 55.45 | 40.75 | -26.46 | 28.08 | -2.80 | 21.50 | 100.08 | 69.93 | 9.19 | 121.38 | 100.53 | 50.97 |
| 11:15-12:15 | -10.22 | 34.95 | 20.97 | -27.50 | 27.56 | -3.73 | 2.22 | 74.11 | 45.56 | -6.69 | 104.59 | 83.99 | 37.49 |
| 11:30-12:30 | -17.20 | 49.75 | 29.94 | -34.72 | 34.07 | -6.06 | 6.15 | 65.74 | 41.38 | -5.66 | 86.78 | 71.26 | 34.10 |
| 11:45-12:45 | -16.59 | 34.34 | 19.71 | -20.65 | 27.23 | 0.09 | 5.46 | 69.49 | 43.17 | -5.10 | 97.56 | 79.36 | 36.55 |
| 12:00-13:00 | -34.51 | 26.66 | 9.49 | -31.22 | 30.53 | -5.04 | -4.99 | 71.33 | 38.49 | -17.84 | 75.99 | 57.68 | 26.86 |
| 16:30-17:30 | 179.07 | 52.39 | 95.50 | 57.44 | 231.72 | 195.61 | 312.81 | 41.91 | 140.00 | -46.36 | 512.09 | 396.84 | 240.55 |
| 16:45-17:45 | 261.47 | 103.64 | 160.65 | -5.57 | 210.82 | 174.20 | 271.03 | 38.23 | 120.44 | -59.27 | 478.28 | 392.89 | 266.57 |
| 17:00-18:00 | 247.62 | 174.14 | 202.36 | -9.01 | 291.41 | 242.83 | 297.01 | 47.89 | 141.65 | -55.96 | 388.52 | 322.24 | 264.99 |
| 17:15-18:15 | 254.26 | -12.06 | 96.02 | -14.06 | 181.78 | 144.40 | 368.46 | 50.07 | 167.30 | -53.20 | 425.10 | 357.39 | 245.36 |
| 17:30-18:30 | 202.98 | 8.06 | 89.52 | 84.39 | 230.58 | 196.01 | 310.68 | 50.76 | 146.14 | -56.94 | 363.48 | 299.23 | 227.74 |

Table F-4: Percentage Difference Between Observed and Simulated Delay for Hourly Volume at the Downstream Intersections of Study Site 2

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL |
| 7:15 - 8:15 | 2.05 | 36.26 | 28.92 | 28.64 | 122.86 | 32.12 | 360.00 | -68.14 | -36.56 | 61.05 | -45.15 | -41.59 |
| 7:30 - 8:30 | -6.45 | 60.43 | 43.82 | 41.77 | 99.57 | 44.48 | 192.50 | -60.18 | -28.84 | 9.09 | -35.99 | -33.25 |
| 11:00-12:00 | 0.38 | 212.29 | 109.63 | 338.88 | 95.65 | 256.00 | 440.00 | 90.19 | 145.71 | 35.85 | 30.19 | 31.60 |
| 11:15-12:15 | -10.48 | 193.73 | 95.31 | 242.58 | 101.72 | 188.48 | 384.14 | 57.33 | 115.12 | 19.08 | 18.51 | 18.67 |
| 11:30-12:30 | -20.37 | 193.14 | 84.64 | 307.37 | 103.23 | 215.65 | 399.35 | 70.20 | 127.53 | 28.18 | 20.35 | 22.52 |
| 11:45-12:45 | -13.10 | 189.38 | 89.61 | 310.13 | 77.39 | 201.62 | 242.00 | 49.81 | 89.23 | 16.05 | 18.87 | 17.96 |
| 12:00-13:00 | -20.83 | 170.00 | 75.02 | 248.11 | 63.20 | 171.49 | 181.89 | 64.63 | 93.27 | 8.00 | 40.91 | 30.59 |
| 16:30-17:30 | -16.03 | 250.03 | 100.35 | 112.73 | -38.92 | 22.20 | 451.61 | 39.82 | 89.88 | -25.19 | -53.13 | -46.84 |
| 16:45-17:45 | -21.32 | 250.63 | 93.30 | 108.47 | -45.95 | 4.67 | 315.71 | -19.00 | 15.97 | -68.70 | -79.93 | -77.75 |
| 17:00-18:00 | -20.24 | 261.44 | 98.94 | 107.46 | -38.88 | 8.13 | 218.46 | -46.70 | -24.32 | -22.50 | -58.82 | -51.90 |
| 17:15-18:15 | -3.83 | 260.00 | 113.30 | 144.11 | -44.95 | 4.52 | 197.27 | -62.95 | -41.98 | -6.75 | -51.13 | -41.28 |
| 17:30-18:30 | -12.22 | 269.95 | 109.19 | 137.21 | -39.02 | 6.63 | 168.77 | -67.35 | -48.20 | 3.94 | -48.18 | -37.13 |

Table F-5: Percentage Difference Between Observed and Simulated Delay for Hourly Volume at the Critical Intersection of Study Site 3

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | |
| 6:45 - 7:45 | 6.80 | -61.15 | -54.02 | 108.97 | 229.16 | 223.08 | -7.68 | 74.23 | 44.85 | 17.48 | 107.79 | 82.48 | 67.96 |
| 7:00 - 8:00 | 53.33 | -36.24 | -25.02 | 173.40 | 234.67 | 231.58 | -21.62 | 65.79 | 36.61 | 29.73 | 89.83 | 76.88 | 77.57 |
| 7:15 - 8:15 | 70.47 | 40.46 | 44.50 | 49.04 | 226.53 | 214.73 | -14.78 | 65.89 | 39.04 | 41.41 | 103.86 | 92.34 | 100.55 |
| 7:30 - 8:30 | 86.51 | 63.11 | 66.58 | 85.73 | 249.67 | 237.36 | -6.36 | 95.94 | 62.23 | 44.69 | 87.52 | 79.91 | 106.64 |
| 11:00-12:00 | 20.36 | 156.70 | 131.36 | 59.11 | 677.95 | 365.03 | 34.30 | 65.20 | 54.86 | 67.13 | 89.11 | 81.94 | 124.02 |
| 11:15-12:15 | 36.06 | 231.95 | 189.58 | 68.97 | 870.64 | 467.16 | 11.96 | 64.81 | 45.59 | 115.41 | 131.60 | 126.58 | 159.31 |
| 11:30-12:30 | 37.68 | 257.28 | 207.40 | 0.00 | 459.67 | 459.67 | 2.75 | 57.32 | 36.74 | 81.40 | 88.57 | 86.37 | 141.39 |
| 11:45-12:45 | 53.90 | 250.40 | 201.85 | 50.65 | 694.05 | 377.17 | -9.29 | 55.15 | 29.27 | 77.42 | 106.56 | 97.91 | 131.23 |
| 12:00-13:00 | 71.78 | 330.76 | 265.10 | 89.50 | 597.95 | 366.23 | -17.99 | 54.77 | 23.82 | 82.71 | 94.63 | 91.14 | 135.79 |
| 16:45-17:45 | 0.57 | 498.55 | 414.86 | 74.10 | -5.59 | 15.64 | 90.57 | 31.72 | 48.43 | 100.32 | 439.56 | 339.43 | 144.64 |
| 17:00-18:00 | -13.95 | 389.30 | 325.81 | 46.26 | 8.18 | 18.67 | 144.68 | 46.28 | 75.26 | 63.93 | 351.58 | 267.61 | 138.77 |
| 17:15-18:15 | -6.85 | 620.12 | 506.68 | 99.62 | 1.69 | 27.24 | 84.92 | 84.48 | 84.61 | 91.40 | 307.85 | 244.52 | 170.95 |

Table F-6: Percentage Difference Between Observed and Simulated Delay for Hourly Volume at the Downstream Intersections of Study Site 3

| TIME PERIOD | SIMULATED TOTAL AVERAGE STOPPED DELAY (veh-hr/hr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| (hours) | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL |
| 6:45 - 7:45 | 81.02 | 8.72 | 25.21 | 325.06 | 1793.38 | 1229.17 | -93.56 | -95.37 | -93.97 | 147.50 | 104.14 | 107.79 |
| 7:00 - 8:00 | 501.26 | 177.88 | 259.24 | 202.67 | 1785.71 | 1166.26 | -96.11 | -87.20 | -94.00 | 147.12 | 122.20 | 124.63 |
| 7:15 - 8:15 | 673.23 | 331.33 | 403.29 | 165.57 | 1911.30 | 1178.58 | -93.58 | -90.97 | -92.94 | 137.14 | 88.87 | 93.85 |
| 7:30 - 8:30 | 794.94 | 269.02 | 366.32 | 167.87 | 2444.67 | 1445.90 | -87.93 | -91.99 | -89.01 | 106.47 | 158.51 | 152.37 |
| 11:00-12:00 | -16.04 | 67.31 | 56.17 | 61.28 | 836.72 | 389.41 | -87.18 | -88.80 | -88.04 | 479.23 | 407.17 | 430.89 |
| 11:15-12:15 | -12.26 | 50.82 | 43.37 | 40.67 | 789.93 | 337.34 | -85.83 | -97.62 | -92.23 | 479.74 | 384.10 | 415.04 |
| 11:30-12:30 | -13.56 | 51.00 | 43.30 | 54.29 | 1093.13 | 361.46 | -83.81 | -97.63 | -91.37 | 513.97 | 360.47 | 406.20 |
| 11:45-12:45 | 26.06 | 44.41 | 42.49 | 55.64 | 1256.23 | 380.12 | -74.71 | -97.32 | -88.21 | 438.00 | 369.81 | 394.46 |
| 12:00-13:00 | 19.67 | 68.40 | 62.84 | 51.26 | 954.79 | 329.76 | -82.93 | -97.19 | -91.20 | 387.80 | 340.23 | 357.53 |
| 16:45-17:45 | 105.80 | 499.27 | 476.23 | 29.75 | -35.40 | -27.60 | -93.53 | -91.17 | -92.92 | 59.52 | 1014.49 | 346.51 |
| 17:00-18:00 | 69.97 | 1514.05 | 1439.33 | 105.24 | -58.20 | -42.43 | -90.02 | -82.72 | -88.16 | 50.08 | 940.00 | 308.94 |
| 17:15-18:15 | 60.21 | 1365.10 | 1302.10 | -14.04 | -68.11 | -62.88 | -88.13 | -84.11 | -87.14 | 37.31 | 936.70 | 273.31 |

Table F-7: Percentage Difference Between Observed and Simulated Total Delay for Hourly Volume at the Critical Intersection of Study Site 4

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | |
| 6:45 - 7:45 | 115.86 | 88.29 | 95.71 | 36.82 | 75.52 | 68.46 | 14.86 | 74.28 | 56.48 | 34.91 | 26.65 | 28.37 | 55.98 |
| 7:00 - 8:00 | 104.45 | 95.35 | 97.70 | 35.00 | 79.70 | 69.37 | -11.22 | 49.36 | 30.02 | 46.41 | 23.28 | 28.16 | 48.34 |
| 7:15 - 8:15 | 66.15 | 87.25 | 82.14 | 38.84 | 67.16 | 59.80 | -24.58 | 43.77 | 20.37 | 37.63 | 11.28 | 16.63 | 38.12 |
| 7:30 - 8:30 | 61.09 | 87.42 | 81.23 | 44.07 | 66.14 | 59.92 | -25.41 | 28.18 | 11.20 | 48.03 | 10.25 | 17.36 | 35.84 |
| 11:00-12:00 | -29.81 | -28.60 | -28.92 | -20.28 | 5.26 | -6.90 | -6.24 | 236.91 | 137.96 | 53.36 | 163.80 | 133.69 | 38.28 |
| 11:15-12:15 | -19.89 | -37.23 | -33.39 | -19.31 | 9.32 | -4.10 | 13.39 | 241.51 | 158.89 | 57.02 | 162.99 | 135.01 | 41.70 |
| 11:30-12:30 | -11.50 | -37.95 | -32.64 | -12.31 | 8.63 | -1.16 | 25.39 | 240.51 | 161.26 | 43.45 | 139.24 | 113.60 | 40.00 |
| 11:45-12:45 | -24.28 | -34.66 | -32.47 | -12.63 | 16.64 | 3.07 | 33.93 | 221.82 | 157.09 | 70.29 | 130.80 | 116.46 | 39.67 |
| 12:00-13:00 | -18.22 | -29.25 | -27.03 | 3.27 | 19.59 | 12.54 | 47.35 | 187.57 | 143.14 | 58.98 | 385.57 | 294.72 | 67.93 |
| 16:30-17:30 | 24.64 | 65.31 | 59.35 | 158.78 | 597.23 | 371.03 | 279.69 | 80.00 | 167.74 | 99.61 | 457.33 | 422.03 | 248.83 |
| 16:45-17:45 | 22.44 | 19.70 | 20.01 | 201.67 | 725.75 | 456.82 | 420.21 | 120.98 | 261.11 | 102.91 | 695.81 | 635.25 | 308.13 |
| 17:00-18:00 | 19.46 | 95.18 | 86.50 | 321.43 | 876.63 | 619.40 | 423.77 | 113.43 | 254.74 | 82.36 | 668.66 | 612.48 | 360.80 |
| 17:15-18:15 | 25.29 | -7.36 | -4.21 | 383.61 | 456.15 | 426.77 | 280.70 | 110.70 | 194.25 | 92.15 | 599.47 | 548.13 | 240.97 |
| 17:30-18:30 | 31.09 | -42.39 | -37.92 | 224.50 | 301.17 | 271.13 | 109.15 | 101.43 | 105.11 | 91.25 | 344.12 | 313.65 | 96.31 |

Table F-8: Percentage Difference Between Observed and Simulated Delay for Hourly Volume at the Downstream Intersections of Study Site 4

| TIME PERIOD (hours) | SIMULATED TOTAL AVERAGE STOPPED DELAY (veh-hr/hr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL |
| 6:45 - 7:45 | 0.00 | 555.56 | 555.56 | -20.80 | 76.67 | 68.41 | 84.62 | -60.84 | -51.16 | 129.09 | 675.38 | 512.97 |
| 7:00 - 8:00 | 0.00 | 618.30 | 618.30 | -37.93 | 63.75 | 54.76 | 94.59 | -66.06 | -57.57 | 37.65 | 2920.00 | 1035.38 |
| 7:15 - 8:15 | 0.00 | 634.40 | 634.40 | -45.66 | 74.75 | 52.97 | 128.29 | -48.65 | -37.74 | 152.00 | 2384.00 | 1268.00 |
| 7:30 - 8:30 | 0.00 | 786.25 | 786.25 | -51.43 | 65.63 | 38.91 | 182.00 | -50.68 | -38.89 | 180.00 | 1616.92 | 1029.09 |
| 11:00-12:00 | 0.00 | 76.33 | 76.33 | 11.27 | -81.05 | 1.74 | 178.18 | 119.77 | 121.58 | -15.29 | 3.98 | 3.32 |
| 11:15-12:15 | 0.00 | 49.49 | 49.49 | -30.77 | -73.00 | -34.95 | 24.62 | 125.26 | 118.23 | -12.57 | -10.64 | -10.75 |
| 11:30-12:30 | 0.00 | 31.29 | 31.29 | -22.86 | -81.05 | -28.00 | -3.08 | 120.28 | 108.01 | 2.00 | 3.78 | 3.69 |
| 11:45-12:45 | 0.00 | 60.00 | 60.00 | -2.31 | -78.82 | -8.33 | 6.07 | 109.76 | 96.29 | 21.76 | -1.31 | -0.15 |
| 12:00-13:00 | 0.00 | 63.13 | 63.13 | 29.47 | -80.00 | 19.05 | 10.15 | 120.05 | 102.97 | 2.27 | 7.84 | 7.51 |
| 16:30-17:30 | 0.00 | 281.27 | 281.27 | -0.00 | -77.50 | -2.38 | 6.03 | -56.54 | -52.69 | 71.29 | -54.47 | -45.88 |
| 16:45-17:45 | 0.00 | 419.26 | 419.26 | -4.15 | -55.00 | -5.75 | 57.85 | -50.41 | -43.28 | 58.68 | -56.73 | -47.58 |
| 17:00-18:00 | 0.00 | 319.42 | 319.42 | 8.46 | -55.00 | 6.36 | 65.71 | -57.23 | -50.13 | 58.68 | -59.57 | -51.09 |
| 17:15-18:15 | 0.00 | 473.14 | 473.14 | 10.53 | -48.57 | 8.77 | 80.00 | -60.11 | -52.99 | 33.12 | -64.45 | -55.52 |
| 17:30-18:30 | 0.00 | 627.04 | 627.04 | 19.22 | -74.29 | 16.47 | 87.83 | -56.24 | -49.78 | 25.14 | -62.38 | -53.53 |

Table F-9: Percentage Difference Between Observed and Simulated Total Delay for Hourly Volume at the Critical Intersection of Study Site 5

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | |
| 6:30 - 7:30 | 58.48 | 83.38 | 73.59 | 585.00 | 1333.53 | 1200.79 | -21.06 | 0.82 | -6.79 | -3.08 | 84.18 | 73.04 | 98.43 |
| 6:45 - 7:45 | 53.49 | 144.07 | 103.92 | 329.40 | 2885.56 | 1903.33 | 15.01 | 86.38 | 61.02 | -9.61 | 96.79 | 85.16 | 165.03 |
| 7:00 - 8:00 | 73.03 | 242.07 | 157.64 | 226.67 | 3601.14 | 2280.70 | 53.96 | 110.45 | 89.41 | -7.82 | 65.13 | 59.54 | 213.64 |
| 7:15 - 8:15 | 81.67 | 354.89 | 212.61 | 186.23 | 3598.18 | 2166.10 | 112.41 | 150.62 | 135.22 | 1.60 | 75.45 | 70.91 | 249.18 |
| 7:30 - 8:30 | 57.66 | 531.12 | 249.27 | 168.72 | 3290.00 | 1920.79 | 97.11 | 155.04 | 131.65 | 5.13 | 83.81 | 79.26 | 248.05 |
| 11:15-12:15 | -23.69 | 196.68 | 57.98 | 5.65 | 677.37 | 271.62 | 81.79 | 81.30 | 81.44 | 34.15 | -16.91 | -12.78 | 68.36 |
| 11:30-12:30 | -18.70 | 188.24 | 66.31 | 23.59 | 953.13 | 298.44 | 94.08 | 90.45 | 91.48 | 29.38 | 4.39 | 6.95 | 84.85 |
| 11:45-12:45 | -24.29 | 146.61 | 47.15 | 27.95 | 1082.46 | 312.95 | 77.73 | 121.55 | 107.36 | 15.88 | -13.17 | -10.50 | 75.37 |
| 12:00-13:00 | -2.57 | 197.17 | 78.98 | 24.66 | 1013.42 | 331.27 | 69.00 | 124.17 | 105.53 | 9.09 | -16.72 | -14.17 | 87.06 |
| 16:30-17:30 | -18.58 | 310.12 | 135.24 | 61.32 | 28.34 | 34.00 | 37.05 | -43.38 | -26.93 | 43.00 | 0.65 | 3.98 | 11.92 |
| 16:45-17:45 | -41.69 | 250.60 | 91.84 | 51.72 | -31.58 | -21.60 | 10.60 | -71.47 | -57.01 | -0.65 | 9.31 | 8.50 | -19.30 |
| 17:00-18:00 | -52.71 | 182.89 | 54.66 | 36.98 | -51.28 | -42.76 | 39.55 | -73.17 | -55.31 | 23.65 | 37.92 | 36.59 | -27.86 |
| 17:15-18:15 | -55.19 | 142.44 | 32.76 | 21.78 | -59.10 | -51.28 | 0.07 | -73.24 | -62.22 | 8.69 | 9.37 | 9.29 | -39.32 |
| 17:30-18:30 | -46.47 | 209.79 | 64.26 | 10.82 | -63.09 | -55.94 | 2.08 | -61.03 | -49.20 | 54.35 | 10.46 | 15.67 | -32.21 |

**Table F-10: Percentage Difference Between Observed and Simulated Delay for Hourly Volume at the Downstream Intersections of Study Site 5**

| TIME PERIOD (hours) | SIMULATED TOTAL AVERAGE STOPPED DELAY (veh-hr/hr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL |
| 6:30 - 7:30 | -41.86 | -73.07 | -70.76 | -50.68 | 249.05 | 219.76 | 0.00 | 521.68 | 185.21 | 24.14 | -35.91 | -32.78 |
| 6:45 - 7:45 | -36.51 | -71.12 | -67.49 | -80.80 | 78.06 | 59.21 | 0.00 | 359.42 | 97.68 | 126.45 | -66.73 | -59.89 |
| 7:00 - 8:00 | 2.22 | -66.77 | -58.13 | -84.47 | 190.50 | 159.33 | 0.00 | 215.87 | 68.97 | 150.00 | -70.94 | -65.02 |
| 7:15 - 8:15 | 74.48 | -57.34 | -39.60 | -79.74 | 158.49 | 129.71 | 0.00 | 213.70 | 64.69 | 143.00 | -76.33 | -71.17 |
| 7:30 - 8:30 | 169.77 | 16.98 | 39.59 | -69.89 | 176.01 | 143.77 | 0.00 | 138.80 | 31.67 | 63.93 | -79.98 | -75.91 |
| 11:15-12:15 | 0.59 | 148.52 | 116.53 | 156.07 | -47.38 | -26.22 | 0.00 | -71.45 | -57.38 | 177.63 | 18.43 | 31.69 |
| 11:30-12:30 | 4.59 | 174.22 | 135.69 | 122.35 | -48.19 | -27.35 | 0.00 | -76.61 | -58.33 | 167.00 | 35.58 | 45.94 |
| 11:45-12:45 | 30.95 | 198.13 | 156.83 | 141.03 | -61.76 | -34.88 | 0.00 | -77.71 | -62.45 | 207.24 | 25.01 | 38.82 |
| 12:00-13:00 | 46.19 | 228.66 | 182.39 | 112.73 | -0.03 | 16.37 | 0.00 | -78.21 | -60.00 | 250.00 | 26.91 | 42.30 |
| 16:30-17:30 | -2.44 | 273.02 | 228.17 | 352.63 | 337.47 | 343.86 | 0.00 | -6.51 | -23.07 | 38.80 | 47.57 | 46.76 |
| 16:45-17:45 | -17.37 | 345.54 | 284.55 | 361.04 | 396.72 | 380.09 | 0.00 | -81.32 | -76.49 | 30.45 | 4.45 | 6.31 |
| 17:00-18:00 | -32.98 | 567.22 | 472.72 | 482.37 | 403.05 | 439.05 | 0.00 | -89.05 | -84.40 | 20.65 | -8.96 | -6.64 |
| 17:15-18:15 | -22.74 | 313.69 | 252.81 | 423.07 | 330.39 | 367.18 | 0.00 | -91.62 | -86.75 | 23.18 | -2.32 | -0.12 |
| 17:30-18:30 | -31.83 | 841.15 | 647.92 | 481.82 | 270.93 | 354.44 | 0.00 | -93.38 | -88.53 | 36.32 | 0.85 | 4.03 |

Table F-11: Percentage Difference Between Observed and Simulated Total Delay for Hourly Volume at the Critical Intersection of Study Site 6

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | |
| 6:30 - 7:30 | 0.23 | 168.11 | 108.22 | 35.00 | 211.68 | 134.34 | -40.96 | 27.43 | 9.01 | -52.50 | 142.56 | 105.31 | 70.88 |
| 6:45 - 7:45 | 13.53 | 116.29 | 86.06 | 320.00 | 160.21 | 223.32 | 45.52 | -50.12 | -23.82 | 40.87 | 3.90 | 9.40 | 47.03 |
| 7:00 - 8:00 | 1.28 | 115.65 | 81.71 | 135.48 | 152.48 | 145.81 | 50.81 | -44.12 | -18.25 | 41.57 | 32.14 | 33.77 | 44.04 |
| 7:15 - 8:15 | -20.39 | 54.58 | 31.11 | 34.09 | 216.63 | 148.29 | -14.29 | -14.94 | -14.74 | 37.76 | 84.81 | 76.38 | 35.03 |
| 7:30 - 8:30 | -23.93 | 47.74 | 24.56 | 24.82 | 156.12 | 106.70 | -13.16 | -23.81 | -20.77 | 42.33 | 65.67 | 61.75 | 24.34 |
| 11:00-12:00 | -4.05 | 92.09 | 30.21 | 33.48 | 164.26 | 122.24 | 82.32 | 2.86 | 27.94 | 32.50 | 45.85 | 43.93 | 49.21 |
| 11:15-12:15 | -5.47 | 85.07 | 25.14 | 9.57 | 151.20 | 103.29 | 52.73 | 7.49 | 23.83 | 37.92 | 41.63 | 41.14 | 43.75 |
| 11:30-12:30 | 16.40 | 45.10 | 27.37 | 63.02 | 168.59 | 137.68 | 11.10 | 144.98 | 102.26 | -70.00 | 70.39 | 52.54 | 75.09 |
| 11:45-12:45 | -4.77 | 24.29 | 6.59 | 31.21 | 135.66 | 104.27 | 71.86 | -16.98 | 9.68 | 21.82 | 23.33 | 23.12 | 28.02 |
| 12:00-13:00 | -4.12 | 23.55 | 7.45 | -2.17 | 106.43 | 71.08 | 50.24 | -18.65 | 2.44 | 15.84 | 23.55 | 22.45 | 21.04 |
| 16:30-17:30 | -8.32 | 8.76 | -1.38 | 69.20 | 53.11 | 55.16 | 39.51 | 34.27 | 36.14 | -43.80 | 8.78 | -2.37 | 19.83 |
| 16:45-17:45 | 31.08 | -5.48 | 16.28 | 85.92 | 63.77 | 66.37 | 80.47 | 7.82 | 31.85 | -40.51 | 7.44 | -2.27 | 23.17 |
| 17:00-18:00 | 8.96 | -8.73 | 1.32 | 75.31 | 45.40 | 49.43 | 108.66 | -0.54 | 34.60 | -42.34 | 24.92 | 11.21 | 23.43 |
| 17:15-18:15 | -2.74 | 1.04 | -1.28 | 53.87 | 82.16 | 77.39 | 110.66 | -8.50 | 25.97 | -43.14 | -0.23 | -9.43 | 17.04 |
| 17:30-18:30 | -9.34 | 8.42 | -2.48 | 19.69 | 73.56 | 63.70 | 64.96 | -18.52 | 6.52 | -36.64 | 4.19 | -4.51 | 12.51 |

**Table F-12: Percentage Difference Between Observed and Simulated Delay for Hourly Volume at the Downstream Intersections of Study Site 6**

| TIME PERIOD (hours) | SIMULATED TOTAL AVERAGE STOPPED DELAY (veh-hr/hr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL |
| 6:30 - 7:30 | 475.45 | 509.49 | 501.49 | 80.00 | 53.95 | 63.64 | 15.71 | 1043.24 | 761.18 | -40.39 | -64.50 | -48.14 |
| 6:45 - 7:45 | 354.74 | 84.79 | 145.31 | -77.96 | 420.71 | 236.99 | 120.00 | 511.25 | 404.55 | -70.11 | -85.19 | -75.99 |
| 7:00 - 8:00 | 328.76 | 88.12 | 144.93 | -71.20 | 503.19 | 303.75 | 88.18 | 737.00 | 562.93 | -69.83 | -85.78 | -76.76 |
| 7:15 - 8:15 | 262.31 | 84.91 | 122.21 | -68.70 | 290.00 | 186.88 | 31.54 | 792.80 | 532.37 | -67.64 | -81.98 | -73.98 |
| 7:30 - 8:30 | 249.57 | 105.71 | 138.05 | -73.33 | 331.65 | 192.36 | 52.31 | 902.86 | 633.17 | -61.13 | -82.67 | -70.84 |
| 11:00-12:00 | 123.20 | 94.85 | 100.66 | -75.29 | 291.20 | 142.86 | 9.41 | 210.57 | 168.52 | -65.86 | 132.50 | -54.79 |
| 11:15-12:15 | 98.62 | 100.00 | 99.69 | -77.89 | 307.37 | 142.26 | -5.00 | 174.82 | 131.08 | -67.95 | 125.00 | -57.28 |
| 11:30-12:30 | 92.00 | 92.27 | 92.20 | -76.77 | 303.20 | 131.24 | -16.00 | 251.04 | 173.76 | -67.58 | 209.60 | -52.08 |
| 11:45-12:45 | 86.21 | 78.24 | 80.00 | -85.35 | 342.70 | 112.63 | -25.32 | 178.03 | 115.77 | -73.43 | 84.86 | -62.12 |
| 12:00-13:00 | 114.62 | 102.69 | 104.83 | -87.01 | 368.49 | 108.59 | -15.56 | 185.14 | 130.03 | -79.93 | 36.80 | -70.71 |
| 16:30-17:30 | 87.83 | -35.36 | 6.93 | -88.94 | 97.18 | 21.63 | -24.25 | 308.91 | 153.95 | -79.55 | 43.39 | -66.41 |
| 16:45-17:45 | 112.73 | -51.95 | 0.40 | -91.00 | 91.09 | 21.66 | -17.38 | 299.04 | 165.00 | -76.17 | 47.04 | -60.60 |
| 17:00-18:00 | 100.66 | -32.60 | 13.98 | -92.47 | 53.13 | -4.45 | -18.12 | 284.52 | 158.65 | -79.72 | 26.19 | -62.42 |
| 17:15-18:15 | 129.09 | -41.27 | 5.00 | -92.50 | 40.56 | -10.13 | -6.48 | 218.91 | 131.35 | -74.34 | 37.05 | -56.77 |
| 17:30-18:30 | 164.19 | -46.09 | 2.38 | -92.61 | 93.25 | 18.01 | 2.99 | 240.53 | 156.56 | -76.43 | 73.33 | -55.69 |

# APPENDIX G

## COMPARISON OF OBSERVED AND SIMULATED DELAYS FOR HOURLY PERIODS USING SATURATION FLOW RATE OF 1800 VPHG

Table G-1: Percentage Difference Between Observed and Simulated Total Delay for Hourly Volume at the Critical Intersection of Study Site 1

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | |
| 6:30 - 7:30 | 12.38 | 1.21 | 7.47 | 100.05 | 8.68 | 24.89 | 71.70 | 75.31 | 74.85 | 121.48 | 169.55 | 161.10 | 68.74 |
| 6:45 - 7:45 | 21.73 | -3.24 | 10.67 | 112.52 | 6.60 | 22.80 | 62.97 | 95.17 | 90.24 | 159.60 | 144.60 | 146.56 | 69.98 |
| 7:00 - 8:00 | 52.50 | 4.44 | 33.60 | 139.64 | 16.91 | 35.09 | 69.60 | 55.01 | 57.40 | 212.91 | 164.29 | 169.83 | 70.15 |
| 7:15 - 8:15 | 58.05 | 10.22 | 39.78 | 135.44 | 47.63 | 62.08 | 104.53 | 53.98 | 63.26 | 151.32 | 135.21 | 136.85 | 77.41 |
| 7:30 - 8:30 | -77.10 | -73.04 | -75.61 | -42.66 | -65.31 | -60.80 | -60.87 | -67.66 | -66.35 | -46.67 | -41.98 | -42.44 | -60.30 |
| 11:00-12:00 | -86.87 | -66.69 | -78.09 | -59.93 | -40.91 | -49.34 | -87.84 | -78.00 | -82.12 | -79.74 | -81.58 | -81.36 | -77.49 |
| 11:15-12:15 | -84.23 | -61.53 | -74.79 | -60.97 | -59.57 | -60.11 | -88.83 | -79.46 | -83.62 | -75.80 | -80.53 | -80.07 | -77.79 |
| 11:30-12:30 | -81.13 | -58.54 | -70.95 | -65.22 | -77.77 | -74.40 | -85.14 | -78.42 | -81.25 | -71.71 | -82.12 | -81.17 | -78.47 |
| 16:30-17:30 | -79.93 | -82.58 | -82.08 | -71.13 | -87.19 | -83.02 | -84.00 | -74.91 | -80.34 | -76.61 | -65.91 | -66.63 | -77.63 |
| 16:45-17:45 | -81.07 | -83.58 | -83.19 | -65.93 | -89.51 | -84.64 | -84.59 | -73.67 | -80.46 | -75.96 | -57.45 | -58.40 | -76.11 |
| 17:00-18:00 | -82.95 | -91.33 | -90.19 | -63.40 | -92.20 | -87.14 | -87.90 | -73.50 | -82.57 | -63.79 | -70.56 | -70.27 | -83.43 |
| 17:15-18:15 | -80.08 | -90.91 | -89.67 | -70.31 | -93.00 | -88.82 | -85.82 | -74.28 | -81.73 | -59.86 | -48.94 | -49.38 | -79.92 |
| 17:15-18:30 | -79.56 | -87.93 | -86.94 | -81.41 | -93.26 | -91.12 | -84.37 | -73.41 | -80.46 | -60.15 | -45.30 | -46.12 | -80.38 |

Table G-2: Percentage Difference Between Observed and Simulated Delay for Hourly Volume at the Downstream Intersections of Study Site 1

| TIME PERIOD (hours) | SIMULATED TOTAL AVERAGE STOPPED DELAY (veh-hr/hr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL |
| 6:30 - 7:30 | 1160.00 | 517.14 | 597.50 | 34.25 | 4.32 | 10.24 | 3680.00 | 645.71 | 1025.00 | -14.74 | 60.31 | 50.61 |
| 6:45 - 7:45 | 1160.00 | 883.08 | 920.00 | 15.49 | -6.34 | -2.01 | 3680.00 | 334.12 | 520.00 | -44.14 | 60.80 | 43.80 |
| 7:00 - 8:00 | 1070.00 | 1220.00 | 1202.35 | 49.92 | -8.57 | 3.28 | 2600.00 | 33.33 | 125.00 | -26.88 | 80.00 | 63.24 |
| 7:15 - 8:15 | 2420.00 | 1191.76 | 1260.00 | 35.56 | -16.42 | -5.29 | 1700.00 | 15.52 | 64.35 | -31.72 | 51.71 | 41.59 |
| 7:30 - 8:30 | 800.00 | 1122.11 | 1078.18 | -0.62 | 17.11 | 2.84 | 3920.00 | 52.31 | 195.56 | -43.43 | 160.25 | 123.13 |
| 11:00-12:00 | 1295.00 | 305.00 | 415.00 | 122.52 | 67.96 | 85.45 | 656.00 | 231.58 | 265.81 | -3.48 | 569.55 | 372.84 |
| 11:15-12:15 | 1295.00 | 270.29 | 375.38 | 158.83 | 15.15 | 60.51 | 890.00 | 284.83 | 323.87 | 234.80 | 3422.30 | 2088.62 |
| 11:30-12:30 | 1655.00 | 380.00 | 517.84 | 184.89 | 37.14 | 84.57 | 980.00 | 150.43 | 206.49 | -7.22 | 453.04 | 263.06 |
| 16:30-17:30 | 1592.00 | 252.55 | 275.25 | 82.76 | -37.70 | 4.66 | 300.00 | 450.00 | 428.57 | -23.39 | 13.82 | -6.37 |
| 16:45-17:45 | 1340.00 | 141.63 | 164.78 | 95.76 | -32.31 | 10.04 | 1610.00 | 528.24 | 569.06 | -15.43 | 15.27 | -1.10 |
| 17:00-18:00 | 996.36 | 133.84 | 154.07 | 97.30 | -40.00 | 5.98 | 755.00 | 536.92 | 552.50 | -24.63 | 35.96 | 1.61 |
| 17:15-18:15 | 900.00 | 119.74 | 134.65 | 110.00 | -35.34 | 11.56 | 620.00 | 386.32 | 405.16 | -19.15 | 19.33 | -2.61 |
| 17:15-18:30 | 865.45 | 219.74 | 241.67 | 107.85 | -37.05 | 10.45 | 755.00 | 211.29 | 235.73 | -13.43 | 21.03 | 2.19 |

Table G-3: Percentage Difference Between Observed and Simulated Delay for Hourly Volume at the Critical Intersection of Study Site 2

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | |
| 7:15 - 8:15 | -25.15 | 161.85 | 137.38 | 68.05 | 62.31 | 65.55 | -39.65 | 75.76 | 58.18 | 164.75 | 99.66 | 117.05 | 84.31 |
| 7:30 - 8:30 | -28.64 | 59.46 | 48.88 | 40.56 | 48.51 | 44.09 | -40.70 | 113.38 | 87.52 | 271.56 | 92.02 | 135.17 | 74.21 |
| 11:00-12:00 | 1.52 | 48.38 | 34.92 | -31.72 | 23.60 | -7.71 | 12.12 | 88.17 | 58.99 | 7.21 | 111.26 | 91.93 | 43.48 |
| 11:15-12:15 | -15.61 | 46.61 | 27.36 | -28.57 | 39.13 | 0.66 | 9.37 | 67.24 | 44.26 | -4.48 | 101.32 | 81.74 | 39.08 |
| 11:30-12:30 | -15.40 | 37.84 | 22.09 | -38.13 | 28.20 | -10.50 | -0.36 | 59.92 | 35.28 | -6.20 | 75.52 | 61.80 | 27.17 |
| 11:45-12:45 | -21.41 | 29.38 | 14.79 | -33.17 | 25.53 | -7.74 | -0.35 | 61.19 | 35.90 | -6.65 | 83.78 | 67.75 | 28.38 |
| 12:00-13:00 | -31.04 | 18.36 | 4.49 | -34.80 | 21.47 | -10.94 | -14.76 | 64.88 | 30.61 | -19.95 | 64.38 | 47.92 | 19.53 |
| 16:30-17:30 | 72.92 | -2.37 | 23.25 | 20.53 | 25.28 | 24.30 | 91.87 | 40.95 | 59.39 | -48.91 | 233.30 | 175.06 | 84.80 |
| 16:45-17:45 | 56.15 | 22.00 | 34.34 | -18.85 | 94.07 | 74.97 | 167.07 | 31.70 | 79.50 | -60.37 | 228.01 | 182.20 | 118.20 |
| 17:00-18:00 | 134.36 | 17.11 | 62.14 | -14.30 | 126.97 | 104.12 | 200.66 | 43.66 | 102.75 | -57.40 | 179.64 | 144.29 | 117.40 |
| 17:15-18:15 | 142.31 | -12.36 | 50.41 | -20.45 | 141.74 | 110.78 | 134.80 | 36.04 | 72.40 | -57.19 | 150.54 | 121.13 | 102.68 |
| 17:30-18:30 | 106.97 | -4.48 | 42.10 | 26.27 | 98.73 | 81.60 | 198.09 | 39.54 | 97.72 | -59.03 | 94.74 | 71.24 | 71.63 |

Table G-4: Percentage Difference Between Observed and Simulated Delay for Hourly Volume at the Downstream Intersections of Study Site 2

| TIME PERIOD | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| (hours) | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL |
| 7:15 - 8:15 | 2.05 | 27.74 | 22.23 | 24.54 | 131.43 | 28.48 | 360.00 | -69.73 | -38.03 | 80.00 | -43.83 | -39.68 |
| 7:30 - 8:30 | 1.84 | 59.26 | 45.00 | 35.24 | 107.39 | 38.62 | 192.50 | -61.77 | -30.23 | 20.00 | -33.52 | -30.26 |
| 11:00-12:00 | 3.85 | 186.27 | 97.89 | 342.92 | 91.74 | 257.33 | 440.00 | 102.08 | 155.71 | 35.85 | 25.66 | 28.21 |
| 11:15-12:15 | -10.48 | 193.73 | 95.31 | 242.58 | 101.72 | 188.48 | 440.00 | 66.67 | 132.68 | 19.08 | 18.51 | 18.67 |
| 11:30-12:30 | -17.88 | 166.57 | 72.83 | 295.53 | 77.10 | 197.39 | 405.16 | 53.06 | 114.38 | 30.91 | 17.21 | 21.01 |
| 11:45-12:45 | -15.76 | 170.43 | 78.69 | 291.90 | 56.52 | 182.16 | 242.00 | 45.16 | 85.54 | 20.79 | 14.34 | 16.43 |
| 12:00-13:00 | -18.33 | 145.23 | 63.82 | 249.81 | 51.20 | 167.51 | 188.68 | 41.59 | 77.51 | 12.50 | 35.77 | 28.47 |
| 16:30-17:30 | -18.61 | 228.43 | 89.45 | 128.13 | -40.87 | 27.24 | 498.06 | 34.20 | 90.59 | -27.53 | -54.49 | -48.42 |
| 16:45-17:45 | -22.04 | 231.40 | 84.78 | 113.56 | -46.94 | 5.67 | 315.71 | -49.50 | -18.96 | -71.30 | -79.93 | -78.26 |
| 17:00-18:00 | -18.82 | 252.30 | 95.88 | 115.59 | -47.06 | 5.19 | 228.85 | -48.30 | -24.90 | -22.50 | -60.59 | -53.33 |
| 17:15-18:15 | -6.73 | 263.18 | 113.09 | 144.11 | -54.13 | -2.26 | 213.64 | -52.19 | -30.77 | -6.75 | -54.23 | -43.69 |
| 17:30-18:30 | -14.27 | 255.03 | 101.60 | 144.19 | -46.34 | 3.01 | 183.56 | -61.48 | -41.60 | 3.94 | -50.91 | -39.28 |

Table G-5: Percentage Difference Between Observed and Simulated Delay for Hourly Volume at the Critical Intersection of Study Site 3

| TIME PERIOD (houre) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | |
| 6:45 - 7:45 | 6.80 | -61.15 | -54.02 | 108.97 | 229.16 | 223.08 | -7.68 | 74.23 | 44.85 | 17.48 | 107.79 | 82.48 | 67.96 |
| 7:00 - 8:00 | 53.33 | -36.24 | -25.02 | 173.40 | 234.67 | 231.58 | -21.62 | 65.79 | 36.61 | 29.73 | 89.83 | 76.88 | 77.57 |
| 7:15 - 8:15 | 70.47 | 40.46 | 44.50 | 49.04 | 226.53 | 214.73 | -14.78 | 65.89 | 39.04 | 41.41 | 103.86 | 92.34 | 100.55 |
| 7:30 - 8:30 | 86.51 | 63.11 | 66.58 | 85.73 | 249.67 | 237.36 | -6.36 | 95.94 | 62.23 | 44.69 | 87.52 | 79.91 | 106.64 |
| 11:00-12:00 | 20.36 | 156.70 | 131.36 | 59.11 | 677.95 | 365.03 | 34.30 | 65.20 | 54.86 | 67.13 | 89.11 | 81.94 | 124.02 |
| 11:15-12:15 | 36.06 | 231.95 | 189.58 | 68.97 | 870.64 | 467.16 | 11.96 | 64.81 | 45.59 | 115.41 | 131.60 | 126.58 | 159.31 |
| 11:30-12:30 | 37.68 | 257.28 | 207.40 | 0.00 | 459.67 | 459.67 | 2.75 | 57.32 | 36.74 | 81.40 | 88.57 | 86.37 | 141.39 |
| 11:45-12:45 | 53.90 | 250.40 | 201.85 | 50.65 | 694.05 | 377.17 | -9.29 | 55.15 | 29.27 | 77.42 | 106.56 | 97.91 | 131.23 |
| 12:00-13:00 | 71.78 | 330.76 | 265.10 | 89.50 | 597.95 | 366.23 | -17.99 | 54.77 | 23.82 | 82.71 | 94.63 | 91.14 | 135.79 |
| 16:45-17:45 | 0.57 | 498.55 | 414.86 | 74.10 | -5.59 | 15.64 | 90.57 | 31.72 | 48.43 | 100.32 | 439.56 | 339.43 | 144.64 |
| 17:00-18:00 | -13.95 | 389.30 | 325.81 | 46.26 | 8.18 | 18.67 | 144.68 | 46.28 | 75.26 | 63.93 | 351.58 | 267.61 | 138.77 |
| 17:15-18:15 | -6.85 | 620.12 | 506.68 | 99.62 | 1.69 | 27.24 | 84.92 | 84.48 | 84.61 | 91.40 | 307.85 | 244.52 | 170.95 |

Table G-6: Percentage Difference Between Observed and Simulated Delay for Hourly Volume at the Downstream Intersections of Study Site 3

| TIME PERIOD | SIMULATED TOTAL AVERAGE STOPPED DELAY (veh-hr/hr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| (hours) | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL |
| 6:45 - 7:45 | 81.02 | 8.72 | 25.21 | 325.06 | 1793.38 | 1229.17 | -93.56 | -95.37 | -93.97 | 147.50 | 104.14 | 107.79 |
| 7:00 - 8:00 | 501.26 | 177.88 | 259.24 | 202.67 | 1785.71 | 1166.26 | -96.11 | -87.20 | -94.00 | 147.12 | 122.20 | 124.63 |
| 7:15 - 8:15 | 673.23 | 331.33 | 403.29 | 165.57 | 1911.30 | 1178.58 | -93.58 | -90.97 | -92.94 | 137.14 | 88.87 | 93.85 |
| 7:30 - 8:30 | 794.94 | 269.02 | 366.32 | 167.87 | 2444.67 | 1445.90 | -87.93 | -91.99 | -89.01 | 106.47 | 158.51 | 152.37 |
| 11:00-12:00 | -16.04 | 67.31 | 56.17 | 61.28 | 836.72 | 389.41 | -87.18 | -88.80 | -88.04 | 479.23 | 407.17 | 430.89 |
| 11:15-12:15 | -12.26 | 50.82 | 43.37 | 40.67 | 789.93 | 337.34 | -85.83 | -97.62 | -92.23 | 479.74 | 384.10 | 415.04 |
| 11:30-12:30 | -13.56 | 51.00 | 43.30 | 54.29 | 1093.13 | 361.46 | -83.81 | -97.63 | -91.37 | 513.97 | 360.47 | 406.20 |
| 11:45-12:45 | 26.06 | 44.41 | 42.49 | 55.64 | 1256.23 | 380.12 | -74.71 | -97.32 | -88.21 | 438.00 | 369.81 | 394.46 |
| 12:00-13:00 | 19.67 | 68.40 | 62.84 | 51.26 | 954.79 | 329.76 | -82.93 | -97.19 | -91.20 | 387.80 | 340.23 | 357.53 |
| 16:45-17:45 | 105.80 | 499.27 | 476.23 | 29.75 | -35.40 | -27.60 | -93.53 | -91.17 | -92.92 | 59.52 | 1014.49 | 346.51 |
| 17:00-18:00 | 69.97 | 1514.05 | 1439.33 | 105.24 | -58.20 | -42.43 | -90.02 | -82.72 | -88.16 | 50.08 | 940.00 | 308.94 |
| 17:15-18:15 | 60.21 | 1365.10 | 1302.10 | -14.04 | -68.11 | -62.88 | -88.13 | -84.11 | -87.14 | 37.31 | 936.70 | 273.31 |

Table G-7: Percentage Difference Between Observed and Simulated Total Delay for Hourly Volume at the Critical Intersection of Study Site 4

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | |
| 6:45 - 7:45 | 87.03 | 111.34 | 104.79 | 72.30 | 64.27 | 65.73 | 8.76 | 73.90 | 54.39 | 43.37 | 19.23 | 24.26 | 54.42 |
| 7:00 - 8:00 | 68.45 | 116.85 | 104.36 | 47.76 | 52.84 | 51.67 | -21.62 | 38.45 | 19.27 | 18.70 | 5.33 | 8.15 | 34.95 |
| 7:15 - 8:15 | 46.64 | 81.41 | 72.98 | 30.85 | 31.65 | 31.45 | -35.44 | 27.23 | 5.77 | 13.46 | -4.78 | -1.07 | 19.74 |
| 7:30 - 8:30 | 76.09 | 41.27 | 49.46 | 6.15 | 123.90 | 90.69 | -6.59 | 50.55 | 32.45 | 59.85 | 34.01 | 38.87 | 51.49 |
| 11:00-12:00 | -29.81 | -28.60 | -28.92 | -20.28 | 5.26 | -6.90 | -6.24 | 236.91 | 137.96 | 53.36 | 163.80 | 133.69 | 38.28 |
| 11:15-12:15 | -19.89 | -37.23 | -33.39 | -19.31 | 9.32 | -4.10 | 13.39 | 241.51 | 158.89 | 57.02 | 162.99 | 135.01 | 41.70 |
| 11:30-12:30 | -11.50 | -37.95 | -32.64 | -12.31 | 8.63 | -1.16 | 25.39 | 240.51 | 161.26 | 43.45 | 139.24 | 113.60 | 40.00 |
| 11:45-12:45 | -24.28 | -34.66 | -32.47 | -12.63 | 16.64 | 3.07 | 33.93 | 221.82 | 157.09 | 70.29 | 130.80 | 116.46 | 39.67 |
| 12:00-13:00 | -18.22 | -29.25 | -27.03 | 3.27 | 19.59 | 12.54 | 47.35 | 187.57 | 143.14 | 58.98 | 385.57 | 294.72 | 67.93 |
| 16:30-17:30 | 24.27 | 10.45 | 12.47 | 53.74 | 170.95 | 110.48 | 92.02 | 74.54 | 82.22 | 87.70 | 102.54 | 101.07 | 73.63 |
| 16:45-17:45 | 27.94 | -16.45 | -11.40 | 92.22 | 247.94 | 168.03 | 192.67 | 113.23 | 150.43 | 90.47 | 250.39 | 234.06 | 116.85 |
| 17:00-18:00 | 24.34 | -12.49 | -8.26 | 173.84 | 384.72 | 287.02 | 189.24 | 101.82 | 141.63 | 77.64 | 282.64 | 263.00 | 148.94 |
| 17:15-18:15 | 23.60 | -30.05 | -24.87 | 104.97 | 220.11 | 173.47 | 90.06 | 97.46 | 93.82 | 86.37 | 209.04 | 196.62 | 85.69 |
| 17:30-18:30 | 29.89 | -52.34 | -47.33 | 65.22 | 132.79 | 106.32 | 15.92 | 90.26 | 54.82 | 85.92 | 74.40 | 75.79 | 16.25 |

Table G-8: Percentage Difference Between Observed and Simulated Delay for Hourly Volume at the Downstream Intersections of Study Site 4

| TIME PERIOD (hours) | SIMULATED TOTAL AVERAGE STOPPED DELAY (veh-hr/hr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL |
| 6:45 - 7:45 | 0.00 | 453.33 | 453.33 | -28.00 | 54.00 | 47.05 | 80.00 | -61.50 | -52.08 | 145.45 | 640.77 | 493.51 |
| 7:00 - 8:00 | 0.00 | 574.15 | 574.15 | -37.93 | 52.91 | 44.88 | 94.59 | -66.61 | -58.09 | 37.65 | 2820.00 | 1000.77 |
| 7:15 - 8:15 | 0.00 | 604.16 | 604.16 | -49.06 | 62.75 | 42.53 | 123.90 | -49.52 | -38.83 | 134.00 | 2420.00 | 1277.00 |
| 7:30 - 8:30 | 0.00 | 725.00 | 725.00 | -51.43 | 44.51 | 22.61 | 182.00 | -52.92 | -41.01 | 180.00 | 1630.77 | 1037.27 |
| 11:00-12:00 | 0.00 | 76.33 | 76.33 | 11.27 | -81.05 | 1.74 | 178.18 | 119.77 | 121.58 | -15.29 | 3.98 | 3.32 |
| 11:15-12:15 | 0.00 | 49.49 | 49.49 | -30.77 | -73.00 | -34.95 | 24.62 | 125.26 | 118.23 | -12.57 | -10.64 | -10.75 |
| 11:30-12:30 | 0.00 | 31.29 | 31.29 | -22.86 | -81.05 | -28.00 | -3.08 | 120.28 | 108.01 | 2.00 | 3.78 | 3.69 |
| 11:45-12:45 | 0.00 | 60.00 | 60.00 | -2.31 | -78.82 | -8.33 | 6.07 | 109.76 | 96.29 | 21.76 | -1.31 | -0.15 |
| 12:00-13:00 | 0.00 | 63.13 | 63.13 | 29.47 | -80.00 | 19.05 | 10.15 | 120.05 | 102.97 | 2.27 | 7.84 | 7.51 |
| 16:30-17:30 | 0.00 | 272.91 | 272.91 | 8.57 | -77.50 | 5.92 | 6.03 | -59.93 | -55.87 | 77.10 | -57.23 | -48.06 |
| 16:45-17:45 | 0.00 | 400.74 | 400.74 | 20.73 | -77.50 | 17.64 | 57.85 | -47.48 | -40.55 | 53.95 | -59.59 | -50.58 |
| 17:00-18:00 | 0.00 | 328.65 | 328.65 | 38.46 | -55.00 | 35.37 | 65.71 | -54.78 | -47.82 | 56.32 | -62.13 | -53.64 |
| 17:15-18:15 | 0.00 | 418.56 | 418.56 | 38.95 | -74.29 | 35.57 | 80.00 | -58.08 | -51.07 | 29.37 | -65.21 | -56.55 |
| 17:30-18:30 | 0.00 | 548.00 | 548.00 | 16.10 | -74.29 | 13.45 | 87.83 | -55.87 | -49.42 | 23.43 | -64.89 | -55.95 |

Table G-9: Percentage Difference Between Observed and Simulated Total Delay for Hourly Volume at the Critical Intersection of Study Site 5

| TIME PERIOD (houre) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | |
| 6:30 - 7:30 | 48.04 | 76.20 | 73.59 | 580.00 | 1278.56 | 1200.79 | -27.34 | -4.63 | -6.79 | -3.94 | 82.41 | 73.04 | 98.43 |
| 6:45 - 7:45 | 43.72 | 137.04 | 103.92 | 327.23 | 2735.34 | 1903.33 | 1.06 | 44.19 | 61.02 | -3.32 | 91.58 | 85.16 | 165.03 |
| 7:00 - 8:00 | 36.01 | 227.80 | 157.64 | 230.67 | 3311.43 | 2280.70 | 30.57 | 97.69 | 89.41 | -7.82 | 60.13 | 59.54 | 213.64 |
| 7:15 - 8:15 | 54.00 | 341.49 | 212.61 | 193.11 | 3194.07 | 2166.10 | 58.16 | 135.88 | 135.22 | 0.80 | 59.07 | 70.91 | 249.18 |
| 7:30 - 8:30 | 29.99 | 513.94 | 249.27 | 182.37 | 3042.67 | 1920.79 | 87.49 | 144.66 | 131.65 | 1.15 | 49.24 | 79.26 | 248.05 |
| 11:15-12:15 | -24.75 | 230.79 | 57.98 | 21.72 | 610.80 | 271.62 | 90.21 | 70.57 | 81.44 | 34.15 | -20.04 | -12.78 | 68.36 |
| 11:30-12:30 | -20.89 | 189.88 | 66.31 | 20.70 | 957.50 | 298.44 | 97.09 | 100.81 | 91.48 | 11.70 | -3.03 | 6.95 | 84.85 |
| 11:45-12:45 | -17.93 | 165.07 | 47.15 | 8.97 | 1107.38 | 312.95 | 77.73 | 113.95 | 107.36 | 23.61 | -15.75 | -10.50 | 75.37 |
| 12:00-13:00 | -19.93 | 167.29 | 78.98 | -16.72 | 854.53 | 331.27 | 28.96 | 65.46 | 105.53 | 47.95 | -23.44 | -14.17 | 87.06 |
| 16:30-17:30 | -18.96 | 302.12 | 135.24 | 36.48 | 26.40 | 34.00 | 25.95 | -44.52 | -26.93 | 10.28 | -14.10 | 3.98 | 11.92 |
| 16:45-17:45 | -43.62 | 174.85 | 91.84 | 18.09 | -35.12 | -21.60 | -17.02 | -72.94 | -57.01 | 0.65 | -7.55 | 8.50 | -19.30 |
| 17:00-18:00 | -54.78 | 125.07 | 54.66 | 6.67 | -52.74 | -42.76 | -14.54 | -75.12 | -55.31 | -6.44 | -8.90 | 36.59 | -27.86 |
| 17:15-18:15 | -56.96 | 108.04 | 32.76 | -9.48 | -60.34 | -51.28 | -22.38 | -74.63 | -62.22 | -19.24 | -3.97 | 9.29 | -39.32 |
| 17:30-18:30 | -45.04 | 192.96 | 64.26 | -13.62 | -63.61 | -55.94 | -19.50 | -65.08 | -49.20 | 5.34 | -7.75 | 15.67 | -32.21 |

Table G-10: Percentage Difference Between Observed and Simulated Delay for Hourly Volume at the Downstream Intersections of Study Site 5

| TIME PERIOD (hours) | SIMULATED TOTAL AVERAGE STOPPED DELAY (veh-hr/hr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL |
| 6:30 - 7:30 | -44.10 | -73.16 | -71.01 | -50.68 | 211.66 | 186.02 | 0.00 | 474.79 | 166.20 | 17.93 | -37.61 | -34.72 |
| 6:45 - 7:45 | -38.01 | -74.19 | -70.39 | -80.80 | 67.24 | 49.67 | 0.00 | 354.19 | 96.47 | 103.23 | -57.56 | -51.86 |
| 7:00 - 8:00 | 1.11 | -68.20 | -59.52 | -84.47 | 179.29 | 149.39 | 0.00 | 202.52 | 63.74 | 140.00 | -71.63 | -65.96 |
| 7:15 - 8:15 | 61.95 | -55.16 | -39.39 | -79.74 | 156.56 | 128.01 | 0.00 | 203.86 | 61.00 | 120.50 | -75.79 | -71.17 |
| 7:30 - 8:30 | 132.09 | -34.08 | -9.48 | -69.89 | 183.38 | 150.18 | 0.00 | 153.24 | 36.58 | 51.07 | -79.23 | -75.55 |
| 11:15-12:15 | 10.12 | 177.60 | 141.37 | 129.29 | -51.11 | -32.35 | 0.00 | -75.17 | -53.61 | 165.42 | 51.71 | 61.19 |
| 11:30-12:30 | 37.19 | 189.94 | 155.25 | 152.35 | -61.94 | -35.76 | 0.00 | -77.45 | -58.16 | 161.00 | 28.64 | 39.08 |
| 11:45-12:45 | 35.00 | 205.37 | 163.27 | 137.17 | -0.85 | 17.44 | 0.00 | -78.08 | -58.67 | 204.14 | 30.35 | 43.53 |
| 12:00-13:00 | 48.93 | 251.31 | 200.00 | -5.23 | 105.28 | 89.22 | 0.00 | -80.24 | -65.38 | 190.00 | 9.14 | 21.61 |
| 16:30-17:30 | 1.88 | 174.17 | 146.12 | 156.84 | 335.94 | 260.44 | 0.00 | -4.98 | -22.16 | 29.40 | 42.21 | 41.02 |
| 16:45-17:45 | -15.12 | 147.81 | 120.42 | 328.37 | 394.08 | 363.46 | 0.00 | -81.41 | -76.26 | 26.69 | 1.24 | 3.07 |
| 17:00-18:00 | -30.34 | 206.95 | 169.59 | 330.32 | 397.31 | 366.91 | 0.00 | -88.78 | -83.87 | 10.92 | -10.33 | -8.66 |
| 17:15-18:15 | -23.01 | 122.43 | 96.11 | 267.84 | 315.53 | 296.60 | 0.00 | -91.68 | -87.01 | 9.30 | -7.71 | -6.25 |
| 17:30-18:30 | -29.28 | 352.69 | 268.14 | 332.12 | 263.18 | 290.48 | 0.00 | -93.01 | -87.97 | 8.09 | -3.53 | -2.49 |

Table G-11: Percentage Difference Between Observed and Simulated Total Delay for Hourly Volume at the Critical Intersection of Study Site 6

| TIME PERIOD (hours) | Percentage Difference Between Observed and Simulated Total Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | |
| 6:30 - 7:30 | -3.18 | 163.19 | 103.84 | 19.48 | 211.68 | 127.55 | -42.40 | 23.98 | 6.10 | -52.50 | 137.25 | 101.01 | 66.83 |
| 6:45 - 7:45 | 15.29 | 133.22 | 98.52 | 168.57 | 173.26 | 171.41 | 34.42 | -53.67 | -29.45 | 33.04 | -3.85 | 1.64 | 42.45 |
| 7:00 - 8:00 | 6.53 | 141.77 | 101.64 | 198.36 | 151.68 | 170.00 | 41.08 | -50.19 | -25.32 | 29.44 | 13.93 | 16.61 | 48.51 |
| 7:15 - 8:15 | -21.41 | 53.43 | 30.00 | 24.43 | 205.06 | 137.44 | -17.14 | -16.95 | -17.01 | 26.73 | 83.21 | 73.09 | 31.96 |
| 7:30 - 8:30 | -20.18 | 47.48 | 25.60 | 18.25 | 145.81 | 97.80 | -14.89 | -25.42 | -22.41 | 33.95 | 63.98 | 58.95 | 22.55 |
| 11:00-12:00 | 1.90 | 98.81 | 36.44 | 41.57 | 163.30 | 124.19 | 82.32 | -1.96 | 24.64 | 27.50 | 39.11 | 37.43 | 48.01 |
| 11:15-12:15 | -1.58 | 90.14 | 29.43 | 14.26 | 149.60 | 103.82 | 51.82 | 2.34 | 20.22 | 30.91 | 34.82 | 34.30 | 41.65 |
| 11:30-12:30 | 7.32 | 46.02 | 22.11 | 44.34 | 158.75 | 125.25 | 8.52 | 135.29 | 94.84 | -70.00 | 61.36 | 44.66 | 67.21 |
| 11:45-12:45 | -9.72 | 25.14 | 3.91 | 22.80 | 132.05 | 99.21 | 67.34 | -18.53 | 7.24 | 12.73 | 21.86 | 20.59 | 25.08 |
| 12:00-13:00 | -1.76 | 25.18 | 9.51 | 3.04 | 103.92 | 71.08 | 47.34 | -22.17 | -0.89 | 8.71 | 16.45 | 15.35 | 18.35 |
| 16:30-17:30 | -14.29 | 8.22 | -5.14 | 77.60 | 47.66 | 51.48 | 26.31 | 18.95 | 21.57 | -44.24 | 0.51 | -8.98 | 12.56 |
| 16:45-17:45 | -8.31 | -9.55 | -8.81 | 52.76 | 43.75 | 44.81 | 68.37 | 6.21 | 26.77 | -40.13 | -1.86 | -9.61 | 10.08 |
| 17:00-18:00 | -5.82 | -7.04 | -6.35 | 91.25 | 46.57 | 52.59 | 67.01 | -11.38 | 13.85 | -44.19 | -5.74 | -13.58 | 8.85 |
| 17:15-18:15 | -22.20 | 0.54 | -13.41 | 29.68 | 74.31 | 66.79 | 77.16 | -10.81 | 14.64 | -44.64 | -5.68 | -14.04 | 8.51 |
| 17:30-18:30 | -16.62 | 7.89 | -7.16 | 26.19 | 67.74 | 60.13 | 45.61 | -23.12 | -2.51 | -40.00 | -4.44 | -12.01 | 5.99 |

Table G-12: Percentage Difference Between Observed and Simulated Delay for Hourly Volume at the Downstream Intersections of Study Site 6

| TIME PERIOD (hours) | SIMULATED TOTAL AVERAGE STOPPED DELAY (veh-hr/hr) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL |
| 6:30 - 7:30 | 573.64 | 570.60 | 571.32 | 80.00 | 68.16 | 72.56 | 28.57 | 1038.38 | 761.18 | -47.96 | -69.50 | -54.88 |
| 6:45 - 7:45 | 357.11 | 73.84 | 137.35 | 87.35 | 103.57 | 97.59 | 120.00 | 500.00 | 396.36 | -71.07 | -85.94 | -76.88 |
| 7:00 - 8:00 | 326.74 | 87.50 | 143.98 | 130.40 | 66.60 | 88.75 | 112.73 | 674.00 | 523.41 | -77.11 | -89.33 | -82.42 |
| 7:15 - 8:15 | 253.08 | 79.39 | 115.90 | 95.65 | -0.53 | 27.12 | 31.54 | 792.80 | 532.37 | -73.14 | -84.96 | -78.37 |
| 7:30 - 8:30 | 252.17 | 84.54 | 122.21 | 66.67 | -0.39 | 22.68 | 52.31 | 912.50 | 639.76 | -61.58 | -83.40 | -71.41 |
| 11:00-12:00 | 137.60 | 76.29 | 88.85 | 5.88 | 65.60 | 41.43 | 5.88 | 200.31 | 159.67 | -65.42 | 132.50 | -54.37 |
| 11:15-12:15 | 98.62 | 94.55 | 95.47 | 4.21 | 63.42 | 38.05 | -10.00 | 165.18 | 122.57 | -67.95 | 125.00 | -57.28 |
| 11:30-12:30 | 92.00 | 90.23 | 90.68 | -1.29 | 70.40 | 37.96 | -16.00 | 242.90 | 167.97 | -67.58 | 209.60 | -52.08 |
| 11:45-12:45 | 92.41 | 74.71 | 78.63 | -24.65 | 99.46 | 32.75 | -23.40 | 172.96 | 112.83 | -73.43 | 84.86 | -62.12 |
| 12:00-13:00 | 114.62 | 93.61 | 97.38 | -27.63 | 114.52 | 33.41 | -11.11 | 175.05 | 123.93 | -79.93 | 36.80 | -70.71 |
| 16:30-17:30 | 84.70 | -37.00 | 4.78 | -14.53 | -36.11 | -27.35 | -22.00 | 265.22 | 131.63 | -78.46 | 49.49 | -64.78 |
| 16:45-17:45 | 106.18 | -52.71 | -2.20 | -10.00 | -27.90 | -21.07 | -16.64 | 257.29 | 141.25 | -76.90 | 39.44 | -62.21 |
| 17:00-18:00 | 109.51 | -40.53 | 11.92 | -32.24 | -28.81 | -30.17 | -14.87 | 225.30 | 125.41 | -77.18 | 35.46 | -58.79 |
| 17:15-18:15 | 125.00 | -42.03 | 3.33 | -34.55 | -49.65 | -43.90 | -11.41 | 209.98 | 123.98 | -73.96 | 30.91 | -57.42 |
| 17:30-18:30 | 161.29 | -46.09 | 1.71 | -18.73 | -48.83 | -36.65 | 5.88 | 225.26 | 147.71 | -75.36 | 75.56 | -54.46 |

# APPENDIX H

## SUMMARY OF REDUCTION IN DELAY WHEN NORTH-SOUTH ARTERIAL IS GRADE SEPARATED

## Table H-1: Average Reduction in Delay During AM-Peak Period When North-South Arterial is Grade Separated

| Type of Delay | Crit-eria | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 |
|---|---|---|---|---|---|---|---|
| Total delay for the system | - 40 | - 75 | - 69 | - 31 | - 56 | - 33 | - 27 |
| Grade separated approach of critical intersection | - 70 | - 76 | - 86 | - 91 | - 83 | - 91 | - 68 |
| At-grade approach of critical intersection | - 50 | - 62 | - 69 | - 23 | - 33 | - 14 | - 14 |
| Total delay at Critical Intersection | - 60 | - 67 | - 76 | - 58 | - 59 | - 60 | - 47 |
| Grade separated approach of D/S intersection | + 25 | + 74 | - 20 | + 10 | -74 | - 12 | + 2 |
| At-grade approach of D/S intersection | + 15 | + 71 | + 13 | - 28 | + 33 | + 14 | + 39 |
| Total delay at D/S intersections | + 20 | + 56 | - 15 | + 4 | - 40 | - 9 | + 18 |

## Table H-2: Average Reduction in Delay During Off-Peak Period When North-South Arterial is Grade-Separated

| Type of Delay | Crit-eria | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 |
|---|---|---|---|---|---|---|---|
| Total delay for the system | - 40 | - 72 | - 29 | - 39 | - 31 | - 30 | - 37 |
| Grade separated approach of critical intersection | - 70 | - 66 | - 77 | - 81 | - 64 | - 80 | - 61 |
| At-grade approach of critical intersection | - 50 | - 47 | - 10 | - 84 | - 30 | - 10 | - 34 |
| Total delay at Critical Intersection | - 60 | - 54 | - 35 | - 40 | - 48 | - 48 | - 46 |
| Grade separated approach of D/S intersection | + 25 | + 40 | + 3 | - 22 | +193 | - 36 | + 9 |
| At-grade approach of D/S intersection | + 15 | + 71 | - 10 | - 38 | + 6 | - 6 | - 33 |
| Total delay at D/S intersections | + 20 | + 15 | - 2 | - 25 | + 30 | - 26 | - 22 |

**Table H-3: Average Reduction in Delay During PM-Peak Period When North-South Arterial is Grade Separated**

| Type of Delay | Crit-eria | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 |
|---|---|---|---|---|---|---|---|
| Total delay for the system | - 40 | - 87 | - 79 | - 60 | - 65 | - 28 | - 42 |
| Grade separated approach of critical intersection | - 70 | - 83 | - 91 | - 95 | - 77 | - 88 | - 68 |
| At-grade approach of critical intersection | - 50 | - 78 | - 78 | - 48 | - 26 | - 18 | - 38 |
| Total delay at Critical Intersection | - 60 | - 80 | - 83 | - 70 | - 51 | - 58 | - 52 |
| Grade separated approach of D/S intersection | + 25 | + 6 | + 31 | - 4 | + 14 | - 2 | - 2 |
| At-grade approach of D/S intersection | + 15 | + 34 | + 41 | + 10 | + 42 | + 23 | - 19 |
| Total delay at D/S intersections | + 20 | + 14 | + 33 | 0 | + 35 | - 4 | - 15 |

**Table H-4: Average Reduction in Delay for the Mean of the Three Periods When North-South Arterial is Grade Separated**

| Type of Delay | Crit-eria | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 |
|---|---|---|---|---|---|---|---|
| Total delay for the system | - 40 | - 78 | - 58 | - 42 | - 51 | - 34 | - 35 |
| Grade separated approach of critical intersection | - 70 | - 75 | - 85 | - 88 | - 78 | - 88 | - 66 |
| At-grade approach of critical intersection | - 50 | - 63 | - 53 | - 26 | - 40 | - 14 | - 29 |
| Total delay at Critical Intersection | - 60 | - 68 | - 65 | - 59 | - 58 | - 55 | - 48 |
| Grade separated approach of D/S intersection | + 25 | + 34 | + 22 | - 6 | + 44 | - 18 | + 4 |
| At-grade approach of D/S intersection | + 15 | + 33 | + 30 | - 19 | + 26 | + 10 | - 4 |
| Total delay at D/S intersections | + 20 | + 27 | + 6 | - 9 | + 7 | - 12 | - 6 |

# APPENDIX I

## COMPARISON OF AT-GRADE AND GRADE SEPARATED DELAY WHEN NORTH-SOUTH ARTERIAL IS GRADE SEPARATED

Table I-1: Percentage Reduction in Simulated Average Total Stopped Delay at the Critical Intersection of Study Site 1

| TIME PERIOD (hours) | Percentage Reduction in Average Total Stopped Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT &RT | TH | TOTAL | LT &RT | TH | TOTAL | LT | TH &RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | -4.32 | -100.00 | -43.99 | -14.07 | -100.00 | -74.86 | -38.92 | -66.03 | -62.92 | -22.80 | -69.22 | -62.00 | -64.70 |
| 6:45 - 7:00 | -12.33 | -100.00 | -58.71 | -27.16 | -100.00 | -79.55 | -42.48 | -71.76 | -68.86 | -45.22 | -60.82 | -57.32 | -68.64 |
| 7:00 - 7:15 | -2.19 | -100.00 | -43.34 | 115.32 | -100.00 | -48.04 | -13.92 | -10.42 | -10.85 | -22.47 | -3.38 | -7.02 | -22.20 |
| 7:15 - 7:30 | -50.37 | -100.00 | -63.34 | -20.25 | -100.00 | -92.97 | -57.64 | -89.45 | -87.44 | -52.03 | -67.66 | -65.45 | -84.93 |
| 7:30 - 7:45 | -77.95 | -100.00 | -81.47 | 13.93 | -100.00 | -94.98 | -73.64 | -75.24 | -74.86 | -51.78 | -88.62 | -86.86 | -87.74 |
| 7:45 - 8:00 | -63.92 | -100.00 | -73.07 | -71.55 | -100.00 | -95.16 | -75.77 | -66.66 | -69.36 | -52.29 | -88.51 | -86.63 | -87.40 |
| 8:00 - 8:15 | -19.97 | -100.00 | -55.07 | 7.24 | -100.00 | -75.43 | -58.58 | -56.10 | -56.68 | -37.18 | -64.25 | -61.28 | -62.95 |
| 8:15 - 8:30 | 7.76 | -100.00 | -43.94 | -30.26 | -100.00 | -76.72 | -45.11 | -46.13 | -45.90 | -19.93 | -59.60 | -56.02 | -59.13 |
| 11:00-11:15 | 51.17 | -100.00 | -57.84 | 1.90 | -100.00 | -63.48 | -31.61 | -35.92 | -34.77 | -7.69 | -48.00 | -43.67 | -48.23 |
| 11:15-11:30 | 14.22 | -100.00 | -53.29 | 13.50 | -100.00 | -59.90 | -23.21 | -28.58 | -26.99 | -3.14 | -43.80 | -39.24 | -43.72 |
| 11:30-11:45 | 12.66 | -100.00 | -61.79 | 2.77 | -100.00 | -61.30 | -28.04 | -20.70 | -23.60 | -3.37 | -37.90 | -34.14 | -44.46 |
| 11:45-12:00 | 16.38 | -100.00 | -56.80 | 15.49 | -100.00 | -61.33 | -30.89 | -32.32 | -31.93 | -7.33 | -44.07 | -39.28 | -45.66 |
| 12:00-12:15 | -48.61 | -100.00 | -68.15 | 116.26 | -100.00 | -82.93 | -69.20 | -30.15 | -52.39 | -9.09 | -81.02 | -78.46 | -74.48 |
| 12:30-12:45 | -63.40 | -100.00 | -74.49 | 175.61 | -100.00 | -87.22 | -79.32 | -35.83 | -62.73 | -23.54 | -86.97 | -84.11 | -80.39 |
| 12:45-13:00 | 8.06 | -100.00 | -57.71 | -22.23 | -100.00 | -65.45 | -35.61 | -28.60 | -31.04 | -8.52 | -45.02 | -40.04 | -46.44 |
| 16:30-16:45 | -14.04 | -100.00 | -84.59 | -45.31 | -100.00 | -72.59 | -75.40 | -55.14 | -67.52 | -5.96 | -85.74 | -83.84 | -80.17 |
| 16:45-17:00 | -42.25 | -100.00 | -88.65 | -55.99 | -100.00 | -73.58 | -74.90 | -46.45 | -64.84 | -8.87 | -88.52 | -87.53 | -83.47 |
| 17:00-17:15 | -3.28 | -100.00 | -90.25 | -48.04 | -100.00 | -70.76 | -76.01 | -45.97 | -63.75 | -15.89 | -81.59 | -79.55 | -79.15 |
| 17:15-17:30 | 31.08 | -100.00 | -82.75 | -49.26 | -100.00 | -71.03 | -69.19 | -55.47 | -62.44 | -12.75 | -83.25 | -81.23 | -77.42 |
| 17:30-17:45 | -36.74 | -100.00 | -91.49 | -67.78 | -100.00 | -87.46 | -78.23 | -54.58 | -70.86 | -9.68 | -91.27 | -90.53 | -88.33 |
| 17:45-18:00 | 2.84 | -100.00 | -78.17 | -0.87 | -100.00 | -66.75 | -62.00 | -47.14 | -53.62 | -8.85 | -82.12 | -78.49 | -72.90 |
| 18:00-18:15 | -26.16 | -100.00 | -90.94 | -67.85 | -100.00 | -84.86 | -82.21 | -49.81 | -75.27 | -4.82 | -90.14 | -89.17 | -87.41 |
| 18:15:18:30 | -24.61 | -100.00 | -76.73 | -12.35 | -100.00 | -85.07 | -53.59 | -49.56 | -51.05 | -13.84 | -72.77 | -69.30 | -70.67 |

Table I-2: Percentage Difference in Simulated Average Total Stopped Delay at the Downstream Intersections of Study Site 1

| TIME PERIOD (hours) | Percentage Difference in Average Total Stopped Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT &RT | TH | TOTAL | LT &RT | TH | TOTAL | LT | TH &RT | TOTAL | LT | TH & RT | TOTAL |
| 6:30 - 6:45 | 0.00 | 22.00 | 22.00 | -17.95 | 69.00 | 48.42 | 0.00 | 92.00 | 40.43 | 0.00 | 28.64 | 28.64 |
| 6:45 - 7:00 | 0.00 | -10.00 | -10.00 | -17.76 | 95.31 | 75.23 | 0.00 | 103.23 | 103.23 | 33.33 | 163.06 | 156.02 |
| 7:00 - 7:15 | 35.71 | -83.93 | -60.00 | -11.82 | 71.28 | 53.87 | 5.26 | -45.95 | -28.57 | 5.88 | 0.58 | 1.05 |
| 7:15 - 7:30 | 35.29 | 9.09 | 13.83 | -9.98 | 55.78 | 40.80 | -9.52 | 145.00 | 91.80 | 40.00 | 200.00 | 183.56 |
| 7:30 - 7:45 | 26.67 | -0.79 | 2.13 | -12.16 | 120.11 | 82.65 | -2.63 | 170.18 | 101.05 | 50.00 | 77.08 | 76.00 |
| 7:45 - 8:00 | 0.00 | 4.07 | 4.07 | -9.76 | 81.91 | 50.00 | 0.00 | 116.36 | 55.65 | 33.33 | 62.91 | 60.96 |
| 8:00 - 8:15 | 18.75 | -25.56 | -20.81 | -20.69 | 106.19 | 69.02 | -7.62 | 104.05 | 38.55 | 40.00 | 87.50 | 85.32 |
| 8:15 - 8:30 | 15.00 | 14.58 | 14.66 | -20.30 | 130.06 | 89.16 | -7.14 | 93.10 | 43.86 | 30.00 | 29.63 | 29.64 |
| 11:00-11:15 | 0.00 | 192.00 | 192.00 | -30.06 | 73.57 | 30.26 | 0.00 | 46.87 | 46.87 | 31.82 | -12.71 | -10.51 |
| 11:15-11:30 | -40.63 | 197.01 | 120.20 | -28.95 | 85.78 | 45.54 | -5.00 | 9.91 | 7.63 | 31.25 | -16.80 | -12.72 |
| 11:30-11:45 | -37.84 | 204.76 | 115.00 | -31.11 | 80.90 | 27.70 | -3.85 | 16.16 | 12.00 | 21.05 | -22.00 | -19.59 |
| 11:45-12:00 | 0.00 | 224.62 | 224.62 | -30.89 | 71.88 | 20.63 | -5.88 | -3.21 | -3.47 | 26.19 | -4.41 | -1.56 |
| 12:00-12:15 | -37.84 | 157.02 | 111.39 | 8.11 | 22.18 | 16.52 | 2.08 | -25.00 | -15.97 | 25.64 | -2.19 | 3.27 |
| 12:15-12:30 | -38.10 | 159.60 | 68.85 | -35.40 | 48.95 | 11.72 | -4.35 | -58.65 | -48.82 | 25.64 | 8.74 | 10.28 |
| 12:30-12:45 | -38.71 | 153.27 | 110.14 | 110.94 | -56.01 | -25.92 | 5.77 | -57.38 | -28.32 | 34.29 | 19.64 | 22.17 |
| 12:45-13:00 | -32.79 | 137.23 | 84.85 | -33.03 | 54.67 | 17.76 | -4.65 | -37.04 | -25.81 | 25.97 | -5.91 | -2.15 |
| 16:30-16:45 | -24.00 | 1.31 | 0.00 | -26.42 | 60.95 | 9.63 | -5.00 | -71.58 | -60.00 | 35.29 | 179.67 | 114.22 |
| 16:45-17:00 | -15.00 | 4.11 | 1.92 | -27.51 | 59.45 | 9.80 | 5.26 | -60.69 | -53.05 | 29.29 | 168.22 | 107.89 |
| 17:00-17:15 | -15.07 | 5.05 | 2.63 | -28.69 | 54.46 | 2.51 | 0.00 | -59.64 | -53.80 | 34.12 | 150.00 | 105.83 |
| 17:15-17:30 | -17.86 | -2.89 | -3.50 | -23.24 | 46.25 | 7.07 | -4.17 | -81.09 | -66.27 | 48.28 | 161.76 | 109.52 |
| 17:30-17:45 | -13.79 | 26.40 | 20.44 | -17.81 | 71.86 | 22.20 | 7.69 | -66.94 | -59.70 | 33.65 | 170.87 | 109.09 |
| 17:45-18:00 | -23.46 | -4.75 | -7.01 | -23.97 | 54.02 | 6.80 | -5.26 | -75.12 | -69.40 | 44.04 | 129.73 | 93.39 |
| 18:00-18:15 | -20.83 | 33.00 | 29.05 | -22.67 | 56.87 | 5.97 | 5.00 | -65.77 | -54.96 | 28.23 | 120.57 | 77.36 |
| 18:15:18:30 | -26.09 | -5.44 | -7.61 | -21.26 | 65.15 | 13.03 | -10.00 | -72.88 | -66.50 | 37.21 | 123.18 | 91.98 |

Table I-3: Percentage Reduction in Simulated Average Total Stopped Delay at the Critical Intersection of Study Site 2

| TIME PERIOD (hours) | Percentage Reduction in Average Total Stopped Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT &RT | TH | TOTAL | LT &RT | TH | TOTAL | LT | TH &RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | 79.69 | -100.00 | -79.20 | -31.98 | -100.00 | -73.29 | -7.29 | -44.81 | -41.67 | -6.90 | -11.55 | -10.85 | -52.25 |
| 6:45 - 7:00 | 74.73 | -100.00 | -81.00 | -34.36 | -100.00 | -69.99 | -9.09 | -47.42 | -44.95 | -45.32 | -17.92 | -26.95 | -55.30 |
| 7:00 - 7:15 | 123.81 | -100.00 | -91.27 | -67.34 | -100.00 | -77.37 | 19.35 | -89.84 | -85.30 | -60.61 | -18.42 | -37.67 | -78.68 |
| 7:15 - 7:30 | 0.00 | -100.00 | -95.76 | -77.04 | -100.00 | -83.48 | -3.59 | -91.19 | -90.08 | -62.37 | -14.82 | -37.50 | -87.18 |
| 7:30 - 7:45 | 39.92 | -100.00 | -95.71 | -87.04 | -100.00 | -89.99 | -9.13 | -91.53 | -90.60 | -62.52 | -14.66 | -34.02 | -89.45 |
| 7:45 - 8:00 | 83.33 | -100.00 | -94.50 | -75.12 | -100.00 | -81.94 | -3.72 | -90.32 | -88.53 | -48.95 | -19.05 | -26.71 | -85.41 |
| 8:00 - 8:15 | -3.94 | -100.00 | -96.56 | -73.00 | -100.00 | -80.93 | -18.10 | -85.94 | -84.34 | -58.04 | -13.20 | -30.74 | -82.83 |
| 8:15 - 8:30 | 91.59 | -100.00 | -92.18 | -64.59 | -100.00 | -76.20 | -18.91 | -78.05 | -76.06 | -65.80 | -12.67 | -45.20 | -74.79 |
| 11:00-11:15 | 18.68 | -100.00 | -85.62 | -24.15 | -100.00 | -63.43 | -10.58 | -9.42 | -9.72 | -11.38 | -6.63 | -7.25 | -33.07 |
| 11:15-11:30 | -52.03 | -100.00 | -91.27 | -20.23 | -100.00 | -64.97 | -4.79 | -12.03 | -10.15 | -9.74 | -9.21 | -9.27 | -32.65 |
| 11:30-11:45 | -53.90 | -100.00 | -88.08 | -26.79 | -100.00 | -69.29 | -14.51 | -15.64 | -15.33 | -15.19 | -11.94 | -12.26 | -40.01 |
| 11:45-12:00 | -60.66 | -100.00 | -90.22 | -12.93 | -100.00 | -65.44 | -8.89 | -12.73 | -11.44 | -11.64 | -10.98 | -11.03 | -36.85 |
| 12:00-12:15 | -49.55 | -100.00 | -88.03 | -25.47 | -100.00 | -68.23 | -6.75 | -9.86 | -8.93 | -7.85 | -9.29 | -9.15 | -35.04 |
| 12:15-12:30 | -54.61 | -100.00 | -93.88 | -16.13 | -100.00 | -58.10 | -9.64 | -6.46 | -7.42 | -5.43 | -9.77 | -9.33 | -34.15 |
| 12:30-12:45 | -58.02 | -100.00 | -89.18 | -30.87 | -100.00 | -65.73 | -14.96 | -12.59 | -13.31 | -14.21 | -10.66 | -11.03 | -37.27 |
| 12:45-13:00 | -59.71 | -100.00 | -92.50 | -24.24 | -100.00 | -66.91 | -2.61 | -12.63 | -9.71 | -11.83 | -9.59 | -9.82 | -34.66 |
| 16:30-16:45 | -73.43 | -100.00 | -95.04 | 20.09 | -100.00 | -87.35 | -61.81 | -19.85 | -45.79 | -30.58 | -79.16 | -78.35 | -82.93 |
| 16:45-17:00 | -89.03 | -100.00 | -92.95 | -62.82 | -100.00 | -92.54 | -53.79 | -13.94 | -36.21 | -21.87 | -87.29 | -86.24 | -85.13 |
| 17:00-17:15 | -86.31 | -100.00 | -95.68 | 53.77 | -100.00 | -94.67 | -71.00 | -27.65 | -55.30 | -22.71 | -89.87 | -89.06 | -89.32 |
| 17:15-17:30 | -79.21 | -100.00 | -86.30 | 76.79 | -100.00 | -93.67 | -74.23 | -30.09 | -58.47 | -29.67 | -87.33 | -86.17 | -84.53 |
| 17:30-17:45 | -81.49 | -100.00 | -90.14 | -55.51 | -100.00 | -92.94 | -74.36 | -18.63 | -55.02 | -27.06 | -88.53 | -87.67 | -87.00 |
| 17:45-18:00 | -78.32 | -100.00 | -90.10 | -47.01 | -100.00 | -83.49 | -62.99 | -13.71 | -44.75 | -20.17 | -83.98 | -82.92 | -80.37 |
| 18:00-18:15 | -57.53 | -100.00 | -83.40 | -75.54 | -100.00 | -93.32 | -69.24 | -15.82 | -51.23 | -22.22 | -84.98 | -83.63 | -83.72 |
| 18:15:18:30 | -24.61 | -100.00 | -76.73 | -12.35 | -100.00 | -85.07 | -53.59 | -49.56 | -51.05 | -13.84 | -72.77 | -69.30 | -70.67 |

Table I-4: Percentage Difference in Simulated Average Total Stopped Delay at the Downstream Intersections of Study Site 2

| TIME PERIOD (hours) | Percentage Difference in Average Total Stopped Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:30 - 6:45 | 60.00 | -16.22 | -3.37 | -42.58 | 28.07 | -33.97 | 0.00 | -18.75 | -18.75 | 27.27 | 72.64 | 68.38 |
| 6:45 - 7:00 | 56.41 | -29.73 | -16.86 | -26.29 | 66.67 | -12.11 | 0.00 | -31.03 | -31.03 | 21.43 | 14.37 | 14.92 |
| 7:15 - 7:30 | 62.86 | -21.03 | -9.24 | -44.57 | 27.78 | -40.14 | 8.00 | -43.75 | -12.20 | 30.77 | 15.72 | 16.86 |
| 7:30 - 7:45 | 72.00 | -2.75 | 9.51 | -31.58 | 44.23 | -27.57 | 4.35 | -12.50 | -5.45 | 31.82 | 7.88 | 10.70 |
| 7:45 - 8:00 | 67.82 | -9.23 | 7.04 | -39.65 | 46.77 | -33.77 | 3.33 | -21.43 | -8.62 | 28.57 | 63.82 | 60.84 |
| 8:00 - 8:15 | 68.18 | -21.89 | -6.63 | -25.87 | 14.81 | -23.02 | 4.55 | -40.00 | -31.25 | 31.25 | -9.29 | -6.03 |
| 8:15 - 8:30 | 72.29 | -0.88 | 10.37 | -32.46 | -19.70 | -31.13 | 5.56 | -44.44 | -22.22 | 25.00 | -23.91 | -19.12 |
| 11:00-11:15 | 77.65 | -13.44 | 6.41 | 2.60 | 30.00 | 6.15 | 0.00 | -16.85 | -13.27 | 6.90 | -11.48 | -7.95 |
| 11:15-11:30 | 82.05 | -18.02 | 8.00 | -29.76 | 70.13 | 1.63 | 3.45 | -14.29 | -10.00 | 5.88 | -9.65 | -6.08 |
| 11:30-11:45 | 87.50 | -27.52 | -1.30 | -11.66 | 44.64 | 2.74 | 3.13 | -15.54 | -9.34 | 5.56 | -8.55 | -5.23 |
| 11:45-12:00 | 75.70 | -3.05 | 13.80 | -22.60 | 90.16 | 6.30 | -0.94 | -13.29 | -8.03 | 5.26 | -4.26 | -0.66 |
| 12:00-12:15 | 79.13 | -11.55 | 7.48 | -21.63 | 64.29 | -0.00 | 2.27 | -19.62 | -11.79 | 126.32 | -67.27 | -54.88 |
| 12:15-12:30 | 65.56 | -61.48 | -27.25 | -18.30 | 112.79 | 28.87 | 2.22 | -12.95 | -9.24 | 1.85 | 4.88 | 3.95 |
| 12:30-12:45 | 78.31 | -19.08 | 3.01 | -19.02 | 29.79 | -9.09 | 2.67 | -8.93 | -4.28 | 6.38 | -7.87 | -4.02 |
| 12:45-13:00 | 74.11 | -1.03 | 15.77 | -35.48 | 54.10 | -20.75 | -1.61 | -5.92 | -3.99 | 6.12 | -10.40 | -5.75 |
| 16:30-16:45 | 59.89 | 5.80 | 20.30 | -1.44 | 23.33 | 6.04 | 5.04 | -12.75 | -6.19 | 5.71 | 0.00 | 1.72 |
| 16:45-17:00 | 57.81 | 31.58 | 37.87 | -6.28 | 19.81 | 2.13 | -5.75 | 51.11 | 32.10 | 15.38 | 41.94 | 34.09 |
| 17:00-17:15 | 47.06 | 32.83 | 36.44 | -3.03 | 34.41 | 7.72 | 6.78 | 92.41 | 69.12 | 4.76 | -1.54 | 0.00 |
| 17:15-17:30 | 77.65 | 38.90 | 46.73 | 8.50 | 65.83 | 27.25 | 8.70 | 148.68 | 95.90 | 11.43 | -11.84 | -4.50 |
| 17:30-17:45 | 34.11 | 33.97 | 34.01 | 8.45 | 46.38 | 27.14 | -0.76 | 150.87 | 85.53 | 11.54 | -26.56 | -15.56 |
| 17:45-18:00 | 49.05 | 38.29 | 40.96 | 9.26 | 30.19 | 16.15 | 8.33 | 169.72 | 121.78 | 8.82 | -7.14 | -2.54 |
| 18:00-18:15 | 42.45 | 31.64 | 34.18 | -0.62 | 38.79 | 15.83 | 5.47 | 70.64 | 47.66 | 5.56 | 0.00 | 2.34 |
| 18:15:18:30 | 49.29 | 31.97 | 37.80 | -2.96 | 52.07 | 27.63 | 8.08 | 36.03 | 24.26 | 6.82 | -3.06 | 0.00 |

Table I-5: Percentage Reduction in Simulated Average Total Stopped Delay at the Critical Intersection of Study Site 3

| TIME PERIOD | Percentage Reduction in Average Total Stopped Delay | | | | | | | | | | | | TOTAL FOR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| (hours) | LT &RT | TH | TOTAL | LT &RT | TH | TOTAL | LT | TH &RT | TOTAL | LT | TH & RT | TOTAL | THE INTER |
| 6:30 - 6:45 | 192.31 | -100.00 | -71.54 | -38.89 | -100.00 | -97.82 | -78.89 | -27.91 | -37.05 | -97.43 | -2.09 | -30.90 | -59.89 |
| 6:45 - 7:00 | 51.85 | -100.00 | -78.76 | -28.89 | -100.00 | -96.46 | -85.71 | -27.68 | -43.15 | -98.19 | -1.49 | -29.70 | -60.51 |
| 7:00 - 7:15 | 88.52 | -100.00 | -62.66 | -40.54 | -100.00 | -98.80 | -81.61 | -34.62 | -41.65 | -98.30 | -6.16 | -28.64 | -60.15 |
| 7:15 - 7:30 | 21.03 | -100.00 | -68.45 | -52.31 | -100.00 | -98.97 | -80.00 | -38.39 | -48.89 | -96.62 | 0.00 | -16.03 | -57.67 |
| 7:30 - 7:45 | -22.89 | -100.00 | -81.14 | -45.95 | -100.00 | -99.61 | -83.23 | -74.81 | -75.70 | -97.30 | -50.87 | -53.96 | -82.46 |
| 7:45 - 8:00 | 48.32 | -100.00 | -70.08 | -69.23 | -100.00 | -98.67 | -67.93 | -46.42 | -49.40 | -88.03 | 5.17 | -5.75 | -50.59 |
| 8:00 - 8:15 | 61.45 | -100.00 | -74.90 | -36.25 | -100.00 | -94.82 | -74.79 | -45.64 | -51.68 | -80.38 | 119.93 | 97.30 | -29.43 |
| 8:15 - 8:30 | 20.87 | -100.00 | -80.53 | -60.71 | -100.00 | -97.46 | -70.28 | -30.62 | -39.40 | -92.45 | -0.08 | -17.61 | -59.48 |
| 11:00-11:15 | 182.04 | -100.00 | -74.66 | -66.19 | -100.00 | -93.12 | -58.39 | 4.94 | -15.46 | -64.71 | 15.70 | -8.73 | -50.59 |
| 11:15-11:30 | 142.44 | -100.00 | -67.85 | -66.28 | -100.00 | -95.65 | -57.26 | -2.12 | -16.19 | -57.47 | -9.88 | -24.41 | -55.48 |
| 11:30-11:45 | 290.00 | -100.00 | -76.04 | -54.62 | -100.00 | -92.14 | -56.81 | -1.95 | -19.51 | -58.90 | 16.55 | -7.95 | -51.61 |
| 11:45-12:00 | 155.06 | -100.00 | -75.93 | -66.77 | -100.00 | -95.75 | -51.76 | 1.22 | -13.47 | -53.67 | 17.01 | -3.86 | -49.38 |
| 12:00-12:15 | 121.53 | -100.00 | -72.59 | -70.40 | -100.00 | -94.39 | -53.24 | -15.42 | -25.19 | -31.06 | 13.79 | 2.74 | -48.33 |
| 12:15-12:30 | 206.27 | -100.00 | -68.46 | -63.74 | -100.00 | -89.57 | -48.40 | -6.73 | -18.35 | -26.70 | 16.39 | 2.79 | -46.64 |
| 12:30-12:45 | 176.01 | -100.00 | -62.50 | -72.22 | -100.00 | -95.46 | -46.35 | 8.39 | -8.01 | -22.48 | 17.72 | 7.25 | -37.80 |
| 12:45-13:00 | 167.97 | -100.00 | -68.49 | -60.15 | -100.00 | -93.40 | -40.20 | 2.67 | -8.49 | -34.30 | 20.81 | 2.41 | -45.37 |
| 16:30-16:45 | 238.02 | -100.00 | -76.82 | -77.14 | -100.00 | -94.14 | -29.89 | -37.59 | -34.08 | -37.86 | 2.64 | -1.95 | -49.19 |
| 16:45-17:00 | 266.99 | -100.00 | -92.47 | -94.25 | -100.00 | -97.28 | -73.61 | -39.28 | -60.64 | -50.06 | -41.41 | -42.72 | -77.95 |
| 17:00-17:15 | 209.54 | -100.00 | -84.59 | -77.80 | -100.00 | -91.51 | -53.14 | -49.57 | -51.26 | -55.52 | -28.07 | -31.88 | -60.99 |
| 17:15-17:30 | 168.92 | -100.00 | -94.04 | -87.27 | -100.00 | -94.54 | -76.31 | -78.53 | -77.72 | -65.07 | -50.32 | -51.48 | -81.78 |
| 17:30-17:45 | 276.96 | -100.00 | -89.21 | -87.07 | -100.00 | -95.16 | -29.33 | -77.92 | -69.33 | -65.02 | -3.12 | -20.35 | -69.87 |
| 17:45-18:00 | 177.98 | -100.00 | -93.35 | -86.37 | -100.00 | -94.50 | -77.97 | -56.99 | -69.78 | -56.71 | -44.50 | -45.49 | -78.63 |
| 18:00-18:15 | -49.51 | -100.00 | -95.51 | -82.07 | -100.00 | -94.86 | -26.01 | -54.85 | -47.50 | -58.20 | 4.41 | -13.52 | -59.38 |
| 18:15:18:30 | 151.37 | -100.00 | -94.66 | -89.73 | -100.00 | -96.56 | -22.82 | -85.38 | -79.60 | -43.78 | -50.52 | -49.88 | -85.05 |

Table I-6: Percentage Difference in Simulated Average Total Stopped Delay at the Downstream Intersections of Study Site 3

| TIME PERIOD (hours) | Percentage Difference in Average Total Stopped Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:45 - 7:00 | 9.09 | 6.68 | 7.24 | -11.40 | 132.86 | 110.75 | 0.00 | 20.00 | 19.40 | -5.26 | -23.82 | -21.41 |
| 7:00 - 7:15 | 2.08 | -1.52 | 0.15 | -4.92 | 9.55 | 8.53 | 0.00 | 30.91 | 30.36 | 0.00 | -27.12 | -24.72 |
| 7:15 - 7:30 | 1.38 | -14.67 | -7.29 | -0.58 | -4.02 | -3.82 | 0.00 | 59.02 | 58.06 | -7.06 | -46.14 | -40.86 |
| 7:30 - 7:45 | 4.08 | -32.64 | -22.90 | 3.64 | -3.59 | -3.14 | 0.00 | 43.37 | 42.86 | 0.00 | -33.07 | -30.54 |
| 7:45 - 8:00 | 4.01 | -43.13 | -25.29 | 9.42 | 14.30 | 13.98 | 0.00 | 79.38 | 77.78 | -11.11 | -52.31 | -45.84 |
| 8:00 - 8:15 | -7.27 | -18.33 | -14.80 | -18.41 | 73.51 | 64.69 | -96.77 | -56.63 | -60.06 | -48.51 | -23.90 | -28.77 |
| 8:15 - 8:30 | 4.98 | -43.70 | -29.02 | 4.04 | 6.76 | 6.54 | -50.00 | 96.97 | 92.65 | -10.39 | -46.52 | -42.82 |
| 11:00-11:15 | 13.21 | -24.87 | -20.64 | -21.81 | -20.49 | -20.68 | 0.00 | 141.38 | 134.43 | -24.48 | -49.20 | -43.16 |
| 11:15-11:30 | 15.66 | -26.03 | -22.12 | -14.37 | -16.13 | -15.85 | 0.00 | 83.33 | 78.95 | -24.67 | -59.90 | -47.93 |
| 11:30-11:45 | 28.17 | -34.21 | -32.01 | -27.34 | -8.18 | -12.39 | 0.00 | 167.44 | 160.00 | -21.46 | -49.81 | -43.42 |
| 11:45-12:00 | 20.42 | -36.53 | -33.01 | -19.91 | -19.15 | -19.34 | 0.00 | 144.68 | 138.78 | -21.58 | -51.10 | -45.27 |
| 12:00-12:15 | 15.06 | -26.33 | -23.03 | -6.87 | -8.56 | -8.26 | 0.00 | 39.78 | 38.54 | -17.24 | -58.70 | -47.84 |
| 12:15-12:30 | 18.02 | -30.78 | -26.64 | -14.76 | -21.89 | -20.12 | 0.00 | 86.57 | 82.86 | -22.86 | -64.12 | -50.64 |
| 12:30-12:45 | 7.37 | -32.53 | -28.56 | -10.06 | -14.31 | -12.89 | 0.00 | 39.39 | 38.24 | -27.85 | -64.34 | -51.98 |
| 12:45-13:00 | 18.52 | -45.74 | -39.99 | -9.93 | -15.91 | -14.69 | 0.00 | 72.82 | 70.09 | -25.36 | -57.32 | -50.16 |
| 16:45-17:00 | -12.04 | 1.99 | 1.53 | 0.63 | -26.97 | -19.50 | -22.22 | -3.92 | -5.41 | 24.01 | -0.24 | 4.32 |
| 17:00-17:15 | 32.42 | -2.91 | -2.71 | 5.30 | -10.95 | -6.64 | -33.33 | 64.95 | 51.79 | 16.64 | 19.14 | 18.49 |
| 17:15-17:30 | 48.10 | -1.59 | -1.39 | 6.24 | -14.16 | -10.08 | -27.78 | 0.00 | -2.34 | 32.44 | 22.94 | 24.94 |
| 17:30-17:45 | 23.01 | -4.33 | -4.08 | -1.70 | -11.85 | -9.47 | -30.00 | 125.61 | 108.70 | 21.11 | 28.13 | 26.04 |
| 17:45-18:00 | 40.17 | -2.61 | -2.34 | 3.25 | -10.12 | -6.22 | -21.74 | -6.16 | -7.69 | 25.96 | 14.69 | 17.35 |
| 18:00-18:15 | 25.34 | -10.19 | -9.83 | 31.27 | 12.32 | 18.06 | -23.08 | -1.33 | -3.07 | 17.67 | 19.56 | 18.90 |

Table I-7: Percentage Reduction in Simulated Average Total Stopped Delay at the Critical Intersection of Study Site 4

| TIME PERIOD (hours) | Percentage Reduction in Average Total Stopped Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT &RT | TH | TOTAL | LT &RT | TH | TOTAL | LT | TH &RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | -35.08 | -100.00 | -91.46 | -10.13 | -100.00 | -84.91 | -47.49 | -49.14 | -48.70 | -44.44 | -29.17 | -32.05 | -67.77 |
| 6:45 - 7:00 | 0.52 | -100.00 | -86.78 | -5.23 | -100.00 | -84.08 | -54.52 | -44.10 | -46.90 | -37.18 | -16.47 | -20.37 | -63.37 |
| 7:00 - 7:15 | -28.24 | -100.00 | -77.07 | 19.48 | -100.00 | -84.82 | -63.94 | -53.97 | -56.35 | -48.13 | -9.82 | -18.14 | -58.96 |
| 7:15 - 7:30 | -47.94 | -100.00 | -82.92 | 17.61 | -100.00 | -82.80 | -62.67 | -54.43 | -56.44 | -49.88 | -15.60 | -23.09 | -60.13 |
| 7:30 - 7:45 | -32.64 | -100.00 | -82.15 | 2.73 | -100.00 | -81.95 | -52.18 | -61.76 | -59.78 | -40.62 | -16.00 | -21.63 | -60.39 |
| 7:45 - 8:00 | -40.00 | -100.00 | -90.45 | -23.11 | -100.00 | -74.37 | -32.46 | -39.07 | -37.77 | -40.15 | -7.39 | -15.72 | -54.52 |
| 8:00 - 8:15 | -29.28 | -100.00 | -85.53 | -8.29 | -100.00 | -77.48 | -25.66 | -36.58 | -34.03 | -26.89 | -13.08 | -16.00 | -53.78 |
| 8:15 - 8:30 | -24.12 | -100.00 | -84.93 | -4.31 | -100.00 | -75.82 | -44.19 | -43.45 | -43.60 | -33.19 | 22.37 | 9.52 | -50.12 |
| 11:00-11:15 | -6.20 | -100.00 | -74.47 | 9.43 | -100.00 | -54.64 | -48.48 | -58.04 | -56.29 | -54.92 | 21.78 | 7.32 | -42.82 |
| 11:15-11:30 | -16.41 | -100.00 | -79.02 | 20.50 | -100.00 | -52.68 | -37.15 | -63.37 | -59.47 | -54.63 | 37.78 | 18.32 | -41.69 |
| 11:30-11:45 | 4.17 | -100.00 | -74.36 | 24.39 | -100.00 | -50.61 | -32.61 | -48.82 | -46.42 | -55.09 | 45.98 | 29.32 | -32.85 |
| 11:45-12:00 | -28.44 | -100.00 | -75.00 | -9.86 | -100.00 | -63.55 | -50.37 | -57.79 | -56.47 | -61.61 | -3.75 | -12.84 | -50.21 |
| 12:00-12:15 | -21.97 | -100.00 | -80.12 | 2.31 | -100.00 | -59.10 | -34.29 | -65.17 | -59.58 | -53.72 | 30.04 | 13.61 | -44.91 |
| 12:15-12:30 | -12.79 | -100.00 | -80.60 | 5.69 | -100.00 | -57.27 | -31.83 | -63.74 | -57.57 | -49.56 | 17.53 | 4.76 | -46.55 |
| 12:30-12:45 | -10.27 | -100.00 | -75.18 | 11.16 | -100.00 | -50.61 | -29.59 | -65.33 | -59.98 | -54.13 | 48.43 | 25.66 | -43.21 |
| 12:45-13:00 | -12.50 | -100.00 | -79.18 | -4.95 | -100.00 | -61.74 | -25.89 | -60.53 | -52.85 | -53.90 | 15.69 | -0.47 | -48.28 |
| 16:30-16:45 | 5.13 | -100.00 | -92.69 | -67.49 | -100.00 | -80.70 | -74.10 | -18.05 | -50.38 | -39.56 | -70.48 | -69.12 | -73.40 |
| 16:45-17:00 | 3.80 | -100.00 | -88.98 | -39.57 | -100.00 | -72.71 | -51.56 | -25.24 | -35.01 | -41.24 | -39.98 | -40.14 | -59.79 |
| 17:00-17:15 | -1.05 | -100.00 | -84.83 | -78.03 | -100.00 | -92.75 | -84.45 | -28.07 | -64.93 | -39.08 | -82.76 | -81.44 | -83.61 |
| 17:15-17:30 | 12.00 | -100.00 | -76.28 | -83.94 | -100.00 | -94.87 | -88.09 | -40.86 | -77.08 | -28.87 | -90.61 | -89.57 | -88.91 |
| 17:30-17:45 | 6.87 | -100.00 | -97.50 | -82.48 | -100.00 | -95.04 | -87.40 | -37.54 | -72.29 | -42.03 | -88.40 | -87.49 | -90.54 |
| 17:45-18:00 | 9.09 | -100.00 | -94.64 | -57.68 | -100.00 | -82.01 | -77.23 | -25.13 | -54.75 | -51.50 | -71.40 | -70.15 | -78.18 |
| 18:00-18:15 | -18.66 | -100.00 | -84.30 | -35.41 | -100.00 | -69.86 | -48.53 | -17.85 | -28.37 | -48.82 | -35.79 | -37.91 | -54.98 |
| 18:15:18:30 | -18.28 | -100.00 | -84.33 | -26.63 | -100.00 | -68.42 | -39.45 | -6.33 | -15.96 | -53.23 | -33.05 | -36.27 | -51.37 |

Table I-8: Percentage Difference in Simulated Average Total Stopped Delay at the Downstream Intersections of Study Site 4

| TIME PERIOD (hours) | Percentage Difference in Average Total Stopped Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:30 - 6:45 | 0.00 | -54.65 | -54.65 | 90.00 | -91.92 | -87.44 | 0.00 | 16.54 | 12.90 | 0.00 | 120.83 | 120.83 |
| 6:45 - 7:00 | 0.00 | -69.07 | -69.07 | 90.00 | -94.95 | -90.39 | 0.00 | 20.30 | 27.74 | 0.00 | 156.94 | 173.61 |
| 7:00 - 7:15 | 0.00 | -52.86 | -52.86 | 100.00 | -92.28 | -86.12 | -4.55 | -18.69 | -17.37 | -13.33 | 58.25 | 49.15 |
| 7:15 - 7:30 | 0.00 | -65.06 | -65.06 | 80.00 | -93.71 | -87.84 | -6.00 | -5.37 | -5.49 | -13.33 | 42.96 | 37.58 |
| 7:30 - 7:45 | 0.00 | -63.47 | -63.47 | 72.73 | -93.59 | -89.35 | -3.17 | 2.78 | 1.23 | 0.00 | 156.60 | 136.07 |
| 7:45 - 8:00 | 0.00 | -70.17 | -70.17 | 72.73 | -93.90 | -83.43 | -2.44 | 29.86 | 22.70 | -13.33 | 58.08 | 53.05 |
| 8:00 - 8:15 | 0.00 | -70.74 | -70.74 | 205.00 | -90.91 | -51.97 | -4.92 | -19.64 | -14.45 | 0.00 | 99.22 | 90.71 |
| 8:15 - 8:30 | 0.00 | -83.17 | -83.17 | 205.00 | -89.91 | -44.19 | 0.00 | -37.56 | -33.06 | 7.14 | 114.29 | 100.89 |
| 11:00-11:15 | 0.00 | 246.88 | 246.88 | 14.49 | 3050.00 | 100.00 | 25.00 | -58.82 | -52.51 | 55.56 | 118.22 | 116.10 |
| 11:15-11:30 | 0.00 | 258.73 | 258.73 | 51.67 | 1666.67 | 128.57 | 11.76 | -52.79 | -50.12 | 38.89 | 91.04 | 87.88 |
| 11:30-11:45 | 0.00 | 290.32 | 290.32 | -6.74 | 2550.00 | 49.45 | -21.74 | -78.80 | -77.50 | 30.00 | 68.95 | 67.72 |
| 11:45-12:00 | 0.00 | 802.86 | 802.86 | 62.50 | 2350.00 | 124.32 | 0.00 | -57.23 | -57.23 | 100.00 | 209.13 | 205.51 |
| 12:00-12:15 | 0.00 | 306.76 | 306.76 | 41.77 | 1366.67 | 90.24 | 17.07 | -56.38 | -50.66 | 41.03 | 47.60 | 47.03 |
| 12:15-12:30 | 0.00 | 353.26 | 353.26 | -4.59 | 1233.33 | 28.57 | 15.15 | -64.16 | -57.89 | 53.85 | 33.50 | 34.12 |
| 12:30-12:45 | 0.00 | 317.39 | 317.39 | -9.43 | 1350.00 | 15.74 | 12.70 | -49.26 | -41.98 | 23.53 | 91.39 | 84.52 |
| 12:45-13:00 | 0.00 | 308.28 | 308.28 | -24.82 | 800.00 | -2.07 | 23.81 | -47.46 | -43.47 | 70.59 | 71.06 | 71.05 |
| 16:30-16:45 | 0.00 | 50.00 | 50.00 | 49.23 | 1000.00 | 56.49 | 1.85 | -21.52 | -17.18 | -15.22 | 116.06 | 93.18 |
| 16:45-17:00 | 0.00 | -2.28 | -2.28 | 123.60 | 800.00 | 131.11 | 0.00 | -37.85 | -34.42 | -16.00 | 157.71 | 123.11 |
| 17:00-17:15 | 0.00 | -22.98 | -22.98 | 23.29 | 400.00 | 28.38 | 4.76 | -43.79 | -38.19 | -22.58 | 251.81 | 185.10 |
| 17:15-17:30 | 0.00 | 16.35 | 16.35 | 28.36 | 600.00 | 36.76 | 13.33 | -25.74 | -16.79 | -10.59 | 190.21 | 129.03 |
| 17:30-17:45 | 0.00 | 37.78 | 37.78 | 31.47 | 800.00 | 42.07 | 10.59 | -18.56 | -9.68 | -24.62 | 185.37 | 134.81 |
| 17:45-18:00 | 0.00 | -13.61 | -13.61 | -1.14 | 1000.00 | 4.55 | 0.00 | -26.98 | -23.78 | -15.09 | 128.02 | 101.40 |
| 18:00-18:15 | 0.00 | -4.05 | -4.05 | 104.29 | 133.33 | 106.58 | 0.00 | -37.05 | -33.20 | -14.67 | 104.18 | 75.80 |
| 18:15:18:30 | 0.00 | -19.38 | -19.38 | 189.23 | 50.00 | 177.46 | -3.85 | -39.62 | -36.43 | -26.37 | 112.90 | 75.52 |

Table I-9: Percentage Reduction in Simulated Average Total Stopped Delay at the Critical Intersection of Study Site 5

| TIME PERIOD (hours) | Percentage Reduction in Average Total Stopped Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT &RT | TH | TOTAL | LT &RT | TH | TOTAL | LT | TH &RT | TOTAL | LT | TH & RT | TOTAL | |
| 6:30 - 6:45 | -28.93 | -100.00 | -74.17 | -0.97 | -100.00 | -88.91 | -57.34 | -2.86 | -18.66 | -85.29 | 12.64 | 6.74 | -50.58 |
| 6:45 - 7:00 | -52.79 | -100.00 | -90.60 | 2.73 | -100.00 | -89.64 | -78.24 | -24.19 | -44.05 | -90.38 | 7.14 | -2.46 | -57.96 |
| 7:00 - 7:15 | -52.45 | -100.00 | -84.68 | 1.57 | -100.00 | -93.75 | -82.52 | -15.64 | -37.17 | -90.73 | 5.01 | -3.17 | -55.85 |
| 7:15 - 7:30 | -63.89 | -100.00 | -87.41 | 3.16 | -100.00 | -95.53 | -79.75 | -14.94 | -33.66 | -90.00 | 9.66 | 4.64 | -59.46 |
| 7:30 - 7:45 | -70.22 | -100.00 | -90.78 | 9.37 | -100.00 | -94.02 | -83.78 | -6.79 | -33.67 | -82.47 | 2.96 | 0.55 | -62.14 |
| 7:45 - 8:00 | -69.29 | -100.00 | -91.16 | 8.05 | -100.00 | -94.04 | -75.32 | -27.06 | -47.94 | -76.34 | -13.32 | -15.00 | -63.95 |
| 8:00 - 8:15 | -67.89 | -100.00 | -92.34 | 14.02 | -100.00 | -89.31 | -71.29 | -20.97 | -41.76 | -81.95 | -21.25 | -23.46 | -65.90 |
| 8:15 - 8:30 | -65.08 | -100.00 | -91.13 | 0.74 | -100.00 | -92.92 | -60.62 | -24.74 | -36.95 | -76.92 | 15.12 | 10.40 | -62.68 |
| 11:00-11:15 | -31.82 | -100.00 | -78.72 | -3.56 | -100.00 | -87.63 | -51.97 | 2.97 | -15.10 | -59.57 | 9.35 | 2.89 | -51.37 |
| 11:15-11:30 | -5.32 | -100.00 | -68.67 | -5.20 | -100.00 | -87.34 | -42.15 | 9.98 | -3.28 | -54.55 | 24.40 | 18.07 | -42.41 |
| 11:30-11:45 | -36.67 | -100.00 | -82.38 | -7.91 | -100.00 | -82.44 | -51.71 | -0.42 | -18.37 | -67.14 | 9.14 | -1.51 | -52.66 |
| 11:45-12:00 | -21.60 | -100.00 | -73.53 | -17.03 | -100.00 | -80.67 | -39.05 | -7.76 | -17.74 | -36.28 | 6.08 | 2.09 | -48.29 |
| 12:00-12:15 | -4.98 | -100.00 | -70.79 | -11.80 | -100.00 | -86.21 | -43.98 | 4.23 | -10.74 | -60.32 | 36.06 | 17.42 | -43.63 |
| 12:15-12:30 | -21.09 | -100.00 | -77.19 | -20.04 | -100.00 | -80.49 | -37.72 | -10.50 | -18.36 | -30.08 | 9.80 | 5.68 | -48.15 |
| 12:30-12:45 | -43.57 | -100.00 | -79.31 | -41.15 | -100.00 | -79.63 | -53.31 | -31.88 | -37.80 | -27.54 | 25.53 | 19.98 | -51.59 |
| 12:45-13:00 | -35.62 | -100.00 | -78.77 | -20.99 | -100.00 | -85.49 | -49.49 | -15.19 | -24.83 | -35.54 | 37.21 | 28.05 | -47.93 |
| 16:30-16:45 | -11.24 | -100.00 | -85.58 | -17.00 | -100.00 | -87.30 | -24.56 | -18.94 | -20.83 | 11.33 | 18.26 | 17.19 | -55.60 |
| 16:45-17:00 | -16.36 | -100.00 | -86.42 | -31.71 | -100.00 | -89.55 | 1.55 | -52.81 | -34.51 | -45.32 | 69.71 | 51.87 | -57.60 |
| 17:00-17:15 | -42.38 | -100.00 | -94.27 | -63.91 | -100.00 | -91.06 | -65.91 | -28.08 | -53.07 | -2.42 | -59.39 | -57.38 | -77.07 |
| 17:15-17:30 | -30.84 | -100.00 | -84.55 | -25.09 | -100.00 | -86.45 | 9.39 | -22.57 | -10.43 | 16.36 | 31.58 | 30.02 | -47.89 |
| 17:30-17:45 | -52.23 | -100.00 | -90.68 | -53.75 | -100.00 | -90.29 | -36.19 | -11.38 | -23.71 | 14.47 | -19.18 | -17.18 | -64.80 |
| 17:45-18:00 | -30.07 | -100.00 | -90.13 | -48.64 | -100.00 | -86.69 | -41.64 | -10.07 | -25.11 | -15.49 | -12.08 | -12.55 | -57.97 |
| 18:00-18:15 | 84.48 | -100.00 | -83.92 | -26.22 | -100.00 | -77.85 | -8.58 | -52.66 | -43.95 | -52.51 | -29.20 | -32.66 | -57.49 |
| 18:15:18:30 | -23.35 | -100.00 | -85.06 | -30.54 | -100.00 | -86.87 | 16.68 | 3.40 | 7.84 | 20.23 | 33.39 | 30.92 | -43.55 |

Table I-10: Percentage Difference in Simulated Average Total Stopped Delay at the Downstream Intersections of Study Site 5

| TIME PERIOD (hours) | Percentage Difference in Average Total Stopped Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:30 - 6:45 | 20.00 | 15.08 | 15.62 | 14.29 | -59.92 | -55.58 | 0.00 | -19.90 | -18.89 | 16.67 | 15.91 | 15.97 |
| 6:45 - 7:00 | 3.45 | -6.08 | -3.97 | -2.84 | -4.85 | -4.63 | 0.00 | -1.02 | -0.48 | 18.75 | 39.61 | 38.12 |
| 7:00 - 7:15 | 14.29 | -9.09 | -2.30 | 5.37 | 2.91 | 3.03 | 21.05 | 18.55 | 18.78 | 8.82 | 58.75 | 50.00 |
| 7:15 - 7:30 | 8.14 | -58.49 | -41.31 | 0.00 | -9.28 | -9.16 | -1.61 | 10.03 | 8.35 | 0.00 | 46.12 | 40.40 |
| 7:30 - 7:45 | 9.53 | -56.15 | -40.20 | 1.53 | -6.98 | -6.87 | 5.62 | 8.31 | 7.71 | 1.49 | 56.91 | 42.35 |
| 7:45 - 8:00 | 5.04 | -47.26 | -36.68 | -13.13 | -7.79 | -7.88 | -4.08 | 10.91 | 8.85 | 0.00 | 46.40 | 36.65 |
| 8:00 - 8:15 | 52.05 | -15.33 | -6.05 | 2.06 | -7.08 | -6.97 | -3.09 | -4.00 | -3.84 | 2.44 | 30.57 | 26.80 |
| 8:15 - 8:30 | 10.09 | -28.41 | -22.20 | -3.69 | -15.19 | -14.88 | 1.03 | -1.61 | -1.18 | 0.00 | 41.44 | 37.07 |
| 11:00-11:15 | 16.74 | -42.70 | -34.47 | 6.29 | -67.31 | -55.05 | -14.55 | -14.53 | -14.54 | -1.52 | -16.73 | -15.00 |
| 11:15-11:30 | 31.13 | -20.00 | -16.57 | 10.70 | -38.79 | -25.41 | 9.85 | -19.79 | -4.36 | -5.56 | -2.75 | -3.40 |
| 11:30-11:45 | 21.05 | -30.05 | -24.98 | -25.30 | -70.23 | -64.50 | -26.07 | -13.58 | -21.49 | -7.61 | 1.90 | 0.48 |
| 11:45-12:00 | 5.09 | -33.78 | -28.76 | -19.75 | -65.86 | -62.34 | -22.33 | -19.58 | -21.27 | -4.82 | -11.91 | -10.80 |
| 12:00-12:15 | 14.64 | -30.69 | -25.83 | -14.41 | -67.48 | -61.75 | -29.15 | 1.75 | -17.19 | -10.14 | 0.17 | -0.91 |
| 12:15-12:30 | 6.19 | -23.68 | -19.45 | 10.94 | -48.66 | -34.51 | -5.62 | 1.83 | -2.27 | -10.40 | 1.68 | -0.61 |
| 12:30-12:45 | 0.00 | -19.91 | -17.49 | -5.51 | -50.35 | -44.12 | -30.35 | -9.88 | -21.90 | -8.33 | 0.34 | -1.26 |
| 12:45-13:00 | 21.70 | 4.55 | 5.77 | 1.99 | -28.11 | -23.64 | 0.00 | 47.03 | 42.26 | 38.56 | 36.05 | 36.26 |
| 16:30-16:45 | 30.64 | 15.72 | 16.78 | 24.82 | -67.15 | -53.51 | 42.54 | -73.31 | -42.24 | 20.26 | 26.73 | 26.20 |
| 16:45-17:00 | 32.35 | 10.89 | 11.94 | 1.48 | -20.15 | -16.11 | 115.62 | -53.19 | 15.19 | 31.58 | 31.05 | 31.09 |
| 17:00-17:15 | 19.76 | 13.20 | 13.34 | 1.93 | -8.47 | -7.92 | 69.10 | -65.94 | -30.90 | 30.42 | 19.96 | 21.11 |
| 17:15-17:30 | 41.57 | 5.95 | 6.94 | 1.21 | -31.69 | -16.90 | 42.67 | -27.23 | 6.96 | 23.77 | 34.80 | 33.68 |
| 17:30-17:45 | 22.04 | 5.62 | 6.01 | 2.59 | -20.05 | -18.62 | 46.76 | -49.04 | -9.85 | 31.02 | 40.73 | 39.63 |
| 17:45-18:00 | 67.41 | 42.14 | 43.56 | -1.05 | 15.64 | 10.02 | -60.52 | 11.48 | -51.08 | -32.65 | 37.36 | 23.73 |
| 18:00-18:15 | 2.49 | 4.95 | 4.90 | 1.04 | -47.03 | -36.24 | 34.63 | -29.52 | 4.08 | 36.14 | 41.48 | 40.91 |
| 18:15:18:30 | 0.00 | -19.38 | -19.38 | 189.23 | 50.00 | 177.46 | -3.85 | -39.62 | -36.43 | -26.37 | 112.90 | 75.52 |

Table I-11: Percentage Reduction in Simulated Average Total Stopped Delay at the Critical Intersection of Study Site 6

| TIME PERIOD | Percentage Reduction in Average Total Stopped Delay | | | | | | | | | | | | TOTAL FOR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| (hours) | LT &RT | TH | TOTAL | LT &RT | TH | TOTAL | LT | TH &RT | TOTAL | LT | TH & RT | TOTAL | THE INTER |
| 6:30 - 6:45 | 16.35 | -87.15 | -69.51 | -36.92 | -93.68 | -78.24 | -16.95 | -11.66 | -12.44 | -15.38 | -19.49 | -19.30 | -46.61 |
| 6:45 - 7:00 | -36.53 | -82.50 | -72.62 | -73.17 | -85.00 | -81.72 | -39.69 | 75.18 | 19.03 | -52.05 | 2.01 | -15.77 | -55.64 |
| 7:00 - 7:15 | -15.34 | -85.95 | -76.32 | -72.95 | -78.93 | -76.92 | -47.67 | 47.06 | -3.31 | -50.91 | 33.33 | 12.83 | -54.70 |
| 7:15 - 7:30 | 44.85 | -72.46 | -55.52 | -43.51 | -82.95 | -72.26 | -24.69 | -15.77 | -18.58 | -56.45 | -33.53 | -36.03 | -44.24 |
| 7:30 - 7:45 | 21.67 | -85.64 | -71.97 | -50.75 | -80.20 | -71.17 | -6.19 | -41.50 | -30.97 | -31.43 | -34.87 | -34.65 | -53.03 |
| 7:45 - 8:00 | 0.00 | -67.31 | -51.54 | -61.82 | -79.27 | -75.77 | -25.44 | -4.13 | -8.75 | -41.35 | -12.68 | -17.85 | -40.21 |
| 8:00 - 8:15 | 0.81 | -71.96 | -56.33 | -43.53 | -72.07 | -65.60 | -5.13 | -15.41 | -11.83 | -37.88 | -25.19 | -27.05 | -40.30 |
| 8:15 - 8:30 | -7.63 | -75.71 | -58.69 | -48.44 | -72.96 | -68.26 | -5.93 | -19.48 | -14.90 | -25.86 | -19.80 | -20.79 | -41.76 |
| 11:00-11:15 | -3.23 | -84.85 | -51.11 | -50.00 | -72.90 | -67.50 | -35.00 | -20.00 | -27.74 | -14.29 | -34.53 | -32.27 | -43.53 |
| 11:15-11:30 | -16.53 | -72.19 | -47.43 | -55.00 | -74.42 | -70.75 | -36.15 | -17.14 | -25.25 | -23.26 | -35.24 | -33.80 | -44.05 |
| 11:30-11:45 | -20.23 | -88.76 | -54.09 | -60.44 | -75.32 | -72.48 | -20.35 | -72.18 | -63.88 | 214.29 | -46.36 | -39.17 | -58.07 |
| 11:45-12:00 | -11.54 | -77.56 | -42.01 | -50.00 | -66.97 | -63.61 | -40.63 | -21.59 | -30.65 | -22.22 | -34.10 | -32.38 | -41.85 |
| 12:00-12:15 | -8.88 | -63.77 | -33.55 | -54.81 | -71.78 | -68.02 | -43.89 | -20.00 | -32.85 | -22.81 | -34.66 | -33.40 | -42.72 |
| 12:15-12:30 | -18.18 | -100.00 | -53.64 | 84.09 | -100.00 | -77.56 | -28.99 | -10.27 | -18.51 | -12.70 | -26.96 | -25.15 | -40.35 |
| 12:30-12:45 | 3.06 | -77.63 | -46.00 | -45.31 | -74.84 | -69.79 | -71.35 | -28.29 | -46.15 | -19.05 | -35.26 | -32.76 | -48.43 |
| 12:45-13:00 | -53.36 | -100.00 | -68.35 | -30.29 | -100.00 | -73.07 | -23.58 | -38.22 | -35.59 | -16.18 | -27.95 | -26.20 | -49.32 |
| 16:30-16:45 | -2.38 | -81.46 | -48.68 | -47.67 | -77.87 | -72.58 | -29.84 | -43.43 | -38.63 | -34.15 | -34.03 | -34.04 | -49.37 |
| 16:45-17:00 | -14.78 | -81.11 | -45.95 | -37.29 | -67.32 | -65.18 | -35.48 | -23.83 | -27.62 | -44.07 | -20.63 | -25.03 | -40.70 |
| 17:00-17:15 | -80.71 | -87.64 | -82.34 | -91.51 | -83.81 | -85.50 | -80.55 | -40.73 | -62.80 | -37.34 | -78.87 | -76.71 | -77.88 |
| 17:15-17:30 | -44.97 | -81.87 | -58.38 | -71.82 | -73.92 | -73.59 | -35.91 | -42.80 | -39.98 | -32.20 | -36.08 | -35.68 | -51.91 |
| 17:30-17:45 | -73.25 | -74.75 | -73.57 | -77.70 | -86.88 | -85.67 | -39.52 | -46.35 | -42.06 | -17.51 | -57.59 | -53.70 | -65.86 |
| 17:45-18:00 | -13.68 | -83.26 | -48.71 | -53.76 | -71.34 | -68.38 | -33.10 | -33.67 | -33.43 | -39.10 | -29.76 | -31.06 | -46.18 |
| 18:00-18:15 | -24.80 | -91.18 | -50.24 | -46.99 | -69.15 | -66.87 | -25.11 | -28.57 | -27.17 | -31.76 | -24.56 | -25.69 | -42.60 |
| 18:15:18:30 | -25.71 | -87.37 | -47.41 | -46.15 | -69.02 | -66.67 | -19.90 | -28.72 | -25.15 | -28.21 | -23.82 | -24.40 | -41.24 |

Table I-12: Percentage Difference in Simulated Average Total Stopped Delay at the Downstream Intersections of Study Site 6

| TIME PERIOD (hours) | Percentage Difference in Average Total Stopped Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:30 - 6:45 | 34.04 | 8.32 | 10.00 | 8.16 | 37.31 | 25.00 | 0.00 | -8.24 | -8.08 | 60.00 | 206.94 | -11.55 |
| 6:45 - 7:00 | -28.83 | -1.62 | -11.82 | -10.34 | -14.75 | -13.33 | -33.33 | 1.55 | 0.00 | 63.33 | 250.00 | 34.22 |
| 7:00 - 7:15 | -29.79 | 34.20 | 4.37 | -7.14 | -2.00 | -4.72 | -25.71 | 0.36 | -2.56 | 20.00 | 180.58 | 33.48 |
| 7:15 - 7:30 | -14.62 | 1.76 | -3.71 | 12.50 | 35.19 | 24.51 | 16.67 | -5.17 | -4.10 | 140.00 | 84.51 | 6.05 |
| 7:30 - 7:45 | -16.76 | -2.71 | -7.63 | 10.20 | 32.76 | 22.43 | 18.18 | -9.82 | -7.82 | 50.00 | 132.08 | -19.88 |
| 7:45 - 8:00 | -19.23 | 28.28 | 10.23 | 14.75 | 35.19 | 24.35 | 0.00 | -1.42 | -1.32 | 166.67 | 57.07 | 7.67 |
| 8:00 - 8:15 | -11.11 | -2.14 | -4.85 | 9.52 | 28.57 | 20.41 | 13.04 | -10.20 | -8.27 | 241.67 | 115.62 | -2.16 |
| 8:15 - 8:30 | -11.58 | 4.32 | -1.56 | 15.38 | 9.43 | 11.96 | 6.67 | -9.29 | -8.47 | 42.86 | 136.73 | -2.33 |
| 11:00-11:15 | 11.54 | 0.93 | 2.99 | 50.36 | -18.06 | 1.10 | 14.29 | -6.78 | -5.83 | 155.56 | -49.61 | 9.29 |
| 11:15-11:30 | 10.53 | 3.92 | 5.71 | 40.63 | -5.88 | 9.00 | 14.81 | -15.46 | -13.08 | -11.11 | -60.57 | 0.00 |
| 11:30-11:45 | -2.38 | 31.03 | 20.16 | 26.32 | 10.14 | 13.64 | -2.50 | -22.14 | -20.36 | 140.00 | -71.57 | -7.50 |
| 11:45-12:00 | 0.00 | 14.89 | 12.39 | 33.33 | -16.44 | -1.94 | 0.00 | -5.62 | -5.03 | 155.56 | -73.00 | 1.08 |
| 12:00-12:15 | 3.70 | 4.00 | 3.94 | 43.24 | -13.92 | 4.31 | 8.57 | -7.43 | -5.87 | -46.15 | -74.04 | 7.50 |
| 12:15-12:30 | 8.82 | 22.58 | 19.62 | 50.00 | -20.69 | 0.00 | 15.22 | 1.17 | 2.54 | 69.23 | -78.48 | 1.85 |
| 12:30-12:45 | 2.78 | 7.63 | 6.59 | 44.85 | -11.11 | 5.09 | 8.11 | -9.35 | -7.49 | -50.00 | -59.60 | 13.01 |
| 12:45-13:00 | 112.50 | 13.85 | 24.66 | 258.82 | -12.70 | 19.58 | -12.16 | 24.15 | 14.59 | 176.47 | -60.65 | 33.13 |
| 16:30-16:45 | -18.37 | -26.42 | -22.55 | 30.36 | 29.79 | 30.00 | 24.10 | -18.58 | -12.28 | -13.04 | -41.74 | 65.35 |
| 16:45-17:00 | -17.02 | -15.09 | -16.00 | 21.88 | 16.30 | 18.59 | 13.92 | -13.87 | -9.39 | -24.00 | -37.81 | 33.61 |
| 17:00-17:15 | -20.13 | 38.89 | 2.09 | -29.82 | 19.13 | -5.24 | 69.00 | -4.59 | 4.64 | -30.65 | -74.61 | -24.59 |
| 17:15-17:30 | -25.31 | -31.46 | -27.49 | 11.11 | 9.00 | 9.94 | 24.53 | -25.17 | -17.52 | -2.35 | -51.03 | 57.52 |
| 17:30-17:45 | -23.74 | -36.11 | -27.96 | 17.35 | 7.07 | 12.18 | 30.83 | -31.53 | -23.70 | 7.69 | -18.05 | 71.22 |
| 17:45-18:00 | -18.95 | -19.40 | -19.14 | 23.46 | 7.69 | 14.14 | 20.16 | -19.60 | -13.96 | 135.85 | -55.17 | 40.49 |
| 18:00-18:15 | -13.24 | -9.09 | -11.38 | 8.96 | 2.82 | 4.29 | 16.49 | -18.80 | -13.49 | 20.00 | -56.49 | 39.57 |
| 18:15:18:30 | -14.55 | -15.25 | -14.91 | -5.08 | 6.25 | 3.20 | 16.67 | -17.34 | -12.26 | -7.69 | -53.23 | 37.93 |

# APPENDIX J

## SUMMARY OF REDUCTION IN DELAY WHEN EAST-WEST ARTERIAL IS GRADE SEPARATED

**Table J-1: Average Reduction in Delay During AM-Peak Period When East-West Arterial is Grade Separated**

| Type of Delay | Crit-eria | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 |
|---|---|---|---|---|---|---|---|
| Total delay for the system | - 40 | - 65 | - 66 | - 44 | - 49 | - 32 | - 30 |
| Grade separated approach of critical intersection | - 70 | - 75 | - 91 | - 67 | - 77 | - 73 | - 69 |
| At-grade approach of critical intersection | - 50 | - 7 | - 56 | - 65 | - 31 | - 64 | -27 |
| Total delay at Critical Intersection | - 60 | - 50 | - 76 | - 66 | - 54 | - 66 | -46 |
| Grade separated approach of D/S intersection | + 25 | +328 | +280 | - 15 | +252 | - 1 | + 12 |
| At-grade approach of D/S intersection | + 15 | + 13 | - 81 | - 15 | - 68 | + 3 | - 1 |
| Total delay at D/S intersections | + 20 | + 79 | + 43 | - 15 | + 36 | 0 | + 6 |

**Table J-2: Average Reduction in Delay During Off-Peak Period When East-West Arterial is Grade Separated**

| Type of Delay | Crit-eria | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 |
|---|---|---|---|---|---|---|---|
| Total delay for the system | - 40 | - 74 | - 32 | - 27 | - 48 | - 31 | - 47 |
| Grade separated approach of critical intersection | - 70 | - 93 | - 75 | - 65 | - 90 | - 61 | - 76 |
| At-grade approach of critical intersection | - 50 | - 68 | + 19 | - 19 | - 10 | - 23 | - 33 |
| Total delay at Critical Intersection | - 60 | - 83 | - 41 | - 40 | - 57 | - 40 | - 57 |
| Grade separated approach of D/S intersection | + 25 | +211 | + 64 | - 5 | + 10 | + 23 | - 10 |
| At-grade approach of D/S intersection | + 15 | + 24 | - 22 | - 4 | +193 | - 22 | + 2 |
| Total delay at D/S intersections | + 20 | +122 | + 8 | - 6 | + 40 | - 9 | - 8 |

**Table J-3: Average Reduction in Delay During PM-Peak Period When East-West Arterial is Grade Separated**

| Type of Delay | Crit-eria | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 |
|---|---|---|---|---|---|---|---|
| Total delay for the system | - 40 | - 83 | - 77 | - 65 | - 54 | - 49 | - 38 |
| Grade separated approach of critical intersection | - 70 | - 87 | - 92 | - 78 | - 86 | - 72 | - 71 |
| At-grade approach of critical intersection | - 50 | - 44 | - 67 | - 52 | - 57 | - 27 | - 26 |
| Total delay at Critical Intersection | - 60 | - 70 | - 84 | - 65 | - 72 | - 48 | - 51 |
| Grade separated approach of D/S intersection | + 25 | +579 | +159 | 0 | +272 | - 23 | + 6 |
| At-grade approach of D/S intersection | + 15 | + 11 | + 9 | - 4 | + 63 | - 28 | - 12 |
| Total delay at D/S intersections | + 20 | +166 | + 46 | - 2 | +154 | - 2 | + 8 |

**Table J-4: Average Reduction in Delay for Mean of the Three Periods When East-West Arterial is Grade Separated**

| Type of Delay | Crit-eria | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 |
|---|---|---|---|---|---|---|---|
| Total delay for the system | - 40 | - 74 | - 59 | - 28 | - 46 | - 27 | - 38 |
| Grade separated approach of critical intersection | - 70 | - 85 | - 86 | - 70 | - 84 | - 69 | - 72 |
| At-grade approach of critical intersection | - 50 | - 39 | - 35 | - 45 | - 32 | - 38 | - 29 |
| Total delay at Critical Intersection | - 60 | - 68 | - 67 | - 57 | - 61 | - 51 | - 51 |
| Grade separated approach of D/S intersection | + 25 | +358 | +154 | - 8 | +171 | - 2 | +13 |
| At-grade approach of D/S intersection | + 15 | + 16 | - 7 | - 6 | +63 | - 1 | - 4 |
| Total delay at D/S intersections | +20 | + 118 | +30 | - 7 | +74 | - 1 | -10 |

# APPENDIX K

## COMPARISON OF AT-GRADE AND GRADE SEPARATED DELAYS WHEN EAST-WEST ARTERIAL IS GRADE SEPARATED

Table K-1: Percentage Reduction in Simulated Average Total Stopped Delay at the Critical Intersection of Study Site 1

| TIME PERIOD (hours) | Percentage Reduction in Average Total Stopped Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT &RT | TH | TOTAL | LT & RT | TH | TOTAL | |
| 6:30 - 6:45 | 33.51 | 50.38 | 40.51 | -60.00 | 0.00 | -17.56 | 183.25 | -100.00 | -67.50 | -48.40 | -100.00 | -91.98 | -54.91 |
| 6:45 - 7:00 | 57.53 | 65.24 | 61.61 | -65.55 | 0.00 | -18.41 | 209.15 | -100.00 | -69.38 | -62.39 | -100.00 | -91.56 | -54.66 |
| 7:00 - 7:15 | 31.39 | 56.78 | 42.07 | -45.05 | -9.67 | -18.21 | 221.52 | -100.00 | -60.82 | -45.84 | -100.00 | -89.68 | -66.94 |
| 7:15 - 7:30 | 131.65 | 68.07 | 115.04 | -57.46 | 93.32 | 80.02 | 1058.25 | -100.00 | -26.49 | -53.22 | -100.00 | -93.39 | 10.68 |
| 7:30 - 7:45 | -35.74 | 31.50 | -25.00 | -39.89 | -15.87 | -16.93 | 261.65 | -100.00 | -13.83 | -39.41 | -100.00 | -97.11 | -44.57 |
| 7:45 - 8:00 | -29.75 | 32.35 | -13.99 | -83.98 | -72.55 | -74.50 | 53.55 | -100.00 | -54.37 | -42.28 | -100.00 | -97.00 | -76.71 |
| 8:00 - 8:15 | 28.74 | 28.85 | 28.79 | -38.28 | -18.90 | -23.34 | 37.87 | -100.00 | -68.06 | -37.18 | -100.00 | -93.11 | -55.51 |
| 8:15 - 8:30 | 60.87 | 46.46 | 53.96 | -62.55 | -36.02 | -44.88 | 31.54 | -100.00 | -70.97 | -11.03 | -100.00 | -91.97 | -61.33 |
| 11:00-11:15 | 24.22 | -28.40 | -13.73 | -32.51 | -35.10 | -34.17 | -15.90 | -100.00 | -77.51 | 1.67 | -100.00 | -89.06 | -62.91 |
| 11:15-11:30 | -10.19 | -31.48 | -22.77 | -34.53 | -25.96 | -28.99 | -6.25 | -100.00 | -72.15 | -14.63 | -100.00 | -90.43 | -60.96 |
| 11:30-11:45 | -12.02 | -38.33 | -29.40 | -38.39 | -32.83 | -34.92 | -18.21 | -100.00 | -67.63 | -2.36 | -100.00 | -89.38 | -59.80 |
| 11:45-12:00 | -23.51 | -43.00 | -35.77 | -36.39 | -38.61 | -37.87 | -20.18 | -100.00 | -78.05 | -13.61 | -100.00 | -88.76 | -65.18 |
| 12:00-12:15 | -71.85 | -52.23 | -64.39 | -16.70 | -81.90 | -76.76 | -71.14 | -100.00 | -83.56 | -0.76 | -100.00 | -96.47 | -85.72 |
| 12:30-12:45 | -76.58 | -48.03 | -67.93 | -8.71 | -82.58 | -79.15 | -79.32 | -100.00 | -87.20 | -23.82 | -100.00 | -96.56 | -88.42 |
| 12:45-13:00 | -23.66 | -33.76 | -29.80 | -45.85 | -31.21 | -37.71 | -40.21 | -100.00 | -79.23 | -45.95 | -100.00 | -92.62 | -67.22 |
| 16:30-16:45 | -46.03 | -75.79 | -70.45 | -63.43 | -35.14 | -49.32 | -77.60 | -100.00 | -86.32 | 125.96 | -100.00 | -94.61 | -81.97 |
| 16:45-17:00 | -61.89 | -82.93 | -78.80 | -72.31 | -41.93 | -60.17 | -79.09 | -100.00 | -86.49 | 164.53 | -100.00 | -96.72 | -87.22 |
| 17:00-17:15 | -36.66 | -85.24 | -80.35 | -68.28 | -36.64 | -54.45 | -74.35 | -100.00 | -84.82 | 66.89 | -100.00 | -94.81 | -84.10 |
| 17:15-17:30 | -30.11 | -75.99 | -69.95 | -67.90 | -26.34 | -50.07 | -63.86 | -100.00 | -81.64 | 72.11 | -100.00 | -95.06 | -81.36 |
| 17:30-17:45 | -61.67 | -87.60 | -84.11 | -77.56 | -76.39 | -76.85 | -77.40 | -100.00 | -84.45 | 120.97 | -100.00 | -97.98 | -90.04 |
| 17:45-18:00 | -31.11 | -59.20 | -53.24 | -47.02 | -36.70 | -40.17 | -67.39 | -100.00 | -85.77 | 19.41 | -100.00 | -94.09 | -77.57 |
| 18:00-18:15 | -58.39 | -87.77 | -84.16 | -74.60 | -68.10 | -71.16 | -88.60 | -100.00 | -91.04 | 179.82 | -100.00 | -96.83 | -89.66 |
| 18:15:18:30 | -55.08 | -64.07 | -61.29 | -31.85 | -57.22 | -52.90 | -48.77 | -100.00 | -81.11 | 42.45 | -100.00 | -91.62 | -75.09 |

Table K-2: Percentage Difference in Simulated Average Total Stopped Delay at the Downstream Intersections of Study Site 1

| TIME PERIOD (hours) | Percentage Difference in Average Total Stopped Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT &RT | TH | TOTAL | LT &RT | TH | TOTAL | LT | TH &RT | TOTAL | LT | TH & RT | TOTAL |
| 6:30 - 6:45 | 0.00 | -22.00 | -22.00 | 0.00 | -4.61 | -3.52 | 0.00 | 380.00 | 195.74 | 0.00 | 109.22 | 109.22 |
| 6:45 - 7:00 | 0.00 | -15.00 | -15.00 | 0.00 | -3.41 | -2.80 | 0.00 | 380.65 | 380.65 | 111.11 | 440.76 | 422.89 |
| 7:00 - 7:15 | 28.57 | -8.93 | -1.43 | -3.94 | 42.82 | 33.02 | 0.00 | 402.70 | 266.07 | 88.24 | 289.02 | 271.05 |
| 7:15 - 7:30 | 100.00 | -68.83 | -38.30 | -5.57 | 2.81 | 0.90 | -9.52 | 280.00 | 180.33 | 106.67 | 966.41 | 878.08 |
| 7:30 - 7:45 | 66.67 | -63.49 | -49.65 | -3.60 | 37.01 | 25.51 | 7.89 | 445.61 | 270.53 | 137.50 | 431.25 | 419.50 |
| 7:45 - 8:00 | 0.00 | -71.54 | -71.54 | -2.79 | 53.30 | 33.77 | 6.67 | 354.55 | 173.04 | 106.67 | 279.34 | 267.98 |
| 8:00 - 8:15 | 56.25 | -63.91 | -51.01 | -10.92 | 49.76 | 31.99 | -4.76 | 352.70 | 143.02 | 130.00 | 350.00 | 339.91 |
| 8:15 - 8:30 | 90.00 | -86.46 | -56.03 | -9.77 | 62.08 | 42.54 | -7.14 | 701.72 | 353.51 | 90.00 | 266.36 | 261.08 |
| 11:00-11:15 | 0.00 | 238.00 | 238.00 | -15.95 | 9.25 | -1.28 | 0.00 | 826.56 | 826.56 | 86.36 | 71.06 | 71.81 |
| 11:15-11:30 | -65.63 | 191.04 | 108.08 | -7.02 | 7.58 | 2.46 | -5.00 | 499.10 | 422.14 | 108.33 | 71.62 | 74.73 |
| 11:30-11:45 | -62.16 | 242.86 | 130.00 | -7.22 | 7.04 | 0.26 | -11.54 | 376.77 | 296.00 | 97.37 | 37.91 | 41.24 |
| 11:45-12:00 | 0.00 | 180.00 | 180.00 | -8.38 | 7.29 | -0.52 | 11.76 | 504.49 | 456.07 | 88.10 | 86.03 | 86.22 |
| 12:00-12:15 | -59.46 | 88.43 | 53.80 | 23.78 | 2.55 | 11.09 | 8.33 | 1104.17 | 738.89 | 88.46 | 154.06 | 141.21 |
| 12:15-12:30 | -44.05 | 121.21 | 45.36 | 0.00 | 4.55 | 2.54 | -10.87 | 662.02 | 540.16 | 76.92 | 105.66 | 103.04 |
| 12:30-12:45 | -58.06 | 95.33 | 60.87 | 7.81 | 34.02 | 29.30 | 11.54 | 1418.03 | 770.80 | 82.86 | 122.62 | 115.76 |
| 12:45-13:00 | -45.90 | 78.10 | 39.90 | 0.00 | 7.33 | 4.25 | -4.65 | 1872.84 | 1221.77 | 81.82 | 113.74 | 109.97 |
| 16:30-16:45 | -28.00 | 22.66 | 20.04 | 7.69 | 0.48 | 4.72 | 15.00 | 1622.11 | 1342.61 | 72.55 | 343.90 | 220.89 |
| 16:45-17:00 | -28.33 | 22.29 | 16.48 | 6.80 | 1.57 | 4.56 | 0.00 | 1233.79 | 1090.85 | 67.68 | 396.12 | 253.51 |
| 17:00-17:15 | -28.77 | 16.26 | 10.86 | 3.22 | 4.91 | 3.85 | 5.56 | 963.25 | 869.57 | 87.06 | 327.54 | 235.87 |
| 17:15-17:30 | -28.57 | 11.40 | 9.77 | 9.48 | -0.79 | 5.00 | 8.33 | 966.67 | 781.93 | 98.28 | 270.59 | 191.27 |
| 17:30-17:45 | -19.54 | 29.40 | 22.15 | 16.60 | -0.50 | 8.97 | 46.15 | 1750.41 | 1585.07 | 71.15 | 366.14 | 233.33 |
| 17:45-18:00 | -22.22 | 12.39 | 8.21 | 7.87 | 6.90 | 7.48 | 0.00 | 1090.14 | 1000.86 | 96.33 | 189.19 | 149.81 |
| 18:00-18:15 | -8.33 | 50.17 | 45.87 | 12.27 | 6.16 | 10.07 | 15.00 | 1734.23 | 1471.76 | 60.48 | 217.73 | 144.15 |
| 18:15:18:30 | -31.88 | 10.71 | 6.24 | 10.30 | -2.53 | 5.21 | 15.00 | 1111.30 | 1000.00 | 84.88 | 232.45 | 178.90 |

Table K-3: Percentage Reduction in Simulated Average Total Stopped Delay at the Critical Intersection of Study Site 2

| TIME PERIOD (hours) | Percentage Reduction in Average Total Stopped Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT &RT | TH | TOTAL | LT & RT | TH | TOTAL | |
| 6:30 - 6:45 | -32.81 | -26.38 | -27.12 | -25.10 | -23.56 | -24.17 | 82.29 | -100.00 | -84.74 | 70.69 | -100.00 | -74.42 | -57.51 |
| 6:45 - 7:00 | -39.56 | -15.01 | -17.68 | -37.91 | -22.16 | -29.36 | 99.09 | -100.00 | -87.13 | -20.20 | -100.00 | -73.70 | -57.77 |
| 7:00 - 7:15 | -42.86 | -58.18 | -57.59 | -67.53 | 17.71 | -41.34 | 58.06 | -100.00 | -93.42 | -41.04 | -100.00 | -73.09 | -71.34 |
| 7:15 - 7:30 | -68.87 | -82.50 | -81.93 | -78.99 | -21.59 | -62.89 | 84.75 | -100.00 | -97.67 | -59.74 | -100.00 | -80.80 | -90.57 |
| 7:30 - 7:45 | -38.27 | -89.75 | -88.17 | -84.28 | -30.24 | -72.01 | 66.09 | -100.00 | -98.12 | -48.63 | -100.00 | -79.22 | -92.24 |
| 7:45 - 8:00 | -27.78 | -85.40 | -83.67 | -77.63 | -21.68 | -62.28 | 49.81 | -100.00 | -96.90 | 55.86 | -100.00 | -60.05 | -87.97 |
| 8:00 - 8:15 | -29.13 | -72.06 | -70.52 | -70.32 | -21.25 | -55.91 | 68.97 | -100.00 | -96.02 | -20.98 | -100.00 | -69.08 | -83.74 |
| 8:15 - 8:30 | -36.23 | -51.14 | -50.53 | -62.12 | -20.08 | -48.34 | 80.10 | -100.00 | -93.94 | -70.62 | -100.00 | -82.01 | -78.91 |
| 11:00-11:15 | 5.49 | -22.12 | -18.77 | -11.15 | 95.10 | 43.88 | 32.76 | -100.00 | -65.94 | 67.07 | -100.00 | -78.25 | -41.71 |
| 11:15-11:30 | 4.07 | -2.71 | -1.48 | 3.18 | 88.01 | 50.76 | 13.36 | -100.00 | -70.53 | 92.82 | -100.00 | -77.93 | -40.32 |
| 11:30-11:45 | 4.09 | -6.49 | -3.75 | -9.82 | 85.38 | 45.44 | -2.47 | -100.00 | -72.95 | 114.56 | -100.00 | -78.90 | -38.89 |
| 11:45-12:00 | -11.07 | -14.91 | -13.95 | -21.95 | 60.35 | 27.69 | -4.57 | -100.00 | -67.80 | 154.11 | -100.00 | -81.06 | -43.69 |
| 12:00-12:15 | -0.90 | -4.76 | -3.85 | -21.12 | 67.54 | 29.74 | 24.34 | -100.00 | -63.12 | 130.37 | -100.00 | -77.52 | -38.69 |
| 12:15-12:30 | -8.51 | -19.58 | -18.09 | -3.72 | 96.28 | 46.32 | -11.17 | -100.00 | -73.22 | 132.58 | -100.00 | -76.60 | -40.61 |
| 12:30-12:45 | -7.25 | 0.13 | -1.77 | -20.65 | 72.86 | 26.51 | 3.99 | -100.00 | -68.65 | 92.63 | -100.00 | -79.71 | -41.80 |
| 12:45-13:00 | -15.83 | 27.96 | 19.81 | -25.07 | 95.30 | 42.72 | -2.61 | -100.00 | -71.62 | 72.78 | -100.00 | -82.07 | -38.31 |
| 16:30-16:45 | -25.25 | -8.47 | -13.00 | -60.81 | -61.76 | -61.44 | -71.85 | -100.00 | -88.16 | 200.45 | -100.00 | -90.52 | -76.41 |
| 16:45-17:00 | -53.32 | -73.37 | -69.62 | -16.11 | -72.93 | -66.95 | -87.88 | -100.00 | -92.51 | 393.13 | -100.00 | -91.74 | -83.97 |
| 17:00-17:15 | -55.31 | -28.52 | -45.76 | -54.31 | -78.16 | -73.37 | -86.12 | -100.00 | -92.24 | 368.49 | -100.00 | -92.51 | -83.94 |
| 17:15-17:30 | -80.66 | -82.48 | -81.90 | -22.95 | -85.84 | -83.66 | -82.19 | -100.00 | -88.64 | 178.64 | -100.00 | -96.65 | -90.53 |
| 17:30-17:45 | -82.15 | -28.17 | -63.75 | -21.43 | -86.03 | -83.72 | -82.57 | -100.00 | -88.80 | 73.63 | -100.00 | -96.51 | -89.68 |
| 17:45-18:00 | -39.84 | -61.04 | -49.75 | -52.05 | -43.64 | -44.97 | -91.36 | -100.00 | -94.36 | 1156.44 | -100.00 | -82.44 | -70.11 |
| 18:00-18:15 | -69.52 | -41.71 | -54.41 | -72.21 | -80.20 | -77.71 | -89.24 | -100.00 | -93.22 | 134.29 | -100.00 | -96.11 | -88.76 |
| 18:15:18:30 | 26.59 | -68.03 | -31.05 | -72.56 | -80.20 | -78.11 | -87.39 | -100.00 | -91.64 | 186.45 | -100.00 | -93.86 | -85.69 |

Table K-4: Percentage Difference in Simulated Average Total Stopped Delay at the Downstream Intersections of Study Site 2

| TIME PERIOD (hours) | Percentage Difference in Average Total Stopped Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH &RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:30 - 6:45 | 3.33 | 4.05 | 3.93 | -15.57 | 3.51 | -13.25 | 0.00 | 306.25 | 306.25 | 27.27 | 339.62 | 310.26 |
| 6:45 - 7:00 | 17.95 | 4.95 | 6.90 | -19.14 | -4.76 | -16.95 | 0.00 | 251.72 | 251.72 | 0.00 | 317.37 | 292.82 |
| 7:15 - 7:30 | 28.57 | 0.93 | 4.82 | -14.73 | 11.11 | -13.15 | -36.00 | 481.25 | 165.85 | 15.38 | 386.79 | 358.72 |
| 7:30 - 7:45 | 38.00 | 5.49 | 10.82 | -14.18 | -23.08 | -14.65 | -30.43 | 278.13 | 149.09 | 45.45 | 396.36 | 355.08 |
| 7:45 - 8:00 | 12.64 | 14.46 | 14.08 | -10.00 | 14.52 | -8.33 | -36.67 | 325.00 | 137.93 | 28.57 | 460.53 | 424.10 |
| 8:00 - 8:15 | 12.73 | 0.37 | 2.47 | -10.91 | -59.26 | -14.30 | -27.27 | 146.67 | 112.50 | 37.50 | 263.39 | 245.23 |
| 8:15 - 8:30 | 3.61 | -6.35 | -4.81 | -13.33 | -45.45 | -16.67 | -27.78 | 248.89 | 125.93 | 50.00 | 226.63 | 209.31 |
| 11:00-11:15 | 197.65 | -60.33 | -4.10 | 18.59 | -90.00 | 4.53 | -33.33 | 28.09 | 15.04 | 37.93 | 40.98 | 40.40 |
| 11:15-11:30 | 197.44 | -53.60 | 11.67 | -66.67 | -57.14 | -63.67 | -34.48 | 154.95 | 109.17 | 26.47 | 42.98 | 39.19 |
| 11:30-11:45 | 203.41 | -62.42 | -1.81 | -49.08 | -51.79 | -49.77 | -39.58 | 156.99 | 91.70 | 30.56 | 70.09 | 60.78 |
| 11:45-12:00 | 177.57 | -58.78 | -8.20 | -59.89 | -14.75 | -48.32 | -39.62 | 197.90 | 96.79 | 21.05 | 89.36 | 63.58 |
| 12:00-12:15 | 188.70 | -55.43 | -4.20 | -61.54 | -57.14 | -60.43 | -37.50 | 146.20 | 80.49 | 178.95 | -56.83 | -41.75 |
| 12:15-12:30 | 142.22 | -64.75 | -8.98 | -50.33 | -59.30 | -53.56 | -26.67 | 43.17 | 26.09 | 27.78 | 52.85 | 45.20 |
| 12:30-12:45 | 185.54 | -61.13 | -5.19 | -54.35 | -68.09 | -57.14 | -36.00 | 244.64 | 132.09 | 31.91 | 50.39 | 45.40 |
| 12:45-13:00 | 168.75 | -57.07 | -6.59 | -75.48 | -45.90 | -70.62 | -41.13 | 169.08 | 74.64 | 32.65 | 54.40 | 48.28 |
| 16:30-16:45 | -5.65 | 6.83 | 3.48 | -5.77 | 16.67 | 1.01 | -31.93 | 300.98 | 178.33 | 34.29 | 120.99 | 94.83 |
| 16:45-17:00 | 3.65 | 17.93 | 14.50 | 1.35 | 5.66 | 2.74 | -18.14 | 75.56 | 44.23 | -7.69 | 161.29 | 111.36 |
| 17:00-17:15 | -3.43 | 10.83 | 7.21 | 7.36 | 16.13 | 9.88 | -15.25 | 365.82 | 262.21 | 23.81 | 166.15 | 131.40 |
| 17:15-17:30 | 5.59 | 26.03 | 21.90 | 2.43 | 35.83 | 13.35 | -17.39 | 394.08 | 238.93 | 20.00 | 161.84 | 117.12 |
| 17:30-17:45 | -12.25 | 9.11 | 3.69 | -2.11 | 35.51 | 16.43 | -23.66 | 326.59 | 175.66 | 30.77 | 218.75 | 164.44 |
| 17:45-18:00 | 0.38 | 19.27 | 14.57 | 4.63 | 7.55 | 5.59 | -16.67 | 254.93 | 174.26 | 23.53 | 158.33 | 119.49 |
| 18:00-18:15 | -6.12 | 14.22 | 9.45 | -1.23 | 17.24 | 6.47 | -21.88 | 253.19 | 156.20 | 16.67 | 163.51 | 101.56 |
| 18:15:18:30 | -7.11 | 8.89 | 3.51 | 2.22 | 18.34 | 11.18 | -23.23 | 398.53 | 220.85 | 25.00 | 134.69 | 100.70 |

Table K-5: Percentage Reduction in Simulated Average Total Stopped Delay at the Critical Intersection of Study Site 3

| TIME PERIOD (hours) | Percentage Reduction in Average Total Stopped Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT &RT | TH | TOTAL | LT & RT | TH | TOTAL | |
| 6:30 - 6:45 | 0.00 | -65.98 | -59.55 | -19.44 | -62.51 | -60.97 | 218.89 | -100.00 | -42.83 | 18.33 | -100.00 | -64.24 | -58.79 |
| 6:45 - 7:00 | 0.00 | -71.69 | -61.66 | -15.56 | -60.26 | -58.03 | 112.38 | -100.00 | -43.40 | 19.20 | -100.00 | -65.22 | -58.74 |
| 7:00 - 7:15 | 0.00 | -74.90 | -60.06 | -21.62 | -59.44 | -58.68 | 282.76 | -100.00 | -42.69 | 18.26 | -100.00 | -71.15 | -61.95 |
| 7:15 - 7:30 | -42.99 | -89.79 | -77.59 | -27.69 | -68.70 | -67.82 | 128.29 | -100.00 | -42.36 | 32.60 | -100.00 | -77.99 | -70.19 |
| 7:30 - 7:45 | -44.89 | -93.02 | -81.25 | -31.53 | -90.47 | -90.04 | 86.23 | -100.00 | -80.30 | 63.85 | -100.00 | -89.11 | -88.13 |
| 7:45 - 8:00 | -35.29 | -92.99 | -81.36 | -58.46 | -58.12 | -58.13 | 153.26 | -100.00 | -64.91 | 58.62 | -100.00 | -81.41 | -72.98 |
| 8:00 - 8:15 | -25.82 | -83.20 | -74.28 | -15.63 | -30.20 | -29.02 | 58.12 | -100.00 | -67.20 | 358.37 | -100.00 | -48.22 | -52.63 |
| 8:15 - 8:30 | -24.93 | -90.09 | -79.60 | -43.88 | -48.91 | -48.58 | 120.63 | -100.00 | -51.16 | 53.37 | -100.00 | -70.89 | -63.19 |
| 11:00-11:15 | -2.91 | -33.01 | -30.31 | -28.94 | -35.46 | -34.13 | 17.26 | -100.00 | -62.22 | 25.04 | -100.00 | -62.00 | -45.49 |
| 11:15-11:30 | -4.18 | -28.12 | -24.95 | -29.11 | -40.26 | -38.82 | 9.68 | -100.00 | -72.02 | 24.65 | -100.00 | -61.95 | -47.12 |
| 11:30-11:45 | -7.69 | -1.41 | -1.80 | -31.72 | -50.20 | -47.00 | 2.16 | -100.00 | -67.30 | 23.43 | -100.00 | -59.92 | -44.03 |
| 11:45-12:00 | -9.36 | -12.61 | -12.30 | -10.39 | -25.78 | -23.81 | 31.16 | -100.00 | -63.64 | 29.27 | -100.00 | -61.82 | -38.70 |
| 12:00-12:15 | -4.17 | -14.38 | -13.12 | -6.40 | -12.16 | -11.07 | 6.48 | -100.00 | -72.47 | 21.91 | -100.00 | -69.98 | -38.41 |
| 12:15-12:30 | -2.64 | -1.33 | -1.46 | -13.16 | -16.83 | -15.78 | 5.60 | -100.00 | -70.55 | 32.65 | -100.00 | -58.15 | -32.39 |
| 12:30-12:45 | -5.05 | -15.16 | -13.79 | 5.85 | -3.42 | -1.91 | 0.52 | -100.00 | -69.89 | 19.03 | -100.00 | -69.01 | -38.85 |
| 12:45-13:00 | -5.30 | -19.62 | -17.94 | -5.62 | -11.75 | -10.74 | 13.00 | -100.00 | -70.59 | 20.32 | -100.00 | -59.82 | -36.35 |
| 16:30-16:45 | -5.70 | -21.28 | -20.21 | -2.97 | -3.14 | -3.10 | -15.19 | -100.00 | -61.25 | 167.10 | -100.00 | -69.72 | -40.36 |
| 16:45-17:00 | -3.53 | -75.00 | -73.53 | -41.30 | -28.04 | -34.30 | -58.20 | -100.00 | -73.99 | 53.15 | -100.00 | -76.72 | -70.60 |
| 17:00-17:15 | -5.65 | -42.99 | -41.14 | -20.75 | -7.48 | -12.56 | -51.81 | -100.00 | -77.24 | 48.84 | -100.00 | -79.37 | -59.19 |
| 17:15-17:30 | -8.77 | -79.14 | -77.58 | -54.49 | -27.69 | -39.19 | -58.45 | -100.00 | -84.98 | 137.40 | -100.00 | -81.36 | -76.19 |
| 17:30-17:45 | -6.91 | -52.39 | -51.09 | -39.64 | -7.74 | -19.68 | -13.98 | -100.00 | -84.80 | -10.22 | -100.00 | -75.00 | -65.60 |
| 17:45-18:00 | -7.44 | -69.96 | -68.46 | -48.36 | -17.65 | -30.04 | -61.13 | -100.00 | -76.30 | 78.45 | -100.00 | -85.54 | -68.77 |
| 18:00-18:15 | -19.76 | -67.01 | -62.80 | -17.77 | -3.23 | -7.40 | -12.75 | -100.00 | -77.76 | 1.40 | -100.00 | -70.95 | -62.01 |
| 18:15:18:30 | -8.84 | -88.03 | -86.35 | -53.49 | -26.15 | -35.32 | 46.57 | -100.00 | -86.46 | 84.06 | -100.00 | -82.54 | -81.19 |

Table K-6: Percentage Difference in Simulated Average Total Stopped Delay at the Downstream Intersections of Study Site 3

| TIME PERIOD (hours) | Percentage Difference in Average Total Stopped Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH &RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:45 - 7:00 | 8.44 | -20.24 | -13.57 | -13.16 | -6.03 | -7.12 | 0.00 | 21.54 | 43.28 | 15.79 | -30.89 | -24.83 |
| 7:00 - 7:15 | 2.56 | -30.58 | -15.26 | -9.02 | -34.53 | -32.74 | 1000.00 | 38.18 | 55.36 | 42.55 | -4.35 | -0.19 |
| 7:15 - 7:30 | 4.13 | -33.45 | -16.16 | -13.87 | -27.41 | -26.64 | 600.00 | 13.11 | 22.58 | 52.94 | -10.29 | -1.75 |
| 7:30 - 7:45 | 10.78 | -56.67 | -38.77 | -11.92 | -11.39 | -11.42 | 600.00 | -13.25 | -5.95 | 62.50 | -40.47 | -32.57 |
| 7:45 - 8:00 | 5.77 | -59.63 | -34.88 | -15.91 | -13.61 | -13.77 | 700.00 | -12.37 | 2.02 | 48.72 | -9.54 | -0.40 |
| 8:00 - 8:15 | -3.81 | -32.27 | -23.17 | -21.82 | 54.48 | 47.15 | -67.74 | -78.31 | -77.41 | -17.82 | -8.54 | -10.37 |
| 8:15 - 8:30 | 7.79 | -52.90 | -34.59 | -12.40 | -10.74 | -10.87 | 550.00 | 4.55 | 20.59 | 48.05 | -41.93 | -32.71 |
| 11:00-11:15 | -0.94 | 3.42 | 2.93 | -15.01 | -14.70 | -14.74 | 733.33 | -32.76 | 4.92 | -33.61 | -17.83 | -21.68 |
| 11:15-11:30 | 0.60 | 2.25 | 2.09 | -15.84 | -16.08 | -16.04 | 800.00 | -33.33 | 10.53 | -32.57 | -20.30 | -24.47 |
| 11:30-11:45 | 0.00 | 7.43 | 7.17 | -12.81 | -12.71 | -12.74 | 1000.00 | 2.33 | 46.67 | -34.33 | -24.09 | -26.40 |
| 11:45-12:00 | 0.00 | 3.01 | 2.83 | -9.66 | -11.32 | -10.92 | 1250.00 | -25.53 | 26.53 | -33.16 | -33.20 | -33.19 |
| 12:00-12:15 | -0.42 | 1.16 | 1.03 | -8.29 | -8.15 | -8.17 | 933.33 | -62.37 | -31.25 | -31.42 | -17.53 | -21.16 |
| 12:15-12:30 | 0.00 | 3.79 | 3.47 | -7.54 | -8.61 | -8.34 | 766.67 | -37.31 | -2.86 | -32.86 | -11.96 | -18.79 |
| 12:30-12:45 | -1.05 | 2.40 | 2.06 | -7.19 | -9.68 | -8.85 | 900.00 | -49.49 | -21.57 | -36.39 | -34.36 | -35.05 |
| 12:45-13:00 | 0.00 | -0.20 | -0.18 | -10.11 | -10.20 | -10.18 | 750.00 | -47.57 | -17.76 | 124.88 | 158.98 | 151.34 |
| 16:45-17:00 | 3.68 | 4.61 | 4.58 | -7.10 | -11.23 | -10.12 | 522.22 | 26.47 | 66.67 | -8.77 | 3.63 | 1.30 |
| 17:00-17:15 | 0.00 | 0.25 | 0.25 | -2.46 | -7.98 | -6.51 | 433.33 | -21.65 | 39.29 | -16.81 | -14.37 | -15.00 |
| 17:15-17:30 | 10.00 | 2.44 | 2.47 | -8.13 | -11.94 | -11.17 | 377.78 | -31.12 | 3.27 | -8.56 | 5.82 | 2.78 |
| 17:30-17:45 | 0.61 | 0.52 | 0.52 | -2.64 | -7.74 | -6.54 | 510.00 | -14.63 | 42.39 | -13.33 | -14.42 | -14.10 |
| 17:45-18:00 | 5.02 | 2.31 | 2.32 | -3.14 | -8.18 | -6.71 | 356.52 | -36.49 | 2.14 | -13.22 | 4.39 | 0.23 |
| 18:00-18:15 | -0.45 | -0.72 | -0.72 | 11.14 | -6.16 | -0.92 | 461.54 | -17.33 | 20.86 | -14.95 | -5.48 | -8.81 |

Table K-7: Percentage Reduction in Simulated Average Total Stopped Delay at the Critical Intersection of Study Site 4

| TIME PERIOD (hours) | Percentage Reduction in Average Total Stopped Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT &RT | TH | TOTAL | LT & RT | TH | TOTAL | |
| 6:30 - 6:45 | -13.09 | -38.14 | -34.85 | -4.25 | -45.05 | -38.20 | 67.22 | -100.00 | -55.08 | -0.43 | -100.00 | -81.24 | -50.17 |
| 6:45 - 7:00 | 25.13 | -55.59 | -44.97 | -10.78 | -38.92 | -34.19 | 58.86 | -100.00 | -57.32 | 23.93 | -100.00 | -76.65 | -50.91 |
| 7:00 - 7:15 | -15.27 | -25.09 | -21.95 | -10.86 | -39.69 | -36.03 | 6.76 | -100.00 | -74.55 | -7.20 | -100.00 | -79.86 | -55.32 |
| 7:15 - 7:30 | -30.59 | -21.41 | -24.42 | -11.65 | -38.25 | -34.36 | -12.22 | -100.00 | -78.52 | -10.93 | -100.00 | -80.54 | -56.54 |
| 7:30 - 7:45 | -21.07 | -28.13 | -26.26 | -12.02 | -38.73 | -34.04 | 15.40 | -100.00 | -76.16 | -43.71 | -100.00 | -87.12 | -58.21 |
| 7:45 - 8:00 | -10.42 | -23.58 | -21.49 | -19.70 | -39.19 | -32.69 | 26.18 | -100.00 | -75.06 | -26.85 | -100.00 | -81.40 | -52.91 |
| 8:00 - 8:15 | -7.66 | -23.41 | -20.18 | -8.29 | -30.58 | -25.11 | 3.62 | -100.00 | -75.75 | -40.15 | -100.00 | -87.36 | -51.42 |
| 8:15 - 8:30 | -8.24 | -22.59 | -19.74 | -11.49 | -38.78 | -31.88 | 9.77 | -100.00 | -77.78 | -51.77 | -100.00 | -88.84 | -53.89 |
| 11:00-11:15 | 87.60 | 73.62 | 77.43 | -38.51 | 32.68 | 3.18 | -48.48 | -100.00 | -90.57 | -54.92 | -100.00 | -91.50 | -78.89 |
| 11:15-11:30 | 97.66 | 48.43 | 60.78 | -34.85 | 27.69 | 3.13 | -37.15 | -100.00 | -90.65 | -54.63 | -100.00 | -90.45 | -79.49 |
| 11:30-11:45 | 49.31 | 34.01 | 37.78 | -50.41 | 21.59 | -7.00 | -32.61 | -100.00 | -90.02 | -55.09 | -100.00 | -92.60 | -76.51 |
| 11:45-12:00 | 26.61 | 68.23 | 53.69 | -50.14 | 7.46 | -15.83 | -50.37 | -100.00 | -91.17 | -61.61 | -100.00 | -93.96 | -82.21 |
| 12:00-12:15 | 46.82 | 73.72 | 66.86 | -42.70 | 48.93 | 12.30 | -34.29 | -100.00 | -88.10 | -53.72 | -100.00 | -90.92 | -79.97 |
| 12:15-12:30 | 23.26 | -2.00 | 3.62 | -49.29 | 14.13 | -11.51 | -31.83 | -100.00 | -86.82 | -49.56 | -100.00 | -90.40 | -78.81 |
| 12:30-12:45 | -10.27 | -30.39 | -24.83 | -31.89 | 81.97 | 31.38 | -29.59 | -100.00 | -89.46 | -54.13 | -100.00 | -89.82 | -78.49 |
| 12:45-13:00 | -12.50 | -31.71 | -27.14 | -51.93 | 10.14 | -14.84 | -25.89 | -100.00 | -83.56 | -53.90 | -100.00 | -89.29 | -78.84 |
| 16:30-16:45 | 61.54 | -63.31 | -54.63 | -68.06 | -58.82 | -64.30 | -62.02 | -100.00 | -78.09 | 33.33 | -100.00 | -94.15 | -75.06 |
| 16:45-17:00 | 74.68 | -45.41 | -32.66 | -38.33 | -52.13 | -45.90 | -16.51 | -100.00 | -69.01 | 18.61 | -100.00 | -85.33 | -57.99 |
| 17:00-17:15 | 57.07 | -34.22 | -20.22 | -75.51 | -87.18 | -83.32 | -71.85 | -100.00 | -81.59 | 34.86 | -100.00 | -95.93 | -81.62 |
| 17:15-17:30 | 44.21 | -16.06 | -3.30 | -86.80 | -89.56 | -88.68 | -81.49 | -100.00 | -85.81 | -7.44 | -100.00 | -98.44 | -88.33 |
| 17:30-17:45 | 80.41 | -85.84 | -81.95 | -80.29 | -91.63 | -88.42 | -74.94 | -100.00 | -82.53 | 12.54 | -100.00 | -97.78 | -88.90 |
| 17:45-18:00 | 53.87 | -75.23 | -68.89 | -62.01 | -60.95 | -61.40 | -57.49 | -100.00 | -75.83 | 26.25 | -100.00 | -92.03 | -75.20 |
| 18:00-18:15 | -15.31 | -40.30 | -35.47 | -35.06 | -23.41 | -28.85 | -23.42 | -100.00 | -73.75 | -9.71 | -100.00 | -85.33 | -56.41 |
| 18:15:18:30 | -10.22 | -34.12 | -29.54 | -24.12 | -21.62 | -22.70 | -10.09 | -100.00 | -73.84 | 12.90 | -100.00 | -81.97 | -52.13 |

Table K-8: Percentage Difference in Simulated Average Total Stopped Delay at the Downstream Intersections of Study Site 4

| TIME PERIOD (hours) | Percentage Difference in Average Total Stopped Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH &RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:30 - 6:45 | 0.00 | -71.77 | -71.77 | 20.00 | -78.54 | -76.11 | 0.00 | 107.52 | 90.32 | 0.00 | 443.06 | 443.06 |
| 6:45 - 7:00 | 0.00 | -73.57 | -73.57 | 20.00 | -88.13 | -85.47 | 0.00 | 2.26 | 7.10 | 0.00 | 695.83 | 722.22 |
| 7:00 - 7:15 | 0.00 | -65.00 | -65.00 | 11.11 | -75.74 | -72.95 | -13.64 | -20.56 | -19.92 | 26.67 | 683.50 | 600.00 |
| 7:15 - 7:30 | 0.00 | -70.63 | -70.63 | 0.00 | -67.48 | -65.20 | -24.00 | -4.88 | -8.63 | 26.67 | 651.41 | 591.72 |
| 7:30 - 7:45 | 0.00 | -71.94 | -71.94 | 0.00 | -78.38 | -76.39 | -17.46 | -3.89 | -7.41 | 43.75 | 1294.34 | 1130.33 |
| 7:45 - 8:00 | 0.00 | -49.40 | -49.40 | 18.18 | -78.05 | -72.00 | -21.95 | 24.31 | 14.05 | 53.33 | 671.72 | 628.17 |
| 8:00 - 8:15 | 0.00 | -52.84 | -52.84 | 45.00 | -73.48 | -57.89 | -22.95 | -28.57 | -26.59 | 58.33 | 679.69 | 626.43 |
| 8:15 - 8:30 | 0.00 | -69.80 | -69.80 | 55.00 | -77.06 | -56.59 | -20.69 | -36.62 | -34.71 | 35.71 | 763.27 | 672.32 |
| 11:00-11:15 | 0.00 | 246.88 | 246.88 | 14.49 | 3050.00 | 100.00 | 0.00 | 0.00 | 0.00 | 55.56 | 118.22 | 116.10 |
| 11:15-11:30 | 0.00 | 258.73 | 258.73 | 51.67 | 1666.67 | 128.57 | 11.76 | -52.79 | -50.12 | 38.89 | 91.04 | 87.88 |
| 11:30-11:45 | 0.00 | 290.32 | 290.32 | -6.74 | 2550.00 | 49.45 | -21.74 | -78.80 | -77.50 | 30.00 | 68.95 | 67.72 |
| 11:45-12:00 | 0.00 | 802.86 | 802.86 | 62.50 | 2350.00 | 124.32 | 0.00 | -57.23 | -57.23 | 100.00 | 209.13 | 205.51 |
| 12:00-12:15 | 0.00 | 306.76 | 306.76 | 41.77 | 1366.67 | 90.24 | 17.07 | -56.38 | -50.66 | 41.03 | 47.60 | 47.03 |
| 12:15-12:30 | 0.00 | 353.26 | 353.26 | -4.59 | 1233.33 | 28.57 | 15.15 | -64.16 | -57.89 | 53.85 | 33.50 | 34.12 |
| 12:30-12:45 | 0.00 | 317.39 | 317.39 | -9.43 | 1350.00 | 15.74 | 12.70 | -49.26 | -41.98 | 23.53 | 91.39 | 84.52 |
| 12:45-13:00 | 0.00 | 308.28 | 308.34 | -24.82 | 800.00 | -2.07 | 23.81 | -47.46 | -43.47 | 70.59 | 71.06 | 71.05 |
| 16:30-16:45 | 0.00 | 79.69 | 79.69 | -41.54 | 4900.00 | -3.82 | -3.70 | 585.23 | 475.95 | 23.91 | 99.54 | 86.36 |
| 16:45-17:00 | 0.00 | 77.64 | 77.64 | -3.37 | 3400.00 | 34.44 | -24.00 | 572.51 | 518.48 | 26.00 | 145.27 | 121.51 |
| 17:00-17:15 | 0.00 | 51.35 | 51.35 | -45.89 | 4800.00 | 19.59 | -2.38 | 336.96 | 297.80 | 17.74 | 155.44 | 121.96 |
| 17:15-17:30 | 0.00 | 30.49 | 30.49 | -47.76 | 5350.00 | 31.62 | 5.00 | 457.43 | 353.82 | 27.06 | 300.00 | 216.85 |
| 17:30-17:45 | 0.00 | 131.39 | 131.39 | -41.26 | 5950.00 | 41.38 | -1.18 | 512.89 | 356.27 | 18.46 | 417.56 | 321.48 |
| 17:45-18:00 | 0.00 | 72.50 | 72.50 | -50.86 | 5100.00 | -21.59 | -5.88 | 449.21 | 395.10 | 30.19 | 135.78 | 116.14 |
| 18:00-18:15 | 0.00 | 65.99 | 65.99 | -22.86 | 1283.33 | 80.26 | -11.54 | 505.80 | 452.00 | 33.33 | 132.22 | 108.60 |
| 18:15:18:30 | 0.00 | 63.08 | 63.08 | -10.77 | 766.67 | 54.93 | -11.54 | 311.32 | 282.47 | 29.67 | 147.98 | 116.22 |

Table K-9: Percentage Reduction in Simulated Average Total Stopped Delay at the Critical Intersection of Study Site 5

| TIME PERIOD (hours) | Percentage Reduction in Average Total Stopped Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT &RT | TH | TOTAL | LT & RT | TH | TOTAL | |
| 6:30 - 6:45 | -24.37 | -45.51 | -37.82 | 0.00 | -56.30 | -50.00 | 106.29 | -100.00 | -40.16 | 176.47 | -100.00 | -83.33 | -39.54 |
| 6:45 - 7:00 | -51.78 | -67.68 | -64.51 | 7.27 | -52.50 | -46.47 | 51.85 | -100.00 | -44.22 | 150.00 | -100.00 | -75.40 | -59.11 |
| 7:00 - 7:15 | -52.15 | -73.76 | -66.80 | 4.72 | -70.68 | -66.04 | 70.33 | -100.00 | -45.16 | 101.99 | -100.00 | -82.75 | -68.60 |
| 7:15 - 7:30 | -64.71 | -77.60 | -73.11 | 5.26 | -77.89 | -74.29 | 55.52 | -100.00 | -55.09 | 182.14 | -100.00 | -85.79 | -75.11 |
| 7:30 - 7:45 | -69.62 | -69.37 | -69.44 | 11.56 | -76.86 | -72.03 | 51.69 | -100.00 | -47.05 | 162.89 | -100.00 | -92.59 | -73.60 |
| 7:45 - 8:00 | -75.41 | -44.52 | -53.41 | 5.46 | -78.50 | -73.87 | 6.20 | -100.00 | -54.06 | 198.47 | -100.00 | -92.02 | -73.89 |
| 8:00 - 8:15 | -72.46 | -58.08 | -61.51 | 26.22 | -78.04 | -68.27 | 20.22 | -100.00 | -50.33 | 233.83 | -100.00 | -87.83 | -69.74 |
| 8:15 - 8:30 | -67.21 | -51.05 | -55.15 | 4.69 | -74.52 | -68.96 | 24.18 | -100.00 | -57.76 | 289.10 | -100.00 | -80.03 | -66.92 |
| 11:00-11:15 | -37.59 | -15.78 | -22.59 | -2.77 | -41.34 | -36.39 | 65.90 | -100.00 | -45.42 | 140.43 | -100.00 | -77.47 | -41.29 |
| 11:15-11:30 | -33.97 | -0.22 | -11.39 | -4.00 | -37.98 | -33.44 | 93.55 | -100.00 | -50.77 | 131.82 | -100.00 | -81.39 | -39.16 |
| 11:30-11:45 | -43.72 | -2.12 | -13.70 | -7.30 | -47.11 | -39.52 | 43.96 | -100.00 | -49.63 | 87.79 | -100.00 | -73.79 | -40.48 |
| 11:45-12:00 | -33.30 | -14.76 | -21.02 | -15.20 | -29.77 | -26.38 | 44.96 | -100.00 | -53.75 | 137.17 | -100.00 | -77.65 | -39.99 |
| 12:00-12:15 | -31.60 | -16.44 | -21.10 | -10.87 | -18.76 | -17.52 | 66.04 | -100.00 | -48.44 | 78.17 | -100.00 | -65.54 | -34.92 |
| 12:15-12:30 | -39.17 | -14.04 | -21.30 | -18.32 | -25.31 | -23.60 | 66.19 | -100.00 | -52.00 | 111.28 | -100.00 | -78.15 | -39.25 |
| 12:30-12:45 | -57.30 | -6.39 | -25.06 | -39.40 | -9.70 | -19.98 | 23.00 | -100.00 | -66.05 | 102.90 | -100.00 | -78.80 | -46.55 |
| 12:45-13:00 | -52.84 | -4.60 | -20.51 | -19.49 | -17.00 | -17.46 | 33.30 | -100.00 | -62.52 | 74.70 | -100.00 | -78.01 | -41.90 |
| 16:30-16:45 | -13.88 | -14.55 | -14.44 | -7.74 | -8.61 | -8.47 | 13.63 | -100.00 | -61.74 | 54.19 | -100.00 | -76.09 | -33.59 |
| 16:45-17:00 | -2.81 | -16.89 | -14.60 | -21.24 | -53.71 | -48.75 | -5.60 | -100.00 | -68.22 | -4.93 | -100.00 | -85.26 | -49.21 |
| 17:00-17:15 | -31.07 | -67.06 | -63.48 | -38.49 | -27.63 | -30.32 | -59.58 | -100.00 | -73.30 | 44.85 | -100.00 | -94.88 | -64.60 |
| 17:15-17:30 | -21.30 | -19.25 | -19.71 | -14.91 | -14.37 | -14.47 | -5.07 | -100.00 | -63.96 | 53.33 | -100.00 | -84.28 | -39.99 |
| 17:30-17:45 | -43.31 | -51.23 | -49.68 | -34.51 | -24.86 | -26.88 | -28.61 | -100.00 | -64.53 | 153.29 | -100.00 | -84.97 | -51.70 |
| 17:45-18:00 | -19.58 | -45.97 | -42.24 | -36.26 | -17.09 | -22.06 | -42.50 | -100.00 | -72.62 | 21.47 | -100.00 | -83.26 | -53.61 |
| 18:00-18:15 | 54.89 | -39.26 | -31.05 | -8.41 | 6.86 | 2.27 | 18.96 | -100.00 | -76.51 | -15.99 | -100.00 | -87.53 | -54.05 |
| 18:15:18:30 | -11.91 | -12.31 | -12.23 | -13.57 | -16.19 | -15.70 | 29.81 | -100.00 | -56.58 | 19.47 | -100.00 | -77.59 | -34.11 |

Table K-10: Percentage Difference in Simulated Average Total Stopped Delay at the Downstream Intersections of Study Site 5

| TIME PERIOD (hours) | Percentage Difference in Average Total Stopped Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH &RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:30 - 6:45 | 0.00 | -0.50 | -0.45 | -15.87 | 56.07 | 51.86 | 0.00 | -42.57 | -38.01 | 38.89 | -25.45 | -20.59 |
| 6:45 - 7:00 | 3.45 | -27.84 | -20.63 | -24.82 | 16.40 | 11.84 | 0.00 | -18.83 | -10.93 | 56.25 | -21.26 | -15.70 |
| 7:00 - 7:15 | 7.94 | -22.08 | -13.36 | -22.15 | 5.29 | 3.91 | 228.95 | 13.17 | 33.17 | 52.94 | -15.00 | -3.09 |
| 7:15 - 7:30 | 7.24 | -63.84 | -45.51 | -29.61 | -0.77 | -1.14 | 179.03 | 23.85 | 46.17 | 38.71 | -37.90 | -28.40 |
| 7:30 - 7:45 | 2.66 | -65.25 | -48.76 | -33.44 | -4.16 | -4.52 | 226.97 | -10.22 | 42.29 | 31.34 | -46.28 | -25.88 |
| 7:45 - 8:00 | -1.68 | -28.88 | -23.37 | -40.92 | -2.63 | -3.30 | 100.00 | -1.14 | 12.78 | 23.73 | -36.94 | -24.20 |
| 8:00 - 8:15 | 29.51 | -18.41 | -11.81 | -32.47 | -0.14 | -0.53 | 136.08 | -40.44 | -9.14 | 36.59 | -35.85 | -26.14 |
| 8:15 - 8:30 | -3.46 | -27.02 | -23.22 | -33.62 | -9.49 | -10.14 | 118.56 | -17.54 | 4.72 | 38.71 | -37.64 | -29.59 |
| 11:15-11:30 | -31.38 | -40.69 | -39.40 | 15.43 | -23.20 | -16.76 | 10.91 | -7.82 | 2.51 | 31.82 | 26.46 | 27.07 |
| 11:30-11:45 | -15.09 | -25.36 | -24.67 | 31.10 | 32.47 | 32.10 | 23.65 | -1.07 | 11.79 | 25.93 | 36.64 | 34.18 |
| 11:45-12:00 | -23.44 | -32.26 | -31.39 | -22.32 | -43.30 | -40.62 | 15.00 | -17.90 | 2.94 | 31.52 | 28.84 | 29.24 |
| 12:00-12:15 | -28.74 | -33.60 | -32.97 | -14.01 | -36.09 | -34.40 | 3.33 | -45.50 | -15.54 | 28.92 | 41.80 | 39.77 |
| 12:15-12:30 | -25.94 | -30.09 | -29.64 | -4.80 | -30.72 | -27.92 | 38.01 | -16.37 | 16.97 | 24.64 | 34.97 | 33.89 |
| 12:30-12:45 | -23.78 | -30.89 | -29.88 | 38.67 | 34.67 | 35.62 | 66.29 | -28.90 | 23.51 | 24.00 | 49.25 | 44.48 |
| 12:45-13:00 | -25.00 | -31.08 | -30.35 | 10.63 | -1.40 | 0.27 | 21.68 | -40.74 | -4.07 | 26.52 | 50.86 | 46.36 |
| 16:30-16:45 | -5.53 | -0.32 | -0.69 | -0.10 | -0.51 | -0.45 | 161.54 | 7.96 | 23.54 | 41.18 | -39.20 | -32.62 |
| 16:45-17:00 | 5.53 | 343.83 | 319.83 | 23.46 | -30.44 | -22.44 | 112.28 | -36.82 | 3.18 | 26.14 | -45.25 | -39.41 |
| 17:00-17:15 | -5.04 | 1.34 | 1.03 | 0.00 | -0.01 | -0.01 | 137.50 | -3.90 | 53.38 | 45.26 | -47.91 | -39.60 |
| 17:15-17:30 | -6.59 | 2.22 | 2.04 | 0.00 | -0.13 | -0.12 | 109.55 | -28.54 | 7.29 | 42.31 | -49.44 | -39.37 |
| 17:30-17:45 | -6.18 | -1.00 | -1.14 | 0.00 | 0.46 | 0.25 | 136.44 | -1.70 | 65.87 | 43.40 | -48.14 | -38.82 |
| 17:45-18:00 | -6.25 | 0.56 | 0.40 | 0.00 | -0.43 | -0.40 | 130.09 | -16.67 | 43.37 | 43.89 | -41.86 | -32.15 |
| 18:00-18:15 | 6.70 | 25.50 | 24.44 | -2.00 | 45.01 | 29.18 | -30.07 | 70.49 | -16.88 | -20.61 | -43.98 | -39.43 |
| 18:15:18:30 | -3.40 | 1.04 | 0.95 | 0.00 | -1.53 | -1.19 | 119.48 | 9.52 | 67.12 | 47.79 | -41.96 | -32.36 |

Table K-11: Percentage Reduction in Simulated Average Total Stopped Delay at the Critcal Intersection of Study Site 6

| TIME PERIOD (hours) | Percentage Reduction in Average Total Stopped Delay | | | | | | | | | | | | TOTAL FOR THE INTER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | | |
| | LT | TH &RT | TOTAL | LT | TH &RT | TOTAL | LT &RT | TH | TOTAL | LT & RT | TH | TOTAL | |
| 6:30 - 6:45 | -61.54 | -37.55 | -41.64 | -27.69 | 12.07 | 1.26 | 10.17 | -95.63 | -80.10 | 46.15 | -75.74 | -70.18 | -50.33 |
| 6:45 - 7:00 | -73.97 | -63.63 | -65.85 | -56.91 | -17.19 | -28.22 | -54.20 | -78.10 | -66.42 | -45.21 | -67.79 | -60.36 | -56.76 |
| 7:00 - 7:15 | -70.55 | -56.59 | -58.49 | -59.84 | 8.68 | -14.29 | -55.96 | -88.82 | -71.35 | -40.00 | -38.01 | -38.50 | -51.07 |
| 7:15 - 7:30 | -40.44 | -11.04 | -15.29 | -40.46 | 5.40 | -7.04 | -29.29 | -92.88 | -72.86 | -46.77 | -63.51 | -61.69 | -39.30 |
| 7:30 - 7:45 | -44.17 | -13.87 | -17.73 | -47.76 | 5.28 | -10.98 | -29.05 | -92.91 | -73.86 | -40.00 | -66.09 | -64.45 | -41.44 |
| 7:45 - 8:00 | -61.95 | -21.64 | -31.09 | -47.27 | 2.28 | -7.65 | -26.32 | -89.56 | -75.86 | -25.96 | -71.88 | -63.60 | -42.74 |
| 8:00 - 8:15 | -45.16 | -15.45 | -21.84 | -30.59 | 5.17 | -2.93 | -45.51 | -90.75 | -75.00 | -43.94 | -75.06 | -70.51 | -42.73 |
| 8:15 - 8:30 | -52.54 | -27.40 | -33.69 | -29.69 | 4.07 | -2.40 | -52.54 | -77.49 | -69.05 | -36.21 | -81.88 | -74.44 | -44.54 |
| 11:00-11:15 | -22.58 | -28.03 | -25.78 | -27.27 | -20.56 | -22.14 | -53.13 | -82.00 | -67.10 | -57.14 | -79.86 | -77.32 | -50.53 |
| 11:15-11:30 | -38.84 | -32.45 | -35.29 | -38.33 | -20.93 | -24.21 | -46.15 | -85.14 | -68.52 | -51.16 | -79.68 | -76.26 | -52.27 |
| 11:30-11:45 | -43.35 | -44.97 | -44.15 | -51.65 | -37.92 | -40.55 | -23.01 | -91.23 | -80.31 | 85.71 | -94.53 | -89.57 | -67.22 |
| 11:45-12:00 | -47.25 | -35.26 | -41.72 | -46.34 | -26.43 | -30.36 | -45.63 | -76.70 | -61.90 | -56.79 | -94.80 | -89.32 | -59.18 |
| 12:00-12:15 | -37.87 | -37.68 | -37.79 | -45.19 | -31.23 | -34.33 | -52.94 | -73.68 | -62.53 | -57.89 | -92.28 | -88.62 | -58.56 |
| 12:15-12:30 | -44.92 | -24.48 | -36.06 | -36.36 | -17.35 | -19.67 | -48.31 | -72.62 | -61.91 | -55.56 | -90.32 | -85.92 | -54.76 |
| 12:30-12:45 | -17.35 | -43.42 | -33.20 | -25.00 | -34.84 | -33.16 | -53.37 | -79.28 | -68.53 | -58.73 | -86.71 | -82.40 | -57.32 |
| 12:45-13:00 | -61.13 | -28.36 | -50.60 | -28.57 | -30.58 | -29.80 | 16.98 | -79.13 | -61.86 | -55.88 | -85.64 | -81.22 | -56.47 |
| 16:30-16:45 | -33.33 | -8.43 | -18.75 | -44.19 | -11.12 | -16.92 | -63.81 | -71.45 | -68.76 | 4.88 | -80.76 | -72.46 | -47.95 |
| 16:45-17:00 | -42.86 | -6.67 | -25.85 | -33.90 | -2.73 | -4.96 | -67.74 | -62.69 | -64.34 | -7.34 | -91.25 | -75.50 | -44.77 |
| 17:00-17:15 | -84.62 | 9.09 | -62.63 | -84.17 | -33.74 | -44.81 | -74.07 | -46.57 | -61.81 | 10.13 | -95.13 | -89.65 | -68.89 |
| 17:15-17:30 | -73.08 | 19.17 | -39.55 | -77.35 | 7.19 | -6.06 | -61.42 | -43.83 | -51.03 | 22.03 | -94.08 | -82.16 | -44.94 |
| 17:30-17:45 | -78.26 | 0.50 | -61.71 | -71.00 | -45.94 | -49.26 | -75.48 | -52.14 | -66.82 | 6.78 | -94.71 | -84.86 | -65.52 |
| 17:45-18:00 | -54.25 | 9.30 | -22.25 | -59.68 | -0.43 | -10.39 | -64.44 | -35.46 | -47.63 | 12.82 | -90.53 | -76.22 | -41.68 |
| 18:00-18:15 | -50.13 | -49.16 | -49.76 | -43.37 | 1.24 | -3.34 | -63.68 | -44.07 | -51.99 | 2.03 | -88.99 | -74.63 | -45.31 |
| 18:15:18:30 | -56.57 | -41.58 | -51.30 | -46.15 | 4.41 | -0.79 | -58.16 | -47.75 | -51.96 | 14.53 | -91.49 | -77.41 | -45.67 |

Table K-12: Percentage Difference in Simulated Average Total Stopped Delay at the Downstream Intersections of Study Site 6

| TIME PERIOD (hours) | Percentage Difference in Average Total Stopped Delay | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NB | | | SB | | | EB | | | WB | | |
| | LT | TH &RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL | LT | TH & RT | TOTAL |
| 6:30 - 6:45 | 12.77 | 3.86 | 4.44 | -26.53 | 4.48 | -8.62 | 100.00 | -14.90 | -12.69 | 6.67 | 68.06 | 57.47 |
| 6:45 - 7:00 | -25.23 | 11.89 | -2.03 | -34.48 | -3.28 | -13.33 | 11.11 | 11.34 | 11.33 | 0.00 | 83.33 | 68.97 |
| 7:00 - 7:15 | -27.23 | 22.30 | -0.79 | -33.93 | 22.00 | -7.55 | 22.86 | 0.72 | 3.19 | -33.33 | 35.92 | 27.12 |
| 7:15 - 7:30 | -14.62 | 0.29 | -4.69 | -12.50 | 14.81 | 1.96 | 83.33 | 11.21 | 14.75 | 33.33 | -9.15 | -5.10 |
| 7:30 - 7:45 | -16.76 | -1.51 | -6.85 | -14.29 | 18.97 | 3.74 | 68.18 | 23.51 | 26.71 | 6.25 | 8.49 | 8.20 |
| 7:45 - 8:00 | -19.78 | 7.41 | -2.92 | -18.03 | 77.78 | 26.96 | 64.29 | 10.23 | 14.21 | 40.00 | -28.28 | -23.47 |
| 8:00 - 8:15 | -13.58 | 11.23 | 3.73 | -19.05 | 32.14 | 10.20 | 73.91 | 12.94 | 17.99 | 100.00 | 0.00 | 8.57 |
| 8:15 - 8:30 | -15.79 | 24.69 | 9.73 | -20.51 | 45.28 | 17.39 | 66.67 | 10.71 | 13.56 | -14.29 | 15.31 | 11.61 |
| 11:00-11:15 | -11.54 | -25.93 | -23.13 | 42.86 | -16.67 | 0.00 | 42.86 | -49.49 | -45.31 | 277.78 | -22.87 | -12.73 |
| 11:15-11:30 | -10.53 | -21.57 | -18.57 | 40.63 | -2.94 | 11.00 | 44.44 | -49.84 | -42.44 | 38.89 | -39.07 | -34.34 |
| 11:30-11:45 | -21.43 | 12.64 | 1.55 | 26.32 | 15.94 | 18.18 | 27.50 | -54.23 | -46.83 | 230.00 | -56.54 | -47.47 |
| 11:45-12:00 | -15.79 | 3.19 | 0.00 | 43.33 | -13.70 | 2.91 | 33.33 | -41.57 | -33.67 | 255.56 | -62.36 | -51.84 |
| 12:00-12:15 | -18.52 | -10.00 | -11.81 | 32.43 | -16.46 | -0.86 | 40.00 | -47.37 | -38.83 | -25.64 | -61.78 | -58.68 |
| 12:15-12:30 | -11.76 | -17.74 | -16.46 | 58.33 | -31.03 | -4.88 | 45.65 | -47.54 | -38.48 | 153.85 | -67.24 | -60.43 |
| 12:30-12:45 | -19.44 | -6.11 | -8.98 | 18.18 | -7.41 | 0.00 | 40.54 | -49.68 | -40.06 | -32.35 | -36.75 | -36.31 |
| 12:45-13:00 | 81.25 | -14.62 | -4.11 | 576.47 | -34.92 | 37.76 | -31.08 | 126.57 | 85.05 | 105.88 | -79.63 | -72.61 |
| 16:30-16:45 | -12.24 | 50.94 | 20.59 | -19.64 | 8.83 | -1.80 | 59.04 | 22.55 | 27.94 | -36.96 | -70.64 | -64.77 |
| 16:45-17:00 | -14.89 | 32.08 | 10.00 | -21.88 | 34.78 | 11.54 | 55.70 | 19.71 | 25.51 | -42.00 | -63.68 | -59.36 |
| 17:00-17:15 | -20.13 | 38.89 | 2.09 | -29.82 | 19.13 | -5.24 | 69.00 | -4.59 | 4.64 | -30.65 | -74.61 | -63.92 |
| 17:15-17:30 | -25.31 | 55.06 | 3.19 | -35.80 | 16.00 | -7.18 | 59.75 | -15.45 | -3.87 | -47.06 | -76.80 | -67.74 |
| 17:30-17:45 | -15.83 | 72.22 | 14.22 | -27.55 | 28.28 | 0.51 | 70.68 | -8.10 | 1.79 | -38.46 | -64.88 | -58.52 |
| 17:45-18:00 | -20.00 | 40.30 | 4.94 | -30.86 | 23.08 | 1.01 | 64.52 | -11.87 | -1.03 | 13.21 | -80.17 | -62.81 |
| 18:00-18:15 | -19.12 | 40.00 | 7.32 | 98.51 | 36.15 | 51.07 | 54.64 | 12.96 | 19.22 | -33.33 | -76.15 | -65.92 |
| 18:15:18:30 | -21.82 | 59.32 | 20.18 | 55.93 | 38.75 | 43.38 | 58.97 | 4.28 | 12.45 | -50.55 | -74.60 | -68.14 |