PERFORMANCE ASSESSMENT OF TETTEH QUARSHIE INTERCHANGE USING COMPUTER SIMULATION

By

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DECLARATION

I hereby declare that this submission is my own work towards the Master of Science and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has made in the text.

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DEDICATION

I dedicate this work to my family especially my parents, wife, and daughters.



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I wish to thank first and foremost the almighty GOD for bringing me to this far in the programme.

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ABSTRACT

Interchanges on urban arterials have in recent years become an essential intervention for most of the shortcomings associated with at-grade intersections. However the absence of the knowledge of their real operations can pose a serious set-back after the infrastructure has been built.

Interchanges are crucial structures in the operations and performance of an intersection in any traffic system. Analysis of the probable or potential performance of interchanges is essential to avoiding the construction of a structure that would not perform after being built or contribute to the problem it was intended to address.

In the advent of modern computers traffic simulation models have been widely used in both transportation operations and traffic analysis because simulation is safe, less expensive and faster than field implementation and testing. The need for micro-simulation has become more important in cities where rapid growth takes place such as Accra which has about fifteen interchanges/overpasses and still counting. Therefore, the need for calibrating simulation models to local situations is urgent to assess the performance of interchanges and also project the performance in the future.

The main objective of this research is to calibrate a micro-simulation models to assess the performance of Tetteh Quarshie Interchange.

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LIST OF ABBREVIATIONS

AMA	Accra Metropolitan Assemble
AWSC	All Way Sopped Controlled
CAD	Computer Aided Design
CBD	Central Business District
CORSIM	An Acronym of Traffic Software
FHWA	Federal Highway Administration
GHA	Ghana Highway Authority
НСМ	Highway Capacity Manual
HCM(2000)	Highway Capacity Manual, 2000 Edition
HCS Plus	An Acronym of Traffic Software
HV	Heavy Vehicles
ICU	Intersection Capacity Utilization
KNUST	Kwame Nkrumah University of Science and Technology
LOS	Level of Service
MOE	Measure of Effectiveness
0-D	Origin - Destination
PCE	Passenger Car Equivalent
PHF	Peak Hour Factor
R/A	Round About Intersection
SIDRA	An Acronym of Traffic Software
SYNCHRO	An Acronym of Traffic Software
TENC	Traffic Engineering Council, US
TIA	Traffic Impact Assessment
TIS	Traffic Impact Statement

TQI	Tetteh Quarshie Interchange
TRB	Transport Research Board
TRRL	Transport Research Laboratory, England
TWSC	Two Way Stopped Controlled
v/c	Volume to Capacity
vphgpl	Vehicle per Hour of Green Time per Lane



CHAPTER 1: INTRODUCTION

1.1 Background

Interchanges on urban arterials have in recent years become an essential intervention to most of the shortcomings associated with at-grade intersections.

Of the many types of interchanges that may be adopted cloverleaves have been widely adopted because of the following advantages associated with them:

- no need of signs to prevent wrong way entrance
- left turn merging at acute angles and hence may not have to stop

However cloverleaves come with some disadvantages such as

- large area requirement
- long distances for left turn movements

In recent years Ghana has seen some of the major at-grade intersections in the country being replaced by an interchange. However some of these interchanges have had some problems after their construction.

Traffic flow and geometric data on the Tetteh Quarshie Interchange were collected on both ramps and mainlines, simulated and analysed to assess the performance of the interchange.

Simulation of traffic as a tool for investigating traffic systems has increased in popularity over the last decades. A large portion of this rise in popularity can be traced back to the rapid development in personal computer. Fast personal computers have made it possible to develop advanced traffic micro-simulation software packages. Traffic simulation is a powerful and cost-effective tool for traffic planning and designing, testing different alternatives and evaluating traffic management schemes. The simulation model enables the engineer to predict the outcomes of a proposed change to the traffic system before it is implemented, and to evaluate the merits of competing designs. For the simulation model to correctly predict the system's response, however, it must first be shown to reproduce the existing traffic condition. The procedure by which the parameters of the model are adjusted so that the simulated response agrees with the measured field conditions is what is known as model calibration.

The Synchro/ SimTraffic simulation model has been calibrated and the capacity values under various turning traffic flows on the interchange analysed. The objective of this research is to provide basic data for performance assessment for a full cloverleaf interchange using computer simulation and modelling.

1.2 Problem Statement

The construction of the Tetteh Quarshie interchange has been completed and in operation. However, the general perception of the public is that the interchange is not performing as expected but rather compounding the existing traffic problem.

This research sought to investigate the overall level of service (LOS) of the interchange. The main reference is the Highway Capacity Manual 2000 (HCM, 2000).

1.3 Study Justification

The findings of this study are expected to offer an engineering insight into the performance of interchanges and also demonstrate the appropriateness of simulating the performance of a proposed interchange before its implementation.

1.4 Research Objectives

The main objectives of this study were as follows:

- to evaluate the over-all performance of the Tetteh Quarshie Interchange at present
- to evaluate the effect of the ongoing development on the interchange
- to develop calibration parameters for the future performance of the interchange.

1.5 Scope of Study

The scope of this study was limited to three scenarios, namely;

- assessment of the present performance of Tetteh Quarshie Interchange
- performance assessment of Tetteh Quarshie Interchange with improved legs (hypothetical)
- performance assessment of an improved interchange arrangement (hypothetical).

CHAPTER 2: LITERATURE REVIEW

2.1 History of Interchange Performance Appraisal

Until very recently, interchanges were not subjected to rigorous performance appraisal. On the advent of modern computer, performance appraisal of interchanges has become very important because investments in interchanges are capital intensive.

The Transportation Research Board's Highway Capacity Manual (HCM) presents methodologies recommended for use in planning and operational analysis of an individual transportation network element such as signalized intersection, interchanges or mainline section of a freeway. The HCM equations and worksheets are based on limited statistical models that can be considered to be macroscopic. In part because the HCM models do not consider the behaviour of individual vehicles, and due to the deterministic (i.e. uniform arrival/ flow pattern) nature of HCM models, there is a growing recognition that stochastic microscopic simulation models can be very useful in operational analysis on small to medium-sized transportation networks. An interchange is considered as a small network consisting of ramps, slipways and mainlines.

2.2 Interchange Inventory

Chapter 26 of the HCM (2000) deals with the inventory and analysis of interchange ramps. Even though a complete methodology is not yet available the chapter expanded on some pertinent factors that affect the performance of an interchange. Some of these factors are:

2.2.1 Influence of Interchange Type on Turning Movements

The type of interchange has a major influence on the turning movements of traffic. Movements that involve a right-side merge in one configuration may become left turns in another. Movements approaching the interchange on the surface facility are also affected by the interchange type depending on whether the ramp movements involve left or right turns.

2.2.2 Queuing Characteristics

The most critical features of an interchange, therefore, are the interdependency of movements and the distance between intersections both of which influence queuing. The distance separating the intersections limits the amount of queuing that can occur downstream without blocking the upstream intersection. The extent of queuing at the downstream intersection depends on several factors such as the number and use of the lanes at both intersections and the flow rates in the movements that feed the downstream intersection.

2.2.3 Lane Change Movements

Because of the turning movements and the high volumes of traffic, the mainlines are subjected to abnormal high number of lane-changing manoeuvres. This occurs because of origin-destination patterns. The turbulence of the lane changing can decrease the normal link speed. In addition if there is queuing on the link, it reduces the effective weaving of lanechanging distance, increasing the turbulence and its potential effects on the traffic.

2.2.4 Lane Utilization

Because of the potential for heavy turning flows at interchanges, lane utilization may differ from those at other intersections. Because of short internal links, segregation may occur at the upstream intersection by driver selection or by designated signing and stripping.

2.2.4.1 Lane Groups and Configuration

The HCM describes a lane group as a single movement, a group of movements, or an entire approach that is defined by the geometry of the intersection and the distribution of movements over the various lanes. According to Garber and Hoel (1994), a lane group consists of one or

more lanes that have a common stopline, carry a set of traffic streams, and whose capacity is shared by all vehicles in the group.

2.3 The History and Concept of Cloverleaf Interchange

The cloverleaf is one of the oldest types of higher-capacity interchanges in the US. The basic idea is that each of the twelve possible movements (right, left, and straight from each of the incoming roads) can be made in the interchange without stopping for cross traffic. They can be found just about anywhere in the United States; almost every state has at least one, although some states (Texas and California, particularly) tend not to use them to any great extent. The first one was built in Avenel, New Jersey in 1929. At the time, it was the intersection of State Routes 4 and 25; it is now the junction of US 1 and 9 and NJ 35.

In the early days of freeway and interstate construction in the United States, cloverleaf interchanges were regarded as a great way to move traffic between two freeways or between a freeway and a busy crossroad. Traffic could keep moving without stopping through the entire interchange, regardless of its destination. Cloverleaf interchanges were comparatively cheap - the only other free-flow intersection with fewer bridges involved is a large traffic circle, which, (luckily) early engineers realized, would be a huge disaster if placed at the intersection of two high-speed freeways. A little bit of land was needed for the 270-degree loop ramps, but this was no problem; the loops could just be made smaller if needed. The interchange would not make a huge impact on the skyline (and the project budget) like a four-level stack might. As a result of all of these advantages, cloverleaf interchanges continued to be built all over the country at many freeway intersections and where a diamond interchange did not have enough traffic capacity.

However, there are a few problems with cloverleaves. First, the loop ramps must go around 270 degrees of rotation. To build the loop ramps, there must be a trade-off between size and utility. A ramp with a much larger radius can be taken at higher speeds and thus move more traffic, but it takes up a lot more real estate. A smaller loop takes up less space at the cost of slower speeds; taken to an extreme, small loop ramps can result in a danger of tipping for truck traffic.

The second (and, in my opinion, most major) problem with cloverleaf interchanges is the weaving that must occur between the left-turn movements. The basic problem is that two types of traffic is switching lanes in the middle of the interchange: traffic that has just entered from the right from the first loop ramp, and traffic that is about to exit to use the second ramp. Both of these streams of traffic must switch places between the right lane of the through highway and the auxiliary entrance/exit lane. In addition, the entering traffic is trying to accelerate to merge into the through traffic, while the exiting traffic must slow down to negotiate the tight turn on the loop ramp. These two factors are the cause of many traffic backups and an increased risk of collisions.

2.4 Micro-Simulation Model Softwares

This section outlines the proposed methods and softwares used for detailed traffic analysis and simulation for the various types of travel facilities included in the short-listed alternatives and identifies the supporting rationale for each method. The detailed traffic analysis will primarily be performed using the methods of the 2000 Highway Capacity Manual (HCM), published by the Transportation Research Board (TRB). This is the accepted practice in all 50 states. There are several software options for capacity analysis and simulation of these facilities. Capacity analysis software packages include HCS Plus (HCS+), Synchro, aaSIDRA (SIDRA), RODEL, and ARCADY. Micro simulation software packages include CORSIM, SimTraffic, VISSIM, and Paramics. It should be noted that HCS+ data can be transferred to CORSIM for simulation. Similarly, Synchro data can be transferred to SimTraffic, CORSIM, or VISSIM for simulation or review of corridor measures of effectiveness (MOEs).

2.4.1 Capacity Analysis

For each type of facility, the applicable software packages are identified including consideration for the data input requirements, methodology, and the advantages and disadvantages for their application.

2.4.1.1 HCS Plus

HCS+ software was developed to translate the capacity analysis methodology of the HCM into a computer model. HCS+ can be used to analyse most types of traffic facilities. For a signalized intersection the MOE used to calculate LOS is average delay per vehicle in seconds. The basic premise is that a user/driver perceives how well a signalized intersection is working based on how long it takes him/her to pass through it. As congestion increases, delays and queue lengths increase, and a motorist may have to wait several cycles to clear the intersection. The inputs to determine average delay in HCS+ are: traffic volumes in vehicles per hour as well as signal data such as cycle length, green ratio, clearance times, etc. The HCS+ analysis yields average delay, LOS, and v/c ratios. The program now also offers a queuing module that can provide the average and 95th percentile queues for each lane group.

The advantage of HCS+ is that it follows the methodology outlined in the HCM verbatim. The disadvantage of HCS+ is that it does not handle interactions between intersections such as queue spillback. The program analyses each intersection separately as an isolated location. In addition, HCS+ software cannot currently analyse two-lane roundabouts.

2.4.1.2 Synchro

Synchro was developed privately as an application of the HCM methodology. It can be used to analyse many different facilities, including arterials and intersections. Its primary function has been to analyse signalized intersections.

For an intersection, inputs include traffic volumes, geometrics, and control data including STOP/YIELD, or green time, cycle length, etc. The program explicitly outputs the Intersection Capacity Utilization (ICU) report and ICU LOS. These are based on the Percentile Delay Method, rather than the HCM methodology (Webster's Method). However, the program offers an HCM report for both signalized and unsignalized intersections that is based on the HCM methodology. The report details the delays, LOS, v/c ratio, and average and 95th percentile queues. The results on-screen do not exactly reflect the HCM methodology. However, the HCM report mirrors the MOEs and LOS as described in Chapters 16 and 17 of the HCM.

2.4.1.3 Sidra

SIDRA is a software package that was developed in Australia to analyse roundabouts. It has been commonly used in the U.S. to analyse roundabouts, particularly two-lane roundabouts. SIDRA is the roundabout analysis software accepted by VTrans. The inputs to SIDRA include the hourly volumes, as well as the intersection geometry. Although the intersection geometry is one of the inputs to SIDRA, it is not explicitly considered in the analysis. Because SIDRA can analyse other types of intersections, including both signalized and unsignalized intersections, particularly those with unusual geometry such as five-legged intersections, the geometry is included in the inputs. However, in the case of roundabout analysis, the geometrics are not used in the analysis. The methodology included in the software is based on critical gaps, much like HCS+. A recent update of SIDRA introduced the use of an adjustment factor to account for the difference between U.S. driving conditions and those in the United Kingdom (U.K.) and Australia, where drivers are more familiar with roundabouts. Recent studies have concluded that SIDRA may overestimate the capacity of single-lane roundabouts and may underestimate capacity for two-lane roundabouts. The MOEs from SIDRA include average delay in seconds, LOS, v/c ratios, and queue lengths.

2.4.1.4 Rodel

RODEL is a software package that was developed in the U.K by Barry Crowne. RODEL has been used as the standard by some Departments of Transportation (DOTs) to analyse roundabouts, most notably in the Northeast by New York State DOT. The program inputs include the hourly volumes as well as the geometry of the roundabout. The program methodology is based solely on the geometrics of the roundabout. Gap theory does not factor into the results. RODEL can be run in design mode with performance targets specified or in evaluation mode with geometric parameters specified. This allows the user to determine the specific impacts on capacity of varying the intersection geometry. One disadvantage of this method for the Circ-Williston project is that it requires detailed knowledge of geometrics, possibly beyond what will be developed for the DEIS. The program is also not calibrated to U.S. conditions, and recent studies indicate that it may underestimate the capacity of single lane roundabouts and overestimate the capacity of two-lane roundabouts. The MOEs from RODEL include average delay, LOS, v/c ratios, and queue lengths.

2.4.1.5 Arcady

Assessment of Roundabout Capacity and DelaY (ARCADY) is a software package developed by TRL Software in the UK for use in analyzing roundabouts. The program is based upon empirical data in the UK. The MOEs that ARCADY predicts include capacity, delay, queue length, and accident risk. It can address all roundabout configurations, including miniroundabouts. It also includes a crash prediction model and a pedestrian crossing model based on UK data and equations. Inputs to ARCADY include hourly volumes and geometry. One disadvantage of ARCADY is that there is only a 50 percent confidence interval in the results. It is also not calibrated to U.S. conditions, so may not accurately predict roundabout capacities in this country.

2.4.2 Simulation

There are several software packages available to perform micro-simulation for the various types of facilities. For each type of facility, the applicable software packages are identified including consideration for the data input requirements, methodology, and the advantages and disadvantages for their application.

2.4.2.1 Corsim

CORSIM is the corresponding micro-simulation program to HCS+ and was developed by the FHWA. The program works reasonably well for signalized and unsignalized intersections, and various freeway segments, including basic segments, ramps, and weaves. Since the data from HSC+ can be transferred directly into CORSIM, the use of CORSIM for the simulation of freeways and freeway segments is desirable. However, the simulation of an arterial corridor with signalized intersections requires additional inputs into CORSIM to complete the simulation, i.e., intersection offsets, must also be input for the simulation to accurately reflect corridor conditions. For an arterial corridor with roundabouts at intersections, CORSIM does

not provide roundabout specific features for input into the simulation model. In addition, there are known flaws with its modeling of roundabouts, particularly two-lane roundabouts. CORSIM can export reports on a variety of measures, including density, travel time, speed, and number of lane changes.

2.4.2.2 Sim Traffic

SimTraffic was privately developed and is the simulation partner to Synchro. Since SimTraffic and Synchro use the same interface, there is no need to input additional data when transferring from Synchro to SimTraffic. As with CORSIM, a high level of labour intensive calibration is required to have confidence in the simulation results. The primary advantage of the Synchro/SimTraffic package is that analysis and simulation can be done from the same interface. There is no need to input additional data, as the signal data, traffic volumes, link data, and other characteristics of the network are all contained in one file. The results will not exactly match the HCM methodology because Synchro is based upon the Percentile Delay Method rather than Webster's Method. However, for signalized intersections, the SimTraffic simulation gives a reasonable approximation of the expected conditions when properly calibrated. SimTraffic adequately simulates results for single-lane roundabouts; however, the results for two-lane roundabouts are flawed because the user cannot control lane use within the roundabout.

In response to a recent Traffic Engineering Council (TENC) listserv ⁽¹⁾ question regarding a corridor analysis project involving roundabouts and the use of SimTraffic, Kittelson & Associates, Inc. (KAI) took a cursory look at SimTraffic's ability to model roundabouts.

⁽¹⁾Listserv is an email based discussion group for TENC members. The discussions are technically oriented with the members seeking / sharing their guidance on various topics.

KAI tested single-lane roundabout capacity by loading a subject approach beyond capacity and then measured the outflow against a range of circulatory flows.

What KAI found was that SimTraffic appears to produce higher estimates of capacity at low circulating flows (<600 vph) than either the FHWA urban compact or FHWA single-lane model. At moderate to high circulating flows, the model appears to be in the same range as the two FHWA models. KAI did not check the SimTraffic results against U.S. field data of NCHRP 3-65.

KAI believes that the logic for lane selection should be the same for roundabouts as for any other intersection. For example, on a two-lane approach with two receiving lanes on the far side of the intersection, a driver would turn left from the left lane, right from the right lane, and proceed through from either lane, unless traffic control devices dictate otherwise. The MUTCD is being updated to better clarify lane use, including providing examples of circulatory roadway and exit striping to guide motorists.

SimTraffic assumes that a multilane roundabout operates as a series of T intersections with a section of circulatory roadway between the legs. Therefore, each downstream exit is considered independent of the upstream entry. However, at most roundabouts the paths of entering vehicles cross vehicles leaving the roundabout at the adjacent downstream exit rather than join and separate. As a result of this assumption, it appears that SimTraffic cannot accurately simulate the normal lane configuration for a standard two-lane roundabout with two lane entries and two-lane exits on all approaches. Due to these findings, KAI did not check the capacities that could be derived by SimTraffic for a two-lane roundabout.

2.4.2.3 Vissim

VISSIM is a simulation program developed overseas and distributed in the U.S. VISSIM can simulate arterials with both signalized and roundabout intersections. The FHWA's research shows that the results of roundabout simulation correlate closely with empirical data gathered at roundabouts within the U.S. VISSIM's graphical interface makes it more user friendly than some other simulation models. VISSIM can also simulate interaction with transit facilities, pedestrians, and other similar specialized cases. The outputs from VISSIM include travel time, queue length, and delay, just to name a few. A specific path or paths can be defined in VISSIM, for which the program will explicitly output travel times. For these defined paths, the program will also output delays. Queue counters at specific locations can also be specified in VISSIM to determine queue lengths at key locations. VISSIM can report average queue length, maximum queue length, and the number of stops within the queue. VISSIM allows the user to import a CAD file or aerial photograph as the background, thus making it easier for the public to relate to the location that is being simulated.

2.4.2.4 Paramics

Paramics is another microscopic simulation model, which was developed in Scotland. It has a good graphical interface, including 3-D animation. Although Paramics explicitly models roundabouts, experience by some Departments of Transportation (DOTs) indicates that it can be quite cumbersome to set up the network. In addition, Paramics is extremely costly. As a result, the use of Paramics in the U.S. has been extremely limited to date.

2.4.3 Conclusion

For the purposes of this research the Synchro and Sim Traffic 7 was adopted for capacity analysis and simulation respectively because they based on the full function of the HCM

methodology. As stated early on the HCM(2000) is adopted for this report as the main reference.

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CHAPTER 3: RESEARCH METHODOLOGY

3.1 Description of Study Area

Accra is the capital and largest city of Ghana with population of about 4,400,000 (Four million and four hundred thousand ; Source 2010 Population and Housing Census by Statistical Service). Accra also doubles as the capital of the Greater Accra Region and the District Capital of the Accra Metropolitan Assembly.

Accra is located at 5°33'00" N 0°12'00" W with an average elevation of 9 m above sea level. The road network is radial with all kinds of intersections including roundabouts, signalized and unsignalized intersections as well as grade-separated intersections.

In recent years, Accra has seen a couple of its major at grade-intersections converted to gradeseparated intersections and the trend seems to continue. Figure 3.2 is the map of Accra captured by Google Maps 2010.



Figure 3.1: Map of Accra, Source: Google Maps 2010

3.2 Description of Study Site

Tetteh Quarshie intersection is located at the intersection of two national roads namely N1 and N4. It is one of the busiest intersections in Accra. The intersection which was rotary until its conversion into a cloverleaf interchange in 1995 had a radius of about 215 m. Figure 3.2 is an aerial view of the interchange sourced from Google Maps 2010.

The immediate surroundings of the site have over the years seen increased mixed landuse, i.e. commercial, residential and industrial.



Figure 3.2: Map of Tetteh Quarshie Interchange, Source: Google Maps 2010

3.2.1 Spintex Road

The Spintex Road is one of the legs to the intersection. It is a major link to one of the fast growing industrial areas in Accra. The area served by the road has also seen increased residential land use lately.

3.2.2 Kwame Nkrumah Motorway

The Kwame Nkrumah Motorway is a very important link so far as Ghana's road network is concerned. It links the two major twin cities of Accra and Tema. Tema is the country's biggest industrial city and contributes a lot of the traffic on the motorway.

3.2.3 Tetteh Quarshie-Madina Road

This corridor forms part of the N4 and has over the years seen much traffic growth. The Madina and its environs are growing rapidly in residential settlements and that could be one of the reasons of the high volume traffic on that corridor.

3.2.4 Motorway Extension

This corridor which forms part of N1 had seen tremendous increase in traffic volumes over the years. Traffic flow has also worsened because of encroachment. The corridor is not uniform in its carriageway layout i.e. single and dual carriageways intermittently arranged.

3.2.5 Liberation Road

This is a very important corridor since it begins the route to the CBD of Accra. This corridor serves all traffic from the northern, western and eastern parts of Accra to the CBD. Even though it has a well-defined and uniform carriageway layout the corridor has seen increase in traffic over the years. The construction of the Arko Adjei interchange has been a great intervention since it has eased the bottle-neck that used to be at that intersection.

Figure 3.3 shows the census stations of Greater Accra Region. The figure shows Tetteh Quarshie at the intersection of N1 and N4 national roads.







Ato K. BADU-PRAH PG 2610708 NOVEMBER, 2010
3.3 Field Studies and Observations

3.3.1 Traffic Studies

3.3.1.1 Classified Manual Counts

Classified manual counts on all the ramps and links of the interchange were conducted. The counts were carried out for three (3) hours within the morning (7am-10am) and evening (3pm-6pm) peak periods for one typical week day. The counts were in 15 minutes segments.

3.3.1.2 Spot Speed Measurements

The speed data were collected as the tail of the vehicles crossed the enumerator who had positioned himself at the mid-way of the link or ramp. A radar gun was operated on randomly selected vehicles of all kinds (i.e. cars, pick-ups, buses, trucks and trailers).

3.3.1.3 Physical Measurements

As built measurements were taken with tapes and pedometer. Lane widths, lengths of ramps and links were measured and compared with the design. Elevations however were assumed to be the same as the design.

3.4 Calibration and Validation of Software Models

3.4.1 Inputs

Every model, no matter how carefully coded will require calibration and validation to ensure its outputs are meaningful. Calibration is the process by which model parameters are adjusted to reflect the unique driving conditions associated with the network being modelled and thereby generate a model that more closely reflect real-world conditions. Validation is the process whereby model outputs are compared to actual field data to determine how well the model replicate real-world conditions. In this study the primary validation parameters were

- traffic volumes
- approach speeds
- geometry
- signing
- others such as %HV, PHF etc.

3.4.2 Outputs

Once the links and ramps were calibrated and validated each was run multiple times and results were analyzed with respect to key performance measures. The primary performance measures selected for comparison in this study were

- simulated volumes
- simulated link and ramp speeds and travel time.
- Simulated delays and queuing

3.4.3 Calibration Procedures

a) Settings

This setting procedure is peculiar to Synchro Studio 7 and Warrant 7. All references were taken from Synchro 7 Getting Started.

b) Map Setting

Map importation was from two sources namely Aerial Survey of Accra by Survey Department and Tetteh Quarshie Interchange design by Twum Boafo Ltd. (2005). The two maps were imported as DXF files at true national coordinates. Figure 3.4 is a screen shot of the imported maps



Figure 3.4: Screen Shot of Synchro 7 Map Setting

c) Lane Setting

This setting allows you to input lane and geometric information including lanes and sharing, street names, link distances, link speed etc. Figure 3.5 is a screen shot of lane setting window.



Figure 3.5: Screen shot of Synchro 7 Lane Setting



Figure 3.6: Designed Layout of TQI

d) Volume Setting

The Volume Setting allows you to enter volume information. This includes traffic volume, conflicting pedestrians, conflicting bicycles, peak hour factor, growth factor etc. Figure 3.7 is a screen shot of Volume Setting window.



Figure 3.7: Screen shot of Synchro 7 Volume Setting window





Figure 3.8: Screen shot of Synchro 7 showing Improved legs layout and volumes

e) Node Setting

The node setting allows for the following:

- Intersection ID or Node Number
- Zone
- Cycle Length, Control Type, Lock Timings and Optimize buttoms
- Coordinates (X, Y, Z)
- Description Note Box
- Signal Timing Data

Nodes are assigned unique number automatically. The X and Y coordinates were left as imported from the aerial survey map. The elevations (Z) were entered from the designed TQI. All the control types were set to Unsignalized. Figures 3.9 and 3.10 provide a screen shot of the Node Settings Window and layout of the Interchange showing node numbers respectively.

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Figure 3.9: Screen shot of Synchro 7 Node Setting window and existing layout



Figure 3.10: Tetteh Quarshie layout showing node numbers

f) Timing/Signing Setting

The Timing Settings become the Signing Setting by selecting unsignalized or roundabout intersection.

There are three Sign Control Settings namely:

- Free: Traffic goes through the intersection without stopping
- Yield: Traffic has a yield sign and slows down, stopping only if necessary
- Stop: All traffic stops, and waits until all conflicting traffic is clear

Synchro models unsignalized intersections based on the methods of HCM Chapter 17. Figure

3.11 is a screen shot of Signing Setting window.



Figure 3.11: Screen shot of Synchro 7 Signing Setting window

3.5 Simulation and Performance Criteria

3.5.1 Intersection Level of Service

For an unsignalized Two-Way Stopped Controlled (TWSC) or All-Way Stopped Controlled (AWSC) intersection, the Level of Service (LOS) for the intersection is calculated by taking the Intersection Delay and converting into a letter using Table 3.1.

LOS Control Delay Per Vehicle(s) A =< 10	
A =< 10	
В >10-15	
C > 15-25	
D > 25-35	
E > 35-50	
F > 50	

Table 3.1: TWSC & AWSC Level of Service Criteria (HCM 2000)

3.5.2 Intersection Capacity Utilization

The ICU is shown for unsignalized intersections as well because it represents the potential capacity for the intersection if it were to be signalized.

3.5.2.1 ICU Level of Service

The ICU Level of Service (LOS) gives insight into how an intersection is functioning and how much extra capacity is available to handle traffic fluctuations and incidents. ICU is not a value that can be measured with a stopwatch, but it does give a good reading on the conditions that can be expected at the intersection. Letters A to H are assigned to the intersection based on the Intersection Capacity Utilization using Table 3.2. Note that the ICU 2003 includes additional level past F to further differentiate congested operation.

ICU (%)	Level of Service
0-55	А
> 55-64	В
> 64-73	C C
> 73-82	D
> 82-91	Е
> 91-100	F
> 100-109	G
> 109	H

Table 3.2:Level of Service Criteria (ICU 2003) for ICU Analysis

A brief description of the conditions expected for each ICU LOS follows:

LOS A, (ICU<55 %): The intersection has no congestion. A cycle length of 80 sec or less will move traffic efficiently. All traffic should be served on the first cycle. Traffic fluctuations, accidents, and lane closure can be handled with minimal congestion. This intersection can accommodate up to 40% more traffic on all movements.

LOS B, (55 %< ICU<64 %): The intersection has very little congestion. Almost all traffic will be served on the first cycle. A cycle length of 90 sec or less will move traffic efficiently. Traffic fluctuations, accidents, and lane closure can be handled with minimal congestion. This intersection can accommodate up to 30% more traffic on all movements.

LOS C, (64 %< ICU<73 %): The intersection has no major congestion. The majority of traffic should be served on the first cycle. A cycle length of 100 sec or less will move traffic efficiently. Traffic fluctuations, accidents, and lane closure may cause some congestion. This intersection can accommodate up to 20% more traffic on all movements.

LOS D, (73 %< ICU<82%): The intersection normally has congestion. Most of the traffic should be served on the first cycle. A cycle length of 110 seconds or less will move traffic efficiently. Traffic fluctuations, accidents, and lane closures cause significant congestion. Sub optimal timings can cause congestion. This intersection can accommodate up to 10 % more traffic on all movements.

LOS E, (82 %< ICU< 91 %): The intersection is right on the verge of congested conditions. Many vehicles are not served on the first cycle. A cycle length of 120 seconds is required to move all traffic. Minor traffic fluctuations, accidents, and lane closures can cause significant congestion. Sub-optimal signal timings can cause significant congestion. This intersection has less than 10 % reserve capacity available.

LOS F, (91 %< ICU< 100 %): The intersection is over capacity and likely experiences congestion period of 15 to 60 consecutive minutes. Residual queues at the end of green are common. A cycle length over 120 seconds is required to move all traffic. Minor traffic fluctuations, accidents, and lane closures can cause increased congestion. Sub-optimal signal timing can cause increased congestion.

LOS G, (100 %< ICU< 109 %): The intersection is up to 9 % over capacity and likely experiences congestion periods of 60 to 120 consecutive minutes. Long queues are common.

A cycle length over 120 seconds is required to move all traffic. Motorist may be choosing alternative routes, if they exist or making fewer trips during peak hour.

LOS H, (109 %< ICU): The intersection is 9 % or greater over capacity and could experience congestion periods of over 120 minutes per day. Long queues are common. A cycle length over 120 seconds is required to move all traffic. Motorists may be choosing alternative routes, if they exist, or make fewer trips during the peak hour. Signal timings can be used to distribute capacity to the priority movements.

If intersections have LOS E or worse, queues between intersections can lead to blocking problems and spillbacks. Such problems could be addressed by in-depth analyses with microscopic simulation(Husch and Albeck, 2003)



CHAPTER 4.0: ANALYSIS OF RESULTS AND DISCUSSION

4.1 Existing/ Calibration Characteristics

4.1.1 Geometry and Lane Setting

The capacity analysis depends partly on the geometric and lane setting. Table 4.1 lists the various configurations for the lane groupings.

Table 4.1: Geometry and Lane Setting Parameters

Intersection	Street or Road Name	Lane Group	Lane Configur ation	Direction to	No of Lanes	Lane Width (m)	Approach Grade (%)	Lane Alignment	Median Width (m)	Lane Utilization Factor
	ay (N1)	EBT	† Þ	Tema	2	4.0	2	Left	6.0	0.95
5	Motorw Extension	WBT	††	Madina	2	4.0	-2	Left	6.0	0.95
		SWR	17	Mallam	2	3.6	0	Right	0.0	0.88
	4D	NBT	^	Madina	3	3.7	1.0	Left	4.0	0.91
9	ACC-M/ (N4)	SBT	***	Tema/ Spin	3	3.7	-1.0	Left	4.0	0.91
		NWR	77	Acc./ Mall.	2	3.0	-3.0	Right	0.0	0.88

Intersection	Street or Road Name	Lane Group	Lane Configur ation	Direction to	No of Lanes	Lane Width (m)	Approach Grade (%)	Lane Alignment	Median Width (m)	Lane Utilization Factor
	AD	NBT	**	Accra	3	3.7	1.0	Left	4.0	0.91
24	CC-M2 (N4)	SER	***	Spin./ Tema	2	3.7	-1.0	Left	4.0	0.91
	AC	SER	77	Madina	3	3.0	-1.0	Right	0.0	0.88
	XT.	EBT	^	Tema	2	3.0	2	Left	6.0	0.95
	VAY E [1]	EBR	۴	Madina/ Spin	1	3.0	2	Right	-	1.00
29	TORW	WBT	† †	Madina	2	3.0	-2	Left	6.0	0.95
	MO	SBR	77	Mad./ Acc	2	3.0	1	Right	0.0	0.88
	AST	WBT	4	Tema/ Mad.	1	3.5	2	Left	0.0	1.00
31	JTH E	NBR	۴	Spintex	1	3.5	2	Right	0.0	1.00
	SOUT	SWR	11	Madina	2	3.0	-2	Right	0.0	0.88

Intersection	Street or Road Name	Lane Group	Lane Configur ation	Direction to	No of Lanes	Lane Width (m)	Approach Grade (%)	Lane Alignment	Median Width (m)	Lane Utilization Factor
37	IXT.	EBT	††	Tema	2	3.0	2	Left	6.0	0.95
	AY E	WBT	† †	Acc/ Mad.	2	3.0	-2	Left	6.0	0.95
	TOR W (N	WBR	۴	Madina	1	3.0	-3	Right	6.0	1.00
	LOM	NER	77	Tema	2	3.0	-3	Right	0.0	0.88
	SOUTH EAST LOOP 2	SBR	77	Mad./ Spin.	2	3.0	-2	Right	0.0	0.88
38		NET	† †	Tema	2	3.0	2	Left	2.0	0.95
	L	EBR	11	Acc/ Tema	2	3.0	2	Right	0.0	0.88
40	OP	NBT	^††	Madina	3	3.6		Left	4.0	0.91
	NORTH LOC	NBR	۴	Mallam	SISAN	3.0	1	Right	0.0	1.00
		SBT	^††	Accra/Tema	3	3.6	-1	Left	4.0	0.91

Intersection	Street or Road Name	Lane Group	Lane Configur ation	Direction to	No of Lanes	Lane Width (m)	Approach Grade (%)	Lane Alignment	Median Width (m)	Lane Utilization Factor
42	XT.	EBT	††	Tema/Mad	2	4.0	2	Left	6.0	0.95
	AY E I)	WBT	††	Mallam	2	4.0	-2	Left	6.0	0.95
	rorw (n	WBR	۴	Accra	1	3.0	-2	Right	0.0	1.00
	LOM	NER	77	Tema/Mad	2	3.0	-1	Right	0.0	0.88
	L	WBR	11	Madina	2	3.0	-2	Right	0.0	0.88
	I EAS)P 1	NBT	***	madina	3	3.7	1	Left	4.0	0.91
46	LOC	SBT	***	Accra	3	3.7	-1	Left	4.0	0.91
	SC	SBT	۴	Tema	1	3.7	2	Left	0.0	1.00
47	HTU ST P 1	NBT	1	Tema		3.7	2	Left	0.0	1.0
	SOU EAS SLII	NBR	۴	Tema	1	3.6	2	Right	0.0	1.0

Intersection	Street or Road Name	Lane Group	Lane Configur ation	Direction to	No of Lanes	Lane Width (m)	Approach Grade (%)	Lane Alignment	Median Width (m)	Lane Utilization Factor
	X	EBT	1	Spintex	1	3.6	0	Left	0.0	1.0
55	INTE	WBT	1	Madina	1	3.6	0	Left	0.0	1.0
	SF	NER	۴	Tema	1	3.6	0	Right	0.0	1.0

4.1.2 Volume and Speed Setting

Traffic volume and speed were the main variables measured at the site. The measurements were done on all the ramps and mainlines. Table 4.2

contains the details of the traffic and speed parameters captured on site.

				Volu	ime		Speed				
T d d'	Street or	Lane	Morn	ing Peak	Evenir	Evening Peak		Morning Peak		Evening Peak	
Intersection	Road Name	Group	Design Vol (vph)	% HV	Design Vol (vph)	% HV	Mean Spot Speed (km/h)	Standard Deviation (km/h)	Mean Spot Speed (km/h)	Standard Deviation (km/h)	
2 otorway xtension (N1)	EBT	2048	10	2048	12	69	9	69	9		
	WBT	1267	6	1874	11	57	12	57	12		
	M. Ey	SWR	676	2	759	8	54	8	54	8	
	AD	NBT	2468	3	3276	2	47	13	35	10	
9	CC-M (N4)	SBT	4389	2	2545	3	36	7	63	8	
	AC	NWR	413	9	608	12	40	6	40	6	
	AD	NBT	2334	3	3920	2	47	13	35	10	
24	CC-M (N4)	SER	5292	2	3385	3	36	7	63	8	
	AC	SER	1169	3	759	8	54	8	54	8	

Table 4.2:	Traffic volume and speed parameters at the site
------------	---

				Volu	me		Speed			
	Street or	Lane	Morn	ing Peak	Evenii	ng Peak	Morr	ning Peak	Even	ing Peak
Intersection	Road Name	Group	Design Vol (vph)	% HV	Design Vol (vph)	% HV	Mean Spot Speed (km/h)	Standard Deviation (km/h)	Mean Spot Speed (km/h)	Standard Deviation (km/h)
	EXT.	EBT	1808	10	3684	12	69	9	69	9
	EBR	848	2	1465	7	44	7	44	7	
29	TORV (Å	WBT	1705	6	2595	11	57	12	57	12
	MO	SBR	1073	5	1851	9	40	6	40	6
	IAST 1	WBT	359	2	359	2	50	6	40	-
31	JTH E .00P	NBR	989	2	989	4	50	-	50	-
	NOS	SWR	848	2	1 <mark>4</mark> 65	7	50	-	50	-
	X	EBT	1808	10	3684	12	69	9	69	9
	R WA . (N1)	WBT	1705	6	744	11	57	12	57	12
37	fOTO EXT.	WBR	413	9	608	12	46	8	46	8
	N	NER	1372	9	1845	7	34	7	34	7

				Volu	me		Speed			
To to man of the m	Street or	Lane	Morn	ing Peak	Evenir	Evening Peak		ning Peak	Evening Peak	
Intersection	Road Name	Group	Design Vol (vph)	% HV	Design Vol (vph)	% HV	Mean Spot Speed (km/h)	Standard Deviation (km/h)	Mean Spot Speed (km/h)	Standard Deviation (km/h)
	JTH ST DP 2	SBR	848	6	1465	7	44	7	44	7
38 Sou	SOI EA LO(NET	1372	9	1845	7	34	7	34	7
WEST	5T	EBR	1511	5	1810	5	43	8	43	8
	ORTH WES LOOP	NBT	2468	3	3276	2	47	13	35	10
40		NBR	1073	2	1851	9	40	6	40	6
	Ž	SBT	4389	2	2545	3	36	7	63	8
	EXT.	EBT	2048	10	4 <mark>179</mark>	12	69	9	69	9
	VAY I [1]	WBT	1267	6	785	11	57	12	57	12
42	rorv (N	WBR	1511	5	1810	5	43	8	43	8
	MO	NER	608	11	970	7	39	5	39	5

				Volu	ime		Speed			
Tutumustian	Street or	Lane	Morn	ing Peak	Evenir	ng Peak	Morning Peak		Evening Peak	
Intersection	Road Name	Group	Design Vol (vph)	% HV	Design Vol (vph)	% HV	Mean Spot Speed (km/h)	Standard Deviation (km/h)	Mean Spot Speed (km/h)	Standard Deviation (km/h)
	L	WBR	1207	2	1207	2	44	7	44	7
46 46	NBT	2334	3	39 <mark>2</mark> 0	2	47	13	35	10	
	TOO	SBT	5292	2	3385	3	36	7	63	8
		SBT	608	2	970	7	39	5	39	5
	JTH ST P 1	NBT	989	4	989	4	34	7	34	7
47	SOU EA SLJ	NBR	1000	4	1000	4	50	_	50	-
	XI XI	EBT	500	2	500	2	50	-	50	-
55	PINTE	WBT	742	2	1215	2	50	-	50	-
	SP	NER	100	4	1000	4	50	-	50	-

4.1.3 Control, Signage and Measure of Effectiveness

Table 4.3 shows the various signage and control type for the intersections. The table also shows the capacity utilisation for those intersections and their respective level of service.

Table 4.3:	Control, Sign	age and I	Measure of	Effectiveness						
					Delay /	Veh (s)	Average	Queue (m)	ICU L	OS (%)
Intersection	Street or Road Name	Lane Group	Control Type	Sign Control	Morning Peak	Evening Peak	Morning Peak	Evening Peak	Morning Peak	Evening Peak
	ay on	EBT	ized	Free	5.4	1.6	10.6	241.1	97.4	156.1
5	otorw ktensi (N1)	WBT	signal	Free	108.9	214.4	228.7	243.5	F	Н
	Mc Ex	SWR	Un-	Free	3.9	11.0	19.6	52.3		
	AD	NBT	ized	Free	1.8	1.4	14.8	7.2	144.3	119.2
9	CC-M/ (N4)	SBT	signal	Free	126.9	3.7	114.2	44.9	Н	Н
	AC	NWR	Un-	Free	6.0	4.0	15.6	7.8		
	AD	NBT	ized	Free	430.2	696.4	107.1	110.4	149.8	124.6
24	CC-ML (N4)	SBT	signal	Free	4.5	2.4	167.6	58.2	Н	Н
	AC	SER	Un-	Yield	3648.7	1302.7	81.1	77.7		

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					Delay /\	Veh (s)	Average	Queue (m)	ICU L	OS (%)
Intersection	Street or Road Name	Lane Group	Control Type	Sign Control	Morning Peak	Evening Peak	Morning Peak	Evening Peak	Morning Peak	Evening Peak
	EXT.	EBT		Free	1.6	1.8	11.1	233.4	104.6	173.0
	/AY F [1]	EBR	gnalize	Free	4.2	4.2	50.7	66.3	G	Н
29	rorw (N	WBT	Un-sig	Free	9.7	292.9	74.4	222.3		
LOW	SBR	_	Free	36.7	59.1	41.4	65.8			
	AST 1	WBT	ized	Yield	34.3	145.8	29.0	27.5	110.2	139.4
31	JTH E JOOP	NBR	signal	Yield	12.2	28.9	19.0	32.5	Н	Н
	T NOS	SWR	Un-	Yield	4.7	3.0	11.6	2.5		
	Y	EBT	q	Yield	3.4	2.8	14.2	15.7	104.6	173.0
	R WA (N1)	WBT	nalize	Free	2.6	996.6	13.4	77.8	G	Н
37	[OTO] EXT.	WBR	Jn-sig	Free	2.1	1246.1		1.2		
	W	NER	1	Yield	108.2	231.7	78.6	80.2		

					Delay /Veh (s)		Average	Queue (m)	ICU LOS (%)	
Intersection	Street or Road Name	Lane Group	Control Type	Sign Control	Morning Peak	Evening Peak	Morning Peak	Evening Peak	Morning Peak	Evening Peak
	UTH ST DP 2	SBR	n- alize	Free	0.5	0.4	3.9		41.3	54.6
38	SOI EA LO(NET	U sign	Free	70.2	184.0	61.6	87.3	А	А
	T	EBR	с T	Free	14.6	24.2	57.8	50.2	144.3	119.2
	ORTH WE LOOP	NBT	nalize	Free	2.1	2.0	68.9	27.2	Н	Н
40		NBR	Jn-sig	Free	4.7	8.6	26.8	0		
	Ž	SBT		Free	24.5	4.8	153.7	34.1		
	EXT.	EBT	q	Free	7.0	6.6	15.6	34.1	97.4	156.1
42	VAY I [1]	WBT	nalize	Free	55.1	293.9	138.8	32.6	F	Н
	TORV (N	WBR	Jn-sig	Free	16.3	64.4	14.7	253.4		
	MO	NER		Free	3.1	6.9	20.6	247.7		

					Delay /V	/eh (s)	Average	Queue (m)	ICU L	OS (%)
Intersection	Street or Road Name	Lane Group	Control Type	Sign Control	Morning Peak	Evening Peak	Morning Peak	Evening Peak	Morning Peak	Evening Peak
	T	WBR		Yield	2.9	0.3	9.4	15.5	149.0	124.6
	H EAS DP 1	NBT	gnalize	Free	1.9	2.8	7.1	4.8	Н	Н
46	DOT	SBT	Un-sig	Free	6.8	1.7	45.6	38.2		
	S	SBR	r	Free	6.8	4.8	20.2	11.0		
	JTH ST IP 1	NBT	n- alize	Free	15.8	51.9	37.2	65.1	65.3	65.3
47	SOU EA SL]	NBR	U sign	Free	3.2	4.8	43.1	56.5	С	С
	EX D	EBT	ized	Free	4.0	4.3	17.5	18.0	94.9	94.9
55	PINTH ROAI	WBT	signal	Free	388.5	2914.9	103.6	115.0	F	F
	S]	NER	Un-	Yield	9.7	7.5	39.6	32.4		
	ТОТА	L NETW	VORK		358	745.6	6223 vehs	13,754 vehs (108	125
							(Queue Penalty)	Queue Penalty)	G	Н

4.2 Improved Legs Case

4.2.1 Sensitivity Analysis for the Interchange Network

Tables 4.4 and 4.5 tabulate changes in vehicular delays as the main link speeds were increased for morning and evening peaks respectively. The speed sensitivity analysis was informed by the fact that speeds on the main links would increase after the reconstruction works on them are completed. Speeds on the ramps and slipways were however maintained.

Intersection	Street	eet Lane	Baseline	Baseline	Percentage Incremental Link Speeds- Morning Peak								
	Iname	Group	(km/h)	Delay (s)	10% increase		20% increase		30% increase				
				1	Adjusted Speed (km/h)	Delay/ Veh (s)	Adjusted Speed (km/h)	Delay/ Veh (s)	Adjusted Speed (km/h)	Delay/ Veh (s)			
5		EBT	69	108.9	76	69.9	83	86.2	90	154.0			
5		WBT	57	5.4	63	1.3	68	2.0	74	2.2			
9		NBT	47	1.8	52	2.6	56	2.4	61	3.3			
		SBT	36	126.9	40	122.4	43	98.0	47	101.3			

Table 4.4:	Effect of increased link speed on the Network Delay	ys-Morning Peak
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Intersection	Street	Lane	Baseline	Baseline	Percentage Incremental Link Speeds- Morning Peak						
	Name	Group	Link Speed (km/h)	Delay (s)	10% in	10% increase		ncrease	30% increase		
					Adjusted Speed (km/h)	Delay/ Veh (s)	Adjusted Speed (km/h)	Delay/ Veh (s)	Adjusted Speed (km/h)	Delay/ Veh (s)	
24		NBT	47	430.2	52	285.0	56	334.7	61	323.2	
24		SBT	36	4.5	40	3.8	43	3.6	47	5.2	
20		EBT	69	1.6	76	3.3	83	2.4	90	2.6	
2)		WBT	57	9.7	63	8.1	68	8.5	74	10.1	
37		EBT	69	3.4	76	3.8	83	4.1	90	4.3	
57		WBT	57	2.6	63	1.5	68	1.6	74	1.1	
40		NBT	47	2.1	52	2.5	56	2.4	61	2.8	
40		SBT	36	24.5	40	25.3	43	18.2	47	15.3	
42		EBT	69	7.0	76	11.3	83	6.6	90	8.5	
72		WBT	57	55.1	63	1.7	68	1.9	74	1.4	

Intersection	Street	Lane	Baseline	Baseline		Percentage	Incremental L	ink Speeds- N	Morning Peak	
	Name	Group	(km/h)	Delay (s)	10% increase		20% increase		30% increase	
					Adjusted Speed (km/h)	Delay/ Veh (s)	Adjusted Speed (km/h)	Delay/ Veh (s)	Adjusted Speed (km/h)	Delay/ Veh (s)
16		NBT	47	1.9	52	3.4	56	3.4	61	4.2
40		SBT	36	6.8	40 5.4		43	5.0	47	6.6
ТОТА	L NETWO	ORK		358.0	196.4 185.8			207.6		



Intersection	Street	Lane	Baseline Link Speed (k/h)	Baseline Delay (s)	Percentage Incremental Link Speed- Evening Peak								
	Name	Group			10% incr	10% increase		crease	30% increase				
					Adjusted Speed (km/h)	Delay/ Veh (s)	Adjusted Speed (km/h)	Delay/ Veh (s)	Adjusted Speed (km/h)	Delay/ Veh (s)			
5		EBT	69	214.4	76	387.9	83	223.3	90	283.5			
5		WBT	57	1.6	63	5.0	68	9.4	74	7.1			
0		NBT	35	1.4	39	3.1	42	2.7	46	4.3			
9		SBT	63	3.7	69	13.4	76	5.1	82	14.0			
24		NBT	35	696.4	39	429.6	42	396.3	46	340.2			
24		SBT	63	2.4	69	3.7	76	3.9	82	4.6			
20		EBT	69	1.8	76	4.4	83	3.1	90	5.5			
29		WBT	57	292.9	63	12.9	68	17.7	74	25.2			

Table 4.5:Effect of increased link speed on the Network Delays- Evening Peak

Intersection	ersection Street Lane Baseline Baseline Percentage Incremental Link Speed- Evening Peak									
	INAILIE	Group	Speed	(s)	10% incr	10% increase		ocrease	30% increase	
			(k/h)		Adjusted Speed (km/h)	Delay/ Veh (s)	Adjusted Speed (km/h)	Delay/ Veh (s)	Adjusted Speed (km/h)	Delay/ Veh (s)
37		EBT	69	2.8	76	5.3	83	5.1	90	6.7
57		WBT	57	996.6	63	15.1	68	16.3	74	24.0
40		NBT	35	2.0	39	4.3	42	4.3	46	5.7
40		SBT	63	4.8	69	21.7	76	13.0	82	16.4
42		EBT	69	6.6	76	33.2	83	9.9	90	20.9
42		WBT	57	293.9	63	2.7	68	2.9	74	4.0
16		NBT	35	2.8	39	3.2	42	5.5	46	12.2
40		SBT	63	1.7	69	2.6	76	8.5	82	2.3
ſ	TOTAL NE	ETWORK		745.6		278.3		256.9		267.8

4.3 Discussions

4.3.1 Existing Scenario

From Table 4.3, the Tetteh Quarshie Interchange presently is over congested with the evening peak showing the worse. The simulation resulted in ICU of **108 %** and **125 %** for morning and evening peaks respectively representing LOS of G and H.

4.3.2 Improved Legs Scenario

A sensitivity analysis performed by varying the speeds on the main-links namely N1-Tetteh Quarshie- Mallam and N4-Tetteh Quarshie-Pantang affected the delays on those links of the Interchange and eventually on the over-all cumulative delay of the Interchange. Tables 4.4 and 4.5 show 10 %, 20 % and 30 % increase in speeds on the main-links (ie N1 and N4) and their corresponding delays. For instance 10 % increase in speed on the main links reduced the overall delay from 745.6 to 278.3 sec/veh in the case of the evening peak representing about 63 % reduction. The simulation results showed progressive reduction in delays when speeds were increased by 10 % and 20 %. However 30 % increase in speeds showed an increase in the over-all delay of the Interchange. This could be attributed to the fact the gap-seeking from the ramps becomes difficult at very high speeds on the mainlines.

4.4 Limitation of Study

Some of the traffic volumes were replicated between the morning and evening peaks. Also where link speed count could not be performed the default setting was adopted. Traffic data collection did not include pedestrian counts and other forms of transport such as cycles. Thus the simulation results did not feature the influence of pedestrians and cyclists on the performance of the Tetteh Quarshie in this study.

5.0: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The performance of the Tetteh Quarshie Interchange has been studied. The objectives of the study were to assess the over-all performance of the present Interchange configuration; establish the impact of the on-going legs improvements namely Tetteh Quarshie- Mallam and Tetteh Quarshie-Panteng would have on the performance of the interchange; establish a calibrated model for future studies on the Tetteh Quarshie Interchange.

The outcome of the study is a useful guide to transportation professionals to assess the performance of any grade-separated interchange before its implementation.

The key research findings are highlighted as follows:

- The present configuration of the Tetteh Quarshie Interchange is congested for the traffic volumes currently being handled.
- Any ancillary structures that tend to reduce such as speed humps, pelican lights etc would further worsen the performance of the Interchange.
- The on-going legs improvement would improve on the performance of the Interchange by reducing the over-all delay of the Interchange through link speed increase.

5.2 **Recommendations**

Based on the above findings the following recommendations are proposed:

• Other alternative routes should be constructed and improved upon to reduce the volume of traffic using the Tetteh Quarshie Interchange.

- Any ancillary structures that would reduce speeds especially on the main links (i.e. N1 and N4) should be discouraged. The present two pelican lights on the N4 even though were not considered in the study in my opinion if replaced with pedestrian overhead bridge would improve on the over-all performance of the Interchange.
- Further research should be carried out to assess the impact of the pelican lights on the N4 and how it affects the over-all performance of the Interchange.



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APPENDIX A- MANUAL TRAFFIC COUNT RESULTS

KNUST



Figure A1: Sample Sheet of Manual Classified Count Form

Table A1:Morning and Evening Peak Traffic- NORTH BOUND (N4)

DATE(MOR) DATE(EVE)		LOCATION TETTEH QUARSHIE INTERCHANGE STATION NO NORTH BOUND							RCHANGE	
					CLASS	IFICATION				ĺ.
DURATION	CARS	PICK-UP	SMALL BUS	MEDIUM BUS	LARGE BUS	LIGHT TRUCK	MEDIUM TRUCK	HEAVY TRUCK	TRUCK TRAILER	TOTAL(PCE)
7:00-7:15	425	51	56	33	2	8	2	1	1	617
7:15-7:30	315	60	38	33	1	6	1	1	1	485
7:30-7:45	250	103	56	77	3	11	0	1	0	548
7:45-8:00	155	80	85	57	0	10	0	0	0	431
8:00-8:15	210	90	85	73	0	6	0	2	3	519
8:15-8:30	175	75	50	49	6	8	2	0	2	409
8:30-8:45	170	80	50	49	2	7	1	0	6	409
8:45-9:00	200	80	55	50	1	5	2	0	2	431
9:00-9:15	192	98	62	70	0	7	1	0	7	488
9:15-9:30	215	101	50	51	4	10	2	3	3	490
9:30-9:45	200	86	65	58	1	10	0	3	3	477
9:45-10:00	176	78	58	50	1	4	2	2	3	414
2 00 2 15	405		FC	22	2					C17
3:00-3:15	425	51	56	33	2	8	2	1	1	617
3:15-3:30	315	60	38	33	1	6		1	1	485
3:30:3:45	515	6/	100	66	0	8	0	0	0	802
3:45-4:00	417	195	42	35	0	12	0	5	2	754
4:00-4:15	494	75	75	30	2	8	0	3	0	734
4:15-4:50	478	70	25	34	3	8	1	1	1	707
4:30-4:45	521	78	25	43	2	8		1	1	707
4:45-5:00	227	04	47	29	3	22	2	3	1	704
5:00-5:15	272	84 126	44 EE	48	10	22 E	E	4	2	700
5:15-5:30	572	04	55	50	19	2	5		2	709
5:45-6:00	567	54	35	28	0	7	0	2	2	737
5.45-0.00	507	00		20	0	<u> </u>		2	2	131
PCE VALUES	1	1	1.2	1.2	1.5	2.6	2.6	2.6	2.7	
	Δκ									
7:00-7:15	425	51	56	33	2	8	2	1	1	617
7:15-7:30	315	60	38	33	1	6	1	1	1	485
7:30-7:45	250	103	56	77	3	11	0	1	0	548
7:45-8:00	155	80	85	57	0	10	0	0	0	431
	V	14	5	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~				59		
5:00-5:15	337	8/	44	48	2	22		1	0	607
5:15-5:30	272	126	55	40	10	5	5		2	709
5:30-5:45	551	94	52	59	3	7	5		2	819
5:45-6:00	567	66	35	28	0	7	0	2	2	737
5.45 0.00	507	00	33	20	0	,	Ū	2	2	/3/
PEAK HOUR F	ACTOR=	<u>VOL</u> 4*VOL. D	UME DURI URING PEA	NG PEAK HO AK 15 MIN. V	<u>DUR</u> WITHIN PE	AK HOUR	DESIGN HO	URLY VOL.=	<u>PEAK HO</u> PEAK HI	OUR VOLUME OUR FACTOR
MORNING PEAK HOUR FA	ACTOR=	0.843					DESIGN HO % HV=	URLY VOL.=	2468 3	
EVENING PEAK HOUR FA	ACTOR=	0.877					DESIGN HO % HV=	URLY VOL.=	3276 2	

MANUAL TRAFIC COUNT

Table A3:Morning and Evening Peak Traffic-SOUTH BOUND (N4)

DATE(MOR) DATE(EVE)	4 August 4 August	t 2010 LOCATION t 2010 STATION NO					TETTEH QUA SOUTH BOU	RCHANGE		
	0	5								ſ
	1				CLASS	FICATION				
DURATION	CARS	PICK-UP	SMALL BUS	MEDIUM BUS	LARGE BUS	LIGHT TRUCK	MEDIUM TRUCK	HEAVY TRUCK	TRUCK TRAILER	TOTAL(PCE)
7:00-7:15										0
7:15-7:30										0
7:30-7:45	240	31	24	20	3	2	1	1	1	341
7:45-8:00	772	22	64	70	2	5	0	3	3	987
8:00-8:15	657	50	40	64	4	10	1	15	1	908
8:15-8:30	865	53	66	71	3	1	3	0	0	1097
8:30-8:45	665	38	62	74	2	7	1	1	0	893
8:45-9:00	545	26	20	47	2	5	0	0	2	673
9:00-9:15	425	36	33	31	3	9	7	4	0	594
9:15-9:30	500	35	33	21	2	13	4	3	2	660
9:30-9:45	315	30	47	30	3	10	7	3	3	502
9:45-10:00	462	48	43	27	5	7	0	1	1	625
0.00.0.15				10				-		101
3:00-3:15	310	45	35	40	1	7	7	0	3	491
3:15-3:30	320	105	65	60	1	10	2	5	1	623
3:30:3:45	335	80	45	65	2	6	3	2	2	584
3:45-4:00	320	95	45	30	5	11	2	6	4	573
4:00-4:15	270	100	40	30	3	11	2	6	2	513
4:15-4:30	330	105	45	30	0	6	1	0	2	549
4:30-4:45	310	85	40	60	1	12	2	4	3	571
4:45-5:00	403	90	60	45	1	4	0	0	2	636
5:00-5:15	286	90	30	45	2	6	1	5	5	514
5:15-5:30	310	130	30	45	0	12	2	2	2	577
5:30-5:45	330	120	35	35	0	17	2	2	1	591
5:45-6:00	285	110	37	47	0	6	2	0	2	522
PCE VALUES	1	1	1.2	1.2	1.5	2.6	2.6	2.6	2.7	
	FAK									
8:00-8:15	657	50	40	64	4	10	1	15	1	908
8:15-8:30	865	53	66	71	3	1	3	0	0	1097
8:30-8:45	665	38	62	74	2	7	1	1	0	893
8:45-9:00	545	26	20	47	2	5	0	0	2	673
		2		-			- /	5		
EVENING PER		100	40	20		1.1	2	6	2	F1 2
4:00-4:15	270	100	40	30	3		2	0	2	513
4:15-4:50	210	105	45	50	1	12		4	2	549
4:45-5:00	403	90	60	45	1	4	0	0	2	636
4.45-5.00	405	50	00	45	-	-	0	0	2	050
PEAK HOUR	FACTOR=	<u>VOL</u> 4*VOL. [UME DURI OURING PE	<u>NG PEAK HC</u> AK 15 MIN. V	<u>UR</u> VITHIN PE	AK HOUR	DESIGN HOU	JRLY VOL.=	<u>РЕАК НС</u> РЕАК НС	DUR VOLUME DUR FACTOR
MORNING PEAK HOUR	FACTOR=	0.814					DESIGN HOU % HV=	JRLY VOL.=	4389 2	
EVENING										
PEAK HOUR	FACTOR=	0.892					DESIGN HOL	JRLY VOL =	2545	

% HV=

MANUAL TRAFIC COUNT

Table A4: Morning and Evening Peak Traffic-SOUTH WEST SLIP

MANUAL TRAFIC COUNT

DATE(MOR) DATE(EVE)	Thursday Friday, 00	, 05 August 6 August 20	: 2010 10		LOCATION STATION N	10	TETTEH QUA SOUTH WES	RCHANGE		
					CLASS	IFICATION				
DURATION	CARS	PICK-UP	SMALL BUS	MEDIUM BUS	LARGE BUS	LIGHT TRUCK	MEDIUM TRUCK	HEAVY TRUCK	TRUCK TRAILER	TOTAL(PCE)
7:00-7:15	223	95	36	4	0	5	3	1	0	389
7:15-7:30	178	66	40	3	0	1	2	0	0	303
7:30-7:45	191	60	20	21	0	5	1	1	0	318
7:45-8:00	190	94	13	24	1	4	0	1	0	343
8:00-8:15	165	85	25	25	2	4	1	0	0	326
8:15-8:30	163	96	20	24	0	11	2	0	0	346
8:30-8:45	210	100	20	23	0	7	0	0	0	380
8:45-9:00	107	53	9	6	0	10	0	0	0	204
9:00-9:15	90	50	15	1	0	2	3	1	0	175
9:15-9:30	76	47	13	0	0	2	4	1	0	157
9:30-9:45	114	58	18	1	1	6	5	2	0	230
9:45-10:00	99	43	15	0	1	5	0	0	0	175
3:00-3:15										
3:15-3:30										
3:30:3:45	58	25	3	0	0	5	3	1	0	110
3:45-4:00	81	38	10	2	0	3	6	0	0	157
4:00-4:15	73	42	7	0	0	4	4	2	0	149
4:15-4:30	92	39	10	1	2	3	4	1	0	168
4:30-4:45	86	42	10	2	9	6	5	2	0	190
4:45-5:00	81	33	8	3	0	2	6	2	0	153
5:00-5:15	83	30	4	0	3	3	6	0	0	146
5:15-5:30	90	42	13	2	0	1	1	0	0	155
5:30-5:45	106	32	15	0	0	5	2	3	0	182
5:45-6:00	76	28	3	1	0	5	6	0	0	119
			~	22	2					
PCE VALUES	1	1	1.2	1.2	1.5	2.6	2.6	2.6	2.7	
MORNING PE	АК									
7:00-7:15	223	95	36	4	0	5	3	1	0	389
7:15-7:30	178	66	40	3	0	1	2	0	0	303
7:30-7:45	191	60	20	21	0	5	1	1	0	318
7:45-8:00	190	94	13	24	1	4	0	1	0	343
		3						121		
EVENING PEA		10			-					1.10
4:00-4:15	/3	42	1	0	0	4	4	2	0	149
4:15-4:30	92	39	10	1	2	3	4	1		168
4:30-4:45	86	42	10	2	9	6	5	2		190
4:45-5:00	81	33	8	3	0	2	6	2	0	153
PEAK HOUR F	ACTOR=	<u>VO</u> 4*VOL.	<u>LUME DUR</u> DURING P	<u>ING PEAK HO</u> EAK 15 MIN.	<u>DUR</u> WITHIN PE	AK HOUR	DESIGN HOU	JRLY VOL.=	<u>PEAK HO</u> PEAK HI	<u>OUR VOLUME</u> OUR FACTOR
<u>MORNING</u> PEAK HOUR F	ACTOR=	0.869					DESIGN HOU % HV=	JRLY VOL.=	1558 3	
<u>EVENING</u> PEAK HOUR F	ACTOR=	0.870					DESIGN HOU	JRLY VOL.=	759	

8

% HV=

Table A5: Morning and Evening Peak Traffic-SOUTH WEST LOOP.

MANUAL TRAFIC COUNT

DATE(MOR): DATE(EVE):	Friday, O	6 August 20	010		LOCATION	N: NO:	TETTEH QUA SOUTH WES			
					CLAS	SIFICATION				1
DURATION	CARS		SMALL	MEDIUM	LARGE	LIGHT	MEDIUM	HEAVY	TRUCK	
DURATION	CARS	PICK-UP	BUS	BUS	BUS	TRUCK	TRUCK	TRUCK	TRAILER	TOTAL(PCE)
7:00-7:15										0
7:15-7:30	31	11	2	1	0	1	0	2	1	56
7:30-7:45	37	18	1	2	0	0	1	2	0	66
7:45-8:00	35	19	1	0	0	3	0	2	1	71
8:00-8:15	45	13	3	1	0	7	1	1	2	92
8:15-8:30	32	22	0	1	0	1	0	1	1	63
8:30-8:45	48	19	3	1	0	3	2	3	1	95
8:45-9:00	44	18	1	4	0	5	2	3	1	97
9:00-9:15	50	30	3	2	0	4	1	6	4	125
9:15-9:30	55	34	2	4	0	4	2	5	3	133
9:30-9:45	57	41	3	2	0	7	2	1	0	130
9:45-10:00	72	34	8	2	0	3	4	3	3	152
3:00-3:15									1	0
3.15-3.30									<u> </u>	0
3.30.3.45	65	25	7	1	3	3	1	2	2	125
3.45-4.00	89	30	4	2	1	3	4	6	3	170
4:00-4:15	92	38	3	2	1	7	3	3		170
4:15-4:30	86	/3	1	2	0	, 5	0	1	2	154
4:30-4:45	97	45	4	4	0	5	3	2	0	179
4:45-5:00	101	30	1	+	1	5	2	0	4	164
5:00-5:15	101	30	6	7	1	1	2	1	2	172
5.00-5.15	101	40	2	15	1	4	2	0	2	212
5.13-5.50	142	40	0	13	0	7	1	2	<u> </u>	215
5.30-3.45	145	47	0	12	0	/	1	2	2	245
5.45-6.00	120	60	3	4	0	0	0	3	3	251
PCE VALUES	1	1	1.2	1.2	1.5	2.6	2.6	2.6	2.7]
	AK									
9.00-9.15	50	30	3	2	0	4	1 1	6	4	125
9.15-9.30	55	34	2	4	0	4	2	5	3	133
9:30-9:45	57	41	3	+	0	7	2	1		130
9:45-10:00	72	34	8	2	0	3	4	3	3	152
5.45 10.00	72	34	<u> </u>	-	0				<u> </u>	152
EVENING PEA	K	12				_		651		
5:00-5:15	101	30	6	7	1	4	2	1	2	172
5:15-5:30	125	40	3	15	0	4	3	0	3	213
5:30-5:45	143	47	8	12	0	7	1	3	0	243
5:45-6:00	126	60	3	4	0	8	0	3	3	231
PEAK HOUR F	ACTOR=	VOLUME DURING PEAK H 4*VOL. DURING PEAK 15 MIN			<u>DUR</u> . WITHIN P	PEAK HOUR	DESIGN HOU	RLY VOL.=	<u>PEAK HO</u> PEAK HO	OUR VOLUME OUR FACTOR
MORNING										
PEAK HOUR F	ACTOR=	0.888					DESIGN HOU % HV=	RLY VOL.=	608 11	
PEAK HOUR F	ACTOR=	0.884					DESIGN HOU	RLY VOL =	970	
· LAN HOUNT		0.004					SESION NOU	THE VOL	270	

% HV=

Table A6:Morning and Evening Peak Traffic-SOUTH EAST SLIP 1.

MANUAL TRAFIC COUNT

DATE(MOR):					LOCATION	:	TETTEH QUA			
DATE(EVE): Friday, 06 August 2010										
					CLASS	IFICATION				l
DURATION	CARS	PICK-LIP	SMALL	MEDIUM	LARGE	LIGHT	MEDIUM	HEAVY	TRUCK	
DONATION	CANO	TICK OF	BUS	BUS	BUS	TRUCK	TRUCK	TRUCK	TRAILER	TOTAL(I CL)
7:00-7:15										0
7:15-7:30										0
7:30-7:45										0
7:45-8:00										0
8:00-8:15										0
8:15-8:30								_		0
8:30-8:45										0
8:45-9:00										0
9:00-9:15)			0
9:15-9:30										0
9:30-9:45										0
9:45-10:00										0
3:00-3:15	188	75	16	1	2	11	4	5	1	341
3:15-3:30	196	96	42	5	2	8	4	6	0	398
3:30:3:45	204	88	22	2	1	7	6	1	0	359
3:45-4:00	220	99	51	1	5	3	8	4	0	428
4:00-4:15	270	110	48	4	5	4	5	4	0	484
4:15-4:30	258	116	35	5	2	8	1	0	1	451
4:30-4:45	277	107	54	2	3	3	10	3	0	497
4:45-5:00	208	110	54	1	3	5	3	4	0	420
5:00-5:15	180	69	42	2	5	4	5	4	0	343
5:15-5:30	234	98	47	1	1	6	5	2	1	428
5:30-5:45	235	110	37	7	4	2	7	3	0	435
5:45-6:00	206	113	34	1	4	2	2	3	0	385
PCE VALUES	1	1	1.2	1.2	1.5	2.6	2.6	2.6	2.7	

EVENING PEA	АK		710							
4:00-4:15	270	110	48	4	5	4	5	4	0	484
4:15-4:30	258	116	35	5	2	8	1	0	1	451
4:30-4:45	277	107	54	2	3	3	10	3	0	497
4:45-5:00	208	110	54	1	3	5	3	4	0	420
PEAK HOUR F	FACTOR= VOLUME DURING PEAK HOUR 4*VOL. DURING PEAK 15 MIN. WITHIN PEAK HOUR					AK HOUR	DESIGN HO	URLY VOL.=	<u>PEAK HO</u> PEAK HI	<u>OUR VOLUME</u> OUR FACTOR
MORNING PEAK HOUR F	DRNING AK HOUR FACTOR= #DIV/0!						DESIGN HO % HV=	URLY VOL.=	#DIV/0! #DIV/0!	
EVENING PEAK HOUR FACTOR= 0.931						DESIGN HO % HV=	URLY VOL.=	1989 4		

Table A7: Morning and Evening Peak Traffic- SOUTH EAST SLIP 2

MANUAL TRAFIC COUNT

DATE(MOR) DATE(EVE)		LOCATION TETTEH STATION NO SOUTH						TETTEH QUARSHIE INTERCHANGE SOUTH EAST SLIP 2		
		r			CLASS	SIFICATION	ſ			1
			SMALL	MEDIUM	LARGE	LIGHT	MEDIUM	HEAVY	TRUCK	
DURATION	CARS	PICK-UP	BUS	BUS	BUS	TRUCK	TRUCK	TRUCK	TRAILER	TOTAL(PCE)
7:00-7:15	179	21	25	30	7	6	3	4	0	310
7:15-7:30	161	7	37	23	1	8	1	1	1	270
7:30-7:45	133	25	23	12	5	6	3	0	2	236
7:45-8:00	103	13	13	17	3	7	1	1	3	188
8:00-8:15	136	8	14	16	1	10	1	3	0	218
8:15-8:30	145	25	13	25	7	10	6	1	1	273
8:30-8:45	80	20	19	20	1	2	3	5	1	177
8:45-9:00	131	37	17	11	2	6	4	4	3	249
9:00-9:15	91	44	16	12	3	3	2	3	2	199
9:15-9:30	146	53	25	20	8	11	13	5	1	343
9:30-9:45	154	53	17	12	3	14	7	2	2	312
9:45-10:00	145	51	30	15	4	8	3	8	1	308
										· · · · · · · · · · · · · · · · · · ·
3:00-3:15										0
3:15-3:30	225	76	25	22	2	6	8	4	3	415
3:30:3:45	220	80	25	6	2	7	1	0	0	361
3:45-4:00	207	52	22	20	5	8	5	1	4	364
4:00-4:15	217	75	42	17	4	8	5	1	1	408
4:15-4:30	245	66	12	16	4	8	4	1	1	387
4:30-4:45	255	39	37	16	3	12	1	2	0	401
4:45-5:00	190	67	13	31	2	6	3	4	2	352
5:00-5:15	237	70	28	15	3	12	3	0	0	402
5:15-5:30	220	72	18	1	1	19	17	3	1	420
5:30-5:45	223	73	16	10	5	6	5	1	0	366
5:45-6:00	193	73	35	18	8	13	30	2	1	461
				1.0						1
PCE VALUES	1	1	1.2	1.2	1.5	2.6	2.6	2.6	2.7	J
	AK									
0.00-0.15	AN 01	44	16	12	2	2	1 2 1	2	2	100
9:15-9:30	146	52	25	20	2	11	12	5	1	242
9:30-9:45	154	53	17	12	3	14	7	2	2	312
9:45-10:00	145	51	30	15	4	8	3	8	1	308
5.15 10.00	115	51		15						500
EVENING PEA	К									
5:00-5:15	237	70	28	15	3	12	3	0	0	402
5:15-5:30	220	72	18	1	1	19	17	3	1	420
5:30-5:45	223	73	16	10	5	6	5	1	0	366
5:45-6:00	193	73	35	18	8	13	30	2	1	461
PEAK HOUR F	ACTOR=	<u>VOL</u> 4*VOL. D	UME DURI OURING PE	ING PEAK HO AK 15 MIN. '	<u>DUR</u> WITHIN PE	AK HOUR	DESIGN HO	URLY VOL.=	<u>PEAK HO</u> PEAK HC	<u>UR VOLUME</u> PUR FACTOR
MORNING PEAK HOUR F	ACTOR=	0.847					DESIGN HO % HV=	URLY VOL.=	13 72 9	
EVENING PEAK HOUR F	ACTOR=	0.894					DESIGN HO % HV=	URLY VOL.=	1845 7	

LOCATION

Table A8: Morning and Evening Peak Traffic- SOUTH EAST LOOP 1

MANUAL TRAFIC COUNT

DATE(MOR) DATE(EVE)	Friday, 06	August 201	0	LOCATIONTETTEH QUARSHIE INTERCHANGESTATION NOSOUTH EAST LOOP 1						
					CLASS	IFICATION				1
DURATION	CARS	PICK-UP	SMALL BUS	MEDIUM BUS	LARGE BUS	LIGHT TRUCK	MEDIUM TRUCK	HEAVY TRUCK	TRUCK TRAILER	TOTAL(PCE)
7:00-7:15										0
7:15-7:30										0
7:30-7:45										0
7:45-8:00				1.71	N 11 1	1.1.2				0
8:00-8:15										0
8:15-8:30										0
8:30-8:45						Ì				0
8:45-9:00										0
9:00-9:15										0
9:15-9:30										0
9:30-9:45										0
9:45-10:00										0
									-	
3:00-3:15						17				0
3:15-3:30	157	58	13	19	1	7	4	4	1	297
3:30:3:45	136	25	19	13	0	8	3	2	2	239
3:45-4:00	120	67	12	17	2	2	1	3	1	243
4:00-4:15	160	75	13	14	0	5	2	1	0	288
4:15-4:30	146	67	15	13	0	5	2	6	4	291
4:30-4:45	147	54	17	12	0	10	0	1	0	264
4:45-5:00	133	64	16	14	0	2	1	3	2	254
5:00-5:15	152	58	7	18	0	6	0	4	0	266
5:15-5:30	160	67	20	18	0	6	2	2	1	301
5:30-5:45	149	51	21	20	1	3	0	1	4	272
5:45-6:00	172	65	13	18	1	8	0	2	0	302
									1	7
PCE VALUES		1	1.2	1.2	1.5	2.6	2.6	2.6	2.7	1

EVENING PEA	K									
5:00-5:15	152	58	7	<mark>1</mark> 8	0	6	0	4	0	266
5:15-5:30	160	67	20	18	0	6	2	2	1	301
5:30-5:45	149	51	21	20	1	3	0	1	4	272
5:45-6:00	172	65	13	18	1	8	0	2	0	302
PEAK HOUR FACTOR= <u>VOLUME DURING PEAK HOUR</u> 4*VOL. DURING PEAK 15 MIN. WITHIN PEA				AK HOUR	DESIGN HO	OURLY VOL.=	<u>PEAK HO</u> PEAK HO	<u>UR VOLUME</u> UR FACTOR		
MORNING PEAK HOUR F	ACTOR=	#DIV/0!					DESIGN HO % HV=	OURLY VOL.=	#DIV/0! #DIV/0!	
EVENING PEAK HOUR F	ACTOR=	0.945					DESIGN HO % HV=	OURLY VOL.=	1207 5	

Table A9:Morning and Evening Peak Traffic- SOUTH EAST LOOP 2

DATE(MOR) DATE(EVE)	Friday, 06 August 2010 Thursday, 05 August 2010			LOCATION STATION NO			TETTEH QUARSHIE INTERCHANGE SOUTH EAST LOOP 2			
					CLASS	IFICATION				1
DURATION	CARS	PICK-UP	SMALL BUS	MEDIUM BUS	LARGE BUS	LIGHT TRUCK	MEDIUM TRUCK	HEAVY TRUCK	TRUCK TRAILER	TOTAL(PCE)
7:00-7:15	45	17	22	17	0	5	3	0	0	130
7:15-7:30	75	19	22	31	1	3	1	1	4	183
7:30-7:45	76	31	25	18	0	2	1	2	0	172
7:45-8:00	72	19	14	9	1	5	0	2	0	138
8:00-8:15	80	32	15	12	0	5	3	4	5	189
8:15-8:30	55	21	16	8	0	1	0	5	1	123
8:30-8:45	105	18	10	12	0	1	2	1	0	160
8:45-9:00	89	35	25	25	0	3	2	2	0	202
9:00-9:15	83	37	17	13	0	0	1	8	1	182
9:15-9:30	82	45	23	15	0	5	3	5	1	209
9:30-9:45	101	52	11	16	0	3	3	1	2	209
9:45-10:00	97	40	20	12	0	2	5	5	2	212
3:00-3:15	191	80	18	12	3	14	1	2	2	361
3:15-3:30	210	60	16	12	2	11	5	5	0	361
3:30:3:45	165	85	20	15	1	10	2	3	1	335
3:45-4:00	158	92	19	17	4	8	4	2	3	344
4:00-4:15	185	90	12	12	0	13	3	8	0	366
4:15-4:30	175	65	18	19	0	8	5	4	7	348
4:30-4:45	183	72	16	12	1	13	6	2	0	345
4:45-5:00	170	75	13	18	2	11	7	1	4	345
5:00-5:15	193	62	6	11	1	15	5	5	0	342
5:15-5:30	171	68	16	14	0	7	4	5	0	317
5:30-5:45	142	60	21	15	1	10	2	2	3	291
5:45-6:00	145	50	15	22	9	3	7	1	2	287
PCE VALUES	1	1	1.2	1.2	1.5	2.6	2.6	2.6	2.7]
			6	446	\sim	S. (C.				
		27	17	12	0	0	1 1	0	1	100
9:00-9:15	00	37	22	15	0	5	1	0 F		102
9.13-9.30	101	43	11	16	0	2	2	1	2	209
9:45-10:00	97	40	20	10	0	2	5	5	2	203
	14	N. S.			-		~ /	51		
EVENING PEA		00	10	12	0	10		0		200
4:00-4:15	185	90	12	12	0	13	3	8		300
4:13-4:50	102	72	16	19	1	0	5			246
4.30-4.43	105	72	12	12	2	11	7			345
4.45-5.00	170	/3	15	10	2	11	/	1	4	545
PEAK HOUR F	ACTOR=	<u>VOL</u> 4*VOL. D	UME DURI OURING PE	ING PEAK HO AK 15 MIN.	<u>DUR</u> WITHIN PE	AK HOUR	DESIGN HO	URLY VOL.=	<u>РЕАК НО</u> РЕАК НС	UR VOLUME DUR FACTOR
MORNING PEAK HOUR F	ACTOR=	0.958					DESIGN HO % HV=	URLY VOL.=	848 6	
EVENING PEAK HOUR F	ACTOR=	0.958					DESIGN HO % HV=	URLY VOL.=	1465 7	

MANUAL TRAFIC COUNT

MANUAL TRAFIC COUNT

DATE(MOR) DATE(EVE)	Wednesday, 04 August 2010 Wednesday, 04 August 2010				LOCATION STATION N	NO	TETTEH QUARSHIE INTERCHANGE EAST BOUND			
					CLASS	SIFICATION				1
DURATION	CARS	PICK-UP	SMALL BUS	MEDIUM BUS	LARGE BUS	LIGHT TRUCK	MEDIUM TRUCK	HEAVY TRUCK	TRUCK TRAILER	TOTAL(PCE)
7:00-7:15										0
7:15-7:30										0
7:30-7:45										0
7:45-8:00										0
8:00-8:15										0
8:15-8:30	201	21	22	30	0	20	4	8	2	373
8:30-8:45	225	33	21	18	1	15	3	7	4	382
8:45-9:00	230	23	15	28	0	16	8	7	13	420
9:00-9:15	151	21	7	22	0	5	6	7	1	256
9:15-9:30	227	25	17	31	2	20	12	10	4	433
9:30-9:45	204	20	12	23	3	15	4	6	6	352
9:45-10:00	272	43	23	34	0	10	5	3	7	449
2 00 2 15	245	20	22	22	2	21	-	10	10	E 47
3:00-3:15	315	36	- 22	33	3	21	/	10	10	547
3:15-3:30	300	28	/	15	1	11	/	9	8	448
3:30:3:45	288	12	22	24	1	16	10	/	9	467
3:45-4:00	410	43	15	16	0	15	10	2	5	574
4:00-4:15	270	33	21	28	1	11	12	4	10	461
4:15-4:30	245	18	14	18	0	16	1	9	10	396
4:30-4:45	185	28	32	23	5	15	10	8	12	405
4:45-5:00	204	25	20	27	1	20	11	5	8	402
5:00-5:15	290	21	13	47	3	16	3	4	6	464
5:15-5:30	262	20	21	35	2	12	7	5	6	431
5:30-5:45	305	36	25	38	4	17	7	15	6	540
5:45-6:00	377	55	55	30	20	58	35	36	8	921
PCE VALUES	1	1	1.2	1.2	1.5	2.6	2.6	2.6	2.7]
MORNING PI	ЕАК									
9:00-9:15	151	21	7	22	0	5	6	7	1	256
9:15-9:30	227	25	17	31	2	20	12	10	4	433
9:30-9:45	204	20	12	23	3	15	4	6	6	352
9:45-10:00	272	43	23	34	0	10	5	3	7	449
EVENING PE	ΔK									
5:00-5:15	290	21	13	47	3	16	3	4	6	464
5:15-5:30	262	20	21	35	2	12	7	5	6	431
5:30-5:45	305	36	25	38	4	17	7	15	6	540
5:45-6:00	377	55	55	30	20	58	35	36	8	921
PEAK HOUR	FACTOR=	<u>VOL</u> 4*VOL. D	UME DURI URING PE	NG PEAK HO AK 15 MIN. Y	<u>DUR</u> WITHIN PE	AK HOUR	DESIGN HO	OURLY VOL.=	<u>PEAK HO</u> PEAK HC	<u>UR VOLUME</u> DUR FACTOR
MORNING										
PEAK HOUR	FACTOR=	0.829					DESIGN HO % HV=	OURLY VOL.=	1796 10	
EVENING PEAK HOUR I	FACTOR=	0.639					DESIGN H	OURLY VOL.=	3684	

% HV=

68

Morning and Evening Peak Traffic-WEST BOUND (N1) Table A11:

MANUAL TRAFIC COUNT

DATE(MOR):	Wednesday, 04 August 2010
DATE(EVE):	Wednesday, 04 August 2010

LOCATION STATION NO TETTEH QUARSHIE INTERCHANGE WEST BOUND

					CLASS	SIFICATION				
DURATION	CARS	PICK-UP	SMALL BUS	MEDIUM BUS	LARGE BUS	LIGHT TRUCK	MEDIUM TRUCK	HEAVY TRUCK	TRUCK TRAILER	TOTAL(PCE)
7:00-7:15										0
7:15-7:30										0
7:30-7:45										0
7:45-8:00										0
8:00-8:15	220	160	38	35	7	22	9	13	19	644
8:15-8:30	305	200	68	38	3	11	2	2	1	678
8:30-8:45	345	165	50	45	7	12	3	6	2	695
8:45-9:00	310	161	51	31	6	17	5	5	1	651
9:00-9:15	300	165	29	31	6	11	5	19	11	667
9:15-9:30	240	130	41	36	4	10	3	6	6	534
9:30-9:45	275	163	40	42	3	12	8	4	2	609
9:45-10:00	330	175	51	38	3	12	7	4	6	692
								7		
3:00-3:15	215	150	50	25	5	21	5	1	10	560
3:15-3:30	255	140	43	20	0	25	6	4	15	602
3:30:3:45	230	150	46	40	3	15	6	8	23	625
3:45-4:00	225	110	33	20	4	18	5	5	13	513
4:00-4:15	220	160	38	35	7	22	9	13	19	644
4:15-4:30	185	80	37	18	6	14	5	6	15	446
4:30-4:45	280	115	40	37	29	22	8	7	8	649
4:45-5:00	205	80	33	26	11	14	6	3	12	465
5:00-5:15	230	66	47	30	9	19	6	5	8	502
5:15-5:30	185	91	34	32	2	11	6	9	11	456
5:30-5:45	230	104	32	25	1	5	5	4	8	462
5:45-6:00	225	130	50	41	7	17	9	8	8	585
			/ 7					~		
PCE VALUES	1	1	1.2	1.2	1.5	2.6	2.6	2.6	2.7	
MORNING PE	<u>AK</u>									
8:00-8:15	220	160	38	35	7	22	9	13	19	644
8:15-8:30	305	200	68	38	3	11	2	2	1	678
8:30-8:45	345	165	50	45	7	12	3	6	2	695
8:45-9:00	310	161	51	31	6	17	5	5	1	651
EVENING PEA	ĸ	E	2	1	-	-	5/	5		
4:00-4:15	220	160	38	35	7	22	9	13	19	644
4:15-4:30	185	80	37	18	6	14	5	6	15	446
4:30-4:45	280	115	40	37	29	22	8	7	8	649
4:45-5:00	205	80	33	26	11	14	6	3	12	465
PEAK HOUR F	ACTOR=	VOL	UME DURI	NG PEAK H	OUR		DESIGN H	OURLY VOL.=	PEAK HC	
		4*VOL. D	URING PE	4K 15 MIN.	WITHIN PE	AK HOUR			PEAK HO	OUR FACTOR
MORNING	ACTOR=	0.960					DESIGN H		2779	
		5.500					% HV=		6	
EVENING PEAK HOUR F	ACTOR=	0.849					DESIGN HO % HV=	OURLY VOL.=	2595 11	

Table A12: Morning and Evening Peak Traffic- NORTH WEST LOOP.

MANUAL TRAFIC COUNT

DATE(MOR)	Wednesday, 04 August 2010
DATE(EVE)	Tuesday, 03 August 2010

LOCATION STATION NO TETTEH QUARSHIE INTERCHANGE NORHT WEST LOOP

	-				CLASS	SIFICATION				
DURATION	CARS		SMALL	MEDIUM	LARGE	LIGHT	MEDIUM		TRUCK	TOTAL (DCE)
DURATION	CARS	FICK-OF	BUS	BUS	BUS	TRUCK	TRUCK	HEAVITROCK	TRAILER	TOTAL(FCE)
7:00-7:15										0
7:15-7:30	217	71	20	4	4	4	0	3	1	344
7:30-7:45	196	70	19	5	2	6	1	2	0	321
7:45-8:00	152	66	11	0	5	1	2	2	1	254
8:00-8:15	173	64	20	7	6	4	4	2	0	304
8:15-8:30	158	86	14	1	7	5	1	3	0	296
8:30-8:45	124	58	18	2	2	5	2	0	0	227
8:45-9:00	161	78	28	5	5	12	0	2	0	323
9:00-9:15	180	70	41	5	4	13	0	2	0	350
9:15-9:30	172	87	43	11	4	11	0	5	1	374
9:30-9:45	213	81	36	8	5	5	0	4	0	378
9:45-10:00	173	83	38	10	2	14	0	3	0	361
3:00-3:15							1			0
3:15-3:30	175	103	42	3	3	7	3	1	7	384
3:30:3:45	162	64	43	4	3	7	1	- 1	2	316
3.45-4.00	253	95	70	11	6	8	6	0	1	493
4:00-4:15	215	80	35	7	2	20	9	0	4	435
4.15-4.30	222	110	59	7	2	1	2	2	4	438
4:30-4:45	110	49	30	2	0	4	3	0	0	216
4:45-5:00	188	102	70	4	0	11	1	2	0	415
5:00-5:15	96	61	/3	2	4	14	1	2	0	262
5:15-5:30	223	90	55	13	2	13	3	2	3	453
5:30-5:45	180	75	43	10	7	5	7	4	3	379
5:45-6:00	162	155	43	10	1	7	2	2	2	415
5.45 0.00	102	155	42	10	-	· · ·	2	2	2	415
PCE VALUES	1	1	12	12	15	2.6	26	2.6	27	1
	-	-	1.2	1.2	1.5	2.0	2.0	2.0	2.7	1
	FAK									
9.00-9.15	180	70	41	5	4	13	0	2	0	350
9:15-9:30	172	87	41	11	4	11	0	5	1	374
9:30-9:45	213	81	36	8	5	5	0	4	0	378
9:45-10:00	173	83	38	10	2	14	0	3	0	361
5.45 10.00	175	05	50	10	2	17				501
5:00-5:15	96	61	43	3	4	14	1	2	0	262
5:15-5:30	223	90	55	13	2	13	3	2	3	453
5:30-5:45	180	75	43	10	7	5	7	4	3	379
5:45-6:00	162	155	43	10	, 1	7	2		2	415
5.45 0.00	102	155	42	10	_	· · ·	2	2	2	415
	EACTOR-	VOI		NG DEAK H						
FLAKHOOK	FACTOR-			VK 15 MIN			DESIGN	JORLI VOL		
		4 VOL. L		AK 15 WIIN.		AK HUUK			PEAK HU	OK FACTOR
MORNING										
INORINING	FACTOR-	0.000					DECICNUM		4 6 4 4	
FEAK HOUR	FACIOR=	0.968						JURLI VUL.=	1511	
							% HV=		5	
EVENING	FACTOR	0.022					DECICNUM		1010	
PEAK HOUR	FACIOR=	0.833						JUKLY VOL.=	1810	
							% HV=		5	

Table A13: Morning and Evening Peak Traffic- NORTHWEST SLIP

MANUAL TRAFIC COUNT

DATE(MOR):	Wednesday, 04 August 2010
DATE(EVE):	Wednesday, 04 August 2010

LOCATION: STATION NO: TETTEH QUARSHIE INTERCHANGE NORTHWEST SLIP

			CLASSIFICATION							
			SMALL	MEDIUM	LARGE	LIGHT	MEDIUM		TRUCK	
DURATION	CARS	PICK-UP	BUS	BUS	BUS	TRUCK	TRUCK	HEAVY TRUCK	TRAILER	TOTAL(PCE)
7:00-7:15	17	11	7	3	0	1	0	0	0	43
7:15-7:30	63	27	9	7	0	0	0	0	0	109
7:30-7:45	60	19	39	14	7	0	2	1	3	169
7:45-8:00	90	20	14	7	0	1	0	0	0	138
8:00-8:15	68	27	18	6	0	3	0	2	0	137
8:15-8:30	86	29	11	13	0	1	0	1	0	149
8:30-8:45	63	21	11	7	0	0	0	0	0	106
8:45-9:00	75	24	7	7	0	2	0	1	0	124
9:00-9:15	64	24	12	10	0	1	1	0	0	120
9:15-9:30	50	25	15	21	0	2	2	1	0	131
9:30-9:45	56	25	8	7	0	2	0	0	0	104
9:45-10:00	48	22	8	10	0	3	0	0	1	102
3:00-3:15	31	6	8	0	0	2	1	2	0	60
3:15-3:30	34	7	8	0	0	2	0	1	0	58
3:30:3:45	31	13	12	0	0	1	1	2	0	69
3:45-4:00	13	12	6	0	0	1	0	0	0	35
4:00-4:15	33	8	7	0	0	2	0	0	1	57
4:15-4:30	44	9	4	0	0	1	1	2	1	71
4:30-4:45	28	5	3	0	0	0	1	1	1	45
4:45-5:00	32	8	2	0	1	3	0	1	0	54
5:00-5:15	28	6	2	1	0	0	0	0	0	38
5:15-5:30	24	6	1	0	0	2	0	0	0	36
5:30-5:45	23	6	2	1	0	0	0	1	0	35
5:45-6:00	42	11	0	0	1	1	1	0	0	60
			5				122	-		
PCE VALUES	1	1	1.2	1.2	1.5	2.6	2.6	2.6	2.7	
	AK 17	11	7	2	0	1	0	0	0	42
7:00-7:15	62	27	/	3	0	1	0	0	0	43
7.13-7.30	60	10	30	14	7	0	2	1	2	169
7:30-7:43	00	20	39	14	/	1	2	1	0	129
7.43-8.00	50	20	14	/	0	1	0	0	0	130
EVENING PEA	K									
4:00-4:15	33	8	7	0	0	2	0	0	1	57
4:15-4:30	44	9	4	0	0	1	1	2	1	71
4:30-4:45	28	5	3	0	0	0	1	1	1	45
4:45-5:00	32	8	2	0	1	3	0	1	0	54
			-	20	TA NE	100		-		
PEAK HOUR F	ACTOR=	VOL	UME DURI	NG PEAK H	OUR		DESIGN HO	OURLY VOL.=	PEAK HO	<u>UR VOLUME</u>
		4*VOL. D	URING PEA	AK 15 MIN.	WITHIN PE	AK HOUR			PEAK HO	UR FACTOR
MODNING										
	ACTOR	0.070					DECICNUM		676	
PEAK HOUR F	ACTOR=	0.678						JUKLY VOL.=	676	
					% HV=		3			
					DESIGNUM		304			
PEAK HOUR FACTOR=		0.800					% HV=	JUNLI VUL.=	284	

Table A14:Morning and Evening Peak Traffic- NORTH EAST LOOP.

MANUAL TRAFIC COUNT

DATE(MOR) DATE(EVE)	Wednesda Tuesday, (ay, 04 Augu: 03 August 2	st 2010 010	LOCATION: STATION NO:			TETTEH QUARSHIE INTERCHANGE NORHT EAST LOOP			
		r			CLASS		1			1
			CNAALL						TRUCK	
DURATION	CARS	PICK-UP	BUS	BUS	BUS	TRUCK	TRUCK	HEAVY TRUCK	TRUCK	TOTAL(PCE)
7:00-7:15	173	60	16	0	3	1	2	0	0	265
7:15-7:30	154	80	7	1	0	6	2	0	0	264
7:30-7:45	150	72	17	0	1	3	4	0	0	262
7:45-8:00	134	74	8	1	2	4	4	0	0	243
8:00-8:15	153	66	11	0	5	6	4	1	0	268
8:15-8:30	136	85	13	0	1	5	3	2	0	264
8:30-8:45	120	68	20	0	1	6	4	1	0	242
8:45-9:00	104	82	19	3	1	14	0	0	0	250
9:00-9:15	122	64	14	1	0	12	0	1	1	241
9:15-9:30	112	63	12	0	0	11	3	1	0	228
9:30-9:45	120	73	16	0	0	8	2	2	1	246
9:45-10:00	106	58	10	0	0	9	2	3	0	212
3.00-3.12		1		1			1			0
3.15-3.30	93	42	8	1	0	14	1	3	0	193
3.30.3.45	111	58	16	0	1	12	4	0	0	231
3:45-4:00	122	52	22		3	11	3	0	0	243
4:00-4:15	2/1	101	33	1	3	21	7	0	1	463
4:15-4:20	110	25	10	2	0	14	1	0	2	403
4:13-4:30	124	25	10	1	0	12	5	2	2	223
4:45 5:00	106	55	15	1	1	15	1	2	0	232
5:00-5:15	122	22	17		1	0	1	2	0	227
5.00-5.15	100	20	1/	5	1	0	4	4	0	233
5:15-5:50	121	30	14	1	0	0	2	1	0	210
5:30-5:45	123	44	14	1	2	8	1	0	0	223
5:45-6:00	96	32	14	1 1	1	4	6	2	0	1/9
PCE VALUES	1	1	1.2	1.2	1.5	2.6	2.6	2.6	2.7]
	- AK									
8:00-8:15	153	66	11	0	5	6	4	1	0	268
8:15-8:30	136	85	13	0	1	5	3	2	0	264
8:30-8:45	120	68	20	0	1	6	4	1	0	242
8:45-9:00	104	82	19	3	1	14	0	0	0	250
	V									
4.00-4.15	2/1	101	22	1	3	21	7	0	1	463
4:15-4:30	110	25	19	2	0	14	1	0	2	403
4.13-4.30	124	25	10	1	0	12		2	2	223
4:45-5:00	106	53	14	1	1	15	1	2	0	232
4.45 5.00	100	55	15	-	-	1.15	-	2	0	227
PEAK HOUR I	HOUR FACTOR= VOLUME DUR 4*VOL. DURING PE		UME DURI DURING PE	<u>NG PEAK HOUR</u> AK 15 MIN. WITHIN PEAK HOUR			DESIGN HOURLY VOL.=		PEAK HOUR VOLUME PEAK HOUR FACTOR	
MORNING										
	FACTOR=	0.955					DESIGN HI % HV=	OURLY VOL.=	1073 5	
PEAK HOUR	ACTOR=	0.618					DESIGN H	OURLY VOL.=	1851	

% HV=

Morning and Evening Peak Traffic- NORTH EAST SLIP. Table A15:

MANUAL TRAFIC COUNT

DATE(MOR): DATE(EVE):					LOCATION	: 10:	TETTEH QUARSHIE INTERCHANGE NORTH EAST SLIP			
					CLASS	IFICATION				
DURATION	CARS	PICK-UP	SMALL BUS	MEDIUM BUS	LARGE BUS	LIGHT TRUCK	MEDIUM TRUCK	HEAVY TRUCK	TRUCK TRAILER	TOTAL(PCE)
7:00-7:15										0
7:15-7:30	47	15	5	0	0	0	5	2	0	86
7:30-7:45	41	11	9	0	0	0	2	0	0	68
7:45-8:00	43	15	6	0	0	0	1	3	1	78
8:00-8:15	51	27	8	0	0	1	1	1	0	95
8:15-8:30	43	23	7	0	0	3	3	0	0	90
8:30-8:45	34	23	7	0	0	2	2	4	1	89
8:45-9:00	48	12	10	0	0	1	4	7	0	103
9:00-9:15	25	14	7	1	0	2	0	1	0	56
9:15-9:30	39	17	6	0	1	2	1	2	1	80
9:30-9:45	38	16	11	1	0	1	4	3	1	92
9:45-10:00	45	21	7	0	0	2	1	5	0	95
2.00 2.15	20	12	7		0	2		C	0	75
3:00-3:15	30	13	/	0	0	3	0	6	0	75
3:15-3:30	30	1/	6	0	0	2	3	2	0	72
3:30:3:45	33	16	5	0	1	3	5	0	0	//
3:45-4:00	34	20	10	1	0	1	4	3	0	84
4:00-4:15	35	15	10	0	0	2	2	2	1	80
4:15-4:30	29	1/	9	1	0	5	3	1	1	84
4:30-4:45	51	23	0 10	1	0	2	3	1	0	80
5:00 5:15	20	40	12	0	1	3	2	Z E	0	134
5.00-5.15	20	40	9	1	1	4	2	5	0	08
5.20 5.45	40	22	12	0	1	5	2	4	0	120
5:45-6:00	76	25	10	0	0	5	2	5	1	153
5.45-0.00	70	25	10		0	5	4		1	152
PCE VALUES	1	1	1.2	1.2	1.5	2.6	2.6	2.6	2.7	
	AK									
8:00-8:15	51	27	8	0	0	1	1	1	0	95
8:15-8:30	43	23	7	0	0	3	3	0	0	90
8:30-8:45	34	23	7	0	0	2	2	4	1	89
8:45-9:00	48	12	10	0	0	1	4	7	0	103
	K									
5:00-5:15	38	40	9	0	0	4	2	5	0	117
5.15-5.30	48	17	5	1	1	4	2	3	0	98
5:30-5:45	65	32	13	0	0	5	2		0	139
5:45-6:00	76	25	10	0	0	5	4	5	1	152
5.45 0.00	70	25	10		0	5		,	-	152
PEAK HOUR FACTOR=		<u>VOL</u> 4*VOL. D	UME DURI OURING PE	NG PEAK HO AK 15 MIN.	<u>DUR</u> WITHIN PE	AK HOUR	DESIGN HOURLY VOL.= <u>PEAK H</u> PEAK H		<u>РЕАК НС</u> РЕАК НС	DUR VOLUME DUR FACTOR
MORNING										
PEAK HOUR F	ACTOR=	0.914					DESIGN HO % HV=	OURLY VOL.=	413 9	
EVENING PEAK HOUR FACTOR=		0.832					DESIGN H	OURLY VOL.=	608	

% HV=

APPENDIX B- SPOT SPEED MEASUREMENT

KNUST

Table B1: Spot Speed Measurement- NORTH BOUND (N4)

SPOT SPEED COUNT

DATE(MOR):	Thursday, August 05, 2010	LOCATION:	
DATE(EVE):		STATION NO:	NORTH BOUND
WEATHER:		ENUMERATOR:	

MORNING

42	54	45	56	52	45	39	39	47	33	32
79	69	54	64	71	49	52	57	45	44	34
 35	39	55	65	73	23	42	45	32	35	27
41	37	25	24	22	46	22	70	34	46	39
42	35	29	59	56	32	28	37	57	67	65
48	54	68	66	45	32	41	49	41	51	55
34	31	32	33	45	52	72	59	45	50	71
72	49	64	54	30	34	36	46	54	59	48
44	46	44	56	60	57	59	45	62	45	
						1				
						_				

EVENING									ançı taançı taançı taançı taançı taançı ta	anner talmer i tamer talmer i talmer i talm
30	25	24	38	41	28	39	39	47	33	32
21	29	54	28	31	49	40	34	45	44	34
33	45	20	35	35	22	29	29	29	31	25
41	45	50	56	58	49	21	25	28	35	26
1	_								_	
:							1			

<u>MORNING</u> No of Observed Vehicl <mark>es (n)=</mark>	98		Standard Deviation(s)=	13	km/h
Time-Mean Speed (μ)=	47	km/h	Stand. Deviation of Mean(su)=	1.36	km/h
Variance=	180.01		85th Percentile(85th %)=	62.9	km/h
<u>EVENING</u> No of Observed Vehicles (n)=	44		Standard Deviation(s)=	10	km/h
Time-Mean Spe <mark>ed (µ)=</mark>	35	km/h	Stand. Deviation of Mean(su)=	1.5	km/h
Variance=	99.13		85th Percentile(85th %)=	46.1	km/h

Table B2:Spot Speed Measurement- SOUTH BOUND (N4)

DATE(MOR):	Thursday, August 05, 2010
DATE(EVE):	
WEATHER:	

LOCATION: STATION NO: S ENUMERATOR:

SOUTH BOUND

MORNING

MORNING	1									
35	40	29	38	50	45	45	48	32	28	30
30	30	39	38	45	42	47	25	36	42	45
40	29	39	51	49	48	35	38	29	38	37
29	45	38	29	28	31	32	35	29	21	25
40	34	35	27	28	35	40	31	31	29	22
42	45	41	31	28	34	30	38	31	41	46
45	40	32	28	32	41	31	40	46	48	50

59	50	65	71	73	75	65	71	65	65	48
59	71	65	65	59	50	51	49	50	53	58
56	56	60	70	68	60	59	55	56	70	72
60	58	68	89	75	62	58	55	68	58	69
59	68	58	52	56	63	63	54	55	68	72
67	67	61	75	65	65	71	68	66	59	49
66	59	59	58	69	68	69	58	73	69	

<u>MORNING</u> No of Observe <mark>d Vehicles (n)=</mark>	77		Standard Deviation(s)=	7	km/h
Time-Mean Speed (μ)=	36	km/h	Stand. Deviation of Mean(su)=	0.85	km/h
Variance	55.14		85th Percentile(85th %)=	45	km/h
<u>EVENING</u> No of Observed Vehicles (n)=	76		Standard Deviation(s)=	8	km/h
Time-Mean Speed (μ)=	63	km/h	Stand. Deviation of Mean(su)=	0.89	km/h
Variance	60.17		85th Percentile(85th %)=	70.75	km/h

Table B3: Spot Speed Measurement- SOUTHWEST SLIP

DATE(MOR):	Thursday, August 05, 2010	LOCATION:	SOLITHW/EST SLIP
WEATHER:		ENUMERATOR:	SCOTTWEST SEI

MORNING

monning	- Y									
66	37	35	37	43	50	41	53	38	69	64
54	50	45	45	61	62	45	52	64	55	50
55	60	40	45	60	50	63	62	52	41	45
40	65	60	58	60	61	68	59	58	62	51
55	58	54	65	54	45	59	54	50	63	52
50	58	55	51	49	50	54	54	59	61	60
60	59	45	56	55	59	60	65	60	58	
						10	Τ.			
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EVENING			 		
		2	~		
			- /		

<u>MORNING</u> No of Observe <mark>d Vehicles</mark> (n)=	76		Standard Deviation(s)=	8.1	km/h
Time-Mean Speed (μ)=	54	km/h	Stand. Deviation of Mean(su)=	0.93	km/h
Variance	65.46		85th Percentile(85th %)=	61	km/h
<u>EVENING</u> No of Observed Vehicles (n)=	0		Standard Deviation(s)=	#DIV/0!	km/h
Time-Mean Speed (μ)=	#DIV/0!	km/h	Stand. Deviation of Mean(su)=	#DIV/0!	km/h
Variance	#DIV/0!		85th Percentile(85th % <mark>)=</mark>	#NUM!	km/h

Table B4:Spot Speed Measurement- SOUTH WEST LOOP.

Thursday, August 05, 2010

SPOT SPEED COUNT

DATE(MOR):	
DATE(EVE):	
WEATHER:	

LOCATION: STATION NO: ENUMERATOR:

SOUTHWEST LOOP

MORNING

45	37	42	34	35	35	40	34	47	34	40
36	43	30	42	40	39	39	40	39	31	43
35	45	38	39	40	26	39	35	44	30	49
33	34	36	34	45	42	48	40	44	38	33
34	40	35	37	45	38	41	38	35	48	37
45	37	44	44	33	39	34	38	38	35	40
50	37	37	40	39	38	49	41	34	38	44
35	39	42	33	37	49	34	38			
- Charles and the second se										

EVENING						
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	1					

MORNING		
No of Obse	rved Vehicles	(n)

No of Observ <mark>ed Vehicles (n)=</mark>	85		Standard Deviation(s)=	4.9	km/h
Time-Mean Speed (μ)=	39	km/h	Stand. Deviation of Mean(su)=	0.53	km/h
Variance(v) =	23.59		85th Percentile(85th %)=	44	km/h
<u>EVENING</u> No of Observed Vehicles (n)=	0		Standard Deviation(s)=	#DIV/0!	km/h
Time-Mean Speed (μ)=	#DIV/0!	km/h	Stand. Deviation of Mean(su)=	#DIV/0!	km/h
Variance(v) =	#DIV/0!		85th Percentile(85th <mark>%)=</mark>	#NUM!	km/h

Table B5: Spot Speed Measurement- SOUTH EAST SLIP

1

SPOT SPEED COUNT

DATE(MOR):	
DATE(EVE):	
WEATHER:	

Friday, August 06, 2010

LOCATION: STATION NO: ENUMERATOR:

SOUHT EAST SLIP

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MORNING

INORIALIAC										
35	26	37	32	41	44	41	39	39	48	43
44	45	40	20	23	20	34	30	32	40	43
35	32	25	34	25	21	46	34	26	31	35
32	28	37	27	27	28	28	36	25	25	29
30	34	35	38	34	40	31	34	41	42	37
36	35	36	32	27	32	35	32	35	31	
						10				
70				K						
EN (EN UNIC										

EVENING					 -
		1	5		
			17		

<u>MORNING</u> No of Observed Vehicl <mark>es (n)=</mark>	65		Standard Deviation(s)=	6.6	km/h
Time-Mean Speed (μ)=	34	km/h	Stand. Deviation of Mean(su)=	0.8	km/h
Variance=	42.94		85th Percentile(85th %)=	41	km/h
<u>EVENING</u> No of Observed Vehicles (n)=	0		Standard Deviation(s)=	#DIV/0!	km/h
Time-Mean Speed (<mark>µ)=</mark>	#DIV/0!	km/h	Stand. Deviation of Mean(su)=	#DIV/0!	km/h
Variance=	#DIV/0!		85th Percentile(85th %)=	#NUM!	km/h

Table B6:Spot Speed Measurement- SOUTH EAST LOOP.

DATE(MOR):	
DATE(EVE):	
WEATHER:	

Thursday, August 05, 2010

LOCATION: STATION NO: ENUMERATOR:

SOUHT EAST LOOP

_

MORNING	1									
30	39	35	43	46	35	43	25	32	35	40
35	42	46	40	44	42	50	45	40	40	39
55	40	41	35	60	45	45	50	48	42	40
56	44	49	51	44	44	41	41	40	42	54
45	60	46	41	49	56	39	42	54	54	50
40	58	47								
	-							1		
200				K						
EV/ENUNC										

EVENING					 -
		1	5		
			17		

<u>MORNING</u> No of Observed Vehicl <mark>es (n)=</mark>	58		Standard Deviation(s)=	7.3	km/h
Time-Mean Speed (μ)=	44	km/h	Stand. Deviation of Mean(su)=	1.0	km/h
Variance=	53.19		85th Percentile(85th %)=	52.35	km/h
<u>EVENING</u> No of Observed Vehicles (n)=	0		Standard Deviation(s)=	#DIV/0!	km/h
Time-Mean Speed (<mark>µ)=</mark>	#DIV/0!	km/h	Stand. Deviation of Mean(su)=	#DIV/0!	km/h
Variance=	#DIV/0!		85th Percentile(85th %)=	#NUM!	km/h

Table B7:Spot Speed Measurement- EAST BOUND (N1)

DATE(MOR):	
DATE(EVE):	
WEATHER:	

Thursday, August 05, 2010

LOCATION: STATION NO: ENUMERATOR:

EAST BOUND

MORNING

-										
56	70	59	59	58	75	56	57	80	61	68
75	74	73	80	83	60	60	67	78	69	60
69	72	63	62	53	64	65	66	86	76	80
70	79	74	58	59	78	65	81	79	79	62
59	61	68	83	77	79	80	63	59	71	68
		1								
						10	H			
<i>i.</i>				K						
EV/ENUNC										

EVENING						
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			A			
			2			
			17			

<u>MORNING</u> No of Observed Vehicl <mark>es (n)=</mark>	55		Standard Deviation(s)=	8.9	km/h
Time-Mean Speed (μ)=	69	km/h	Stand. Deviation of Mean(su)=	1.2	km/h
Variance=	78.32		85th Percentile(85th %)=	79	km/h
<u>EVENING</u> No of Observed Vehicles (n)=	0		Standard Deviation(s)=	#DIV/0!	km/h
Time-Mean Speed (<mark>µ)=</mark>	#DIV/0!	km/h	Stand. Deviation of Mean(su)=	#DIV/0!	km/h
Variance=	#DIV/0!		85th Percentile(85th %)=	#NUM!	km/h

Spot Speed Measurement- WEST BOUND (N1) Table B8:

DATE(MOR):	
DATE(EVE):	
WEATHER:	

Thursday, August 05, 2010

LOCATION: STATION NO: V ENUMERATOR:

WEST BOUND

MORNING

	<u> </u>									
56	57	58	47	61	63	35	35	51	46	44
51	43	42	40	46	52	71	50	52	62	56
50	57	58	47	45	52	56	35	53	49	55
63	65	63	41	75	53	68	74	59	54	62
49	57	56	57	80	65	53	65	54	75	70
54	46	44	50	52	52	34	50	66	74	69
66	43	42	62	45	62	54	52	66	57	67
62	61	61	59	45	38	42	52	49	62	78
84	84	58	72	69	83	78		1		
-				K						

EVENING							
					-		
				A			
				2			
				17			
			/9/				

<u>MORNING</u> No of Observed Vehicl <mark>es (n)=</mark>	95		Standard Deviation(s)=	11.6	km/h
Time-Mean Speed (μ)=	57	km/h	Stand. Deviation of Mean(su)=	1.2	km/h
Variance=	134.26		85th Percentile(85th %)=	68.9	km/h
<u>EVENING</u> No of Observed Vehicles (n)=	0		Standard Deviation(s)=	#DIV/0!	km/h
Time-Mean Speed (<mark>µ)=</mark>	#DIV/0!	km <mark>/</mark> h	Stand. Deviation of Mean(su)=	#DIV/0!	km/h
Variance=	#DIV/0!		85th Percentile(85th %)=	#NUM!	km/h

Table B9:Spot Speed Measurement- NORTH WEST LOOP.

DATE(MOR):	
DATE(EVE):	
WEATHER:	

Thursday, August 05, 2010

LOCATION: STATION NO: ENUMERATOR:

NORTH WEST LOOP

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MORNING

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49	20	
	39	49
34	54	43
52	34	45
45	30	39
55	45	47
-	45 55	32 34 45 30 55 45

EVENING					
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		1	2		
			17		
	-				

<u>MORNING</u> No of Observed Vehicl <mark>es (n)=</mark>	60		Standard Deviation(s)=	8	km/h
Time-Mean Speed (μ)=	43	km/h	Stand. Deviation of Mean(su)=	1.0	km/h
Variance=	59.16		85th Percentile(85th %)=	52	km/h
<u>EVENING</u> No of Observed Vehicles (n)=	0		Standard Deviation(s)=	#DIV/0!	km/h
Time-Mean Speed (<mark>µ)=</mark>	#DIV/0!	km/h	Stand. Deviation of Mean(su)=	#DIV/0!	km/h
Variance=	#DIV/0!		85th Percentile(85th %)=	#NUM!	km/h

 Table B10:
 Spot Speed Measurement- NORTH WEST SLIP.

DATE(MOR):	
DATE(EVE):	
WEATHER:	

Thursday, August 05, 2010

LOCATION: STATION NO: ENUMERATOR:

NORTH WEST SLIP

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MORNING

WORNING										
35	61	49	68	45	54	65	62	82	53	52
73	52	50	48	54	52	45	54	60	62	52
61	63	57	62	59	60	53	52	60	66	71
53	50	53	76	72	68	61	56	59	68	57
54	59	61	66	60	65	65	64	45	63	63
66										
						- 10	ŀ			

EVENING						
				A		
				2		
				1		
			19			

<u>MORNING</u> No of Observed Vehicles (n)=	56		Standard Deviation(s)=	9	km/h
Time-Mean Speed (μ)=	59	km/h	Stand. Deviation of Mean(su)=	1.1	km/h
Variance=	72.67		85th Percentile(85th %)=	66	km/h
<u>EVENING</u> No of Observed Vehicles (n)=	0		Standard Deviation(s)=	#DIV/0!	km/h
Time-Mean Speed (<mark>µ)=</mark>	#DIV/0!	km/h	Stand. Deviation of Mean(su)=	#DIV/0!	km/h
Variance=	#DIV/0!		85th Percentile(85th %)=	#NUM!	km/h

Table B11: Spot Speed Measurement- NORTH EAST LOOP.

DATE(MOR):	
DATE(EVE):	
WEATHER:	

Thursday, August 05, 2010

LOCATION: STATION NO: ENUMERATOR:

NORTH EAST LOOP

1

MORNING

46	46	38	40	40	37	32	33	35	38	50
43	44	38	41	41	45	34	42	39	37	34
42	40	41	32	38	38	32	36	53	38	45
47	42	20	45	34	49	43	44	35	49	34
46	37	45	46	39	30	38	37	37	37	39
47	44	34	39	43	41	37	53	51	48	
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77				K						
the second second second										

EVENING						 -
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			2		-	
			1			

<u>MORNING</u> No of Observed Vehicl <mark>es (n)=</mark>	65		Standard Deviation(s)=	6	km/h
Time-Mean Speed (μ)=	40	km/h	Stand. Deviation of Mean(su)=	0.7	km/h
Variance=	35.86	km/h	85th Percentile(85th %)=	46	km/h
<u>EVENING</u> No of Observed Vehicles (n)=	0		Standard Deviation(s)=	#DIV/0!	km/h
Time-Mean Speed (<mark>µ)=</mark>	#DIV/0!	km/h	Stand. Deviation of Mean(su)=	#DIV/0!	km/h
Variance=	#DIV/0!	km/h	85th Percentile(85th %)=	#NUM!	km/h

Table B12: Spot Speed Measurement- NORTH EAST SLIP

DATE(MOR): DATE(EVE): WEATHER:

Monday, September 20, 2010

LOCATION: STATION NO: **ENUMERATOR:**

NORTH EAST SLIP

MORNING

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	-				
	 		1.0		
77					
EVENING					

EVENING

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43	45	43	45	35	47	54	52	59	57	52
46	45	34	48	45	53	64	36	40	59	39
44	38	41	48	44	40	45	44	40	39	32
55	35	35	43	53	51	36	46	43	53	46
47	52	42	42	50	45	39	46	45	60	56
59	48	49	51	29	63	39	51	43	34	39
43	39	49	49	34	59	59	45	63	47	38
36	63	59	31	56						

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<u>MORNING</u> No of Observed Vehicl <mark>es (n)=</mark>	0		Standard Deviation(s)=	#DIV/0!	km/h
Time-Mean Speed (μ)=	#DIV/0!	km/h	Stand. Deviation of Mean(su)=	#DIV/0!	km/h
Variance=	#DIV/0!		85th Percentile(85th %)=	#NUM!	km/h
<u>EVENING</u> No of Observed Vehicles (n)=	82		Standard Deviation(s)=	8	km/h
Time-Mean Speed (<mark>µ)=</mark>	46	km/h	Stand. Deviation of Mean(su)=	0.93	km/h
Variance=	70.58		85th Percentile(85th %)=	56	km/h

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APPENDIX C – SYNCHRO AND SIM TRAFFIC REPORTS_EXISTING CONDITIONS



APPENDIX C1 – SYNCHRO AND SIM TRAFFIC REPORTS_EXISTING CONDITIONS (Morning Peak)

Lanes, Volumes, Timings 5: Motorway Extension(N1) &

	-1	-	~	5	+	٤	*	ť	6	~
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NWL	NWR	SWL	SWR
Lane Configurations		† ‡			† †					11
Volume (vph)	0	2048	1169	0	1267	0	0	0	0	676
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		2%			-2%		0%		0%	
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	1.00	1.00	1.00	1.00	0.88
Frt		0.945								0.850
Fit Protected										
Satd. Flow (prot)	0	3143	0	0	3440	0	0	0	0	2760
Flt Permitted										
Satd. Flow (perm)	0	3143	0	0	3440	0	0	0	0	2760
Link Speed (k/h)		69			57		54		54	
Link Distance (m)		46.5			275.6		67.2		93.2	
Travel Time (s)		2.4			17.4		4.5		6.2	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	10%	3%	2%	6%	2%	2%	2%	2%	3%
Adj. Flow (vph)	0	2048	1169	0	1267	0	0	0	0	676
Shared Lane Traffic (%)										
Lane Group Flow (vph)	0	3217	0	0	1267	0	0	0	0	676
Enter Blocked Intersection	on No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Right	Left	Right
Median Width(m)		6.0			6.0		0.0		0.0	
Link Offset(m)		0.0			0.0		0.0		0.0	
Crosswalk Width(m)		4.8			4.8		4.8		4.8	
Two way Left Turn Lane										
Headway Factor	1.01	1.01	1.01	0.99	0.99	0.99	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25	15	25	15
Sign Control		Free			Free		Stop		Free	
Intersection Summary	/ /	-	11	M	11	67	-6		1	
Area Type: C	ther									
Control Type: Unsignaliz	ed									
Intersection Capacity Uti	lization	97.4%		ļ	CU Leve	el of Ser	vice F			
Analysis Period (min) 15										
·										
base case-morning peak										Synchro7 - Reno

Figure C1-1: Lanes, Volume & Timing Report-INTERSECTION(S) 5_N1

	*	Ť	۴	L.	ŧ	J.	5	*	*	~
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	NWL	NWR	NEL	NER
Lane Configurations		† ††			*†			11		
Volume (vph)	0	2468	0	0	4389	676	0	413	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		1%			-1%		-3%		0%	
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	0.91	1.00	0.88	1.00	1.00
Frt					0.980			0.850		
Flt Protected										
Satd. Flow (prot)	0	5011	0	0	5009	0	0	2647	0	0
Flt Permitted										
Satd. Flow (perm)	0	5011	0	0	5009	0	0	2647	0	0
Link Speed (k/h)		47			36		40		50	
Link Distance (m)		224.2			157.5		105.3		48.9	
Travel Time (s)		17.2			15.8	-	9.5		3.5	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	3%	2%	2%	2%	2%	2%	9%	2%	2%
Adi, Flow (vph)	0	2468	0	0	4389	676	0	413	0	0
Shared Lane Traffic (%)										
Lane Group Flow (vph)	0	2468	0	0	5065	0	0	413	0	0
Enter Blocked Intersecti	on No	No	No	No	No	No	No	No	No	No
Lane Alianment	Left	Left	Right	Left	Left	Right	Left	Right	Left	Right
Median Width(m)		4.0			4.0	0	0.0		0.0	
ink Offset(m)		0.0			0.0		0.0		0.0	
Crosswalk Width(m)		4.8			4.8		4.8		4.8	
wo way Left Turn Lane										/
Headway Factor	1.01	1.01	1.01	0.99	0.99	0.99	0.98	0.98	1.00	1.00
Furning Speed (k/h)	25		15	25	R	15	25	15	25	15
Bign Control		Free			Free		Free		Stop	
ntersection Summary	1	3	~	de la	-	-13	58	9	<	
Area Type: 0	Other	1	5	~		1	220			
Control Type: Unsignaliz	zed			Pr.	1					
ntersection Capacity Ut	ilization	144.3%		l	CULeve	el of Ser	vice H			
Analysis Period (min) 15	5									

Lanes, Volumes, Timings

base case-morning peak

Synchro 7 - Report

Figure C1-2: Lanes, Volume & Timing Report-INTERSECTION(S) 9_N4

	۲	1	۲	¥	Ļ	۶J	Å	7	4	×.	
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SER	SWL	SWR	
Lane Configurations		<u>ተ</u> ተጉ			***			11			
Volume (vph)	0	2334	1989	0	5292	0	0	1169	0	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Grade (%)		1%			-1%		0%		0%		
Lane Util. Factor	1.00	0.91	0.91	1.00	0.91	1.00	1.00	0.88	1.00	1.00	
Frt		0.931						0.850			
Flt Protected											
Satd. Flow (prot)	0	4686	0	0	5111	0	0	2760	0	0	
Flt Permitted											
Satd. Flow (perm)	0	4686	0	0	5111	0	0	2760	0	0	
Link Speed (k/h)		47	K		36		54		50		
Link Distance (m)		148.4			238.3		101.8		141.7		
Travel Time (s)		11.4	-		23.8	-	6.8		10.2		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Heavy Vehicles (%)	2%	3%	2%	2%	2%	2%	2%	3%	2%	2%	
Adj. Flow (vph)	0	2334	1989	0	5292	0	0	1169	0	0	
Shared Lane Traffic (%)											
Lane Group Flow (vph)	0	4323	0	0	5292	0	0	1169	0	0	
Enter Blocked Intersecti	on No	No	No	No	No	No	No	2 veh	No	No	
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Right	Left	Right	
Median Width(m)		4.0	-		4.0		0.0	-	0.0		
Link Offset(m)		0.0			0.0		0.0		0.0		
Crosswalk Width(m)		4.8			4.8		4.8		4.8		
Two way Left Turn Lane				- A						1	
Headway Factor	1.01	1.01	1.01	0.99	0.99	0.99	1.00	1.00	1.00	1.00	
Turning Speed (k/h)	25		15	25		15	25	15	25	15	
Sign Control		Free			Free		Yield		Stop		
Intersection Summary	1	300	~	E	-	-13	52	9	<		
Area Type: C	Other	/		~		~~	220				
Control Type: Unsignaliz	zed			1×	1						
Intersection Capacity Ut	ilization	149.8%	,	ļ	CU Leve	el of Ser	vice H				
Analysis Period (min) 15	;										

Lanes, Volumes, Timings 24: ACC-MAD(N4) & Southwest Slip

base case-morning peak

Synchro 7 - Report

Figure C1-3: Lanes, Volume & Timing Report-INTERSECTION(S) 24_N4&SW S

Lanes, Volumes, Timings	
29: Motorway Extension(N1) &	

	٠	→	7	5	Ŧ	×	L.	~	*	4	
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR	
Lane Configurations		† †	1		† †			11			
Volume (vph)	0	1808	848	0	1705	0	0	1073	0	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Grade (%)		2%			-2%		1%		-2%		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.88	1.00	1.00	
Frt			0.850					0.850			
Flt Protected											
Satd. Flow (prot)	0	3249	1567	0	3440	0	0	2694	0	0	
FIt Permitted											
Satd. Flow (perm)	0	3249	1567	0	3440	0	0	2694	0	0	
Link Speed (k/h)		69			57		40		50		
Link Distance (m)		264.0			264.8		69.9		53.1		
Travel Time (s)		13.8			16.7	-	6.3		3.8		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Heavy Vehicles (%)	2%	10%	2%	2%	6%	2%	2%	5%	2%	2%	
Adj. Flow (vph)	0	1808	848	0	1705	0	0	1073	0	0	
Shared Lane Traffic (%)											
Lane Group Flow (vph)	0	1808	848	0	1705	0	0	1073	0	0	
Enter Blocked Intersecti	on No	No	No	No	No	No	No	No	No	No	
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Right	Left	Right	
Median Width(m)		6.0			6.0		0.0	_	0.0	-	
Link Offset(m)		0.0			0.0		0.0		0.0		
Crosswalk Width(m)		4.8			4.8		4.8		4.8		
Two way Left Turn Lane	•										
Headway Factor	1.01	1.01	1.01	0.99	0.99	0.99	1.01	1.01	0.99	0.99	
Turning Speed (k/h)	25		15	25		15	25	15	25	15	
Sign Control		Free			Free		Free		Stop		
Intersection Summary	1	3	2	R	1	-12	52	9	5		
Area Type: 0	Other										
Control Type: Unsignalia	zed										
Intersection Capacity Ut	ilization	104.6%			CU Leve	el of Ser	vice G				
Analysis Period (min) 15	5										
				-							

base case-morning peak

Synchro 7 - Report

Figure C1-4: Lanes, Volume & Timing Report-INTERSECTION(S) 29_N1
Lanes, Volumes,	Timings
31: SE Loop 1 &	

	_	-	7	4	+	۲	1	۲	4	~
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBR	SWL	SWR
Lane Configurations					4			1		11
Volume (vph)	0	0	0	0	359	383	0	989	0	848
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		-2%			0%		2%		-2%	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88
Frt					0.930			0.865		0.850
Flt Protected										
Satd. Flow (prot)	0	0	0	0	1732	0	0	1595	0	2815
Flt Permitted										
Satd. Flow (perm)	0	0	0	0	1732	0	0	1595	0	2815
Link Speed (k/h)		50	K		50		50		50	
Link Distance (m)		147.3			57.9		78.5		129.7	
Travel Time (s)		10.6			4.2		5.7		9.3	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	0	0	0	359	383	0	989	0	848
Shared Lane Traffic (%))									
Lane Group Flow (vph)	0	0	0	0	742	0	0	989	0	848
Enter Blocked Intersect	ion No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Right	Left	Right
Median Width(m)		0.0			0.0		0.0		2.0	
Link Offset(m)		0.0			0.0		0.0		0.0	
Crosswalk Width(m)		4.8			4.8		4.8		4.8	
Two way Left Turn Lane	e									
Headway Factor	0.99	0.99	0.99	1.00	1.00	1.00	1.01	1.01	0.99	0.99
Turning Speed (k/h)	25		15	25		15	25	15	25	15
Sign Control		Yield			Yield		Yield		Yield	
Intersection Summary	~	0	2	S	-	R	R	1	7	
Area Type: 0	Other	1		Ľ		-12		2	1	
Control Type: Roundab	out					-				
Intersection Capacity U	tilization	110.2%	///		CU Leve	el of Ser	vice H			
Analysis Period (min) 19	5									
				150	NE					
		res al	N S	SA	NE	X	5	and		

base case-morning peak

Synchro 7 - Report



EBL 0 1900 1.00 0 0	EBT 1808 1900 2% 0.95 3249 3249 69 264.8	EBR 0 1900 1.00 0	WBL 0 1900 1.00	WBT 1705 1900 -2% 0.95 3440	WBR 413 1900 1.00 0.850	0 1900 -3% 1.00	SER 0 1900 1.00	NEL 0 1900 2% 1.00	NER 1372 1900 0.88 0.850
0 1900 1.00 0 0	↑↑ 1808 1900 2% 0.95 3249 3249 69 264.8	0 1900 1.00 0	0 1900 1.00 0	↑↑ 1705 1900 -2% 0.95 3440		0 1900 -3% 1.00	0 1900 1.00	0 1900 2% 1.00	řř 1372 1900 0.88 0.850
0 1900 1.00 0 0	1808 1900 2% 0.95 3249 3249 69 264.8	0 1900 1.00 0	0 1900 1.00 0	1705 1900 -2% 0.95 3440	413 1900 1.00 0.850	0 1900 -3% 1.00	0 1900 1.00	0 1900 2% 1.00	1372 1900 0.88 0.850
1900 1.00 0 0	1900 2% 0.95 3249 3249 69 264.8	1900 1.00 0	1900 1.00 0	1900 -2% 0.95 3440	1900 1.00 0.850	1900 -3% 1.00	1900 1.00	1900 2% 1.00	1900 0.88 0.850
1.00 0 0	2% 0.95 3249 3249 69 264.8	1.00 0	1.00	-2% 0.95 3440	1.00 0.850	-3% 1.00	1.00	2% 1.00	0.88 0.850
1.00 0 0	0.95 3249 3249 69 264.8	1.00 0	1.00 0	0.95 3440	1.00	1.00	1.00	1.00	0.88 0.850
0	3249 3249 69 264.8	0	0	3440	0.850				0.850
0	3249 3249 69 264.8	0	0	3440	1400				
0	3249 3249 69 264,8	0	0	3440	4400				
0	3249 69 264,8	0			1496	0	0	0	2582
0	3249 69 264,8	0							
1 00	69 264.8		0	3440	1496	0	0	0	2582
1 00	264.8			57		50		34	
1.00				88.5		125.6		88.4	
1.00	13.8	-		5.6	-	9.0		9.4	
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2%	10%	2%	2%	6%	9%	2%	2%	2%	9%
0	1808	0	0	1705	413	0	0	0	1372
0	1808	0	0	1705	413	0	0	0	1372
n No	No	No	No	No	No	No	No	No	No
Left	Left	Right	Left	Left	Right	Left	Right	Left	Right
	6.0			6.0	-	0.0		0.0	
	0.0			0.0		0.0		0.0	
	4.8			4.8		4.8		4.8	
									/
1.01	1.01	1.01	0.99	0.99	0.99	0.98	0.98	1.01	1.01
25		15	25		15	25	15	25	15
	Free			Free		Stop		Yield	
1	3~	2	Z	-	-13	5.7	57	5	
ther	/		Y			222	- 1		
ed			Carl	1					
zation	104.6%	1](OU Lev	el of Ser	vice G			
	0 1 No Left 1.01 25 her d	0 1808 No No Left Left 6.0 0.0 4.8 1.01 1.01 25 Free her rd zation 104.6%	0 1808 0 h No No Left Left Right 6.0 0.0 4.8 1.01 1.01 1.01 25 15 Free her d zation 104.6%	0 1808 0 0 h No No No No Left Left Right Left 6.0 0.0 4.8 1.01 1.01 1.01 0.99 25 15 25 Free her rd zation 104.6% IC	0 1808 0 0 1705 n No No No No No Left Left Right Left Left 6.0 0.0 4.8 4.8 1.01 1.01 1.01 0.99 0.99 25 15 25 Free Free her rd zation 104.6% ICU Leve	0 1808 0 0 1705 413 n No No No No No No No Left Left Right Left Left Right 6.0 0.0 0.0 0.0 4.8 1.01 1.01 1.01 0.99 0.99 0.99 25 15 25 15 15 Free Free Free Free	0 1808 0 0 1705 413 0 h No No No No No No No Left Left Right Left Left Right Left 6.0 6.0 0.0 0.0 0.0 0.0 0.0 4.8 4.8 4.8 1.01 1.01 1.01 0.99 0.99 0.99 0.98 25 15 25 15 25 Free Free Stop her d zation 104.6% ICU Level of Service G	0 1808 0 0 1705 413 0 0 n No No No No No No No No Left Left Right Left Left Right Left Right 6.0 6.0 0.0 0.0 0.0 0.0 0.0 4.8 4.8 4.8 4.8 1.01 1.01 1.01 0.99 0.99 0.99 0.98 0.98 25 15 25 15 25 15 25 15 Free Free Stop her d zation 104.6% ICU Level of Service G	0 1808 0 0 1705 413 0 0 0 n No No No No No No No No No Left Left Right Left Left Right Left Right Left 6.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 4.8 4.8 4.8 4.8 1.01 1.01 1.01 0.99 0.99 0.99 0.98 0.98 1.01 25 15 25 15 25 15 25 Free Free Stop Yield her d zation 104.6% ICU Level of Service G

Lanes, Volumes, Timings 37: Motorway Extension(N1) &

base case-morning peak

Synchro 7 - Report

Figure C1-2: Lanes, Volume & Timing Report-INTERSECTION(S) 37_N1

Lanes, Volumes, Timings	
10. CELD 1.9. Couth a pat Clin	

38: SE LP 2 & Sout	heast	Slip 2					
	4	¥	•	*	¥	t	
Lane Group	SBL	SBR	NEL	NET	SWT	SWR	
Lane Configurations		17		† †			
Volume (vph)	0	848	0	1372	0	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Grade (%)	-2%			2%	0%		
Lane Util. Factor	1.00	0.88	1.00	0.95	1.00	1.00	
Frt		0.850					
Flt Protected							
Satd. Flow (prot)	0	2708	0	3279	0	0	
Flt Permitted							
Satd. Flow (perm)	0	2708	0	3279	0	0	
Link Speed (k/h)	44			34	50		
Link Distance (m)	50.0			129.7	176.1		
Travel Time (s)	4.1		-	13.7	12.7	-	<u> </u>
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Heavy Vehicles (%)	2%	6%	2%	9%	2%	2%	
Adj. Flow (vph)	0	848	0	1372	0	0	
Shared Lane Traffic (%))						
Lane Group Flow (vph)	0	848	0	1372	0	0	
Enter Blocked Intersect	ion No	No	No	No	No	No	
Lane Alignment	Left	Right	Left	Left	Left	Right	
Median Width(m)	0.0			2.0	0.0		
Link Offset(m)	0.0			0.0	0.0		
Crosswalk Width(m)	4.8			4.8	4.8		
Two way Left Turn Lane)						
Headway Factor	0.99	0.99	1.01	1.01	1.00	1.00	
Turning Speed (k/h)	25	15	25			15	
Sign Control	Free			Free	Stop		
Intersection Summary	1	3	2	2		-15	7002
Area Type: 0	Other	1	5.57	7	-	~~	and the second sec
Control Type: Unsignali	zed			Pr .	1		
Intersection Capacity U	tilization	41.3%		1	CU Leve	el of Ser	vice A
Analysis Period (min) 19	5						
		_	-	2.5			

base case-morning peak

Synchro 7 - Report

Figure C1-3: Lanes, Volume & Timing Report-INTERSECTION(S) 38

Lanes, Volumes, Timings	
40: NW Loop &	

	_	Y	1	t	۲	G.	ţ	~	4	*	
Lane Group	EBL	EBR	NBL	NBT	NBR	SBL	SBT	SBR	SWL	SWR	
Lane Configurations		17		^	1		***				
Volume (vph)	0	1511	0	2468	1073	0	4389	0	0	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Grade (%)	2%			1%			-1%		0%		
Lane Util. Factor	1.00	0.88	1.00	0.91	1.00	1.00	0.91	1.00	1.00	1.00	
Frt		0.850			0.850						
Flt Protected											
Satd. Flow (prot)	0	2680	0	5011	1575	0	5111	0	0	0	
Flt Permitted											
Satd. Flow (perm)	0	2680	0	5011	1575	0	5111	0	0	0	
Link Speed (k/h)	43			47			36		46		
Link Distance (m)	71.4			262.2			224.2		71.8		
Travel Time (s)	6.0		-	20.1		-	22.4		5.6		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Heavy Vehicles (%)	2%	5%	2%	3%	2%	2%	2%	2%	2%	2%	
Adj. Flow (vph)	0	1511	0	2468	1073	0	4389	0	0	0	
Shared Lane Traffic (%))										
Lane Group Flow (vph)	0	1511	0	2468	1073	0	4389	0	0	0	
Enter Blocked Intersect	ion No	No	No	No	No	No	No	No	No	No	
Lane Alignment	Left	Right	Left	Left	Right	Left	Left	Right	Left	Right	
Median Width(m)	0.0			4.0			4.0		0.0		
Link Offset(m)	0.0			0.0			0.0		0.0		
Crosswalk Width(m)	4.8			4.8	1		4.8		4.8		
Two way Left Turn Lane)										
Headway Factor	1.01	1.01	1.01	1.01	1.01	0.99	0.99	0.99	1.00	1.00	
Turning Speed (k/h)	25	15	25		15	25		15	25	15	
Sign Control	Free			Free			Free		Stop		
Intersection Summary	1	3~	2	Z	- 24	-13	5.2	9	5		
Area Type: (Other		59	Y.		2	225				
Control Type: Unsignali	zed										
Intersection Capacity Ut	tilization	144.3%		1	CU Leve	l of Ser	vice H				
Analysis Period (min) 15	5										
					_						

base case-morning peak

Synchro 7 - Report

Figure C1-4: Lanes, Volume & Timing Report-INTERSECTION(S) 40_NW LP

Lane GroupEBLLane ConfigurationsVolume (vph)0Ideal Flow (vphpl)1900Lane Width (m)3.6Grade (%)1.00Ent5Fit Protected5Satd. Flow (prot)0Flt Permitted0Satd. Flow (perm)0Link Speed (k/h)1.00Link Speed (k/h)1.00Peak Hour Factor1.00Heavy Vehicles (%)2%	EBT 2048 1900 4.0 2% 0.95 3393 3393 3393 69 275.6	EBR 0 1900 3.6 1.00 0	WBL 0 1900 3.6 1.00 0	WBT 1267 1900 4.0 -2% 0.95 3593	WBR 1511 1900 3.6 1.00 0.850 1553	SEL 0 1900 3.6 0% 1.00	SER 0 1900 3.6 1.00	NEL 0 1900 3.6 0% 1.00	NER 608 1900 3.0 0.88 0.850
Lane Configurations Volume (vph) 0 Ideal Flow (vphpl) 1900 Lane Width (m) 3.6 Grade (%) 1900 Lane Util. Factor 1.00 Frt Flt Protected Satd. Flow (prot) 0 Flt Permitted 0 Satd. Flow (perm) 0 Link Speed (k/h) 1 Link Distance (m) 1.00 Peak Hour Factor 1.00 Heavy Vehicles (%) 2%	↑↑ 2048 1900 4.0 2% 0.95 3393 3393 3393 69 275.6	0 1900 3.6 1.00 0	0 1900 3.6 1.00 0	↑↑ 1267 1900 4.0 -2% 0.95 3593		0 1900 3.6 0% 1.00	0 1900 3.6 1.00	0 1900 3.6 0% 1.00	608 1900 3.0 0.88 0.850
Volume (vph) 0 Ideal Flow (vphpl) 1900 Lane Width (m) 3.6 Grade (%) 100 Lane Util. Factor 1.00 Frt 5 Flt Protected 5 Satd. Flow (prot) 0 Flt Permitted 5 Satd. Flow (perm) 0 Link Speed (k/h) 1 Link Distance (m) 1 Travel Time (s) 1 Peak Hour Factor 1.00 Heavy Vehicles (%) 2%	2048 1900 4.0 2% 0.95 3393 3393 3393 69 275.6	0 1900 3.6 1.00 0	0 1900 3.6 1.00 0	1267 1900 4.0 -2% 0.95 3593	1511 1900 3.6 1.00 0.850 1553	0 1900 3.6 0% 1.00	0 1900 3.6 1.00	0 1900 3.6 0% 1.00	608 1900 3.0 0.88 0.850
Ideal Flow (vphpl) 1900 Lane Width (m) 3.6 Grade (%) Lane Util. Factor 1.00 Fit Fit Protected Satd. Flow (prot) 0 Fit Permitted Satd. Flow (perm) 0 Link Speed (k/h) Link Distance (m) Travel Time (s) Peak Hour Factor 1.00 Heavy Vehicles (%) 2%	1900 4.0 2% 0.95 3393 3393 69 275.6	1900 3.6 1.00 0	1900 3.6 1.00 0	1900 4.0 -2% 0.95 3593	1900 3.6 1.00 0.850 1553	1900 3.6 0% 1.00	1900 3.6 1.00	1900 3.6 0% 1.00	1900 3.0 0.88 0.850
Lane Width (m) 3.6 Grade (%) Lane Util. Factor 1.00 Frt Fit Protected Satd. Flow (prot) 0 Fit Permitted Satd. Flow (perm) 0 Link Speed (k/h) Link Distance (m) Travel Time (s) Peak Hour Factor 1.00 Heavy Vehicles (%) 2%	4.0 2% 0.95 3393 3393 69 275.6	3.6 1.00 0	3.6 1.00 0	4.0 -2% 0.95 3593	3.6 1.00 0.850 1553	3.6 0% 1.00	3.6 1.00	3.6 0% 1.00	3.0 0.88 0.850
Grade (%) Lane Util. Factor 1.00 Frt Fit Protected Satd. Flow (prot) 0 Fit Permitted Satd. Flow (perm) 0 Link Speed (k/h) Link Distance (m) Travel Time (s) Peak Hour Factor 1.00 Heavy Vehicles (%) 2%	2% 0.95 3393 3393 69 275.6	1.00 0 0	1.00 0	-2% 0.95 3593	1.00 0.850 1553	0% 1.00 0	1.00	0% 1.00	0.88 0.850
Lane Util. Factor 1.00 Frt Fit Protected Satd. Flow (prot) 0 Fit Permitted Satd. Flow (perm) 0 Link Speed (k/h) Link Distance (m) Travel Time (s) Peak Hour Factor 1.00 Heavy Vehicles (%) 2%	0.95 3393 3393 69 275.6	1.00 0 0	1.00 0	0.95 3593	1.00 0.850 1553	1.00	1.00	1.00	0.88 0.850
Frt Fit Protected Satd. Flow (prot) 0 Fit Permitted Satd. Flow (perm) 0 Link Speed (k/h) Link Distance (m) Travel Time (s) Peak Hour Factor 1.00 Heavy Vehicles (%) 2%	3393 3393 69 275.6	0	0	3593	0.850 1553	0	0		0.850
Flt Protected Satd. Flow (prot) 0 Flt Permitted Satd. Flow (perm) 0 Link Speed (k/h) Link Distance (m) Travel Time (s) Peak Hour Factor 1.00 Heavy Vehicles (%) 2%	3393 3393 69 275.6	0	0	3593	1553	0	0		
Satd. Flow (prot) 0 Flt Permitted 0 Satd. Flow (perm) 0 Link Speed (k/h) 0 Link Distance (m) 0 Travel Time (s) 0 Peak Hour Factor 1.00 Heavy Vehicles (%) 2%	3393 3393 69 275.6	0	0	3593	1553	0	0		
Flt Permitted Satd. Flow (perm) 0 Link Speed (k/h) Link Distance (m) Travel Time (s) Peak Hour Factor 1.00 Heavy Vehicles (%) 2%	3393 69 275.6	0	0		100000		0	0	2390
Satd. Flow (perm) 0 Link Speed (k/h) Link Distance (m) Travel Time (s) Peak Hour Factor 1.00 Heavy Vehicles (%) 2%	3393 69 275.6	0	0						
Link Speed (k/h) Link Distance (m) Travel Time (s) Peak Hour Factor 1.00 Heavy Vehicles (%) 2%	69 275.6			3593	1553	0	0	0	2390
Link Distance (m) Travel Time (s) Peak Hour Factor 1.00 Heavy Vehicles (%) 2%	275.6			57		50		39	
Travel Time (s) Peak Hour Factor 1.00 Heavy Vehicles (%) 2%	444	-		264.0		51.7		67.6	
Peak Hour Factor 1.00 Heavy Vehicles (%) 2%	14.4			16.7		3.7		6.2	
Heavy Vehicles (%) 2%	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	10%	2%	2%	6%	5%	2%	2%	2%	11%
Adj. Flow (vph) 0	2048	0	0	1267	1511	0	0	0	608
Shared Lane Traffic (%)									
Lane Group Flow (vph) 0	2048	0	0	1267	1511	0	0	0	608
Enter Blocked Intersection No.	No	No	No	No	No	No	No	No	No
Lane Alignment Left	Left	Right	Left	Left	Right	Left	Right	Left	Right
Median Width(m)	6.0			6.0	, č	0.0	, in the second s	0.0	, in the second s
Link Offset(m)	0.0			0.0		0.0		0.0	
Crosswalk Width (m)	4.8			4.8		4.8		4.8	1
Two way Left Turn Lane									-
Headway Factor 1.01	0.96	1.01	0.99	0.93	0.99	1.00	1.00	1.00	1.09
Turning Speed (k/h) 25		15	25		15	25	15	25	15
Sign Control	Free			Free		Stop		Free	
Intersection Summary	1	-	4	-	100	500			
Area Type: Other		11	March 1	\sim			-		
Control Type: Unsignalized									
Intersection Capacity Utilization	97.4%		1	CU Leve	el of Ser	vice F			

Lanes, Volumes, Timings 42: Motorway Extension(N1) &

Figure C1-5: Lanes, Volume & Timing Report-INTERSECTION(S) 42_N1

Lane Group WBL WBR NBL NBT NBR SBL SBT SBR NEL NER Lane Configurations 117 1100 1207 0 2334 0 0 5292 608 0 0 Ideal Flow (vphpl) 1900 <		F	*	*	Ť	1	4	ţ	J.	•	1	
Lane Configurations Iff	Lane Group	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER	
Volume (vph) 0 1207 0 2334 0 0 5292 608 0 0 Ideal Flow (vphpl) 1900 1.00 1.00 1.00 1.00 <td< td=""><td>Lane Configurations</td><td></td><td>11</td><td></td><td>^</td><td></td><td></td><td>^</td><td>1</td><td></td><td></td><td></td></td<>	Lane Configurations		11		^			^	1			
Ideal Flow (vphpl)1900190019001900190019001900190019001900Lane Width (m)3.63.03.63.73.63.63.73.73.63.6Grade (%)-2%1%-1%2%Lane Util. Factor1.000.881.000.911.001.001.001.00Frt0.8500.8500.8500.8500.850Fit Protected5066005168160900Satd. Flow (prot)0262705066005168160900Fit Permitted2205066005168160900Link Speed (lv/h)44473650500506506506500Link Distance (m)147.3238.3262.263.650Travel Time (s)12.118.326.24.6Peak Hour Factor1.001.001.001.001.001.001.00Heavy Vehicles (%)2%2%2%2%2%2%2%2%2%	Volume (vph)	0	1207	0	2334	0	0	5292	608	0	0	
Lane Width (m) 3.6 3.0 3.6 3.7 3.6 3.7 3.7 3.7 3.6 3.6 Grade (%) -2% 1% -1% 2% Lane Util. Factor 1.00 0.88 1.00 0.91 1.00 0.91 1.00 0	Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Grade (%) -2% 1% -1% 2% Lane Util. Factor 1.00 0.88 1.00 0.91 1.00 0.91 1.00 0 5066 0 0 5168 1609 0 0 0 Fit Protected 5066 0 0 5168 1609 0 0 0 100 1.00 1.00 1.00 1.00 0	Lane Width (m)	3.6	3.0	3.6	3.7	3.6	3.6	3.7	3.7	3.6	3.6	
Lane Util. Factor 1.00 0.88 1.00 0.91 1.00 1.	Grade (%)	-2%			1%			-1%		2%		
Frt 0.850 0.850 Fit Protected Satd. Flow (prot) 0 2627 0 5066 0 0 5168 1609 0 0 Fit Permitted Satd. Flow (perm) 0 2627 0 5066 0 0 5168 1609 0 0 Satd. Flow (perm) 0 2627 0 5066 0 0 5168 1609 0 0 Link Speed (k/h) 44 47 36 50	Lane Util. Factor	1.00	0.88	1.00	0.91	1.00	1.00	0.91	1.00	1.00	1.00	
Fit Protected Satd. Flow (prot) 0 2627 0 5066 0 0 5168 1609 0 0 Fit Permitted	Frt		0.850						0.850			
Satd. Flow (prot) 0 2627 0 5066 0 0 5168 1609 0 0 Flt Permitted	Flt Protected											
Fit Permitted Satd. Flow (perm) 0 2627 0 5066 0 0 5168 1609 0 0 Link Speed (k/h) 44 47 36 50 50 Link Distance (m) 147.3 238.3 262.2 63.6 Travel Time (s) 12.1 18.3 26.2 4.6 Peak Hour Factor 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 Heavy Vehicles (%) 2%	Satd. Flow (prot)	0	2627	0	5066	0	0	5168	1609	0	0	
Satd. Flow (perm) 0 2627 0 5066 0 0 5168 1609 0 0 Link Speed (k/h) 44 47 36 50 50 Link Distance (m) 147.3 238.3 262.2 63.6 Travel Time (s) 12.1 18.3 26.2 4.6 Peak Hour Factor 1.00 1.00 1.00 1.00 1.00 1.00 1.00 Heavy Vehicles (%) 2%	Flt Permitted											
Link Speed (k/h) 44 47 36 50 Link Distance (m) 147.3 238.3 262.2 63.6 Travel Time (s) 12.1 18.3 26.2 4.6 Peak Hour Factor 1.00 1.00 1.00 1.00 1.00 1.00 1.00 Heavy Vehicles (%) 2%<	Satd. Flow (perm)	0	2627	0	5066	0	0	5168	1609	0	0	
Link Distance (m) 147.3 238.3 262.2 63.6 Travel Time (s) 12.1 18.3 26.2 4.6 Peak Hour Factor 1.00	Link Speed (k/h)	44			47			36		50		
Travel Time (s) 12.1 18.3 26.2 4.6 Peak Hour Factor 1.00 1.	Link Distance (m)	147.3		-	238.3	-	-	262.2		63.6		
Peak Hour Factor 1.00	Travel Time (s)	12.1			18.3			26.2		4.6		
Heavy Vehicles (%) 2% 2% 2% 3% <mark>2%</mark> 2% 2% 2% 2% 2%	Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
	Heavy Vehicles (%)	2%	2%	2%	3%	2%	2%	2%	2%	2%	2%	
Adj. Flow (vph) 0 1207 0 2334 0 0 5292 608 0 0	Adj. Flow (vph)	0	1207	0	2334	0	0	5292	608	0	0	
Shared Lane Traffic (%)	Shared Lane Traffic (%))										
Lane Group Flow (vph) 0 1207 0 2334 0 0 5292 608 0 0	Lane Group Flow (vph)	0	1207	0	2334	0	0	5292	608	0	0	
Enter Blocked Intersection No No No No No No No No No	Enter Blocked Intersect	ion No	No	No	No	No	No	No	No	No	No	
Lane Alignment Left Right Left Left Right Left Right Left Right	Lane Alignment	Left	Right	Left	Left	Right	Left	Left	Right	Left	Right	
Median Width(m) 0.0 4.0 0.0	Median Width(m)	0.0			4.0			4.0		0.0		
Link Offset(m) 0.0 0.0 0.0	Link Offset(m)	0.0			0.0			0.0		0.0		
Crosswalk Width(m) 4.8 4.8 4.8 4.8	Crosswalk Width (m)	4.8			4.8			4.8		4.8		
Two way Left Tu <mark>rn Lane</mark>	Two way Left Turn Lane	e										
Headway Factor 0.99 1.08 1.01 0.99 1.01 0.99 0.98 0.98 1.01 1.01	Headway Factor	0.99	1.08	1.01	0.99	1.01	0.99	0.98	0.98	1.01	1.01	
Turning Speed (k/h) 25 15 25 15 25 15 25 15	Turning Speed (k/h)	25	15	25		15	25		15	25	15	
Sign Control Yield Free Free Stop	Sign Control	Yield			Free			Free	6	Stop		
Intersection Summary	Intersection Summary	1	1		4	-	A	222	-	1		
Area Type: Other	Area Type:	Other										
Control Type: Unsignalized	Control Type: Unsignali	zed										
Intersection Capacity Utilization 149.8% ICU Level of Service H	Intersection Capacity U	tilization	149.8%		þ	CU Leve	el of Ser	vice H				
Analysis Period (min) 15	Analysis Period (min) 19	5										
base area marning peak Ometrica Ban		Ē.			-						Quechr	o7 Donor

Lanes, Volumes, Timings 46: SE Loop 1 &

Figure C1-6: Lanes, Volume & Timing Report-INTERSECTION(S) 46_SE LP 1

Lanes, Volumes, Timings 47: SE Slip 1 &

	4	•	t	1	4	ŧ	
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations			1	1			
Volume (vph)	0	0	989	1000	0	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Grade (%)	0%		2%			0%	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Frt				0.850			
Flt Protected							
Satd. Flow (prot)	0	0	1809	1537	0	0	
Fit Permitted							
Satd. Flow (perm)	0	0	1809	1537	0	0	CT
Link Speed (k/h)	50		34			50	
Link Distance (m)	108.0		141.7			78.5	
Travel Time (s)	7.8		15.0		-	5.7	<u> </u>
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Heavy Vehicles (%)	2%	2%	4%	4%	2%	2%	
Adj. Flow (vph)	0	0	989	1000	0	0	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	0	989	1000	0	0	
Enter Blocked Intersecti	on No	No	No	No	No	No	
Lane Alignment	Left	Right	Left	Right	Left	Left	
Median Width(m)	0.0	-	0.0			0.0	
Link Offset(m)	0.0		0.0			0.0	
Crosswalk Width(m)	4.8		4.8			4.8	
Two way Left Turn Lane							
Headway Factor	1.00	1.00	1.01	1.01	1.00	1.00	
Turning Speed (k/h)	25	15		15	25		
Sign Control	Stop		Free			Stop	122
Intersection Summary	1	3	2	R	1	-12	5757
Area Type: 0	Other	/	5	~	-	~~	and the second sec
Control Type: Unsignaliz	zed			Pr	1		
Intersection Capacity Ut	ilization	65.3%](OU Leve	el of Ser	rvice C
Analysis Period (min) 15	5						
		_	2.	SA	NE	18	

base case-morning peak

Synchro 7 - Report



Lanes, Volumes, Timings 55: Spintex Road &

	-	7	۴	+	1	1	
Lane Group	EBT	EBR	WBL	WBT	NEL	NER	
Lane Configurations	1			1		1	
Volume (vph)	500	0	0	742	0	1000	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Frt						0.865	
Fit Protected							
Satd. Flow (prot)	1863	0	0	1863	0	1611	
Fit Permitted							
Satd. Flow (perm)	1863	0	0	1863	0	1611	
Link Speed (k/h)	50			50	50		
Link Distance (m)	57.9		K	117.1	108.0		
Travel Time (s)	4.2			8.4	7.8		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Adj. Flow (vph)	500	0	0	742	0	1000	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	500	0	0	742	0	1000	
Enter Blocked Intersection	on No	No	No	No	No	No	
Lane Alignment	Left	Right	Left	Left	Left	Right	
Median Width(m)	0.0			0.0	0.0		
Link Offset(m)	0.0			0.0	0.0		
Crosswalk Width(m)	4.8			4.8	4.8		
Two way Left Turn Lane							
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Turning Speed (k/h)		15	25		25	15	
Sign Control	Free			Free	Yield		
Intersection Summary	_	-	Y	21	1	15	(III)
Area Type: C)ther						
Control Type: Unsignaliz	ed			20			2020
Intersection Capacity Uti	lization	94.9%			CU Lev	el of Ser	vice F
Analysis Period (min) 15				(
			2.0	SA	NE	1	

base case-morning peak

Synchro 7 - Report

Figure C1-8: Lanes, Volume & Timing Report-INTERSECTION(S) 55_SPIN

SIMULATION REPORT-MORNING PEAK

KNUST



SimTraffic Simulation S	Summary
Baseline-Existing	8

Summary of All Inte	ervals	
Start Time	6:57	
End Time	7:15	
Total Time (min)	18	
Time Recorded (min)	15	
# of Intervals	2	
# of Recorded Intvls	1	
Vehs Entered	2906	
Vehs Exited	2553	
Starting Vehs	382	
Ending Vehs	735	
Denied Entry Before	209	
Denied Entry After	1438	
Travel Distance (km)	2898	
Travel Time (hr)	345.3	
Total Delay (hr)	271.4	
Total Stops	3575	
Fuel Used (I)	4906.6	
Interval #0 Informa	tion Seeding	
		No. 11 March 199
Start Time	6:57	
Endlime	7:00	
Total Time (min)	3	
Volumes adjusted by G	Growth Factors.	
No data recorded this i	nterval.	

base case-morning peak

SimTraffic Report

Figure C1-13: Performance Report- SUMMARY

Baseline-Existing							
5: Motorway Extens	ion(N1)& P	erform	ance b	y mov	ement	1 2
Movement	EBT	EBR	WBT	SWT	SWR	All	
Total Delay (hr)	0.3	0.2	7.0	0.0	0.1	7.7	
Delay / Veh (s)	5.4	7.4	108.9	0.0	3.9	40.5	
Stop Delay (hr)	0.1	0.2	6.2	0.0	0.1	6.6	
St Del/Veh (s)	2.7	6.1	95.9	0.0	2.0	34.8	
Total Stops	4	4	399	0	48	455	
Stop/Veh	0.02	0.03	1.72	0.00	0.36	0.67	
Travel Dist (km)	8.8	5.5	58.8	0.0	9.7	83.0	
Travel Time (hr)	0.4	0.4	8.1	0.0	0.5	9.4	
Avg Speed (kph)	21	12	7	46	23	9	
Fuel Used (I)	16.1	4.6	99.6	0.0	5.0	125.3	CT
Fuel Eff. (kpl)	0.5	1.2	0.6	0.9	2.0	0.7	
HC Emissions (g)	2	0	3	0	0	5	
CO Emissions (g)	478	11	666	1	28	1184	
NOx Emissions (g)	5	0	7	0	0	12	
Vehicles Entered	196	122	245	1	135	699	
Vehicles Exited	195	119	219	1	135	669	
Hourly Exit Rate	780	476	876	4	540	2 676	
Input Volume	2048	1169	1267	6	676	5166	
% of Volume	38	41	69	67	80	52	
Denied Entry Before	0	0	0	0	0	0	
Denied Entry After	0	0	0	0	0	0	
Density (m/veh)						20	
Occupancy (veh)	2	2	32	0	2	37	

base case-morning peak

SimTraffic Report

Figure C1-14: Performance Report- INTERSECTION(S) 5_N1

9: ACC-MAD(N4) & Performance by movement Movement NBT SBT SBR NWR All Total Delay (hr) 0.2 32.0 4.6 0.2 36.9 Delay /Veh (s) 1.8 126.9 131.1 6.0 89.2 Stop Delay (hr) 0.0 30.2 4.2 0.1 34.6 Stop Delay (hr) 0.0 30.2 4.2 0.1 34.6 Stop Delay (hr) 0.0 30.2 4.2 0.1 34.6 Stop Veh (s) 0.3 119.8 120.1 5.5 83.6 Total Stops 26 156 20 6.3 255 Stop/Veh (m) 1.8 82.2 5.2 0.4 43.7 Travel Dist (km) 1.5 0.3 0.3 1.8 1.8 Fuel Used (lyh) 4.2 2.1 77 76 1818 NOx Emissions (g) 2 5 0 0 74 2 39 Oto Ume 58 </th <th>Daseline-Existing</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>	Daseline-Existing						
Movement NBT SBT SBR NWR All Total Delay (hr) 0.2 32.0 4.6 0.2 36.9 Delay (Veh (s) 1.8 126.9 131.1 6.0 89.2 Stop Delay (hr) 0.0 30.2 4.2 0.1 34.6 Stop Delay (hr) 0.0 31.19.8 120.1 5.5 83.6 Total Stops 2.6 156 20 53 255 StopVeh 0.07 0.17 0.16 0.55 0.17 Travel Dist (km) 7.6.0 139.2 1.1 7.20 25 Fuel Used (l) 1.6 0.5 6.5 52.1 1.4 Fuel Used (l) 5.0.8 408.7 56.5 52.1 1.4 Fuel Used (l) 5.0.8 408.7 56.5 52.1 1.4 Fuel Used (l) 5.0.8 4.8 1.4 1.4 2.2 2.5 Fuel Used (l) 5.0.8 4.9 1.27 7.8	9: ACC-MAD(N4) &	Perfo	rmanc	e by m	novem	ent	
Total Delay (hr) 0.2 32.0 4.6 0.2 36.9 Delay (Veh (s) 1.8 126.9 131.1 6.0 89.2 Stop Delay (hr) 0.0 30.2 4.2 0.1 34.6 Stop Delay (hr) 0.0 311.9 8.120.1 55.5 83.6 Total Stops 2.6 156 20 53 255 StopVeh 0.07 0.17 0.16 0.55 0.17 Travel Time (hr) 1.8 362 5.2 0.4 43.7 Avg Speed (kph) 4.2 21 17 20 25 Fuel Used (l) 50.8 408.7 56.3 56.6 521.4 Fuel Eff. (kpl) 1.5 0.3 0.3 1.6 0.5 HC Emissions (g) 2 5 0 0 7 CO Emissions (g) 3.12 12 96 1.844 Hourly Exit Rate 143.2 3620 500 384 5936 Ioput Volume 24.8 4389 676 413 7946 32 </th <th>Movement</th> <th>NBT</th> <th>SBT</th> <th>SBR</th> <th>NWR</th> <th>All</th> <th></th>	Movement	NBT	SBT	SBR	NWR	All	
Delay / Veh (s) 1.8 126.9 131.1 6.0 89.2 Stop Delay (hr) 0.0 30.2 4.2 0.1 34.6 St Del/Veh (s) 0.3 119.8 120.1 5.5 83.6 Total Stops 26 156 20 53.255 Stop/Veh 0.07 0.17 0.16 0.55 0.17 Travel Time (hr) 1.8 36.2 5.2 0.4 43.7 Avg Speed (kph) 4.2 21 17 20 25 Fuel Used (l) 50.8 408.7 56.3 5.6 521.4 Fuel Eff. (kpl) 1.5 0.3 0.3 1.6 0.5 CO Emissions (g) 3.23 1296 123 76 1818 NOX Emissions (g) 5 1.5 1 1 22 Vehicles Extreted 359 910 127 98 1494 Vehicles Extreted 359 910 127 98 1494 Vehicles Extreted 358 90.5 125 96 1844	Total Delay (hr)	0.2	32.0	4.6	0.2	36.9	
Stop Delay (h) 0.0 30.2 4.2 0.1 34.6 St Del/Veh (s) 0.3 119.8 120.1 5.5 83.6 Total Stops 26 156 20 53 255 Stop/Veh 0.07 0.17 0.16 0.55 0.17 Travel Dist (km) 76 139.2 19.1 9.0 243.2 Travel Dist (km) 76 0 139.2 19.1 9.0 243.2 Travel Dist (km) 76 0 30.3 1.6 0.5 Fuel Eff. (kpl) 1.5 0.3 0.3 1.6 0.5 Fuel Eff. (kpl) 1.5 0.3 1.3 1.6 0.5 HC Emissions (g) 2 5 0 0 7 CO Emissions (g) 5 1.5 1 1.22 Vehicles Entered 359 910 127 98 1494 Vehicles Entered 359 910 127 98 1494 Hourly Exit Rate H423 3620 500 384 5936 Input Volume 2468	Delay / Veh (s)	1.8	126.9	131.1	6.0	89.2	
St Del/Veh (s) 0.3 119.8 120.1 5.5 83.6 Total Stops 26 156 20 53 255 Stop/Veh 0.07 0.17 0.16 0.55 0.17 Travel Dist (km) 76 139.2 19.1 9.0 243.2 Travel Time (hr) 1.8 36.2 5.2 0.4 43.7 Avg Speed (kph) 42 21 17 20 25 Fuel Used (l) 50.8 408.7 56.3 56 521.4 Fuel Eff. (kpl) 1.5 0.3 0.3 1.6 0.5 HC Emissions (g) 2 5 0 0 7 CO Emissions (g) 5 15 1 1 22 Vehicles Exited 358 905 125 96 1484 Hourly Exit Rate 1432 23620 500 384 5936 Input Volume 28 82 74 93 75 Denied Entry Before 0 41 6 0 237 Denied	Stop Delay (hr)	0.0	30.2	4.2	0.1	34.6	
Total Stops 26 156 20 53 255 Stop/Veh 0.07 0.17 0.16 0.55 0.17 Travel Dist (km) 76.0 139.2 19.1 9.0 243.2 Travel Time (h) 1.8 36.2 5.2 0.4 43.7 Avg Speed (kph) 42 21 17 20 25 Fuel Eff. (kpl) 1.5 0.3 0.3 1.6 0.5 Ho Emissions (g) 323 1296 123 76 1818 NOX Emissions (g) 323 1296 123 76 1818 NOX Emissions (g) 5 15 1 1 22 Vehicles Entered 359 910 127 98 1484 Hourly Exit Rate 1432 3620 500 384 5936 Input Volume 248 4389 676 413 7946 % Volume 5 8 82 74 93 75 Denied Entry Before 0 41 6 0 237	St Del/Veh (s)	0.3	119.8	120.1	5.5	83.6	
Stop/Veh 0.07 0.17 0.16 0.55 0.17 Travel Dist (km) 76.0 139.2 19.1 9.0 243.2 Travel Time (hr) 1.8 36.2 5.2 0.4 43.7 Avg Speed (kph) 42 2.1 17 20 25 Fuel Used (l) 50.8 408.7 56.3 5.6 521.4 Fuel Eff (kpl) 1.5 0.3 0.3 1.6 0.5 HC Emissions (g) 2 5 0 0 7 CO Emissions (g) 323 1296 123 76 1818 NOX Emissions (g) 5 15 1 1 22 Vehicles Entered 359 910 127 98 1494 Vehicles Exited 358 905 125 96 1484 Hourty Exit Rate 1432 3620 500 384 5936 Input Volume 2488 4389 676 413 7946 % of Volume 58 82 74 93 75	Total Stops	26	156	20	53	255	
Travel Dist (km) 76.0 139.2 19.1 9.0 243.2 Travel Time (hr) 1.8 36.2 52 0.4 43.7 Avg Speed (kph) 42 21 17 20 25 Fuel Used (l) 50.8 408.7 56.3 56.6 521.4 Fuel Eff. (kpl) 1.5 0.3 0.3 1.6 0.5 HC Emissions (g) 2 5 0 0 7 CO Emissions (g) 323 1296 123 76 1818 NOx Emissions (g) 5 15 1 1 22 Vehicles Exited 358 905 125 96 1484 Hourly Exit Rate 1432 3620 500 384 5936 Input Volume 2468 4389 676 413 7946 % of Volume 58 82 74 93 75 Denied Entry Affer 0 211 26 0 237 Denied Entry Affer 0 211 26 0 237 0 0 0<	Stop/Veh	0.07	0.17	0.16	0.55	0.17	
Travel Time (hr) 1.8 36.2 5.2 0.4 43.7 Avg Speed (kph) 42 21 17 20 25 Fuel Used (l) 50.8 408.7 56.3 5.6 521.4 Fuel Eff. (kpl) 1.5 0.3 0.3 1.6 0.5 HC Emissions (g) 2 5 0 0 7 CO Emissions (g) 323 1296 123 76 1818 NOX Emissions (g) 5 1 1 22 Vehicles Exited 359 910 127 98 1494 Vehicles Exited 358 905 125 96 1484 Hourty Exit Rate 1432 3620 500 384 5936 Input Volume 248 4389 676 413 7946 % of Volume 58 82 74 93 75 Denied Entry After 0 211 26 0 237 Denied Entry After 0 211 26 0 237 0 0 0 0	Travel Dist (km)	76.0	139.2	19.1	9.0	243.2	
Avg Speed (kph) 42 21 17 20 25 Fuel Used (l) 50.8 408.7 56.3 5.6 521.4 Fuel Eff. (kpl) 1.5 0.3 1.6 0.5 HC Emissions (g) 2 5 0 0 7 CO Emissions (g) 323 1296 123 76 1818 NOx Emissions (g) 5 15 1 1 22 Vehicles Entered 359 910 127 98 1494 Vehicles Exited 358 905 125 96 1484 Hourty Exit Rate 1432 3620 500 384 5936 Input Volume 2488 4389 676 413 7946 % of Volume 58 82 74 93 75 Denied Entry After 0 211 26 0 237 Density (m/veh) 7 26 4 2 39 Occupancy (veh) 7 26 4 2 39	Travel Time (hr)	1.8	36.2	5.2	0.4	43.7	
Fuel Used (i) 50.8 408.7 56.3 5.6 521.4 Fuel Eff. (kpl) 1.5 0.3 0.3 1.6 0.5 HC Emissions (g) 2 5 0 0 7 CO Emissions (g) 323 1296 123 76 1818 NOX Emissions (g) 5 15 1 1 22 Vehicles Entered 359 910 127 98 1494 Vehicles Exited 358 905 125 96 1484 Hourly Exit Rate 1432 3620 500 384 5936 Input Volume 2468 4389 676 413 7946 % of Volume 58 82 74 93 75 Denied Entry After 0 211 26 0 237 Density (m/veh) 7 26 4 2 39 Occupancy (veh) 7 26 4 2 39	Avg Speed (kph)	42	21	17	20	25	
Fuel Eff. (kpl) 1.5 0.3 0.3 1.6 0.5 HC Emissions (g) 2 5 0 0 7 CO Emissions (g) 323 1296 123 76 1818 NOx Emissions (g) 5 15 1 1 22 Vehicles Entered 359 910 127 98 1494 Vehicles Exited 358 905 125 96 1484 Hourly Exit Rate 1432 3620 500 384 5936 Input Volume 2468 4389 676 413 7946 % of Volume 58 82 74 93 75 Denied Entry Before 0 211 26 0 237 Denied Entry After 0 211 26 0 237 Density (m/veh) 7 26 4 2 39	Fuel Used (I)	50.8	408.7	56.3	5.6	521.4	ICT
HC Emissions (g) 2 5 0 0 7 CO Emissions (g) 323 1296 123 76 1818 NOX Emissions (g) 5 15 1 1 22 Vehicles Entered 359 910 127 98 1494 Vehicles Exited 358 905 125 96 1484 Hourly Exit Rate 1432 3620 500 384 5936 Input Volume 2468 4389 676 413 7946 % of Volume 58 82 74 93 75 Denied Entry After 0 211 26 0 237 Density (m/veh) 32 Occupancy (veh) 7 26 4 2 39	Fuel Eff. (kpl)	1.5	0.3	0.3	1.6	0.5	
CO Emissions (g) 323 1296 123 76 1818 NOx Emissions (g) 5 15 1 1 22 Vehicles Entered 359 910 127 98 1494 Vehicles Exited 358 905 125 96 1484 Hourly Exit Rate 1432 3620 500 384 5936 Input Volume 2488 4389 676 413 7946 % of Volume 58 82 74 93 75 Denied Entry Before 0 41 6 0 47 Denied Entry After 0 211 26 0 237 Density (m/veh) 7 26 4 2 39	HC Emissions (g)	2	5	0	0	7	
NOx Emissions (g) 5 15 1 1 22 Vehicles Entered 359 910 127 98 1494 Vehicles Exited 358 905 125 96 1484 Hourly Exit Rate 1432 3620 500 384 5936 Input Volume 2468 4389 676 413 7946 % of Volume 58 82 74 93 75 Denied Entry Before 0 41 6 0 47 Denied Entry After 0 211 26 0 237 Denisity (m/veh) 7 26 4 2 39 Occupancy (veh) 7 26 4 2 39	CO Emissions (g)	323	1296	123	76	1818	
Vehicles Entered 359 910 127 98 1494 Vehicles Exited 358 905 125 96 1484 Hourly Exit Rate 1432 3620 500 384 5936 Input Volume 2468 4389 676 413 7946 % of Volume 58 82 74 93 75 Denied Entry Before 0 41 6 0 47 Denied Entry After 0 211 26 0 237 Denisity (m/veh) 7 26 4 2 39	NOx Emissions (g)	5	15	1	1	22	
Vehicles Exited 358 905 125 96 1484 Hourly Exit Rate 1432 3620 500 384 5936 Input Volume 2468 4389 676 413 7946 % of Volume 58 82 74 93 75 Denied Entry Before 0 41 6 0 47 Denied Entry After 0 211 26 0 237 Density (m/veh)	Vehicles Entered	359	910	127	98	1494	
Hourly Exit Rate 1432 3620 500 384 5936 Input Volume 2468 4389 676 413 7946 % of Volume 58 82 74 93 75 Denied Entry Before 0 41 6 0 47 Denied Entry After 0 211 26 0 237 Density (m/veh) 7 26 4 2 39 Occupancy (veh) 7 26 4 2 39	Vehicles Exited	358	905	125	96	1484	
Input Volume 2468 4389 676 413 7946 % of Volume 58 82 74 93 75 Denied Entry Before 0 41 6 0 47 Denied Entry After 0 211 26 0 237 Density (m/veh) 7 26 4 2 39 Occupancy (veh) 7 26 4 2 39	Hourly Exit Rate	1432	3620	500	384	5936	
% of Volume 58 82 74 93 75 Denied Entry Before 0 41 6 0 47 Denied Entry After 0 211 26 0 237 Density (m/veh)	Input Volume	2468	4389	676	413	7946	
Denied Entry Before 0 41 6 0 47 Denied Entry After 0 211 26 0 237 Density (m/veh) 7 26 4 2 39 Occupancy (veh) 7 26 4 2 39	% of Volume	58	82	74	93	75	
Denied Entry After 0 211 26 0 237 Density (m/veh) 7 26 4 2 39 Occupancy (veh) 7 26 4 2 0	Denied Entry Before	0	41	6	0	47	
Density (m/veh) 7 26 4 2 39	Denied Entry After	0	211	26	0	237	
Occupancy (veh) 7 26 4 2 39	Density (m/veh)					32	
	Occupancy (veh)	7	26	4	2	39	

base case-morning peak

SimTraffic Report

Figure C1-15: Performance Report- INTERSECTION(S) 9_N4

24: ACC-MAD(N4)	& Sout	thwest	Slip P	erform	ance b	by movement
Movement	NBT	NBR	SBT	SER	All	
Total Delay (hr)	40.3	35.1	13	61	82.8	
Delay / Veh (s)	430.2	409.2	4.5	3648.7	176.5	
Stop Delay (hr)	40.0	33.6	0.0	61	79.7	
St Del/Veh (s)	427.8	391.4	0.0	3645.2	170.0	
Total Stops	11	101	0.0	13	125	
Stop/Veh	0.03	0.33	0.00	2 17	0.07	
Travel Dist (km)	48.6	44 4	224.5	0.3	317.7	
Travel Time (hr)	41.5	36.5	7 6	6.1	916	
Ava Speed (kph)	32	13	30	0	17	
Fuel Used (I)	412.0	341.6	186.9	50.8	991.3	ICT
Fuel Eff (kpl)	0.1	0.1	12	0.0	0.3	
HC Emissions (a)	6	3	3	2	14	
CO Emissions (g)	1790	831	802	276	3700	
NOx Emissions (a)	13	4	12	1	31	
Vehicles Entered	340	307	1041	13	1701	
Vehicles Exited	335	310	1030	0	1675	
Hourly Exit Rate	1340	1240	4120	0	6700	
Input Volume	2334	1989	5292	1169	10784	
% of Volume	57	62	78	0	62	
Denied Entry Before	39	41	0	0	80	
Denied Entry After	310	233	0	0	543	
Density (m/veh)					17	
Occupancy (veh)	6	13	30	24	74	
			-	2/6	INE	
base case-morning peak						SimTraffic Repo

SimTraffic Report

Figure C1–16: Performance Report- INTERSECTION(S) 24_N4

baseline-Existing							
29: Motorway Exte	nsion(N	1)&	Perforn	nance	by mo	vemer	nt
N Annual and	FDT			CDT	CDD	A 11	
	EBI	ERK	WBI	SBI	SBR	All	
Total Delay (hr)	0.1	0.1	1.2	0.0	1.4	2.8	
Delay / Veh (s)	1.6	4.2	9.7	1.2	36.7	10.7	
Stop Delay (hr)	0.0	0.0	0.3	0.0	1.3	1.6	
St Del/Veh (s)	0.2	0.5	2.7	0.0	34.3	6.2	
Total Stops	0	0	96	0	106	202	
Stop/Veh	0.00	0.00	0.21	0.00	0.80	0.21	
Travel Dist (km)	62.8	32.2	119.8	0.1	7.7	222.5	
Travel Time (hr)	1.3	0.9	3.4	0.0	1.6	7.1	
Avg Speed (kph)	50	37	36	29	5	31	
Fuel Used (I)	70.5	28.9	102.3	0.1	16.8	218.5	
Fuel Eff. (kpl)	0.9	1.1	1.2	2.4	0.5	1.0	
HC Emissions (g)	12	1	6	0	0	20	
CO Emissions (g)	2745	562	1494	0	- 77	4878	
NOx Emissions (g)	33	4	19	0	1	58	
Vehicles Entered	231	120	458	4	135	948	
Vehicles Exited	235	120	453	4	131	943	
Hourly Exit Rate	940	480	1812	16	524	3772	
Input Volume	1882	848	1705	33	1073	5541	
% of Volume	50	57	106	48	49	68	
Denied Entry Before	0	0	0	0	0	0	
Denied Entry After	0	0	0	0	0	0	
Density (m/veh)						53	
Occupancy (veh)	5	3	13	0	6	28	

base case-morning peak

SimTraffic Report

Figure C1–17: Performance Report- INTERSECTION(S) 29_N1

Dasenne-Existing								
31: SE Loop 1 & F	Performa	ance b	y move	ement				
Movement	WBT	WBR	NBT	NBR	SWT	SWR	All	
Total Delay (hr)	0.4	0.4	0.0	0.5	0.0	0.2	15	
Delay / Veh (s)	34.3	33.8	1.3	12.2	0.2	4.7	13.9	
Stop Delay (hr)	0.4	0.3	0.0	0.4	0.0	0.1	1.2	
St Del/Veh (s)	32.5	32.3	0.2	10.0	0.2	1.7	11.6	
Total Stops	45	35	0	58	1	40	179	
Stop/Veh	1.00	0.92	0.00	0.37	0.07	0.32	0.46	
Travel Dist (km)	1.8	1.5	0.2	9.0	0.9	13.1	26.5	
Travel Time (hr)	0.5	0.4	0.0	0.8	0.0	0.6	2.3	
Avg Speed (kph)	4	4	25	12	23	23	12	
Fuel Used (I)	5.2	4.5	0.2	12.6	1.9	17.4	41.9	
Fuel Eff. (kpl)	0.3	0.3	1.1	0.7	0.4	0.8	0.6	
HC Emissions (g)	0	0	0	0	2	0	3	
CO Emissions (g)	12	25	25	73	263	168	565	
NOx Emissions (g)	0	0	0	1	4	2	8	
Vehicles Entered	45	39	6	158	14	125	387	
Vehicles Exited	45	38	7	154	14	126	384	
Hourly Exit Rate	180	152	28	616	56	504	1536	
Input Volume	359	383	20	989	34	848	2633	
% of Volume	50	40	140	62	165	59	58	
Denied Entry Before	0	0	0	0	0	0	0	
Denied Entry After	0	0	0	0	0	0	0	
Density (m/veh)							37	
Occupancy (veh)	2	2	0	3	0	2	9	

base case-morning peak

SimTraffic Report

Figure C1-18: Performance Report- INTERSECTION(S) 31_SE LP 1

	nsion(i)	1)&	Perform	nance	by mo	vement
			UIDD		by mo	venient
Movement	EBI	WBI	WBR	NER	All	
Total Delay (hr)	0.2	0.3	0.1	4.2	4.8	
Delay / Ven (s)	3.4	2.0	2.1	108.2	18.0	
Stop Delay (nr)	0.0	0.2	0.0	4.1	4.3	
St Del/Ven (S)	0.0	1.4	1.1	100.2	10.9	
Total Stops	0.07	0.01	0.00	0.00	0.46	
Stop/ven Troval Diat (km)	0.07	25.7	7.0	0.90	100 1	
Travel Dist (Kill)	1.0	12	1.9	9.4	7.2	
Ava Speed (kpb)	1.0	20	0.4	4.0	1.2	
Evol Upod (I)	27.7	72.1	10.0	111	152.0	
Fuel Eff. (kpl)	21.1	0.5	0.8	0.2	0.7	
HC Emissions (a)	2.0	0.0	0.0	0.2	11	
CO Emissions (g)	785	1354	251	302	2692	
NOx Emissions (g)	12	1/	1	3	32	
Vehicles Entered	225	459	102	142	928	
Vehicles Exited	227	458	102	136	924	
Hourly Exit Rate	908	1832	412	544	3696	
Input Volume	1808	1705	413	1372	5298	
% of Volume	50	107	100	40	70	
Denied Entry Before	0	0	0	0	0	
Denied Entry After	0	2	0	0	2	
Density (m/veh)					31	
Occupancy (veh)	4	5	1	18	28	

base case-morning peak

SimTraffic Report

Figure C1–19: Performance Report- INTERSECTION(S) 37_N1

Movement SBT SBR NET All Total Delay (hr) 0.0 0.0 3.9 3.9 Delay / Veh (s) 0.9 0.5 70.2 42.2 Stop Delay (hr) 0.0 0.0 3.7 3.7 St Del/Veh (s) 0.0 0.1 66.4 39.8 Total Stops 0 0 199 199 Stop/Veh 0.00 0.00 1.01 0.60 Travel Dist (km) 0.2 5.7 28.1 34.0 Travel Dist (km) 0.2 5.7 28.60.7 50 Avg Speed (kph) 33 25 7 8 Fuel Used (I) 0.2 2.8 57.8 60.7 Fuel Used (I) 0.2 2.8 57.0 NO NOx Emissions (g) 0 1 7 8 Vehicles Entered 6 127 203 36 Vehicles Exited 6 128 193 327 Hourly E	38: SE LP 2 & Sou	theast S	Slip 2 F	Perforr	nance
Total Delay (hr) 0.0 0.0 3.9 3.9 Delay / Veh (s) 0.9 0.5 70.2 42.2 Stop Delay (hr) 0.0 0.0 3.7 3.7 St Del/Veh (s) 0.0 0.1 66.4 39.8 Total Stops 0 0 199 199 Stop/Veh 0.00 0.00 1.01 0.60 Travel Dist (km) 0.2 5.7 28.1 34.0 Travel Time (hr) 0.0 0.2 4.7 5.0 Avg Speed (kph) 33 25 7 8 Fuel Used (I) 0.2 2.8 57.8 60.7 Fuel Eff. (kpl) 1.2 2.1 0.5 0.6 HC Emissions (g) 0 1 7 8 Vehicles Entered 6 127 203 336 Vehicles Exited 6 128 193 327 Hourly Exit Rate 24 512 772 1308 Input Volume 34 848 1467 2349 % of Volume	Movement	SBT	SBR	NET	All
Delay / Veh (s) 0.9 0.5 70.2 42.2 Stop Delay (hr) 0.0 0.0 3.7 3.7 St Del/Veh (s) 0.0 0.1 66.4 39.8 Total Stops 0 0 199 199 Stop/Veh 0.00 0.00 1.01 0.60 Travel Dist (km) 0.2 5.7 28.1 34.0 Travel Dist (km) 0.2 5.7 8 50 Avg Speed (kph) 33 25 7 8 Fuel Used (I) 0.2 2.8 57.8 60.7 Fuel Eff. (kpl) 1.2 2.1 0.5 0.6 HC Emissions (g) 0 0 4 5 CO Emissions (g) 0 1 7 8 Vehicles Entered 6 127 203 336 Vehicles Exited 6 128 193 327 Hourly Exit Rate 24 512 777 308 Denied Entry	Total Delay (hr)	0.0	0.0	3.9	3.9
Stop Delay (hr) 0.0 0.0 3.7 3.7 St Del/Veh (s) 0.0 0.1 66.4 39.8 Total Stops 0 0.99 199 199 Stop/Veh 0.00 0.00 1.01 0.60 Travel Dist (km) 0.2 5.7 28.1 34.0 Travel Dist (km) 0.2 5.7 28.1 34.0 Travel Dist (km) 0.2 2.7 7 8 Fuel Used (l) 0.2 2.8 57.8 60.7 Fuel Used (l) 1.2 2.1 0.5 0.6 HC Emissions (g) 0 0 4 5 CO Emissions (g) 2 58 690 750 NOx Emissions (g) 0 1 7 8 Vehicles Exited 6 127 1308 1467 2349 Wehicles Exited 6 128 1467 2349 327 Houry Exit Rate 24 512 772 1308 100 Denied Entry Before 0 0 7 7<	Delay / Veh (s)	0.9	0.5	70.2	42.2
St Del/Veh (s) 0.0 0.1 66.4 39.8 Total Stops 0 0 199 199 Stop/Veh 0.00 0.00 1.01 0.60 Travel Dist (km) 0.2 5.7 28.1 34.0 Travel Time (hr) 0.0 0.2 4.7 5.0 Avg Speed (kph) 33 25 7 8 Fuel Used (I) 0.2 2.8 57.8 60.7 Fuel Eff. (kpl) 1.2 2.1 0.5 0.6 HC Emissions (g) 0 0 4 5 CO Emissions (g) 0 1 7 8 Vehicles Entered 6 127 203 336 Vehicles Exited 6 128 193 327 Hourly Exit Rate 24 512 772 1308 Input Volume 34 848 1467 2349 % of Volume 71 60 53 56 Denied Entry After 0 0 7 7 Denied Entry After 0	Stop Delay (hr)	0.0	0.0	3.7	3.7
Total Stops 0 0 199 199 Stop/Veh 0.00 0.00 1.01 0.60 Travel Dist (km) 0.2 5.7 28.1 34.0 Travel Time (hr) 0.0 0.2 4.7 5.0 Avg Speed (kph) 33 25 7 8 Fuel Used (I) 0.2 2.8 57.8 60.7 Fuel Eff. (kpl) 1.2 2.1 0.5 0.6 HC Emissions (g) 0 0 4 5 CO Emissions (g) 0 1 7 8 Vehicles Entered 6 127 203 336 Vehicles Exited 6 128 193 327 Hourly Exit Rate 24 512 772 1308 Input Volume 34 848 1467 2349 % of Volume 71 60 53 56 Denied Entry After 0 0 7 7 Density (m/veh) 23 23 24 512 17	St Del/Veh (s)	0.0	0.1	66.4	39.8
Stop/Veh 0.00 0.00 1.01 0.60 Travel Dist (km) 0.2 5.7 28.1 34.0 Travel Time (hr) 0.0 0.2 4.7 5.0 Avg Speed (kph) 33 25 7 8 Fuel Used (I) 0.2 2.8 57.8 60.7 Fuel Eff. (kpl) 1.2 2.1 0.5 0.6 HC Emissions (g) 0 0 4 5 CO Emissions (g) 1 7 8 Vehicles Entered 6 127 203 336 Vehicles Exited 6 128 193 327 Hourly Exit Rate 24 512 772 1308 Input Volume 34 848 1467 2349 % of Volume 71 60 53 56 Denied Entry After 0 0 7 7 Density (m/veh) 0 1 16 17	Total Stops	0	0	199	199
Travel Dist (km) 0.2 5.7 28.1 34.0 Travel Time (hr) 0.0 0.2 4.7 5.0 Avg Speed (kph) 33 25 7 8 Fuel Used (I) 0.2 2.8 57.8 60.7 Fuel Eff. (kpl) 1.2 2.1 0.5 0.6 HC Emissions (g) 0 0 4 5 CO Emissions (g) 0 1 7 8 Vehicles Entered 6 127 203 336 Vehicles Exited 6 128 193 327 Hourly Exit Rate 24 512 772 1308 Input Volume 34 848 1467 2349 % of Volume 71 60 53 56 Denied Entry After 0 0 7 7 Density (m/veh) 23 23 24 24 Occupancy (veh) 0 1 16 17	Stop/Veh	0.00	0.00	1.01	0.60
Travel Time (hr) 0.0 0.2 4.7 5.0 Avg Speed (kph) 33 25 7 8 Fuel Used (l) 0.2 2.8 57.8 60.7 Fuel Eff. (kpl) 1.2 2.1 0.5 0.6 HC Emissions (g) 0 0 4 5 CO Emissions (g) 0 1 7 8 Vehicles Entered 6 127 203 336 Vehicles Exited 6 128 193 327 Hourly Exit Rate 24 512 772 1308 Input Volume 34 848 1467 2349 % of Volume 71 60 53 56 Denied Entry Before 0 0 7 7 Density (m/veh) 23 23 24 24 512 77 Denied Entry After 0 0 7 7 24 24 512 7 23 Occupancy (veh) 0 1 16 17 17 16 17	Travel Dist (km)	0.2	5.7	28.1	34.0
Avg Speed (kph) 33 25 7 8 Fuel Used (I) 0.2 2.8 57.8 60.7 Fuel Eff. (kpl) 1.2 2.1 0.5 0.6 HC Emissions (g) 0 0 4 5 CO Emissions (g) 2 58 690 750 NOx Emissions (g) 0 1 7 8 Vehicles Entered 6 127 203 336 Vehicles Exited 6 128 193 327 Hourly Exit Rate 24 512 772 1308 Input Volume 34 848 1467 2349 % of Volume 71 60 53 56 Denied Entry After 0 0 7 7 Density (m/veh) 23 23 24 24 24 Occupancy (veh) 0 1 16 17	Travel Time (hr)	0.0	0.2	4.7	5.0
Fuel Used (I) 0.2 2.8 57.8 60.7 Fuel Eff. (kpl) 1.2 2.1 0.5 0.6 HC Emissions (g) 0 0 4 5 CO Emissions (g) 2 58 690 750 NOx Emissions (g) 0 1 7 8 Vehicles Entered 6 127 203 336 Vehicles Exited 6 128 193 327 Hourly Exit Rate 24 512 772 1308 Input Volume 34 848 1467 2349 % of Volume 71 60 53 56 Denied Entry Before 0 0 0 0 Denied Entry After 0 0 7 7 Density (m/veh) 23 23 24 24 24 Occupancy (veh) 0 1 16 17	Avg Speed (kph)	33	25	7	8
Fuel Eff. (kpl) 1.2 2.1 0.5 0.6 HC Emissions (g) 0 0 4 5 CO Emissions (g) 2 58 690 750 NOx Emissions (g) 0 1 7 8 Vehicles Entered 6 127 203 336 Vehicles Exited 6 128 193 327 Hourly Exit Rate 24 512 772 1308 Input Volume 34 848 1467 2349 % of Volume 71 60 53 56 Denied Entry Before 0 0 0 0 Denied Entry After 0 0 7 7 Density (m/veh) 23 23 23 Occupancy (veh) 0 1 16 17	Fuel Used (I)	0.2	2.8	57.8	60.7
HC Emissions (g) 0 0 4 5 CO Emissions (g) 2 58 690 750 NOx Emissions (g) 0 1 7 8 Vehicles Entered 6 127 203 336 Vehicles Exited 6 128 193 327 Hourly Exit Rate 24 512 772 1308 Input Volume 34 848 1467 2349 % of Volume 71 60 53 56 Denied Entry Before 0 0 7 7 Denied Entry After 0 0 7 7 Density (m/veh) 23 23 23 Occupancy (veh) 0 1 16 17	Fuel Eff. (kpl)	1.2	2.1	0.5	0.6
CO Emissions (g) 2 58 690 750 NOx Emissions (g) 0 1 7 8 Vehicles Entered 6 127 203 336 Vehicles Exited 6 128 193 327 Hourly Exit Rate 24 512 772 1308 Input Volume 34 848 1467 2349 % of Volume 71 60 53 56 Denied Entry Before 0 0 7 7 Denied Entry After 0 0 7 7 Density (m/veh) 23 23 23 Occupancy (veh) 0 1 16 17	HC Emissions (g)	0	0	4	5
NOx Emissions (g) 0 1 7 8 Vehicles Entered 6 127 203 336 Vehicles Exited 6 128 193 327 Hourly Exit Rate 24 512 772 1308 Input Volume 34 848 1467 2349 % of Volume 71 60 53 56 Denied Entry Before 0 0 7 7 Denied Entry After 0 0 7 7 Density (m/veh) 23 22 22 Occupancy (veh) 0 1 16 17	CO Emissions (g)	2	58	690	750
Vehicles Entered 6 127 203 336 Vehicles Exited 6 128 193 327 Hourly Exit Rate 24 512 772 1308 Input Volume 34 848 1467 2349 % of Volume 71 60 53 56 Denied Entry Before 0 0 7 7 Denied Entry After 0 0 7 7 Density (m/veh) 0 1 16 17	NOx Emissions (g)	0	1	7	8
Vehicles Exited 6 128 193 327 Hourly Exit Rate 24 512 772 1308 Input Volume 34 848 1467 2349 % of Volume 71 60 53 56 Denied Entry Before 0 0 0 0 Denied Entry After 0 0 7 7 Density (m/veh) 23 23 23 Doccupancy (veh) 0 1 16 17	Vehicles Entered	6	127	203	336
Hourly Exit Rate 24 512 772 1308 Input Volume 34 848 1467 2349 % of Volume 71 60 53 56 Denied Entry Before 0 0 0 0 Denied Entry After 0 0 7 7 Density (m/veh) 23 23 23 23 Docupancy (veh) 0 1 16 17	Vehicles Exited	6	128	193	327
Input Volume 34 848 1467 2349 % of Volume 71 60 53 56 Denied Entry Before 0 0 0 0 Denied Entry After 0 0 7 7 Density (m/veh) 23 23 23 Occupancy (veh) 0 1 16 17	Hourly Exit Rate	24	512	772	1308
% of Volume 71 60 53 56 Denied Entry Before 0 0 0 0 Denied Entry After 0 0 7 7 Density (m/veh) 23 23 20 Occupancy (veh) 0 1 16 17	Input Volume	34	848	1467	2349
Denied Entry Before 0 0 0 0 Denied Entry After 0 0 7 7 Density (m/veh) 23 Docupancy (veh) 0 1 16 17	% of Volume	71	60	53	56
Denied Entry After 0 0 7 7 Density (m/veh) 23 Occupancy (veh) 0 1 16 17	Denied Entry Before	0	0	0	0
Density (m/veh) 23 Dccupancy (veh) 0 1 16 17	Denied Entry After	0	0	7	7
Occupancy (veh) 0 1 16 17	Density (m/veh)				23
TRANSPORT OF THE NO	Occupancy (veh)	0	1	16	17
TRANSPORT OF THE NO					
THE REAL PROPERTY OF THE REAL					
THE REAL POINT					
THE REAL POINT					
THE REAL POINT					
TANKADO NO SANE NO					
TANKS AD SANE NO					
THE WO SANE NO					
THE SANE NO					
THE WO SANE NO					
THE AD SANE NO					
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SANE					
				-	2/

base case-morning peak

SimTraffic Report

Figure C1–20: Performance Report- INTERSECTION(S) 38_SE LP 2

40: NVV LOOP & Pe	erformal	nce by	move	ment		
Movement	EBR	NBT	NBR	SBT	All	
Total Delay (hr)	1.2	0.2	0.2	6.0	7.7	
Delay / Veh (s)	14.6	2.1	4.7	24.5	16.3	
Stop Delay (hr)	1.0	0.0	0.0	3.8	4.8	
St Del/Veh (s)	11.5	0.3	0.2	15.2	10.1	
Total Stops	101	33	12	457	603	
Stop/Veh	0.33	0.09	0.09	0.51	0.36	
Travel Dist (km)	18.0	98.3	37.2	190.3	343.8	
Travel Time (hr)	1.9	2.4	1.1	11.4	16.8	
Avg Speed (kph)	10	40	34	17	20	
Fuel Used (I)	22.2	83.4	31.2	205.3	342.0	ICT
Fuel Eff. (kpl)	0.8	1.2	1.2	0.9	1.0	
HC Emissions (g)	1	3	1	4	9	
CO Emissions (g)	115	696	317	1002	2130	
NOx Emissions (g)	1	9	3	15	29	
Vehicles Entered	304	366	137	905	1712	
Vehicles Exited	310	359	137	872	1678	
Hourly Exit Rate	1240	1436	548	3488	6712	
Input Volume	1511	2469	1073	4389	9442	
% of Volume	82	58	51	79	71	
Denied Entry Before	0	0	0	0	0	
Denied Entry After	0	0	0	0	0	
Density (m/veh)					27	
Occupancy (veh)	7	10	4	46	67	

base case-morning peak

SimTraffic Report

Figure C1–21: Performance Report- INTERSECTION(S) 40_NW LOOP

Daseline-Existing							
42: Motorway Exte	nsion(N	1) & F	Perforn	nance	by mo	vemer	nt
	EDT	WDT	WDD			A 11	
Movement	EBI	WRI	WBK	NET	NER	All	
Total Delay (hr)	0.4	4.0	1.4	0.0	0.1	5.9	
Delay / Veh (s)	7.0	55.1	16.3	0.4	3.1	23.4	
Stop Delay (hr)	0.1	3.3	0.1	0.0	0.1	3.6	
St Del/Veh (s)	2.2	45.1	0.7	0.0	2.5	14.1	
Total Stops	20	212	44	0	33	309	
Stop/Veh	0.10	0.81	0.14	0.00	0.24	0.34	
Travel Dist (km)	51.4	72.0	82.3	0.3	6.1	212.2	
Travel Time (hr)	1.1	5.4	3.2	0.0	0.3	10.1	
Avg Speed (kph)	45	13	26	33	18	21	
Fuel Used (I)	58.6	95.8	66.9	0.2	4.3	225.9	
Fuel Eff. (kpl)	0.9	0.8	1.2	1.8	1.4	0.9	
HC Emissions (g)	8	6	3	0	0	17	
CO Emissions (g)	2158	1432	816	0	68	4474	
NOx Emissions (g)	21	15	9	0	1	46	
Vehicles Entered	195	280	305	11	136	927	
Vehicles Exited	196	246	305	11	136	894	
Hourly Exit Rate	784	984	1220	44	544	3576	
Input Volume	2048	1271	1511	55	608	5493	
% of Volume	38	77	81	80	89	65	
Denied Entry Before	0	0	0	0	0	0	
Denied Entry After	0	0	0	0	0	0	
Density (m/veh)						35	
Occupancy (veh)	5	22	13	0	1	40	

base case-morning peak

SimTraffic Report

Figure C1–22: Performance Report- INTERSECTION(S) 42_ NI

Babeline Existing						
46: SE Loop 1 & P	erforma	ance b	y move	ement		
Movement	WBR	NBT	SBT	SBR	All	
Total Delay (hr)	0.1	0.2	2.0	0.2	2.5	
Delay / Veh (s)	2.9	1.9	6.8	6.8	5.4	
Stop Delay (hr)	0.0	0.0	0.1	0.0	0.1	
St Del/Veh (s)	0.5	0.2	0.3	0.5	0.3	
Total Stops	17	24	79	16	136	
Stop/Veh	0.10	0.07	0.07	0.12	0.08	
Travel Dist (km)	23.3	76.7	288.0	35.8	423.8	
Travel Time (hr)	0.8	1.8	10.3	1.3	14.2	
Avg Speed (kph)	29	42	28	27	30	
Fuel Used (I)	22.5	53.1	267.1	33.7	376.4	
Fuel Eff. (kpl)	1.0	1.4	1.1	1.1	1.1	
HC Emissions (g)	0	2	7	0	10	
CO Emissions (g)	204	434	1527	148	2313	
NOx Emissions (g)	2	6	24	2	35	
Vehicles Entered	171	335	1060	132	1698	
Vehicles Exited	171	332	1052	127	1682	
Hourly Exit Rate	684	1328	4208	508	6728	
Input Volume	1207	2334	5338	608	9487	
% of Volume	57	57	79	84	71	
Denied Entry Before	0	0	0	0	0	
Denied Entry After	0	0	0	0	0	
Density (m/veh)					37	
Occupancy (veh)	3	7	41	5	57	
					NE	

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SimTraffic Report

Figure C1–23: Performance Report- INTERSECTION(S) 46_SE LP 1

Basenne Existing			
47: SE Slip 1 & Pe	erforma	nce by	mover
Movement	NRT	NRR	Δ١١
Total Delay (hr)	0.7	0.1	0.9
Delay / Veh (s)	15.8	32	9.8
Ston Delay (hr)	0.6	0.2	0.0
St Del/eh (s)	13.4	15	7.7
Total Stops	88	1.5	00
Stop/job	00	0.07	0.31
Travel Dist (km)	21.0	20.2	12.1
Travel Dist (Kill)	21.5	20.2	42.1
Ava Spood (kph)	1.0	0.9	2.0
Avy Speed (kpn)	CI C DC	20.2	10
	29.3	20.3	49.0
ruei Ell. (Kpl)	0.7	1.0	0.0
	017	100	200
CO Emissions (g)	217	182	399
NUX Emissions (g)	3	450	200
venicles Entered	169	153	322
venicles Exited	165	153	318
Hourly Exit Rate	660	612	1272
Input Volume	1029	1000	2029
% of Volume	64	61	63
Denied Entry Before	0	0	0
Denied Entry After	0	0	0
Density (m/veh)			29
Occupancy (veh)	6	4	9

base case-morning peak

SimTraffic Report

Figure C1–24: Performance Report- INTERSECTION(S) 47_SE SLP 1

Baseline-Existing						
55: Spintex Road &	Perfo	rmance	e by m	oveme	ent	
Movement	EBT	WBT	NET	NER	All	
Total Delay (hr)	0.1	9.5	0.0	0.4	10.0	
Delay / Veh (s)	4.0	388.5	0.6	9.7	98.8	
Stop Delay (hr)	0.1	9.4	0.0	0.3	9.8	
St Del/Veh (s)	4.2	385.0	0.0	7.0	96.9	
Total Stops	31	86	0	104	221	
Stop/Veh	0.25	0.98	0.00	0.68	0.60	
Travel Dist (km)	1.6	9.6	0.2	15.0	26.4	
Travel Time (hr)	0.2	9.7	0.0	1.0	11.0	
Ava Speed (kph)	9	3	23	15	6	
Fuel Used (I)	4.4	89.5	0.3	18.8	113.0	ICT
Fuel Eff. (kpl)	0.4	0.1	0.6	0.8	0.2	
HC Emissions (a)	0	1	0	0	2	
CO Emissions (g)	22	302	46	123	494	
NOx Emissions (g)	0	2	1	2	5	
Vehicles Entered	123	92	3	154	372	
Vehicles Exited	122	84	3	152	361	A
Hourly Exit Rate	488	336	12	608	1444	
Input Volume	500	742	20	1000	2262	
% of Volume	98	45	60	61	64	
Denied Entry Before	0	0	0	0	0	
Denied Entry After	0	84	0	0	84	
Density (m/veh)					17	
Occupancy (veh)	1	13	0	4	18	
				2.0	THE	

base case-morning peak

SimTraffic Report

Figure C1–25:Performance Report- INTERSECTION(S) 55_SPINTEX

Baseline-Existing	ΓK	
Total Network Perform	nance	
Tatal Dalaw (ba)	071.4	
Total Delay (nr)	271.4	
Delay / Ven (s)	300.0	
Stop Delay (nr)	201.0	
St Del/Ven (s)	331.Z	
I otal Stops	30/0	
Stop/ven	1.31	
Travel Dist (km)	2898.1	
Travel Time (nr)	345.3	
Avg Speed (kpn)	19	
Fuel Used (I)	4906.6	
Fuel Eff. (kpl)	U.b	
HC Emissions (g)	162	
CO Emissions (g)	39148	
NOX Emissions (g)	430	
Vehicles Entered	2906	
Vehicles Exited	2553	
Hourly Exit Rate	10212	
Input Volume	106044	
% of Volume	10	
Denied Entry Before	209	
Denied Entry After	1438	
Density (m/veh)	28	
Occupancy (veh)	624	
		ANE

base case-morning peak

SimTraffic Report

Figure C1–26:Performance Report- INTERSECTION(S) NETWORK

Queuing and Blocking Report Baseline-Existing

Intersection: 5: Moto	orway	Extens	sion(N ²)&				
Movement	EB	B20	WB	WB	SW			
Directions Served	TR	Т	Т	Т	R			
Maximum Queue (m)	43.7	195.3	241.0	246.3	40.4			
Average Queue (m)	10.6	27.9	228.7	216.1	19.6			
95th Queue (m)	39.0	140.6	274.8	271.4	35.1			
Link Distance (m)	26.6	190.7	225.2	225.2	57.0			
Upstream Blk Time (%)	20	15	62	14				
Queuing Penalty (veh)	0	0	396	88				
Storage Bay Dist (m)								
Storage Blk Time (%)								
Queuing Penalty (veh)								
Intersection: 9: ACC	-MAD	(N4) &				<u> </u>	$ \supset $	
Movement	NB	NB	SB	SB	SB	NW	NW	
Directions Served	Т	Т	Т	Т	TR	R	R	
Maximum Queue (m)	6.2	21.2	157.3	157.3	157.3	34.8	23.5	
Average Queue (m)	1.8	14.8	112.1	114.2	94.3	15.6	10.7	
95th Queue (m)	6.4	23.3	229.0	225.6	213.2	34.1	22.1	
Link Distance (m)	184.4	184.4	152.7	152.7	152.7	71.9	71.9	
Upstream Blk Time (%)			3	2	3			
Queuing Penalty (veh)			0	0	0			
Storage Bay Dist (m)								
Storage Blk Time (%)								
Queuing Penalty (veh)								1
base case-morning peak								SimTraffic Repo

Figure C1–27: Queuing and Blockage Report- INTERSECTION(S) 5 & 9

Queuing and Blocking Report Baseline-Existing

Intersection: 24: ACC-MAD(NA)	& Southwest Slin
Intersection, 24, ACC-MAD(N4)	a Southwest Slip

-												
Movement	NB	NB	NB	SE	SE	B23	B23	B22	B22	B21	B21	
Directions Served	Ţ	I	TR	R	R	Ţ	Ţ	I	Т	Ţ	Ţ	
Maximum Queue (m)	153.0	145.4	148.2	83.0	83.6	216.1	214.7	110.0	110.2	31.1	64.3	
Average Queue (m)	21.9	61.4	107.1	79.5	81.1	167.6	166.0	48.4	49.6	7.8	17.8	
95th Queue (m)	110.2	178.4	214.3	81.9	82.8	278.5	277.0	128.4	130.1	28.5	64.2	
Link Distance (m)	143.6	143.6	143.6	63.5	63.5	195.6	195.6	88.4	88.4	31.1	31.1	
Upstream Blk Time (%)	1	0	10	94	95	56	57	36	37	1	25	
Queuing Penalty (veh)	0	0	0	552	556	328	335	209	217	5	144	
Storage Bay Dist (m)												
Storage Blk Time (%)												
Queuing Penalty (veh)												

Intersection: 29: Motorway Extension(N1) &

Movement	WB	WB	SB	SB	B36	B36	
Directions Served	Т	Т	R	R	Т	Т	
Maximum Queue (m)	77.4	122.8	63.3	62.4	14.7	25.6	
Average Queue (m)	11.1	74.4	50.7	41.4	7.2	4.6	
95th Queue (m)	55.7	127.3	76.6	65.1	17.8	19.3	
Link Distance (m)	225.6	225.6	42.2	42.2	176.8	176.8	
Upstream Blk Time (%)			22	13			
Queuing Penalty (veh)			117	72			
Storage Bay Dist (m)							
Storage Blk Time (%)							
Queuing Penalty (veh)							
HYPE	180	North 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2					BADWER

base case-morning peak

SimTraffic Report

Figure C1–28: Queuing and Blockage Report- INTERSECTION(S) 24 & 29

Queuing and Blocking Report Baseline-Existing

Intersection: 31: SE	Loop	1&									3
Movement	WB	NB	SW								
Directions Served	TR	LR>	<r< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></r<>								
Maximum Queue (m)	29.6	46.6	29.6								
Average Queue (m)	29.0	19.0	11.6								
95th Queue (m)	29.9	55.1	27.4								
Link Distance (m)	25.0	43.0	99.3								
Upstream Blk Time (%)	65	14									
Queuing Penalty (veh)	481	137									
Storage Bay Dist (m)											
Storage Blk Time (%)			-				_		-		
Queuing Penalty (veh)							C	-			
:		-									
Intersection: 37: Mo	torway	Exten	sion(N	1) &	<u> </u>	_	-	-			
Movement	EB	EB	WB	WB	NE	NE	B28	B28			
Directions Served	Т	Т	Т	Т	R	R	Т	Т			
Maximum Queue (m)	19.7	56.2	81.2	81.2	84.8	88.6	168.5	169.8			
Average Queue (m)	2.8	14.2	12.7	13.4	78.6	76.1	144.2	149.5			
95th Queue (m)	14.2	47.1	59.1	59.6	84.9	84.5	208.6	206.5			
Link Distance (m)	225.6	225.6	76.6	76.6	53.3	53.3	162.9	162.9			
Upstream Blk Time (%)			1	1	88	81	49	51			
Queuing Penalty (veh)			0	0	602	556	335	352			
Storage Bay Dist (m)											
Storage Blk Time (%)		_								-	
Queuing Penalty (veh)			~								
			20	SA	NE	100					
base case-morning peak										SimTraff	ic Report

Figure C1–29: Queuing and Blockage Report- INTERSECTION(S) 31 & 37

Queuing and Blocking Report Baseline-Existing

Intersection: 38: SE	LP 28	& Sout	heast	Slip 2					
				- 4					
Movement	SB	NE	NE						
Directions Served	R	I	Т						
Maximum Queue (m)	27.5	96.9	114.5						
Average Queue (m)	3.9	52.2	61.6						
95th Queue (m)	19.8	122.7	143.9						
Link Distance (m)	31.2	99.3	99.3						
Upstream Blk Time (%)	1	10	24						
Queuing Penalty (veh)	2	68	167						
Storage Bay Dist (m)									
Storage Blk Time (%)									
Queuing Penalty (veh)									
Intersection: 40: NW	/Loop	&		_		_		_	
Movement	EB	EB	B17	B17	SB	SB	SB		
Directions Served	R	R	Т	Т	Т	Т	Т		
Maximum Queue (m)	71.2	63.2	117.0	111.5	181.6	188.7	191.9		
Average Queue (m)	57.8	26.8	68.9	43.9	81.6	153.7	151.7		
95th Queue (m)	86.6	58.8	137.7	118.2	204.3	215.8	201.8		
Link Distance (m)	42.9	42.9	240.5	240.5	184.4	184.4	184.4		
Upstream Blk Time (%)	37	4			0	1	2		
Queuing Penalty (veh)	278	34			2	17	28		
Storage Bay Dist (m)									
Storage Blk Time (%)									
Queuing Penalty (veh)									
			~~~	SA	NE	1.5	/		
base case morning peak									SimTroffic Doport

base case-morning peak

SimTraffic Report

## Figure C1–30: Queuing and Blockage Report- INTERSECTION(S) 38&40

#### Queuing and Blocking Report Baseline-Existing

Intersection: 42: Mo	torway	/ Exter	nsion(N	V1) &				
Movement	EB	EB	WB	WB	WB	NE	NE	
Directions Served	T	T	Т	T	R	R	R	
Maximum Queue (m)	7.1	27.5	254.2	250.2	103.2	35.2	33.5	
Average Queue (m)	1.0	15.6	138.8	91.4	14.7	20.6	7.6	
95th Queue (m)	5.1	29.9	286.7	232.8	74.3	42.4	26.3	
Link Distance (m)	225.2	225.2	252.8	252.8	252.8	30.7	30.7	
Upstream Blk Time (%)			4	0		3	1	
Queuing Penalty (veh)			40	2		9	2	
Storage Bay Dist (m)								
Storage Blk Time (%)								
Queuing Penalty (veh)							-	
Intersection: 46: SE	Loop	1&		_		<u> </u>		
Movement	WB	NB	SB	SB				
<b>Directions Served</b>	R	Т	Т	R				
Maximum Queue (m)	16.8	15.5	166.7	141.2				
Average Queue (m)	9.4	7.1	45.6	20.2				
95th Queue (m)	22.8	14.7	164.9	101.7				
Link Distance (m)	107.7	197.3	256.2	256.2				
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (m)					20)			
Storage Bik Time (%)		-						
Queuing Penalty (ven)								1
			-	2/	INE	1.0		
base case-morning peak								SimTraffic Repor

Figure C1–31: Queuing and Blockage Report- INTERSECTION 42 & 46

Queuing	and	Blocking	Report
<b>D</b>		1.1	

Baseline-Existing	ig Re	5011		
Intersection: 47: SE	Slip 1	&		
Movement	NB	NB		
Directions Served	Т	R		
Maximum Queue (m)	111.7	134.6		
Average Queue (m)	37.2	43.1		
95th Queue (m)	115.9	139.3		
Link Distance (m)	107.3	107.3		
Upstream Blk Time (%)	5	3		
Queuing Penalty (veh)	48	32		
Storage Bay Dist (m)				
Storage Blk Time (%)				
Queuing Penalty (veh)				
Intersection: 55: Spi	ntex F	Road &		NUST
Movement	EB	WB	NE	
<b>Directions Served</b>	Т	Т	R	
Maximum Queue (m)	20.3	130.0	84.5	
Average Queue (m)	17.5	103.6	39.6	
95th Queue (m)	19.4	146.7	83.2	
Link Distance (m)		110.8	83.2	
Upstream Blk Time (%)	0	64	1	
Queuing Penalty (veh)	0	0	13	
Storage Bay Dist (m)				
Storage Blk Time (%)				
Queuing Penalty (veh)				
Network Summan				
Network wide Queuing F	Penalty:	6223		and and a
Network while adealing i	churty.	ULLO		2 Marshow

base case-morning peak

SimTraffic Report

Figure C1–32:

## Queuing and Blockage Report- INTERSECTION 47 & 55

# KNUST

APPENDIX C2 – SYNCHRO AND SIM TRAFFIC REPORTS_EXISTING CONDITIONS (Evening Peak)

#### Lanes, Volumes, Timings 5: Motorway Extension(N1) &

+ -*	_	5	-	٤	*	ť	6	*
T EBR	roup EBL	WBL	WBT	WBR	NWL	NWR	SWL	SWR
<b>ħ</b>	onfigurations		<b>†</b> †					77
9 759	(vph) 0	0	2636	0	0	0	0	759
0 1900	ow (vphpl) 1900	1900	1900	1900	1900	1900	1900	1900
%	%)		-2%		0%		0%	
95 0.95	il. Factor 1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.88
77								0.850
	ected							
57 0	ow (prot) 0	0	3285	0	0	0	0	2632
K	nitted							
57 0	ow (perm) 0	0	3285	0	0	0	0	2632
39	eed (k/h)		57		54		54	
.5	tance (m)		275.6		67.2		93.2	
.4	ime (s)		17.4		4.5		6.2	
00 1.00	our Factor 1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
% 3%	/ehicles (%) 2%	2%	11%	2%	2%	2%	2%	8%
9 759	w (vph) 0	0	2636	0	0	0	0	759
	Lane Traffic (%)							
38 0	roup Flow (vph) 0	0	2636	0	0	0	0	759
lo No	locked Intersection No	No	No	No	No	No	No	No
eft Right	ignment Lef	Left	Left	Right	Left	Right	Left	Right
.0	Width(m)		6.0	0	0.0	0	0.0	
0	set(m)		0.0		0.0		0.0	
.8	alk Width (m)		4.8	-	4.8		4.8	
	v Left Turn Lane	2			/			1
01 1.01	v Factor 1.01	0.99	0.99	0.99	1.00	1.00	1.00	1.00
15	Speed (k/h) 25	25		15	25	15	25	15
90	Introl		Free	100	Stop		Free	
100	tion Summary	no-	1			< 1		
	pe: Other	-	5					
	Type: Unsignalized							
1%	tion Capacity Utilization	10	OU Leve	l of Ser	vice H			
	s Period (min) 15							

base case-evening peak

Synchro 7 - Report

Figure C2-1: Lanes, Volumes & Timings Report- INTERSECTION(S) 1_N1

ane Group ane Configurations (olume (yph)	NIDL		2.20	10.00	•		100000	1000		
ane Configurations (olume (yph)	NBL	NBT	NBR	SBL	SBT	SBR	NWL	NWR	NEL	NER
(olume (vph)		***	_		<b>*††</b>			77		
	0	3276	0	0	2545	676	0	608	0	0
deal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Grade (%)		1%			-1%		-3%		0%	
ane Util. Factor	1.00	0.91	1.00	1.00	0.91	0.91	1.00	0.88	1.00	1.00
rt					0.969			0.850		
It Protected										
atd. Flow (prot)	0	5060	0	0	4914	0	0	2576	0	0
t Permitted										
atd. Flow (perm)	0	5060	0	0	4914	0	0	2576	0	0
ink Speed (k/h)	1.00	35			63		40		50	1000
ink Distance (m)		224.2			157.5		105.3		48.9	
ravel Time (s)		23.1			9.0		95		35	
eak Hour Factor	1.00	1.00	1.00	1.00	1.00	1 00	1 00	1.00	1.00	1.00
eavor Vehicles (%)	2%	2%	2%	2%	3%	2%	2%	12%	2%	2%
di Elow (vnh)	0	3276	0	0	2545	676	0	608	0	0
hared Lane Traffic (%)	Ň	0210	~	Ň	2010	010	× ×	~~~~	×	v
ane Group Flow (vph)	, 0	3276	0	0	3221	0	Û	60.8	0	Ω
nter Blocked Intersecti	ion No	No	No	No	No	No	No	No	No	No
ne Alianment	L eft	Left	Right	Left	Left	Right	Left	Right	Left	Right
edian Width(m)	LON	4.0	rugin	LOIL	40	ragin	0.0	rugin	0.0	rugin
nk Offset(m)		0.0			0.0		0.0		0.0	
osswalk Width(m)		1.8			1.8		1.8		1.8	
owayl eft Turn Lans	2	<u>्</u> न.०		-	4.0		-1.0		ч.0	/
eadway Eactor	1.01	1.01	1.01	0.99	0.99	0.99	0.98	0.98	1.00	1.00
rning Speed (k/h)	25	1.01	1.01	25	0.00	15	25	15	25	15
an Control	20	Eroo	10	20	Eroo	10	Eroo	10	Stop	10
an control	_	1166	22	20	TIEC	1	Tiee		otop	
ersection Summary	0.11	7		20		-12		-	<u> </u>	
ealype: (	Jther			-	_					
introl Type: Unsignali	zed									
ersection Capacity UI	tilization	119.2%	)	1	CU Leve	el of Ser	vice H			
alysis Period (min) 18	2									

Lanos Volumos Timings



	۲	t	۲	¥	ŧ	۶J	۲	7	4	×.	
Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SER	SWL	SWR	
Lane Configurations		<b>***</b>			***			77			
Volume (vph)	0	3920	1989	0	3385	0	0	759	0	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Grade (%)		1%			-1%		0%		0%		
Lane Util. Factor	1.00	0.91	0.91	1.00	0.91	1.00	1.00	0.88	1.00	1.00	
Frt		0.950						0.850			
Flt Protected											
Satd. Flow (prot)	0	4807	0	0	5061	0	0	2632	0	0	
Flt Permitted											
Satd. Flow (perm)	0	4807	0	0	5061	0	0	2632	0	0	
Link Speed (k/h)		35			63		54		50		
Link Distance (m)		148.4			238.3		101.8		141.7		
Travel Time (s)		15.3	-		13.6	-	6.8		10.2		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Heavy Vehicles (%)	2%	2%	2%	2%	3%	2%	2%	8%	2%	2%	
Adj. Flow (vph)	0	3920	1989	0	3385	0	0	759	0	0	
Shared Lane Traffic (%)											
Lane Group Flow (vph)	0	5909	.0	0	3385	0	0	759	0	0	
Enter Blocked Intersecti	ion No	No	No	No	No	No	No	2 veh	No	No	
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Right	Left	Right	
Median Width(m)		4.0	0		4.0		0.0	0	0.0		
Link Offset(m)		0.0			0.0		0.0		0.0		
Crosswalk Width(m)		4.8			4.8		4.8		4.8		
Two way Left Turn Lane	)			× /						1	
Headway Factor	1.01	1.01	1.01	0.99	0.99	0.99	1.00	1.00	1.00	1.00	
Turning Speed (k/h)	25		15	25		15	25	15	25	15	
Sian Control		Free			Free		Yield		Stop		
Interception Summon	- 7	1.144		4	1125				-ter		
Area Tyma:	Othor				-			-	<u> </u>		
Area Type. Control Type:	Julei			10	1						
Control Type: Unsignall.	zea 	404.00/			0111	1.40.					
Intersection Capacity Of	ilization	124.6%	)	ļ	CO Leve	el of Ser	vice H				
Analysis Period (min) 15	>										
		_	-	2.0	THE		-				

Lanes, Volumes, Timings 24: ACC-MAD(N4) & Southwest Slip

base case-evening peak

Synchro 7 - Report



Lanes, Volumes, Timings
29: Motorway Extension(N1) &

	٨	+	٦	5	Ŧ	*	L.	4	Ł	*	
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL	SBR	NWL	NWR	
Lane Configurations		<b>†</b> †	1		<b>†</b> †			11			
Volume (vph)	0	3684	1465	0	2595	0	0	1851	0	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Grade (%)		2%			-2%		1%		-2%		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.88	1.00	1.00	
Frt			0.850					0.850			
Flt Protected											
Satd. Flow (prot)	0	3191	1494	0	3285	0	0	2595	0	0	
Flt Permitted											
Satd. Flow (perm)	0	3191	1494	0	3285	0	0	2595	0	0	
Link Speed (k/h)		69			57	0040	40		50		
Link Distance (m)		264.0			264.8		69.9		53.1		
Travel Time (s)		13.8	-		16.7	$\sim$	6.3		3.8		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Heavy Vehicles (%)	2%	12%	7%	2%	11%	2%	2%	9%	2%	2%	
Adi, Flow (vph)	0	3684	1465	0	2595	0	0	1851	0	0	
Shared Lane Traffic (%)	)										
Lane Group Flow (vph)	, 0	3684	1465	0	2595	0	0	1851	0	0	
Enter Blocked Intersect	ion No	No	No	No	No	No	No	No	No	No	
Lane Alianment	Left	Left	Right	Left	Left	Right	Left	Right	Left	Right	
Median Width(m)		6.0	0		6.0		0.0	0	0.0		
Link Offset(m)		0.0			0.0		0.0		0.0		
Crosswalk Width(m)		4.8			4.8		4.8		4.8		
Two way Left Turn Lane	e			Y						1	
Headway Factor	1.01	1.01	1.01	0.99	0.99	0.99	1.01	1.01	0.99	0.99	
Turning Speed (k/h)	25		15	25		15	25	15	25	15	
Sign Control		Free			Free		Free		Stop		
Intersection Summary	1		~	de la		15		-	<		
Area Type:	Other	7	100	-	-	100		-	<u> </u>		
Control Type: Unsignali	ized			pr .	1						
Intersection Capacity U	tilization	173.0%		1	CULeve	el of Ser	vice H				
Analysis Period (min) 1:	5	110.0 /			0.0.200						
		-		-		-					

base case-evening peak

Synchro 7 - Report

Figure C2-4: Lanes, Volumes & Timings Report- INTERSECTION(S) 29(N1)

Lanes,	Volumes,	Timings
31: SE	Loop 1 &	

Lane Group         EBL         EBL         EBR         WBL         WBT         WBR         NBL         NBR         S           Lane Configurations         Image: Configurations         <		4	-	7	1	+	٤	1	۲	f	~
Lane Configurations       Image: Configurations       Image: Configurations       Image: Configurations         Volume (vph)       0       0       0       0       359       856       0       989         Ideal Flow (vphpl)       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900 <th>_ane Group</th> <th>EBL</th> <th>EBT</th> <th>EBR</th> <th>WBL</th> <th>WBT</th> <th>WBR</th> <th>NBL</th> <th>NBR</th> <th>SWL</th> <th>SWR</th>	_ane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBR	SWL	SWR
Volume (vph)         0         0         0         359         856         0         989           Ideal Flow (vphpl)         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900         1900	_ane Configurations					ef (			7		11
Ideal Flow (vphpl)       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1	Volume (vph)	0	0	0	0	359	856	0	989	0	1465
Grade (%)         -2%         0%         2%           Lane Util. Factor         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.564         1.56         1.56         1.57         1.564         1.57         1.57         1.57         1.564         1.56         1.564         1.50         1.50         1.50         1.50         1.50         1.50         1.50         1.50         1.50         1.50         1.50<	deal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.	Grade (%)		-2%			0%		2%		-2%	
Frt       0.905       0.865         FIt Protected       Satd. Flow (prot)       0       0       0       1686       0       0       1564         FIt Permitted       Satd. Flow (perm)       0       0       0       1686       0       0       1564         Link Speed (k/h)       50       50       50       50       12         Link Distance (m)       147.3       57.9       78.5       12         Travel Time (s)       10.6       4.2       5.7       7         Peak Hour Factor       1.00       1.00       1.00       1.00       1.00       1.00         Heavy Vehicles (%)       2%       2%       2%       2%       2%       2%       4%         Adj. Flow (vph)       0       0       0       359       856       0       989         Shared Lane Traffic (%)       Lane Group Flow (vph)       0       0       0       1215       0       0       989         Enter Blocked Intersection No       No       No       No       No       No       No       Left       Right         Median Width(m)       0.0       0.0       0.0       0.0       0.0       0.0       1.01       1.01	_ane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88
Flt Protected         Satd. Flow (prot)       0       0       0       1686       0       0       1564         Flt Permitted       Satd. Flow (perm)       0       0       0       1686       0       0       1564         Link Speed (k/h)       50       50       50       50       12         Link Distance (m)       147.3       57.9       78.5       12         Travel Time (s)       10.6       4.2       5.7       7         Peak Hour Factor       1.00       1.00       1.00       1.00       1.00       1.00         Heavy Vehicles (%)       2%       2%       2%       2%       2%       2%       2%       4%         Adj. Flow (vph)       0       0       0       0       359       856       0       989         Shared Lane Traffic (%)       Lane Group Flow (vph)       0       0       0       1215       0       0       989         Enter Blocked Intersection No       No       No       No       No       No       No       No         Lane Alignment       Left       Left       Right       Left       Right       Left       Right         Median Width(m)	Frt					0.905			0.865		0.850
Satd. Flow (prot)         0         0         0         0         1686         0         0         1564           Flt Permitted         Satd. Flow (perm)         0         0         0         1686         0         0         1564           Link Speed (k/h)         50         50         50         50         12           Link Distance (m)         147.3         57.9         78.5         12           Travel Time (s)         10.6         4.2         5.7         7           Peak Hour Factor         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.01         1.01         0         0         0         0	Flt Protected										
Fit Permitted         Satd. Flow (perm)       0       0       0       1686       0       0       1564         Link Speed (k/h)       50       50       50       50       12         Link Distance (m)       147.3       57.9       78.5       12         Travel Time (s)       10.6       4.2       5.7       12         Peak Hour Factor       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.01       1.00       1.01       1.00       1.01       1.01       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0	Satd. Flow (prot)	0	0	0	0	1686	0	0	1564	0	2683
Satid Flow (perm)         0         0         0         0         1686         0         0         1564           Link Speed (k/h)         50         50         50         50         50         12           Link Distance (m)         147.3         57.9         78.5         12         12           Travel Time (s)         10.6         4.2         5.7         100         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.01         1.01         0         1.01         1.01         0         1.01         1.01         1	Flt Permitted										
Link Speed (k/h)         50         50         50           Link Distance (m)         147.3         57.9         78.5         12           Travel Time (s)         10.6         4.2         5.7         12           Peak Hour Factor         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.01         0.0         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00	Satd. Flow (perm)	0	0	0	0	1686	0	0	1564	0	2683
Link Distance (m)         147.3         57.9         78.5         12           Travel Time (s)         10.6         4.2         5.7         10.6         4.2         5.7           Peak Hour Factor         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.01         0.0         0.0         0.0         0.0         0.0         1.00         1.01         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0	_ink Speed (k/h)		50	K		50		50		50	
Travel Time (s)       10.6       4.2       5.7         Peak Hour Factor       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.01       1.01       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.	_ink Distance (m)		147.3			57.9		78.5		129.7	
Peak Hour Factor         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.01         1.01         0.00         1.00         1.01         1.01         0.00         1.00         1.01         1.01         0.00         1.01         1.01         0.00         1.01         1.01         0.00         1.01         1.01         0.00         1.01         1.01	Fravel Time (s)		10.6			4.2		5.7		9.3	
Heavy Vehicles (%)       2%       2%       2%       2%       2%       2%       4%         Adj. Flow (vph)       0       0       0       359       856       0       989         Shared Lane Traffic (%)	Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)       0       0       0       359       856       0       989         Shared Lane Traffic (%)	Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	4%	2%	7%
Shared Lane Traffic (%)           Lane Group Flow (vph)         0         0         1215         0         989           Enter Blocked Intersection No         No <t< td=""><td>Adj. Flow (vph)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>359</td><td>856</td><td>0</td><td>989</td><td>0</td><td>1465</td></t<>	Adj. Flow (vph)	0	0	0	0	359	856	0	989	0	1465
ane Group Flow (vph)       0       0       0       1215       0       989         Enter Blocked Intersection No	Shared Lane Traffic (%)										
Inter Blocked Intersection No	ane Group Flow (vph)	0	0	.0	0	1215	0	0	989	0	1465
ane Alignment         Left         Left         Right         Left         Left         Right         Right         Left         Right         Right         Right	nter Blocked Intersecti	on No	No	No	No	No	No	No	No	No	No
Itedian Width(m)         0.0         0.0         0.0           ink Offset(m)         0.0         0.0         0.0           rosswalk Width(m)         4.8         4.8         4.8           wo way Left Turn Lane	ane Alignment	Left	Left	Right	Left	Left	Right	Left	Right	Left	Right
ink Offset(m) 0.0 0.0 0.0 rrosswalk Width(m) 4.8 4.8 4.8 wo way Left Turn Lane leadway Factor 0.99 0.99 0.99 1.00 1.00 1.00 1.01 1.01	1edian Width(m)		0.0			0.0		0.0	-	2.0	
Brosswalk Width (m)     4.8     4.8     4.8       Wo way Left Turn Lane     Ieadway Factor     0.99     0.99     1.00     1.00     1.01     1.01     0       Ieadway Factor     0.99     0.99     1.00     1.00     1.01     1.01     0       Iurning Speed (k/h)     25     15     25     15     25     15       Sign Control     Yield     Yield     Yield     Yield     Yield       Itersection Summary	ink Offset(m)		0.0			0.0		0.0		0.0	
wowayLeftTurn Lane leadwayFactor 0.99 0.99 0.99 1.00 1.00 1.00 1.01 1.01	rosswalk Width(m)		4.8			4.8		4.8		4.8	
leadway Factor 0.99 0.99 0.99 1.00 1.00 1.00 1.01 1.01	wo way Left Turn Lane	-									/
iurning Speed (k/h) 25 15 25 15 25 15 rign Control Yield	leadway Factor	0.99	0.99	0.99	1.00	1.00	1.00	1.01	1.01	0.99	0.99
tign Control Yield Yie	urning Speed (k/h)	25		15	25		15	25	15	25	15
tersection Summary	ign Control		Yield		2	Yield		Yield		Yield	
rea Type: Other	tersection Summary	_	3	2	Z	5	-15	52	9	5	
A STATE A DESC	irea Type: 0	Other		>>>	1		~	222			
control Type: Roun dabout	ontrol Type: Roundabo	out									
Itersection Capacity Utilization 139.4% ICU Level of Service H	tersection Consolby Ut	ilization	139.4%	ò	ļ	CU Leve	el of Ser	vice H			
nalysis Period (min) 15	reisection capacity Of										
	nalysis Period (min) 15	·									

base case-evening peak

Synchro 7 - Report

Figure C2-5: lanes, Volumes & Timings Report- INTERSECTION(S) 31_SE LP 1

Lane Group         EBL         EBT         EBR         WEL         WET         WBR         SEL         SER         NEL         NER           Lane Configurations         ↑↑         ↑↑         ↑↑         ↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑         ↑↑		3	-+	P	F	+	*_	1	2	3	1
Lane Configurations       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↑↑       ↓↑       ↓↓       ↓↓       ↓↓       ↓↓       ↓↓       ↓↓       ↓↓       ↓↓       ↓↓       ↓↓       ↓↓       ↓↓↓       ↓↓       ↓↓       ↓↓       ↓↓       ↓↓       ↓↓       ↓↓       ↓↓       ↓↓       ↓↓       ↓↓       ↓↓↓       ↓↓       ↓↓       ↓↓       ↓↓       ↓↓       ↓↓↓       ↓↓       ↓↓↓       ↓↓↓       ↓↓↓       ↓↓↓       ↓↓↓       ↓↓↓	Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SER	NEL	NER
Volume (vph)       0       3684       0       0       2595       608       0       0       1845         ideal Flow (vphp)       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       100       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00	Lane Configurations		1			<b>†</b> †	1				11
deal Flow (vphpl)       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1900       1600       100       100	Volume (vph)	0	3684	0	0	2595	608	0	0	0	1845
Grade (%)       2%       -2%       -3%       2%         Lane Util. Factor       1.00       0.95       1.00       1.00       0.95       1.00       1.00       0.880         Fit       0.850       0.850       0.880       0.880       0.880         Fit Protected       Satal Flow (prot)       0       3191       0       0       3285       1456       0       0       0       2630         Satal Flow (perm)       0       3191       0       0       3285       1456       0       0       0       2630         Link Speed (k/h)       69       57       50       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34       34 </td <td>deal Flow (vphpl)</td> <td>1900</td>	deal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor       1.00       0.95       1.00       1.00       0.95       1.00       1.00       1.00       0.0850       0.850         Fit       0       3191       0       0       3285       1456       0       0       0       2630         Fit Permitted       0       3191       0       0       3285       1456       0       0       0       2630         Link Speed (k/h)       63       57       50       34       34       34       34         Ink Distance (m)       264.8       88.5       125.6       88.4       34       34         Peak Hour Factor       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00         Heavy Vehicles (%)       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2%       2% <td< td=""><td>Grade (%)</td><td></td><td>2%</td><td></td><td></td><td>-2%</td><td></td><td>-3%</td><td></td><td>2%</td><td></td></td<>	Grade (%)		2%			-2%		-3%		2%	
Frt       0.850       0.850         FIt Protected       5atd. Flow (prot)       0       3191       0       0       3285       1456       0       0       0       2630         FIt Permitted       5atd. Flow (perm)       0       3191       0       0       3285       1456       0       0       0       2630         Link Speed (k/h)       69       57       50       34       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341       341	Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.88
Fit Protected         Satd. Flow (prot)       0       3191       0       0       3285       1456       0       0       0       2630         Fit Permitted	Frt						0.850				0.850
Satd. Flow (prot)       0       3191       0       0       3285       1456       0       0       0       2630         Flt Permitted       Satd. Flow (perm)       0       3191       0       0       3285       1456       0       0       0       2630         Link Speed (k/h)       69       57       50       34       34       34       34         Link Speed (k/h)       69       13.8       5.6       9.0       9.4       34         Peak Hour Factor       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00         Heavy Vehicles (%)       2%       12%       2%       2%       11%       12%       2%       2%       7%         Adj. Flow (vph)       0       3684       0       0       2595       608       0       0       1845         Shared Lane Traffic (%)       2       2       2       2       7%       3       3       3         Lane Group Flow (vph)       0       3684       0       0       2595       608       0       0       1845         Enter Blocked Intersection No       No       No       No       No       No	Flt Protected										
Fit Permitted         Satd. Flow (perm)       0       3191       0       0       3285       1456       0       0       0       2630         Link Speed (k/h)       69       57       50       34       34         Link Speed (k/h)       264.8       88.5       125.6       88.4       125.6       88.4         Travel Time (s)       13.8       5.6       9.0       9.4       9.4       100       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.01       1.01       1.01	Satd. Flow (prot)	0	3191	0	0	3285	1456	0	0	0	2630
Satd. Flow (perm)       0       3191       0       0       3285       1456       0       0       0       2630         Link Speed (k/h)       69       57       50       34         Link Distance (m)       264.8       88.5       125.6       88.4         Travel Time (s)       13.8       5.6       9.0       9.4         Peak Hour Factor       1.00       1.00       1.00       1.00       1.00       1.00         Heavy Vehicles (%)       2%       12%       2%       2%       11%       12%       2%       2%       7%         Add, Flow (vph)       0       3684       0       0       2595       608       0       0       1845         Shared Lane Traffic (%)       Lane Group Flow (vph)       0       3684       0       0       2595       608       0       0       1845         Enter Blocked Intersection No         Lane Alignment       Left       Left       Right       Left       Right       Left       Right       Left       Right       Left       Right       Left       Right       Left	Flt Permitted										
Link Speed (k/h)       69       57       50       34         Link Distance (m)       264.8       88.5       125.6       88.4         Travel Time (s)       13.8       5.6       9.0       9.4         Peak Hour Factor       1.00       1.00       1.00       1.00       1.00       1.00         Hour Factor       1.00       1.00       1.00       1.00       1.00       1.00       1.00         Heavy Vehicles (%)       2%       12%       2%       2%       11%       12%       2%       2%       7%         Adj. Flow (vph)       0       3684       0       0       2595       608       0       0       1845         Shared Lane Traffic (%)                 Lane Group Flow (vph)       0       3684       0       0       2595       608       0       0       1845         Lane Group Flow (vph)       0       3684       0       0       0       1845         Lane Alignment       Left       Right       Left       Right       Left       Right       Left       Right       Left       Right       Left	Satd. Flow (perm)	0	3191	0	0	3285	1456	0	0	0	2630
Link Distance (m)         264.8         88.5         125.6         88.4           Fravel Time (s)         13.8         5.6         9.0         9.4           Peak Hour Factor         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.00         1.01         1.01         1.01         1.01         1.01         1.01         1.01         1.01         1.01         1.01         1.01         1.01         1.01         1.01         1.01         1.01         0.99         0.99         0.98	_ink Speed (k/h)		69			57		50		34	
Travel Time (s)       13.8       5.6       9.0       9.4         Peak Hour Factor       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00	Link Distance (m)		264.8			88.5		125.6		88.4	
Peak Hour Factor       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.00       1.0	Travel Time (s)		13.8			5.6	-	9.0		9.4	
Heavy Vehicles (%)       2%       12%       2%       11%       12%       2%       2%       7%         Adj. Flow (vph)       0       3684       0       0       2595       608       0       0       1845         Shared Lane Traffic (%)	Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)       0       3684       0       0       2595       608       0       0       1845         Shared Lane Traffic (%)	Heavy Vehicles (%)	2%	12%	2%	2%	11%	12%	2%	2%	2%	7%
Shared Lane Traffic (%)         Lane Group Flow (vph)       0       3684       0       0       2595       608       0       0       1845         Enter Blocked Intersection No	Adj. Flow (vph)	0	3684	0	0	2595	608	0	0	0	1845
Lane Group Flow (vph)       0       3684       0       0       2595       608       0       0       0       1845         Enter Blocked Intersection No       No <td>Shared Lane Traffic (%)</td> <td></td>	Shared Lane Traffic (%)										
Enter Blocked Intersection No	Lane Group Flow (vph)	0	3684	.0	0	2595	608	0	0	0	1845
Lane Alignment         Left         Left         Right         Median         Width(m)         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0	Enter Blocked Intersection	on No	No	No	No	No	No	No	No	No	No
Median Width(m)         6.0         6.0         0.0         0.0           Link Offset(m)         0.0         0.0         0.0         0.0           Crosswalk Width(m)         4.8         4.8         4.8         4.8           Two way Left Turn Lane         Headway Factor         1.01         1.01         0.99         0.99         0.98         0.98         1.01         1.01           Turning Speed (k/h)         25         15         25         15         25         15         25         15           Sign Control         Free         Free         Stop         Yield         Measage         Measage <td>Lane Alignment</td> <td>Left</td> <td>Left</td> <td>Right</td> <td>Left</td> <td>Left</td> <td>Right</td> <td>Left</td> <td>Right</td> <td>Left</td> <td>Right</td>	Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Right	Left	Right
Link Offset(m) 0.0 0.0 0.0 0.0 Crosswalk Width(m) 4.8 4.8 4.8 4.8 Two way Left Turn Lane Headway Factor 1.01 1.01 1.01 0.99 0.99 0.99 0.98 0.98 1.01 1.01 Turning Speed (k/h) 25 15 25 15 25 15 25 15 Sign Control Free Free Stop Yield Intersection Summary Area Type: Other Control Type: Unsignalized Intersection Capacity Utilization 173.0% ICU Level of Service H Analysis Period (min) 15	Median Width(m)		6.0			6.0	-	0.0		0.0	
Crosswalk Width(m)       4.8       4.8       4.8       4.8         Two way Left Turn Lane       Headway Factor       1.01       1.01       0.99       0.99       0.98       0.98       1.01       1.01         Turning Speed (k/h)       25       15       25       15       25       15       25       15         Sign Control       Free       Free       Stop       Yield       Vield         Intersection Summary         Area Type:       Other       Other         Control Type: Unsignalized       ICU Level of Service H       Analysis Period (min) 15	Link Offset(m)		0.0			0.0		0.0		0.0	
Two way Left Turn Lane Headway Factor 1.01 1.01 1.01 0.99 0.99 0.99 0.98 0.98 1.01 1.01 Turning Speed (k/h) 25 15 25 15 25 15 Sign Control Free Free Stop Yield Intersection Summary Area Type: Other Control Type: Unsignalized Intersection Capacity Utilization 173.0% ICU Level of Service H Analysis Period (min) 15	Crosswalk Width(m)		4.8			4.8		4.8		4.8	
Headway Factor         1.01         1.01         1.01         0.99         0.99         0.98         0.98         1.01         1.01           Turning Speed (k/h)         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         15         25         <	Two way Left Turn Lane										1
Turning Speed (k/h) 25 15 25 15 25 15 25 15 Sign Control Free Free Stop Yield Intersection Summary Area Type: Other Control Type: Unsignalized Intersection Capacity Utilization 173.0% ICU Level of Service H Analysis Period (min) 15	Headway Factor	1.01	1.01	1.01	0.99	0.99	0.99	0.98	0.98	1.01	1.01
Sign Control Free Free Stop Yield Intersection Summary Area Type: Other Control Type: Unsignalized Intersection Capacity Utilization 173.0% ICU Level of Service H Analysis Period (min) 15	Turning Speed (k/h)	25		15	25		15	25	15	25	15
Intersection Summary Area Type: Other Control Type: Unsignalized Intersection Capacity Utilization 173.0% ICU Level of Service H Analysis Period (min) 15	Sign Control		Free		2	Free		Stop		Yield	
Area Type: Other Control Type: Unsignalized Intersection Capacity Utilization 173.0% ICU Level of Service H Analysis Period (min) 15	ntersection Summary	1	7	2	Z	-	-12	5.2	9	7	
Control Type: Unsignalized Intersection Capacity Utilization 173.0% ICU Level of Service H Analysis Period (min) 15	Area Type: 0	Ither		234	1			225			
Intersection Capacity Utilization 173.0% ICU Level of Service H Analysis Period (min) 15	Control Type: Unsignaliz	ed									
Analysis Period (min) 15	Intersection Capacity Uti	lization	173.0%	)	](	CU Lev	el of Ser	vice H			
	Analysis Period (min) 15										
	, , ,										
			_	23	SA	NE	N	2	-		
W J SANE NO BADHE	base case-evening peak										Svnchro7 - Re

Lanes, Volumes, Timings 37: Motorway Extension(N1) &

Figure C2-6: Lanes, Volumes & Timings Report- INTERSECTION(S) 37(N1)
### Lanes, Volumes, Timings 38: SELP 2 & Southeast Slip 2

	4	لر	•	*	¥	t	
Lane Group	SBL	SBR	NEL	NET	SWT	SWR	
Lane Configurations		11		<b>†</b> †			
Volume (vph)	0	1465	0	1845	0	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Grade (%)	-2%			2%	0%		
Lane Util. Factor	1.00	0.88	1.00	0.95	1.00	1.00	
Frt		0.850					
Flt Protected							
Satd. Flow (prot)	0	2683	0	3340	0	0	
Flt Permitted							
Satd. Flow (perm)	0	2683	0	3340	0	0	CT
Link Speed (k/h)	44			34	50		
Link Distance (m)	50.0			129.7	176.1		
Travel Time (s)	4.1			13.7	12.7		0.1
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Heavy Vehicles (%)	2%	7%	2%	7%	2%	2%	
Adi, Flow (vph)	0	1465	0	1845	0	0	
Shared Lane Traffic (%)	)						
Lane Group Flow (vph)	0	1465	0	1845	0	0	
Enter Blocked Intersect	ion No	No	No	No	No	No	5
Lane Alignment	Left	Right	Left	Left	Left	Right	
Median Width(m)	0.0	1.1011		2.0	0.0		
Link Offset(m)	0.0			0.0	0.0		
Crosswalk Width(m)	4.8			4.8	4.8		
Two way Left Turn Lane	9			1.0	1.0		
Headway Eactor	0.99	0.99	1.01	1.01	1.00	1.00	A A
Turning Speed (k/h)	25	15	25		1.00	15	
Sian Control	Free	10	20	Free	Stop	10	1223
Intercection Summan	1100	-	-	1100	orop	-	
Area Tura:	Other	1	-	-	-		
Control Type: Uncignali	zod			pr	1		
Interception Consideration	zeu tilizatian	EA 606		-	CILL or a	al at Car	niao A
Analycic Pariod (min) 1/	unzation S	04.0 %		-	CO Leve	el ul sei	NCEA
Analysis Fellou (min) is	2						
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base case-evening peak

Synchro 7 - Report



Lanes, Volumes, Tir	nings
40: NW Loop &	

	-	7	1	t	۲	4	ŧ	~	¥	~	
Lane Group	EBL	EBR	NBL	NBT	NBR	SBL	SBT	SBR	SWL	SWR	
Lane Configurations		77		***	1		***				
Volume (vph)	0	1810	0	3276	1851	0	2545	0	0	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Grade (%)	2%			1%			-1%		0%		
Lane Util. Factor	1.00	0.88	1.00	0.91	1.00	1.00	0.91	1.00	1.00	1.00	
Frt		0.850			0.850						
Fit Protected											
Satd. Flow (prot)	0	2680	0	5060	1474	0	5061	0	0	0	
Fit Permitted											
Satd. Flow (perm)	0	2680	0	5060	1474	0	5061	0	0	0	
Link Speed (k/h)	43			35			63		46		
Link Distance (m)	71.4			262.2			224.2		71.8		
Travel Time (s)	6.0			27.0	-	<u> </u>	12.8		5.6		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Heavy Vehicles (%)	2%	5%	2%	2%	9%	2%	3%	2%	2%	2%	
Adi. Flow (vph)	0	1810	0	3276	1851	0	2545	0	0	0	
Shared Lane Traffic (%)	4										
Lane Group Flow (vph)	0	1810	0	3276	1851	0	2545	0	0	0	
Enter Blocked Intersection	on No	No	No	No	No	No	No	No	No	No	
Lane Alignment	Left	Right	Left	Left	Right	Left	Left	Right	Left	Right	
Median Width(m)	0.0	1.1011		4.0	1.10111		4.0	1.1.0.1.1	0.0	1.10111	
Link Offset(m)	0.0			0.0			0.0		0.0		
Crosswalk Width(m)	4.8			4.8	~		4.8		4.8		
Two way Left Turn Lane	1.0						1.0		1.1.0	-	
Headway Eactor	1.01	1.01	1.01	1.01	1.01	0.99	0.99	0.99	1.00	1.00	
Turning Speed (k/h)	25	15	25	1.01	15	25	0.00	15	25	15	
Sian Control	Free	10	20	Free	10	20	Free	10	Stop		
Intersection Summany	1.	-		( age of a	-		CI de se		C ALCON	£	
Area Turpe:	)thor	-	-	_	-	-		-	<u> </u>		
Control Type: C				10	-						
Interception Consideration	itation	110.000			OLLING	al of Cor	nino Ll				
Analysia Daviad (min) 45	lization	119.2%		1	CO Leve	a or ser	vice H				
Analysis Period (min) 15	Nov 0 2600 0 6000 1411 0 5001 0 0 0   errm) 0 2680 0 5060 1474 0 5061 0 0 0   whh 43 35 63 46   (m) 71.4 262.2 224.2 71.8   s) 6.0 27.0 12.8 5.6   actor 1.00 1.00 1.00 1.00 1.00 1.00 1.00   es (%) 2% 5% 2% 2% 9% 2% 3% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 2% 100 1.00 1.00 1.00 25 0 0 0										
				SA	INE	1.5	-				
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base case-evening peak

Synchro 7 - Report

Figure C2-8: Lanes, Volumes & Timings Report- INTERSECTION(S) 40_NW LP 1

	3	-+	$\mathbf{F}$	F	-	*_	1	2	3	1
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SER	NEL	NER
Lane Configurations		<b>^</b>			<b>^</b>	1				11
Volume (vph)	0	4179	0	0	2636	1810	0	0	0	970
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.6	4.0	3.6	3.6	4.0	3.6	3.6	3.6	3.6	3.0
Grade (%)		2%			-2%		0%		0%	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.88
Frt						0.850				0.850
Flt Protected										
Satd. Flow (prot)	0	3333	0	0	3431	1553	0	0	0	2479
Flt Permitted										
Satd. Flow (perm)	0	3333	0	0	3431	1553	0	0	0	2479
Link Speed (k/h)		69			57		50		39	
Link Distance (m)		275.6			264.0	-	51.7		67.6	
Travel Time (s)		14.4			16.7		3.7		6.2	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	2%	12%	2%	2%	11%	5%	2%	2%	2%	7%
Adj. Flow (vph)	0	4179	0	0	2636	1810	0	0	0	970
Shared Lane Traffic (%)	)									
Lane Group Flow (vph)	0	4179	0	0	2636	1810	0	0	0	970
Enter Blocked Intersect	ion No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Right	Left	Right
Median Width(m)		6.0			6.0		0.0		0.0	
Link Offset(m)		0.0			0.0		0.0		0.0	
Crosswalk Width(m)		4.8			4.8		4.8		4.8	
Two way Left Turn Lane	e									
Headway Factor	1.01	0.96	1.01	0.99	0.93	0.99	1.00	1.00	1.00	1.09
Turning Speed (k/h)	25		15	25		15	25	15	25	15
Sign Control		Free		H	Free		Stop		Free	
Intersection Summary	1		34	Y	1	D	222	-	1	
Area Type: (	Other									
Control Type: Unsignali	zed									
Intersection Capacity U	tilization	156.1%	)	1	CU Lev	el of Ser	vice H			
Analysis Period (min) 1	5									

#### Lanes, Volumes, Timings 42: Motorway Extension(N1) &

Figure C2-9: Lanes, Volumes and Timings Report- INTERSECTION(S) 42_N 1

	۴	A.	*	Ť	1	4	ŧ	¥	1	1	
Lane Group	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER	
Lane Configurations		11		<b>^</b>			***	1			_
Volume (vph)	0	1207	0	3920	0	0	3385	970	0	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Lane Width (m)	3.6	3.0	3.6	3.7	3.6	3.6	3.7	3.7	3.6	3.6	
Grade (%)	-2%			1%			-1%		2%		
Lane Util. Factor	1.00	0.88	1.00	0.91	1.00	1.00	0.91	1.00	1.00	1.00	
Frt		0.850						0.850			
Flt Protected											
Satd. Flow (prot)	0	2627	0	5116	0	0	5117	1534	0	0	
Flt Permitted			1/				-				
Satd. Flow (perm)	0	2627	0	5116	0	0	5117	1534	0	0	
Link Speed (k/h)	44			35			63		50		
Link Distance (m)	147.3			238.3	-	-	262.2		63.6		
Travel Time (s)	12.1			24.5			15.0		4.6		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	3%	7%	2%	2%	
Adj. Flow (vph)	0	1207	0	3920	0	0	3385	970	0	0	
Shared Lane Traffic (%	)										
Lane Group Flow (vph)	0	1207	0	3920	0	0	3385	970	0	0	
Enter Blocked Intersect	tion No	No	No	No	No	No	No	No	No	No	
Lane Alignment	Left	Right	Left	Left	Right	Left	Left	Right	Left	Right	
Median Width(m)	0.0			4.0			4.0		0.0		
Link Offset(m)	0.0			0.0			0.0		0.0		
Crosswalk Width(m)	4.8			4.8			4.8		4.8		
Two way Left Turn Lan	e										
Headway Factor	0.99	1.08	1.01	0.99	1.01	0.99	0.98	0.98	1.01	1.01	
Turning Speed (k/h)	25	15	25		15	25		15	25	15	
Sign Control	Yield			Free			Free		Stop		
Intersection Summary	1		349	9	-	10	332	-	1		
Area Type:	Other		7/1	1	6						
Control Type: Unsignal	ized										
Intersection Capacity U	tilization	124.6%		þ	CU Leve	el of Ser	vice H				
Analysis Period (min) 1	5										
	20									20 <u>2</u> 9 - 31	<u>a</u> <u>a</u> us a

Lanes, Volumes, Timings 46: SE Loop 1 &

base case-evening peak

Synchro 7 - Report

Figure C2-10: Lanes, Volumes and Timings Report- INTERSEC. (S) 46_SE LP 1

Lanes, Volumes, Timings 47: SE Slip 1 &

	1	•	Ť	1	4	ŧ	
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations			1	1			
Volume (vph)	0	0	989	1000	0	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Grade (%)	0%		2%			0%	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Frt				0.850			
Flt Protected							
Satd. Flow (prot)	0	0	1809	1537	0	0	
Flt Permitted							
Satd. Flow (perm)	0	0	1809	1537	0	0	CT
Link Speed (k/h)	50		34	and a second second	0.000	50	
Link Distance (m)	108.0		141.7			78.5	
Travel Time (s)	7.8		15.0			5.7	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Heavy Vehicles (%)	2%	2%	4%	4%	2%	2%	
Adi Flow (yph)	0	0	989	1000	0	0	
Shared Lane Traffic (%)	) ( ) (						
Lane Group Flow (vph)	, 0	Û	989	1000	Ω	0	
Enter Blocked Intersect	ion No	No	No	No	No	No	
Lane Alignment	Left	Right	Left	Right	Left	Left	
Median Width(m)	0.0	rugin	0.0	1 ugin	Lon	0.0	
Link Offset(m)	0.0		0.0			0.0	
Crosswalk Width (m)	4.8		4.8			4.8	
Two woull off Turn Lone			ч. <u>ч</u>	1		4.0	
Headway Eactor	1.00	1.00	1.01	1.01	1.00	1.00	
Turning Speed (k/h)	25	1.00	1.01	15	25	1.00	
Pign Control	20 Otop	10	Eroo	10	20	Oton	1357
Sign Control	Stop		Fiee	2	-	Stop	
Intersection Summary		7		20		-13	
Area Type: (	Other				_		
Control Type: Unsignali	zed						
Intersection Capacity U	tilization	65.3%		](	CU Leve	el of Ser	rvice C
Analysis Period (min) 15	5						

base case-evening peak

Synchro 7 - Report

Figure C2-11: Lanes, Volumes & Timings Report- INTERSECTION(S) 47_SE SLP 1

Lanes, Volumes, Timings 55: Spintex Road &

	t	ĥ	۴	+	7	1			
Lane Group	EBT	EBR	WBL	WBT	NEL	NER			
Lane Configurations	1			1		1			
Volume (vph)	500	0	0	1215	0	1000			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00			
Frt						0.865			
Flt Protected									
Satd. Flow (prot)	1863	0	0	1863	0	1580			
Flt Permitted									
Satd. Flow (perm)	1863	0	0	1863	0	1580			
Link Speed (k/h)	50		12	50	50		C7		
Link Distance (m)	57.9		K	117.1	108.0				
Travel Time (s)	4.2			8.4	7.8				
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00			
Heavy Vehicles (%)	2%	2%	2%	2%	2%	4%			
Adj. Flow (vph)	500	0	0	1215	0	1000			
Shared Lane Traffic (%)	0.000		100.00		NUCL.				
Lane Group Flow (vph)	500	0	0	1215	0	1000			
Enter Blocked Intersection	on No	No	No	No	No	No			
Lane Alignment	Left	Right	Left	Left	Left	Right	1		
Median Width(m)	0.0			0.0	0.0	0			
Link Offset(m)	0.0			0.0	0.0				
Crosswalk Width(m)	4.8			4.8	4.8				
Two way Left Turn Lane									
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00			1
Turning Speed (k/h)	10.00015	15	25	24.845	25	15	2		-
Sian Control	Free			Free	Yield			1	5
		_	_	_		1	1.5		
Intersection Summary		-	-	×.		-	3 Colo	-	
Area Type: U	uner			2	2				
Control Type: Unsignaliz	ea	04.004			0111	1.10	S.F		
Intersection Capacity Util	lization	94.9%		h	CO Levi	el of Ser	VICE F		
Analysis Period (min) 15									
		_	-	-	THE				

base case-evening peak

Synchro 7 - Report

Figure C2-12: Lanes, Volumes & Timings Report- INTERSEC. (S) 55_SPINTEX

## **APPENDIX D – SIM TRAFFIC REPORTS_IMPROVED LEGS CONDITIONS**

**KNUST** 





# KNUST

APPENDIX D1 – SIM TRAFFIC REPORT (SUMMARY) _IMPROVED LEGS CONDITIONS (Morning Peak)



Page 8





20% speed increase-morning peak

mTraffic Report Page 8





30% speed increase-morning peak

mTraffic Report Page 8



# **KNUST**

APPENDIX D1 – SIM TRAFFIC REPORT (SUMMARY) _ IMPROVED LEGS CONDITIONS (Evening Peak)





### Figure D1-4: Performance Report NETWORK 10 % speed increase-Evening Peak



### Figure D1-5: Performance Report NETWORK 20 % speed increase-Evening Peak



### Figure D1-6: Performance Report NETWORK 30 % speed increase-Evening Peak