UNIVERSITY OF BAHRAIN

College of Engineering

Department of Mechanical Engineering

Mass Transit System for Bahrain: A Macroscopic Planning and Microscopic Management View

A Thesis Submitted in Partial Fulfillment of the Requirements for the Master Degree in Engineering Management

Submitted by

Dalal Yousif Al Kooheji

20029565

Supervised by

Prof. Hashim Mohd Noor Al Madani

Professor of Transportation; Department of Civil Engineering
University of Bahrain

Kingdom of Bahrain

April 2015

University of Bahrain
Graduate Studies Council

Thesis Discussion Committee Decision

Student Name: Dalal Yousif Al-Kooheji	Student ID: 20029565
Department:	College: Engineering
Program: Master of Science in Engineering Management	
Thesis Title: Mass Transit System for Bahrain: A Macroscopic Planning and Microscopic Management View	
Supervisor Name: Prof. Hashim Al-Madani	Student GPA:

The Discussion Committee met on Wednesday (day and date) 14/2015 in Hall no. 14-162 (hall/room no.) ____. Upon discussing the student whose details are stated above in public, the discussion committee recommends the following:

The student awarded grade "A" In the thesis subject Engineering Management

☑ Without making any changes to the thesis
☐ After making the modifications attached with this decision

Discussion Committee Members Approval:

Name	Signature
1. Prof Hashim Al-Madani (Advisor)	
2. Prof. Nemat Youssef (Internal Examiner)	
3. Prof. Nedal Ratrout (External Examiner)	

قسم الهندسة الميكانيكية
DEPT OF MECHANICAL ENGINEERING
UNIVERSITY OF BAHRAIN

Abstract

Mass Transit System is an essential mode of transportation system since it can among many others; accommodate large number of people in lesser overall travel time especially during rush hours. Mass Transit System is becoming more and more pressing issue in the Gulf Countries since vehicle growth rate is high and the public transport ridership is far lesser than any developed countries. As a result, vehicle density on the networks is very high and the congestion is becoming a nightmare. Introducing Mass Transit System is highly feasible from economic, social and environmental point of view than expanding the road network.

Due to the continuous high population and vehicle growth, limitation in space, high demand for mobility, lack of proper public transport system, unacceptable level of operation of the current public transport system, excessive congestion, long travel time and negative environmental consequences of ever increasing of vehicle fleet, Mass Transit System (MTS) is inevitable for Bahrain. This study introduces the planning and managing needs for various types of Mass Transit System inclusive of bus, tram, metro and light rail transit along with their future expansions.

A conceptual design of a network is proposed based on a macro level of data need. These are based on vehicle trends, population, fuel consumption and housing developments. Furthermore, operation and service user's management are based on a micro level of data. These include historical, daily and hourly traffic counts, capacity of the system, fare rate and operation hours. Questionnaires were distributed and analyzed using SPSS program to answer several user's related matters as fare rate, fare validity, operating hours and possibility of using the system. Several interviews needed in order to collect data with representative of some Ministries. A detailed network planning and users estimate system is developed here, utilizing a digital format using X-Cell programming feature. The whole procedure is designed to easily be transferred to any country with very limited Mass Transit System and limited available data except for total daily traffic. The system covers the headways and total number of baggies and buses needed for an integrated system.

As a result, a network is developed; it is consist of two Metro loops, three tram routes and eight rapid bus routes. The total estimated number of riders in the proposed network is close to 900 thousand per day and the generated daily income is around BD 300 thousand.

In order to have sufficient system, proper advertisement and marketing should be considered to attract people to use the system. Furthermore, additional studies should be considered to identify the best model for the system in terms of being elevated from the ground or underground should be carried out.

Dedication

I dedicate my dissertation work to my family.

A special feeling of gratitude to my loving mother, her words of praying, encouragement and push for tenacity ring in my ears.

I also dedicate this dissertation to my husband who has supported me throughout the process.

I will always appreciate all what he has done.

I also dedicate this work and give special thanks to my sisters and brothers

since they have never left my side.

Acknowledgment

I would like to thank the anonymous referees for their constructive and useful comments on this project and it is complimented to every person assisted me and shared his valuable time to accomplish it. First, I would like to thank my thesis supervisor Prof. Hashim AL Madani for his professional assistance, supervision and patience.

Although, I would like to thank the Road Planning and Design Directorate in the Ministry of Works specially Eng. Kadhim Latif (Chief of traffic Planning and Studies), Eng. Rabia Hamza (Head, Traffic Improvement Studies) and Ministry of Interior, (Directorate of traffic), King Fahad Causeway Authority for their generous support in providing the valuable data.

Furthermore, I would like to thank Bahrain petroleum Company (BAPCO) specially Eng. Nooraldeen Ibrahim, Eng. Khalid Al Tayar (Superintendent of Local Sales) and the Directorate of Statistics of the Central Informatics Organization for providing me with the needed urban and human developments statistics.

Moreover, I would like to thank Ameena Mahmoud, Alaa Rashed Ismaeel and Shaikha Al Thawadi for their valuable time to survey the questionnaires.

Finally, I would like to acknowledge and thank the Ministry of Municipalities and Urban Planning for their great supportive while doing this project.

Table of Contents

Subject	Page Number
Defense Committee's Approval	i
Abstract	ii
Dedication	iii
Acknowledgements	iv
Table of Contents	v
List of Tables	ix
List of Figures	xii
Appendices	xv
Chapter One Introduction	
1. Introduction	1
1.1 Background	2
1.2 Problem Statement	3
1.3 Motivations	4
1.4 Objectives	4
1.5 Methodology	5
1.6 Expected Contributions	11
1.7 Thesis outline	12
Chapter Two Literature Review	
2. Literature Review	13
2.1 Introduction	14
2.2 Bahrain Overview	14
2.3 Land Transport in Bahrain	14
2.4 Types of Public Transportation	15
2.4.1 Airline	15
2.4.2 Bus and Coach	15
2.4.3 Rail Transport	16
2.4.4 Commuter, Intercity, and High-Speed Rail	16

2.4.5 Tram and Light Rail	17
2.4.6 Rapid Transit	17
2.4.7 Personal Rapid Transit	17
2.4.8 Cable-Propelled Transit	18
2.4.9 Ferry	18
2.4.10 Motorcycle	18
2.4.11 Pedicabs	18
2.5 Types of Mass Transit System	19
2.5.1 Local Bus	19
2.5.2 Bus Lane	19
2.5.3 Bus way and Bus Rapid Transit	19
2.5.4 Tram System (Tram)	20
2.5.5 Light Rail (Light Rail)	20
2.5.6 Trains the Outskirts of the City (Suburban-Rail)	20
2.5.7 Types of Buses	21
2.6 Taxis	21
2.7 Advantages of Mass Transit System	21
2.8 Environmental Effects of Mass Transit System	22
2.9 Transportation Planning	23
2.10 GCC Countries	24
2.11 Safety Issues	25
Chapter Three **Data Gathering and Analysis**	
3. Data Gathering and Analysis	26
3.1 Introduction	27
3.2 Planning Data	28
3.2.1 CARS Company	28
3.2.2 Classification of Vehicles	29
3.2.3 Vehicle Trend	31
3.2.4 Current Public and Private Buses	34
3.2.5 Taxis	36
3.2.6 King Fahad Causeway	38
3.2.7 Fuel Consumption	40
3.2.8 Population Trend	43
3.2.9 Housing Development	48
3.2.10 Land Use Development	49
3.2.11 Traffic Data (Total Daily and Peak hour Traffic)	50
3.3 Management and Operation Related Data	65
3.3.1 Questionnaire	65

3.3.2 Capacity and speed of the various modes of transport	85
Chapter Four **Results and Discussion: Future Prediction of Public Transport Growth**	
4. Results and Discussion: Future Prediction of Public Transport Growth	86
4.1 Introduction	87
4.2 Target Years	87
4.3 Future Prediction	88
4.4 Mode Choice Shift	94
Chapter Five **Results and Discussion: Planning Network Design**	
5. Results and Discussion: Planning Network Design	99
5.1 Introduction	100
5.2 Defining the site on the map and mode selecting	100
5.3 Networking the system	104
5.3.1 Metro Routs	104
5.3.2 Tram Routs	108
5.3.3 Rapid Bus Routes:	114
Chapter Six **Results and Discussion: Managing and Operating Mass Transit Systems**	
6.Results and Discussion: Managing and Operating Mass Transit Systems	126
6.1 Introduction	127
6.2 Estimated total number of riders and number of trips for each route	127
6.2.1 First Method (model based method)	128
6.2.2 Second Method (Percentage based method)	135
6.3 Operation time of the Mass Transit System	138
6.4 Management of Mass Transit System Routes	138
Chapter Seven **Conclusion and Recommendation**	

7.Conclusion and Recommendation	148
7.1 Conclusions	149
7.2 Recommendations	153

List of Tables

No.	Subject	Page
3.1	Registered vehicles in Bahrain: classified as per vehicle type (1985-2012)	30
3.2	Vehicle Population Along with Corresponding Annual Growth Rates (1980-2012)	31
3.3	Registered Vehicles by Governorates 2012	33
3.4	Historical Bus Data, Public and Private Bus (1985-2012)	34
3.5	Taxi and Taxi on Call (1985-1992)	36
3.6	Arriving and Departing Vehicles through King Fahad Causeway (1987-2012)	38
3.7	Fuel Consumption in Bahrain (in thousand BBL = 156 litters) (1990- 2012)	40
3.8	Population of Bahrain (1941-2010)	43
3.9	Population by Governorate for the year 2011	45
3.10	Population, Area, and density by Governorate for the year 2007	45
3.11	Housing units by governorates for the year 2011	48
3.12	Land Use by Types and Years in Hectare (based on Middle East Spatial Technology, 2007)	49
3.13	The connected cities and main attractive location	53
3.14	Total Daily Traffic, am Peak and pm Peak between Manama and Muharraq	54
3.15	Total Daily Traffic, am Peak and pm Peak between Manama and Sittra	56
3.16	Total Daily Traffic, am Peak and pm Peak between Manama and Isa-Town	57
3.17	Total Daily Traffic, am Peak and pm Peak between Manama and Buddaya	58
3.18	Total Daily Traffic, am Peak and pm Peak between Isa-Town and Riffa	59
3.19	Total Daily Traffic, am Peak and pm Peak between Isa Town and King Fahad	60
3.20	Total Daily Traffic, am Peak and pm Peak between Isa Town and Hammad Town	61
3.21	Total Daily Traffic, am Peak and pm Peak between Riffa and Hammad Town	62
3.22	Total Daily Traffic, am Peak and pm Peak between	63

	Hammad Town and KFC	
3.23	Total Daily Traffic, am Peak and pm Peak between Buddaya and King Fahad Causeway	64
3.24	Table 3.24: Summary of Average Annual Growth Rates between Cities	65
3.25	Transit modes and its capacity and speed [7]	85
4.1	Summery of Vehicles Shift to MTS by year 2030	97
5.1	Ranges of Classifying the total daily Traffic Flow of Vehicle	101
5.2	Traffic Count Sites in Various Part of Bahrain (2012)	102
5.3	Mass Transit System Route Details	124
6.1	Estimated total number of riders shifted to MTS by year 2030, based on the first method (model based method)	129
6.2	Total daily traffic flow shifted towards MTS between cities up to year 2030	130
6.3	Total number of daily traffic flows shifted to MTS between cities, using three different scenarios	131
6.4	Adjusted percentage of traffic between cities of each route	131
6.5	Total number of riders in each routs of Metros and Trams	132
6.6	Total daily Traffic flow of bus routes	133
6.7	Percentage of traffic flow of bus routes	133
6.8	Total number of riders in bus routes	134
6.9	Detailed Mass transit system routes based on the First Method, in term of distance, speed, travel time, number of riders, capacity and number of trips	135
6.10	Total daily traffic of mass transit system routs based on the second method	136
6.11	Detailed MTS routes based on Second Method, in term of distance, speed, travel time, number of riders	136
6.12	Bus routes based on Second Method	137
6.13	Table 6.13: Detailed Mass transit system routes based on the Second Method, in term of distance, speed, travel time, number of riders, capacity and number of trips	137
6.14	Metro 1 route (Excluded hours)	139
6.15	Metro 1 route (Total Daily Traffic for operating hours)	140
6.16	Adjusted number of riders and trips (Metro 1)	142
6.17	Headway time and number of buggies (Metro 1)	142
6.18	Ticketing price	144
6.19	Income from (Metro 1) route	144
6.20	Summary of Mass transit system routes, 1.5% reduction on both methods, in term of distance, speed, travel time,	145

	number of riders, number of trips and income	
6.21	Summary of Mass transit system routes, 2% reduction on both methods, in term of distance, speed, travel time, number of riders, number of trips and income	146
6.22	Summary of MTS routes, 2.5% reduction on both methods, in term of distance, speed, travel time, number of riders, number of trips and income	146
6.23	Summary of Generated Income, Method 1, all scenarios	147
6.24	Summary of Income, Method 2, all scenarios	147

List of Figures

No.	Figure	Page
1.1	Frame Work of Procedure Followed to Achieve the Necessary Goals for MTS	10
3.1	Total Registered Vehicles in Bahrain (1990-2012)	32
3.2	Registered Vehicles by Governorates 2012	33
3.3	Public Buses in Bahrain (1990-2012)	35
3.4	Private Buses in Bahrain (1990-2012)	35
3.5	Taxi in Bahrain (1990-2012)	37
3.6	Taxi on Call in Bahrain (1990-2012)	37
3.7	Modeled Arriving Vehicles through King Fahad Causeway to Bahrain (1990-2012)	38
3.8	Modeled Departing Vehicles through King Fahad Causeway	39
3.9	Total Fuel Consumption (in thousand BBL = 156 litters)	41
3.10	Fuel Consumption- Gasoline (in thousand BBL = 156 litters)	41
3.11	Fuel Consumption- Kerosene (in thousand BBL = 156 litters)	42
3.12	Fuel Consumption- Diesel (in thousand BBL = 156 litters)	42
3.13	Population of Bahrain Country Wise (1940-2010)	44
3.14	Population of Manama (1965-2010)	44
3.15	Population of Muharraq (1965-2010)	44
3.16	Population by Governorate 2011	45
3.17	Population by Governorate	46
3.18	Area by Governorate	46
3.19	Density by Governorate	46
3.20	Development of Housing Units in Bahrain (1965-2010)	48
3.21	Main Cities and Road Network in Bahrain	51
3.22	Analysis of respondents by sex type	67
3.23	Analysis of respondents by age classification	68
3.24	Analysis of respondents by nationality	69

3.25	Analysis of respondents by respondents' occupation	70
3.26	Analysis of respondents by driving license	71
3.27	Analysis of respondents by car ownership	72
3.28	Analysis of respondents by level of education	73
3.29	Analysis of respondents as their monthly income	74
3.30	Analysis of respondents by living area	75
3.31	Analysis of respondents by number of cars in the house	76
3.32	Analysis of respondents by preferred operating hours	77
3.33	Analysis of respondents by ticket pricing system	78
3.34	Analysis of respondents by Validity of tickets of any number of trips	79
3.35	Probability of using the system if the ticket price is 500 fils	80
3.36	Probability of using the system if the ticket price is 750 fils	81
3.37	Probability of using the system if the ticket price is 1 BD	82
3.38	Probability of using the system if the ticket price is 1.5 BD83	83
4.1	Future Prediction of Population for Bahrain as whole	88
4.2	Future Development of Housing Units	89
4.3	Future Prediction of Fuel Consumption (in thousand BBL = 156 litters)	90
4.4	Vehicles Entering Bahrain through King Fahad Causeway	91
4.5	Future Prediction of Vehicles Population	92
4.6	Future Prediction of Private Buses	93
4.7	Future Prediction of Public Buses	94
4.8	Future Prediction of Vehicles Population	96
4.9	Vehicles Entering Bahrain through King Fahad Causeway	96
4.10	Future Prediction of Private Buses	96
5.1	Classified Count Sites	103
5.2	The First Metro Route from King Fahad Causeway to Muharraq	105
5.3	The Second Metro Route from Isa Town to Riffa and Sitra	107
5.4	The First Tram Route from Buddaya to Manama	109
5.5	The Second Tram Route covers the internal part of Riffa	111

	and Isa Town reaching KFC	
5.6	The Third Tram Route from Hammad Town to University of Bahrain	113
5.7	The First Bus Route in Muharraq	115
5.8	The Seconed and Third Bus Routes in Manama	117
5.9	The Fourth Bus Route in Budday	119
5.10	5th, 6th and 7th Bus Routes in Isa Town and Riffa	121
5.11	The Eighth Bus Route in Southern Area	123
5.12	Proposed Mass Transit System Network Routs	125

List of Appendices

No.	Appendix	Page
1	Automatic Traffic Count Sites Data	156
2	Total Daily Traffic between Cities (southbound – westbound)	157
3	Questionnaire	167
4	Detailed of other Routes	171

CHAPTER 1

Introduction

1.1 Background

1.2 Problem Statement

1.3 Motivations

1.4 Objectives

1.5 Methodology

1.6 Expected Contributions

1.7 Thesis Outline

CHAPTER 1

1. Introduction

This chapter covers background and the importance of mass transit system, the problem under investigation, the objectives, methodology, expected contributions, and thesis outline.

1.1 Background

Vehicular density is substantially increasing in Bahrain making it difficult to reach a destination on time without planning it ahead. The shift in vehicular use to public transport will certainly decrease the load on the roads. The population density is increasing and the spaces are getting smaller. Expanding the road network is a solution that will help out for a while; whereas a plan for a long term solution is required. The congestion problem will keep on getting worse if the roads are unplanned for the increase in population and vehicular growths.

The increasing use of the car for travel, both in developing and developed countries and the continuous spread of residence and activities in the urban areas, have increased the length of trips and the use of motorized private transport, reducing in many cases the possibilities to develop an efficient public transport system. The impacts are congestion, increase of travel times, poor air and noise quality pollution, increase number of accidents, excessive production of greenhouse gases and land consumption.

The traditional 'predict and provide' approach to urban transportation planning is no longer an option. However, the former means that also the alternative 'demand management' approach advocated by some may not be an acceptable solution. Though this might be the case in the developed countries with improve Mass Transit System; the predict and provide might be the start initiative for such a system in the region.

The present study proposes a new method to effectively exploit the transit network, modifying the usual planning approach: the method tries to overcome the temporal discrepancy between infrastructural actions on land use and infrastructural actions on the transport system, using the residual capacity of the Mass Transit System as a variable to indicate the location and the magnitude of new residential and activities developments.

1.2 Problem Statement

With the increase in the population in Bahrain and the high growth rate in vehicle population, the demand on mobility increases, since only limited people use the poor current public buses. The available network is becoming overfilled. By the continuous increase in traffic on the network; the congestions are becoming very frequent and becoming longer and longer during peak hours. Consequently, the delays are excessive. Therefore the need for more sustainable transport system is necessary.

1.3 Motivations

As mentioned earlier, one of the major problems is long travel time that influences the daily movements. Such a problem motivates transportation planners to find solutions. Furthermore, one should analyze the problem of noticeable increase in cars, parking difficulties, environmental and safety drawbacks. Current vehicles are a major cause of pollution and excessive congestion. Therefore a study of Mass Transit System will allow us to reach and address solutions of the major problem.

The improvement in the mass transportation will motivate and encourage the public to mode transport shift, from their personal automobile to more sustainable Mass Transit System (MTS).

1.4 Objectives

The main objectives of this study are as follows:

1- To investigate the best route network for a possible Mass Transit System all over the Kingdom of Bahrain utilizing macro-based level of data.

2- To propose various Mass Transit Systems based on micro level of modeled data such as traffic counts, capacity of the selected system and fare rate.

3- Prediction of number of users and generated income to serve current and future needs.

1.5 Methodology

It is important to consider the criteria which are used to install such type of transit system in several projects in several countries in order to check the importance of Mass Transit System.

- **Current System**

Currently Bahrain has a public buses system which is run by CARS Company. The characteristics of this system will be considered in order to provide an improved system. The considered characteristics include: the fleet size, fare rate, number of users, headways, annual income, etc.

- **Questionnaire**

Quantitative research process will be conducted using questionnaires. The public interest in using the system, the ticket validity, operation period and fare rate is the main criteria that will be considered through questionnaires distributed randomly to respondents so as to manage a sustainable Mass Transit System. Analyzing questionnaire data will be conducted through statistical packages as SPSS Program.

- **Data Modeling and Future Prediction**

Two methods are used to estimate future values; modeling the vehicular data available for past years and the average vehicular traffic growth rates. As a result, Microsoft Excel Spreadsheet is created for the gathered data to determine the following:

1. Least square regression models for the vehicular traffic. The considered models include: linear, polynomial, logarithmic, exponential, etc. The best model is selected based on the highest R^2 value.
2. Average annual growth rates in traffic.
3. Select base year to start the operation and the target years for prediction.
4. Necessary charts presenting the statistical data are considered to visualize the estimates for the target years

The analysis of the linear regression model is performed to predict vehicular traffic for the target year. One may use it for any target year. The year 2030 is considered here for the prediction of any number of years.

- **Procedural Frame Work for Mass Transit System**

Figure 1.1 Present a frame work for the procedure used to develop a Mass Transit System network. The flow chart developed and can be used to plan and manage Mass Transit System anywhere. The flow chart is divided into two sectors; planning and management.

The data in the planning sector are grouped into microscopic data based on micro level of data analysis and macroscopic one. Microscopic data is about the detailed data gathered from automatic traffic counts in terms of

total daily traffic and peak hour traffic. While the macroscopic data includes the historical data of housing units, population trends, fuel consumption, King Fahad Causeway traffic data, historical public and private bus data and vehicles trends. The study will build the future prediction based on gathered data. Then it will be super imposed to consider their effects on the design of the Mass Transit System.

Based on the planning data, the conceptual selection of the network will be selected based on geographical, political and population trend; while the detailed selection at the station and routes based on actual range of traffic. The main criteria of network selection types such as metro, tram, bus rapid system and local bus are the capacity and speed of the selected system, route traffic limits and the attractions.

One of the important issues which should be highlighted in planning the network is the station location, which is based on certain criteria such as the importance of the location if it is social, attraction, shopping points, entertainments, airport, seaport and other criteria such as distances, total daily traffic, peak hour traffic, political, travel time, headway time, geographical, rationale, future settlement expansion and availability of space as a constrain.

The second sector of the frame wok is management related part, the needed management data may also be divided into microscopic data and macroscopic data.

Microscopic data are questionnaire based data. These aim to evaluate the interest of the public utilizing possible Mass Transit System and their feedback regarding operation time and fare rates and validity. Other considered data include the number of stations on each route and the capacity of each system.

Macroscopic management data related to the estimate of users of the system are based on future prediction and for assigned target years.

Based in estimated data, mode of transfer will be selected, which is metro, tram and bus rapid system. The criteria of selection the system are as follows:

- Applied Data (Based Year 2017, Target Years 2030)
- Capacity
- Speed
- Rout Time
- Travel Time in Between Stations
- Estimated Headways (Averages Speed, Rout Length)
- Number of Trips
- Number of Vehicles
- Number of Buggies
- Number of Rider

Therefore all data will be shifted to the target year using two methods, the first method is the mode shift method which based on the total number of

riders shift to MTS for year 2030 is estimated considering the total number of registered vehicles, the number of public and private buses and the arriving vehicles from King Fahad Causeway, while the other method in predicting the total number of riders is the percentage based method is fully consider the total daily traffic on each route for metros and trams, the number of riders for bus routes is assumed as a percentage of the total daily traffic of the nearest metro or/and tram routes. Three scenarios of reduction well applied on both methods which are 1.5%, 2% and 2.5%.

Financial estimation and the income of the system will be expected and calculated based on the best fare rates, economical operation hours and ticketing system. A complete computational system well created based on Excel program.

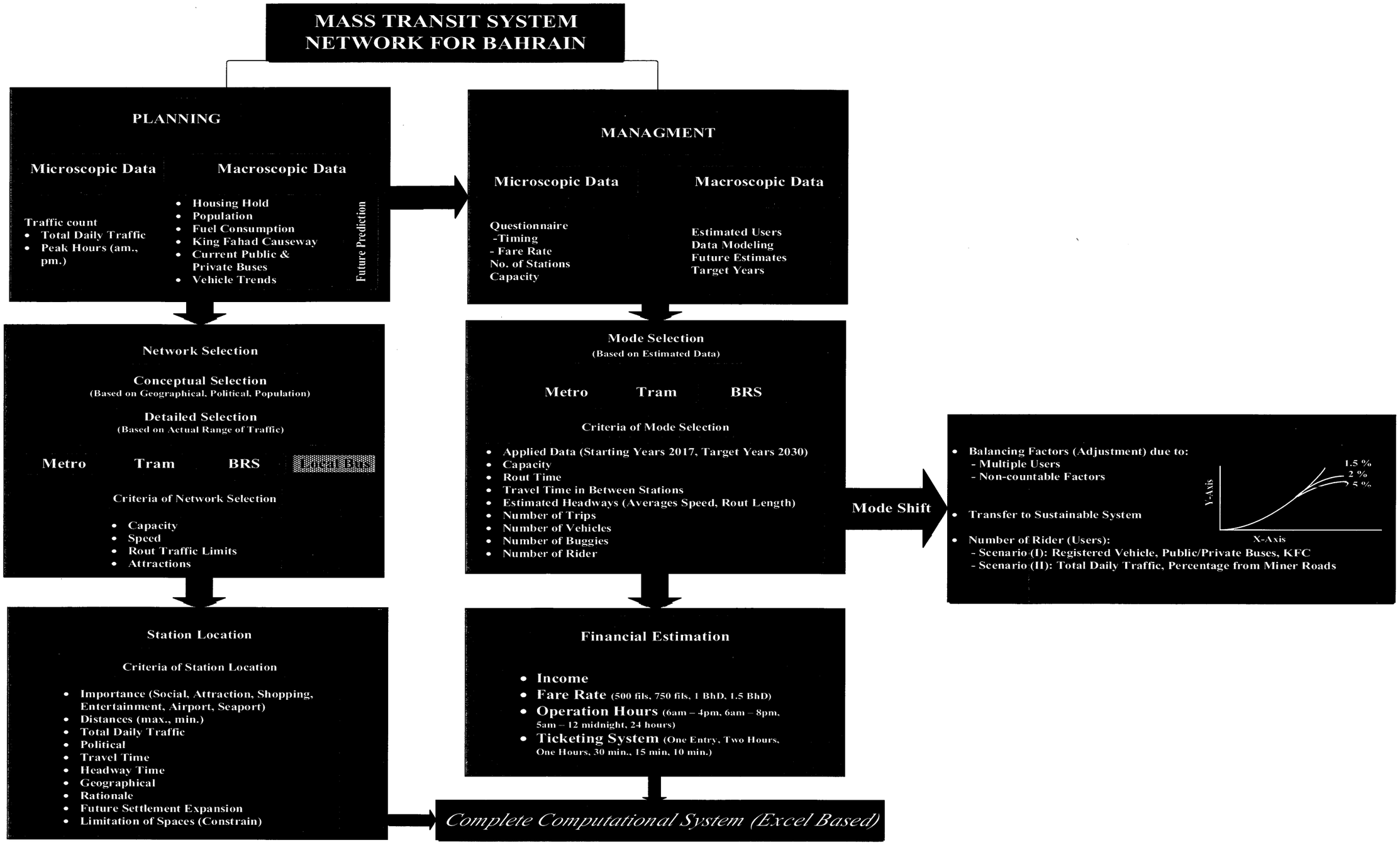


Figure 1.1: Frame Work of Procedure Followed to Achieve the Necessary Goals for MTS

- **Data Gathering**

The data are gathered from several resources, places to collect information required for this study. Gathering historical data from various related governmental institutions, such as Ministry of Interior (King Fahad Causeway), Ministry of Works, Ministry of Transportation, Ministry of Power (BAPCO) and Ministry of Municipalities and Urban Planning. Possible data which will be essential for the study such as traffic data, population trends, registered vehicles, fuel consumption trends, housing growth, urban development and land use development. The considered traffic data covers the years 1980 to 2012. Other housing development is considered as late as 1960 while the population trends as late as 1940.

- **Contacts**

Several contacts were done in order to collect data with representatives of Ministry of Interior, Ministry of works and BAPCO.

1.6 Expected Contributions

The expected contributions of this study, beside the development of the earlier flow chart, includes creation of a digital system for countries with no Mass Transit System or with a poor system, covering macroscopic approach for networking the various possible transport modes within cities and close suburbs area, and microscopic approach for managing the system.

1.7 Thesis outline

The project consists of 7 chapters and an abstract; chapter 1 discusses the major information like the introduction, objective, and the importance of mass transit system, motivation, problem statement and methodology. Chapter 2 is the literature review of the project it includes a brief explanation on the transportation in Bahrain, the types of public transportation and the types of mass transit system. Chapter 3 is the data gathering and analysis it consists of the information collected and the analysis made including the tables and maps. Chapter 4 is the result and discussion of the future prediction of the data including the results. Chapter 5 is the result and discussion of the planning the network design. Chapter 6 is the result and discussion of the management and operating of mass transit system. Chapter 7 is the conclusion and recommendations, finally the list of references.

CHAPTER 2

Literature Review

2.1 Introduction

2.2 Bahrain Overview

2.3 Land Transport in Bahrain

2.4 Types of Public Transportation

2.5 Types of MTS

2.6 Taxis

2.7 Advantages of MTS

2.8 Environmental Effects of MTS

2.9 Transportation Planning

2.10 GCC Countries

2.11 Safety Issues

CHAPTER 2

2. Literature Review

2.1 Introduction

Mass Transit System is widely used all over the world. Each country has its own types and ways of using their public transportation to their demand. This chapter covers some literature that defines various types of Mass transit system, which handles Bahrain overview, transportation in Bahrain and will help us to understand and investigate the types of mass transit systems.

2.2 Bahrain Overview

Kingdom of Bahrain consists of a total area of 765.3 km^2 [1] and a "population in 2011 stood at 1,234,571, including 666,172 non-nationals." [1] Since we are in 2015 the number must have increased causing the kingdom to have traffic issues that lead to many road extends that may solve the problem for a while.

2.3 Land Transport in Bahrain

Currently the Kingdom of Bahrain depends on road transport, airline and ferry/shipping for its public transportation. The road services are either taxis or buses as a way of public transportation. Other than that people use their own vehicles and way of transport. The current public transport system is serviced by the service line of "CARS" Company under the

franchise agreement with the Ministry of Transport. The current percentage of population using the available public transportation is 0.5%.

2.4 Types of Public Transportation

2.4.1 Airline

Airlines offer scheduled service by using aircraft connecting airports. Air travel has the advantage of having a very high speed, but encounter waiting before and after travel. Bush airlines are similar to bus stops; it's an aircraft that waits for the passengers and take off as soon as the aircraft is full.

2.4.2 Bus and Coach

A bus service carries many passengers for short travel on conventional roads. With the buses low capacity compared to other transportation systems i.e. trains functioning, managing inexpensive journeys and bus stops to supply the users. That's why buses are mostly used in smaller cities and towns in rural areas and an enhancement service for large cities. [2] Bus rapid transit is exactly the same as the buses in service on right-of-way like a light rail. Trolleybuses are electric buses that work on wires getting its power for traction. Online Electric Vehicles are buses that work on conventional battery and are recharged regularly by underground wires.

Coach services use long-distance buses. The vehicle is normally operational with many features like comfortable seating, separate luggage

section, video and a possible availability of a toilet. It also has limited stopping guides.

2.4.3 Rail Transport

Passenger rail transport is a transportation wheeled vehicles specially designed to run on railways. They allow high capacity on either short or long distances requiring paths, "signaling, infrastructure and stations to be built and maintained. Urban rail transit consists of trams, light rail, rapid transit, people movers, commuter rail, monorail suspension railways and funiculars." [2]

2.4.4 Commuter, Intercity, and High-Speed Rail

"Commuter rail is part of an urban area's public transport; it provides faster services to outer suburbs and neighboring towns and villages." [2] And stop at locations to provide smaller suburban or town center. The stations frequently being joint with bus transports or park and ride systems at each of the station. The frequency rate may be having several timings per hour, whereas commuter rail systems can either be a part of the national railway or operated by local transit agencies.

Intercity rail connects multiple urban areas by its long-haul passenger services. Having only few stops and might have one stop per city at high average speeds and these services can also be international.

High-speed rail is a passenger train that is operates faster than a conventional rail "typically defined as at least 200 kilometers per hour (120 mph)" [2]. It has been compared with air travel because it offers long distance rail journeys that are as fast as air services, with lower prices and it uses electricity.

2.4.5 Tram and Light Rail

"Trams are rail borne vehicles that run in city streets or dedicated tracks." [2] Buses have less capacity than those trams but there its infrastructure and wire that control it affects its flexibility.

Light rail is a current progress of a tram and use of a tram it is not shared by other traffic, with a high speed.

2.4.6 Rapid Transit

"A rapid transit railway system (also called a metro, underground, or subway) operates in an urban area with high capacity and frequency, and grade separation from other traffic." [2]

These types of systems can transport lots of people with a short distance and little land use. "More than 160 cities have rapid transit systems, totaling more than 8,000 km (4,971 mi) of track and 7,000 stations. Twenty-five cities have systems under construction." [2]

2.4.7 Personal Rapid Transit

Personal rapid transit is a cab service that works automatically on rails. It has complicated automation, which is an unusual mode of transportation. The critical improvement is that it can carry not many passengers the automated vehicles carry just a few passengers, dropping them to the location they need to go to. It attracts passengers at medium density urban areas. It can be compared with "more labor- intensive taxi or para transit modes of transportation, or to the (by now automated) elevators common in many publicly accessible areas." [2]

2.4.8 Cable-Propelled Transit

Cable-propelled transit known as (CPT) "is a transit technology that moves people in motor-less, engine-less vehicles that are propelled by a steel cable." [2] CPT is divided to two groups, which are Gondola lifts and Cable car - railway. The difference between the two is that the Gondola lifts are supported and boosted by above cables whereas cable cars - railway are supported boosted by below cables.

2.4.9 Ferry

A ferry can be a boat or ship that is used for to carry passengers or vehicles or etc. on water. A foot-passenger also known as waterbus is a ferry that has stops. It is counted as a public transport for many waterside cities and islands even with low speed it costs less than bridges or tunnels. Even the long distance connections are also counted as ferry services.

2.4.10 Motorcycle

Many countries count motorcycles as public transportation like the Philippines. It can be rid singly or it can carry more by attaching a sidecar attached known as tricycle. It can be used as a taxi or for personal trips or shared trips like a bus.

2.4.11 Pedicabs

Pedicabs are regularly found in poorer or in more crowded places and it can be found in many shapes and sizes.

2.5 Types of Mass Transit System

Public transit can be divided for the operational capacity, construction cost and the estimated speed into generally seven sections, which are as follows: (all the following types are rephrased from the following reference [3])

2.5.1 Local Bus

A bus shared with other cars in its tracks without any privacy except coordination between the fleet of buses through the center of the bus station. The average density of such operational buses 5500 passengers per hour in each direction, but it is slow; the average speed hardly exceeds 20 km/h. [3]

2.5.2 Bus Lane

The system is in this allocation of private bus routes, especially in crowded areas is done either at all times or only in peak hours. The average density of such operational amounts to 9,000 passengers per hour in each direction, and speed of between 20 and 30 km/h. [3]

2.5.3 Bus way and Bus Rapid Transit

Buses run in this system on a private railway and in an integrated manner, not exceeding asphalt or concrete located on concrete those covering the path. Although a bus driver drives the bus, they must follow the regulations and adhere in all movements. The roofs of the stations that are bus stops must be to the system of the same height as a bus entrance should be. Inside the bus all the information needed for the passenger to know the next movement or stop. The operational cost of such a system is weaker than a tracks system, and the average density operational 11,500

passengers in each direction per hour and speed of between 20 and 50 km/h. [3]

2.5.4 Tram System (Tram)

The traditional tram trains and simpler types of trailers that are going on its own rails, which in terms of old idea but it has evolved considerably in the present time. The Belgians built the first tram in the Arab world in 1906 and in Cairo. The tram goes on in the same railway level vehicles were mixed in busy intersections. Operational and cost twice the operational cost of the bus while average capacity Approximately 6,000 passengers per hour in each direction, but not exceeding the average speed of 20 km/h. [3]

2.5.5 Light Rail (Light Rail)

It trains short of medium density and speed moderate compared with other trains, where average capacity up to 11,500 passengers per hour in each direction and speed of 30 km/h and operational cost not exceeding introduced three major operational cost of the bus. [3]

2.5.6 Trains the Outskirts of the City (Suburban-Rail)

This system is characterized by lack of stoppage, but the operating cost is less than its predecessor and a greater speed and operational capacity less than its predecessor.

The heavy trains that used between cities are often long and high operational capacity and great speed. [3]

2.5.7 Types of Buses

Articulated bus is consisting of two sections connected by flexible joint to allow for short turning and increased number of passenger capacity. [5]

Express buses provide a fast traveling comfortably on a long route with many spaced stops. [6]

Trolley buses are forced by electric power constrained from operating where no power line. [6]

Semi-rapid buses is operating on routes that include substantial sections, it is consist of an exclusive bus way on the freeway utilized by a great number of bus routes. [6]

2.6 Taxis

It is an individual Public Transportation (IPT), a driver takes passengers directly from their origin to their destination. Consider a region of area in which we provide radio-taxi service to customers with demand density and expected trip length. It will assume that providing enough taxis to ensure that every call immediately gets assigned a taxi. [8]

2.7 Advantages of Mass Transit System

An expanding urban population requires access to business activities, education, employment and recreational activities. The transportation system has a great influence and impact on regional patterns of development, economic viability, environmental impacts, and on maintaining socially acceptable levels of quality of life. [12]

Moreover it is important to provide a transportation option for those without access to a motor vehicle, as well as providing a travel alternative to commuters in order to decrease stress on current infrastructure. In all, this provides strong motivation for public transport services. [12]

Public transportation services vitalize economies of nations. These services improve the life of communities by providing safe, efficient, and economic transport; they ensure personal mobility through making available cost effective modes; and they benefit society by easing traffic congestion, saving money, and creating and sustaining jobs. [9]

Improvements in the public transportation links between urban and suburban areas result in a shift in the population from urban to suburban areas. This reduces the disparities in land prices and helps to reduce congestion and other problems. [9]

2.8 Environmental Effects of Mass Transit System

The ensuing mobility growth has major negative impacts on the local and the global environment, as well as on the quality of life and the economic performance of cities. These negative impacts include congestion, emissions (conventional and especially greenhouse), noise, disruption of communities, accidents, use of nonrenewable energy, and production of solid waste. [11]

2.9 Transportation Planning

The first defining feature of the urban transportation planning is a discipline in the midst of a typical transition. New planning goals, processes, tools are being introduced and increasingly applied. Old goals, processes, and tools are show deeply engrained in the existing institutions and practices.

The second distinctive feature of the emerging urban transportation planning is related to its overarching aim: achieving sustainable urban mobility, as part of a broader effort towards enhancing quality of life in cities. There seems to be a broad consensus on this aim and its interpretation. More definitely this implies developing urban regions that offer people and firms the means to reach more opportunities (such as jobs, services, social contacts) with less mobility (or at least less damaging mobility).

The third feature of the emerging urban transportation planning: the importance of collaboration, integration and exchange with other professions and policy sectors. The emerging urban transportation planning is much more multi inter and trans disciplinary than its traditional counterpart. The new challenges demand multi disciplinarily, or collaboration with other professions and policy sectors, such as public health or economic development.

The fourth and final distinctive feature of the emerging urban transportation planning cuts across much of the above. It stems from the recognition that such things as collaboration across disciplines and policy sectors, stakeholder engagement, and public acceptability are key to progress. This demands that urban transportation planning becomes a much more communication-oriented activity. [11]

Transportation planners need to establish means by which the transportation system may be evaluated and monitored to ensure that short and long term objectives are adept. It is a critical element in the evolution and growth of metropolitan regions. Such planning must take into account trip purpose, temporal and spatial distributions of trips, modal splits of travel, and costs. Measuring the effectiveness of public transportation performance is critical in assessing policy goals as well as planning for future improvements.

Transportation planning is a critical element in the evolution and growth of metropolitan regions. Such planning must take into account trip purpose, temporal and spatial distributions of trips, modal splits of travel, and costs. These considerations will impact current and future infrastructure as well as the environment. [12]

2.10 GCC Countries

To overcome such weaknesses, some of the GCC countries have recently taken certain initiatives in this regard. Bahrain launched a BD 4.5 million (US$11.9 million) public-private sector joint venture, the Arabian Cab Company (ACC), adding a fleet of 350 brand new "London cabs" to its existing pool. This project is expected to boost the economy through regulation, competition, and growth in employment. Looking beyond the basic gains, Qatar is planning to launch electric-powered taxis and battery-powered public buses to acquire ecological and economical benefits. MidEast.ru (2009) reports that the Road and Transport Authority (RTA) in the UAE is planning to introduce a fleet of buses exclusively for women. Abu Dhabi has enriched its public transport infrastructure with taxis and buses and is offering free services on four routes. Sharjah

aims to ease the travel woes of residents and daily commuters with 25 buses on three routes, which are expected to amount to a fleet of 172 buses on 18 routes. [9]

2.11 Safety Issues

Better modes of public transport are emerging as a public concern that could help in ensuring safety on the roads. Furthermore, there is a need to investigate road safety mechanisms, since transit users' perception of their safety is crucial to their decisions about whether or not to use public transport. [9]

CHAPTER 3

Data Gathering and Analysis

3.1 Introduction

3.2 Planning Data

3.3 Management and Operation Related Data

CHAPTER 3

3. Data Gathering and Analysis

3.1 Introduction

This chapter covers the data gathered from the various related ministries and institution. These include Ministry of Works, Ministry of Transportation, Ministry of Municipalities and Urban Planning, Ministry of Interior, Bahrain Petroleum Company (BAPCO), Directorate of Statistics of the Central Informatics Organization and King Fahad Causeway Authority. The chapter will also cover data obtained by other means as surveys and on line search.

Planning Data

It is important for this study to collect comprehensive data to provide full scale analysis. The considered data covers the years from 1980 to 2012.

- CARS Company (Public bus operator)
- Classified Vehicle data
- Vehicle Trends
- Historical Data of Current Public and Private Buses
- Taxi data
- King Fahad Causeway Authority
- Fuel Consumption

- Population Trend
- Housing Development
- Land Use Development
- Traffic Count (Total Daily Traffic and Peak Hours)

Management Data

- Questionnaire (Operation time , Fare rate, Ticket validity period)
- Capacity and speed of the mode of transportation

3.2 Planning Data

3.2.1 CARS Company

Cars Company is a private company that operates the public buses in Bahrain. According to verbal interview with the management, there are three main bus stations; Muharraq, Manama and Isa Town. The following information will cover details on how the buses operate. The main goal was to find the route directions, the timings, the current operating buses and there future expectations. The data collected from the representative of Cars Company was as follows:

- Current fleet consist of buses: 50
- The number of the current operating buses: 35
- The average daily passengers is around 16,000
- Number of stations: 169

- Congested stations: Manama station, Muharraq station, Salmabad station and Budaya station
- Rush hours: from 5:30 to 7:30 and from 17:00 to 21:00
- Working hours 4:00 to 20:00 or 22:00 depending on the working area
- There are three lanes which have the longest number of users:
    1. Isa Town to Manama then to Muharraq
    2. Salman Port to Manama
    3. Budaya to Salmanya then to Manama
- Daily fuel consumption is around 8000 liters of diesel
- Number of trips depends on the lanes and it starts from a trip each 15 minutes.

3.2.2 Classification of Vehicles

Registered vehicles in Bahrain are classified as per as their types to more than seven types, the classifications organized according to their usage, as private or public transport, Table 3.1 presents the registered vehicles in Bahrain according to this types; which is: private passenger car, taxi/taxi on call, cars for hire, public transport, cabin pick up and public and private buses. It shows that the values presented are increasing through the years since 1980s.

Table 3.1: Registered vehicles in Bahrain: classified as per vehicle type (1985-2012)

Year	Private Car	Taxi	For Hire	Taxi on Call	Public transport Pick Up	Buses		Total
						Private	**Public**	
1985	78497	927	812	23	593	2272	198	105868
1986	80654	950	996	23	605	2394	197	109982
1987	82776	951	930	14	602	2500	196	112520
1988	88775	921	653	8	617	2535	193	119192
1989	93021	937	702	8	628	2663	189	124604
1990	96592	917	735	8	623	2873	179	130149
1991	98810	915	781	7	615	2970	169	133552
1992	108588	914	828	6	610	3152	167	143322
1993	115484	927	844	6	610	3488	170	154240
1994	123328	913	700	7	597	3707	171	163582
1995	128058	902	585	7	597	3849	161	169318
1996	132816	889	451	8	592	4031	161	175017
1997	140824	891	376	11	582	4289	153	184390
1998	153215	900	290	14	571	4646	155	198617
1999	162153	908	716	14	570	4767	150	209326
2000	166648	896	2199	16	559	5019	149	216679
2001	176054	937	3888	19	612	5025	151	229780
2002	196589	944	7014	33	602	4847	170	250978
2003	212021	953	9692	52	582	5153	195	273230
2004	226918	951	12610	62	545	5473	209	295484
2005	241813	964	14024	52	565	5569	111	315893
2006	256228	971	18242	50	571	6065	113	339544
2007	275389	980	21900	50	572	6823	115	369124
2008	296238	1092	25943	50	550	7924	126	401878
2009	315265	1376	29424	49	569	9460	134	431372
2010	328536	1407	33650	60	591	8418	133	454859
2011	342418	1420	37616	58	610	8944	125	478184
2012	357355	1450	42704	64	621	9176	128	505149

As can be seen from the above table, most type of the vehicles are increasing through the years since 1985, it indicates further traffic jam in the future.

3.2.3 Vehicle Trend

Table 3.2 shows the annual growth rates of the total registered vehicles for the years 1980 to 2012 indicate continuous increasing pattern, continues increase in number of vehicles has a significant effect on the traffic on the road network and indicates a continues demand on mobility. Essentially, the number of vehicles increases without any decreasing pattern since the three past decades. The annual growth rate in population is gradually increasing; consequently the number of buses and other public transportation are not following the total increasing in vehicular population which has an average annual growth rate of 6.5%.

Table 3.2: Vehicle Population Along with Corresponding Annual Growth Rates (1980-2012)

Year	Number of Vehicles	% of Annual Growth	Year	Number of Vehicles	% of Annual Growth
1980	67830	-	**1997**	184390	5.36%
1981	70065	3.30%	**1998**	198617	7.72%
1982	81272	16.00%	**1999**	209326	5.39%
1983	89185	9.74%	**2000**	216679	3.51%
1984	97935	9.81%	**2001**	229780	6.05%
1985	105868	8.10%	**2002**	250978	9.23%
1986	109982	3.89%	**2003**	273230	8.87%
1987	112520	2.31%	**2004**	295484	8.14%
1988	119192	5.93%	**2005**	315893	6.91%
1989	124604	4.54%	**2006**	339544	7.49%
1990	130149	4.45%	**2007**	369124	8.71%
1991	133552	2.61%	**2008**	401878	8.87%
1992	143322	7.32%	**2009**	431372	7.34%
1993	154240	7.62%	**2010**	454859	5.44%
1994	163582	6.06%	**2011**	478184	5.13%
1995	169318	3.51%	**2012**	505149	5.64%
1996	175017	3.37%	**Average annual growth**		**6.51%**

The vehicle population has increased nearly four times in less than 25 years. It was 133552 vehicles in 1990 and it reached 505149 vehicles in 2012. The average annual growth rate is 6.8% in 80's and then decreased in 90's to 5.2% and it again raised in 2000, till now, to 7.3%. As it shown in Figure 3.1, the total registered vehicles are increasing with R^2-value of 0.992.

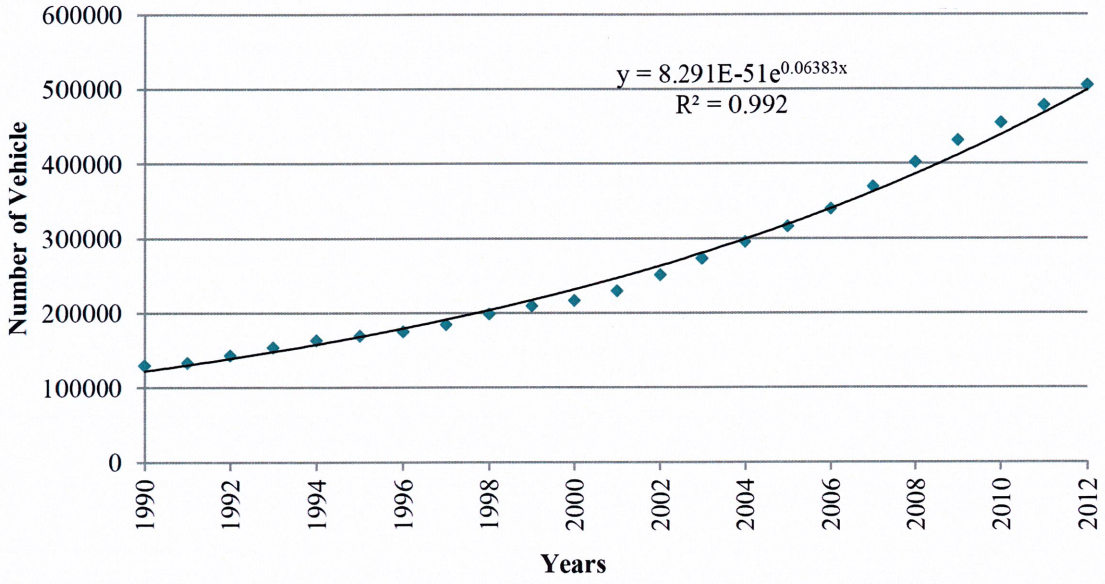


Figure 3.1: Total Registered Vehicles in Bahrain (1990-2012)

Table 3.3: Registered Vehicles by Governorates 2012

Governorate	Number of Vehicles	Percentage of Vehicles
Muharraq	80108	15.86%
Capital	131006	25.93%
Northern	114679	22.70%
Central	110525	21.88%
Southern	68831	13.63%
Total	505149	100%

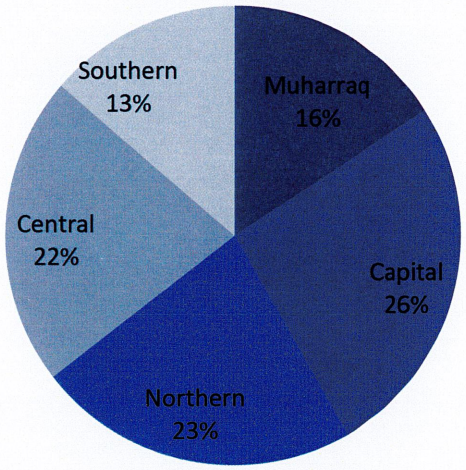


Figure 3.2: Registered Vehicles by Governorates 2012

3.2.4 Current Public and Private Buses

The private buses showed continuous increase since 1985 and even before, the numbers escalated from 2272 in 1985 to 9176 buses in 2012 (Table 3.4), which indicates that the need of the mass transit is significant. On the other hand, the number of public buses decreased rapidly to reach 128 buses in 2012. Decreasing in public buses indicate that there is reasons which should be considered. These changes have significant negative effect on the road network and it will reflect the high need of the mass transportation.

Table 3.4: Historical Bus Data, Public and Private Bus (1985-2012)

Year	Public Buses		Private Buses	
	Public Buses	%of Annual Growth Rate	Private Buses	% of Annual Growth Rate
1985	198		2272	
1986	197	-0.5%	2394	5.4%
1987	196	-0.5%	2500	4.4%
1988	193	-1.5%	2535	1.4%
1989	189	-2.1%	2663	5.0%
1990	179	-5.3%	2873	7.9%
1991	169	-5.6%	2970	3.4%
1992	167	-1.2%	3152	6.1%
1993	170	1.8%	3488	10.7%
1994	171	0.6%	3707	6.3%
1995	161	-5.8%	3849	3.8%
1996	161	0.0%	4031	4.7%
1997	153	-5.0%	4289	6.4%
1998	155	1.3%	4646	8.3%
1999	150	-3.2%	4767	2.6%
2000	149	-0.7%	5019	5.3%
2001	151	1.3%	5025	0.1%
2002	170	12.6%	4847	-3.5%
2003	195	14.7%	5153	6.3%
2004	209	7.2%	5473	6.2%
2005	111	-46.9%	5569	1.8%
2006	113	1.8%	6065	8.9%
2007	115	1.8%	6823	12.5%
2008	126	9.6%	7924	16.1%
2009	134	6.3%	9460	19.4%
2010	133	-0.7%	8418	-11.0%
2011	125	-6.0%	8944	6.2%
2012	128	2.4%	9176	2.6%

As can be seen from Figure 3.3, the public buses in the years from 2002, 2003 and 2004 showed unexplained high frequencies without any rational and then again continued decreasing, the R^2- Value of the developed model is 0.403 which is slightly low.

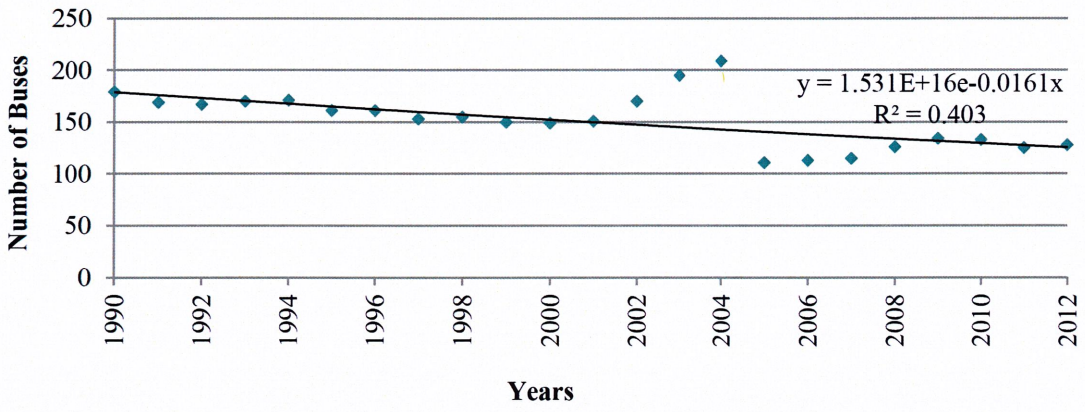


Figure 3.3: Public Buses in Bahrain (1990-2012)

Figure 3.4 shows the model fitted to the private bus trends. The exponential model with high R^2-Value of 0.962 shows continues increasing in the coming future.

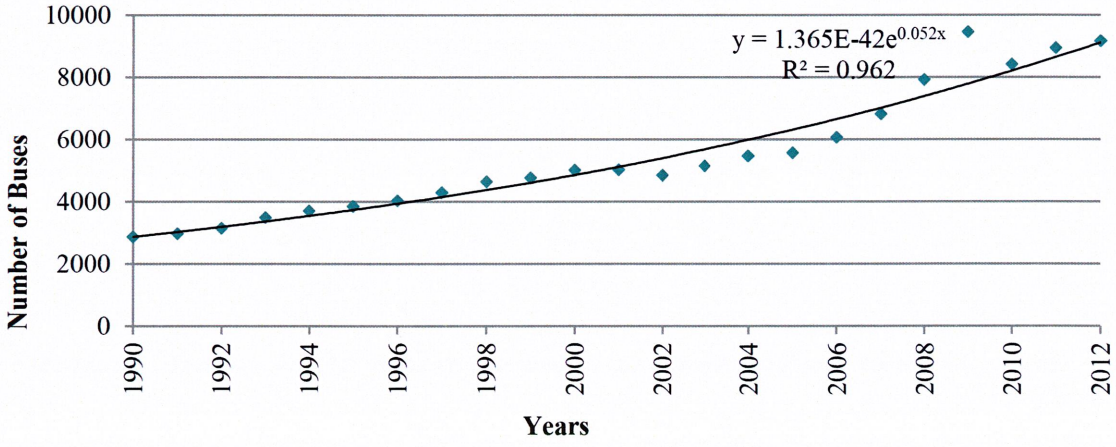


Figure 3.4: Private Buses in Bahrain (1990-2012)

3.2.5 Taxis

Number of taxis during the years 1985 to 2000 is marginally constant as shown in Table 3.5; it is started increasing from year 2009 to reach 1450 in 2012. On the other hand the number of taxi on call has also shown on increasing trends; it was 23 taxis in 1985 to 64 in 2012. Yet they are considered very limited compared with total number of vehicles.

Table 3.5: Taxi and Taxi on Call (1985-1992)

Year	Taxi	Taxi on Call		Year	Taxi	Taxi on Call
1985	927	23		**1999**	908	14
1986	950	23		**2000**	896	16
1987	951	14		**2001**	937	19
1988	921	8		**2002**	944	33
1989	937	8		**2003**	953	52
1990	917	8		**2004**	951	62
1991	915	7		**2005**	964	52
1992	914	6		**2006**	971	50
1993	927	6		**2007**	980	50
1994	913	7		**2008**	1092	50
1995	902	7		**2009**	1376	49
1996	889	8		**2010**	1407	60
1997	891	11		**2011**	1420	58
1998	900	14		**2012**	1450	64

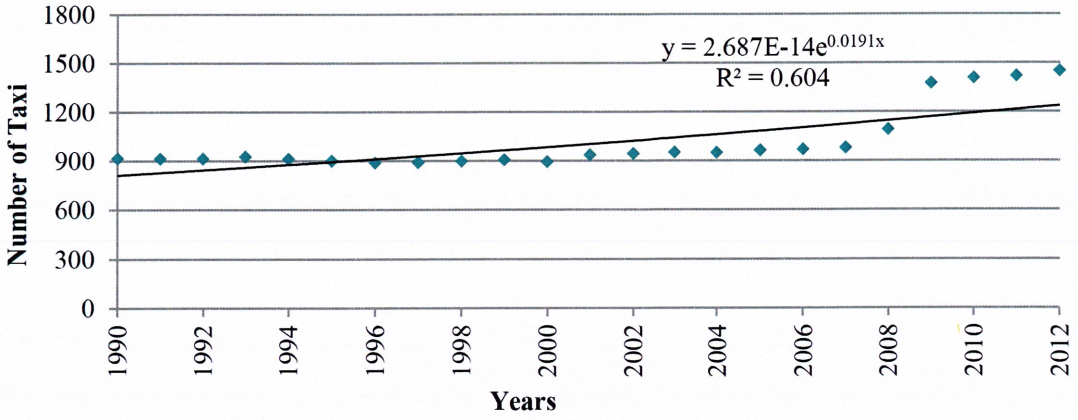


Figure 3.5: Taxi in Bahrain (1990-2012)

It is shown in Figure 3.6 the number of taxi on call, it is increasing in year 2003, 2004 and 2005, then again it is start to decrease without any identified reason, the R^2-Value = 0.891.

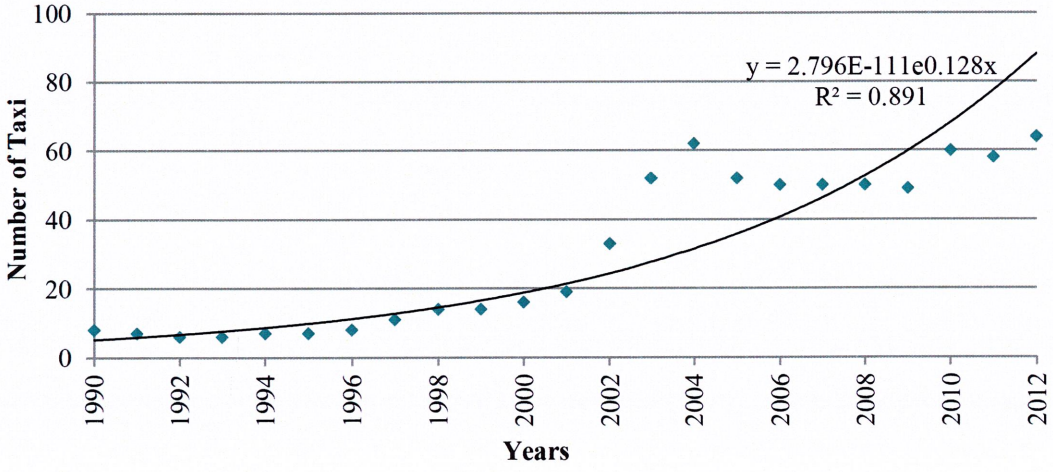


Figure 3.6: Taxi on Call in Bahrain (1990-2012)

3.2.6 King Fahad Causeway

King Fahad Causeway was opened for the public use late in 1986. Table 3.6 presents yearly arriving and departing vehicles through King Fahad Causeway for the years 1987 to 2012. The amount of the vehicles arriving from King Fahad Causeway will affect the traffic jams on major roads of Bahrain. The traffic is continuously increasing.

Table 3.6: Arriving and Departing Vehicles through King Fahad Causeway (1987-2012)

Year	Arriving	Departing		Year	Arriving	Departing
1987	665376	664709		**2000**	1578657	1606032
1988	523304	527177		**2001**	1800421	1827815
1989	502169	501927		**2002**	2021928	2008839
1990	496444	492288		**2003**	2068192	2542321
1991	610415	611778		**2004**	2445276	2470746
1992	682127	690332		**2005**	2960660	2992281
1993	831188	838421		**2006**	3199270	3253865
1994	966979	971701		**2007**	3413943	3302441
1995	906328	903602		**2008**	3807636	3810870
1996	836768	843821		**2009**	3807636	3810870
1997	1055399	1072312		**2010**	3688547	3903559
1998	1167082	1181350		**2011**	3022307	3261815
1999	1328529	1363203		**2012**	3333455	4908464

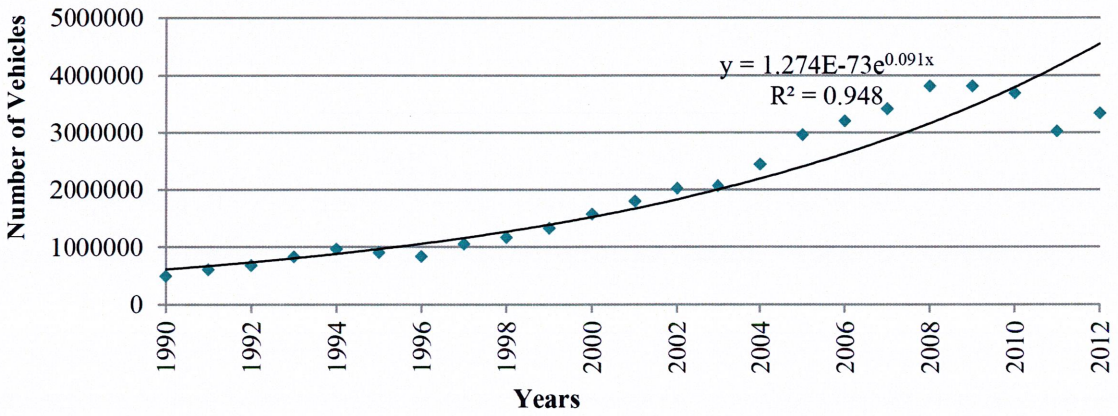


Figure 3.7: Modeled Arriving Vehicles through King Fahad Causeway to Bahrain (1990-2012)

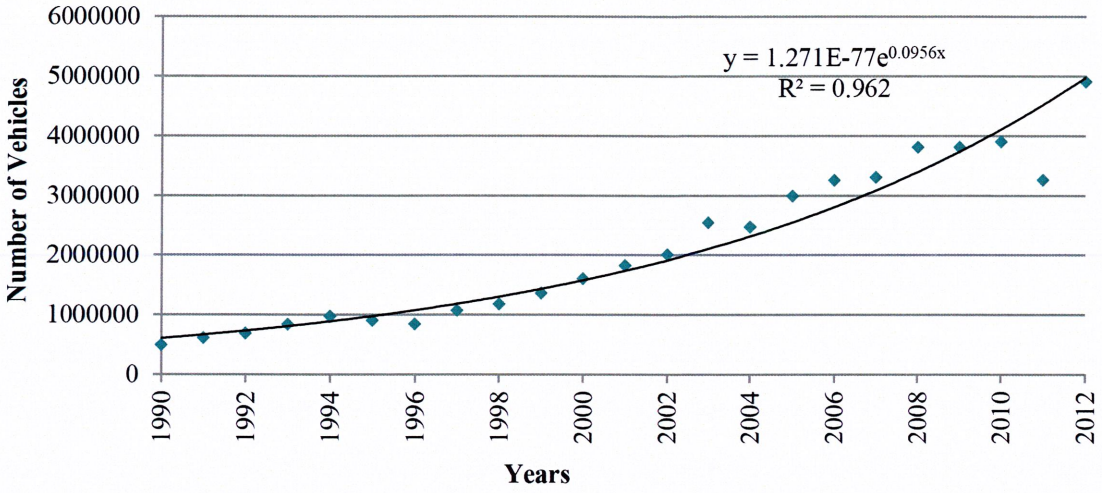


Figure 3.8: Modeled Departing Vehicles through King Fahad Causeway

As it shown in Figure 3.7 and Figure 3.8, the arriving and departing vehicles during the year 2011 has shown clear decreasing figure, probably due to unstable concerns in Bahrain.

3.2.7 Fuel Consumption

Table 3.7 presents the total market sales of fuel in Bahrain for the period from 1990 to 2012 as provided by BAPCO.

Due to the continuous increase in car population, Gasoline consumption, as well as all other types of fuel has also shown an increasing trend. On the other hand, the Kerosene type is also increasing trend except for the years 2007 and 2008.

Table 3.7: Fuel Consumption in Bahrain (in thousand BBL = 156 litters) (1990- 2012)

Year	Total Gasoline (1000 BBL)	Kerosene (1000 BBL)	Diesel (1000 BBL)	Total (1000 BBL)
1990	1909	99	712	2720
1991	1964	107	692	2763
1992	2131	113	816	3060
1993	2257	121	800	3178
1994	2338	125	785	3248
1995	2385	125	856	3366
1996	2468	126	848	3442
1997	2591	131	888	3610
1998	2740	133	933	3806
1999	2862	136	947	3945
2000	3073	141	972	4186
2001	3225	145	984	4354
2002	3437	156	1255	4848
2003	3657	182	1438	5277
2004	3875	192	1676	5743
2005	4101	208	2338	6647
2006	4297	173	2374	6844
2007	4513	173	2722	7408
2008	4790	211	3107	8108
2009	4985	204	2851	8040
2010	8447	300	4220	12967
2011	8112	310	3823	12245
2012	9040	306	4143	13489

Figure 3.9 to Figure 3.12 show the trends in fuel consumption for the period from 1990 to 2012. Such models indicate the future needs of various types of fuel.

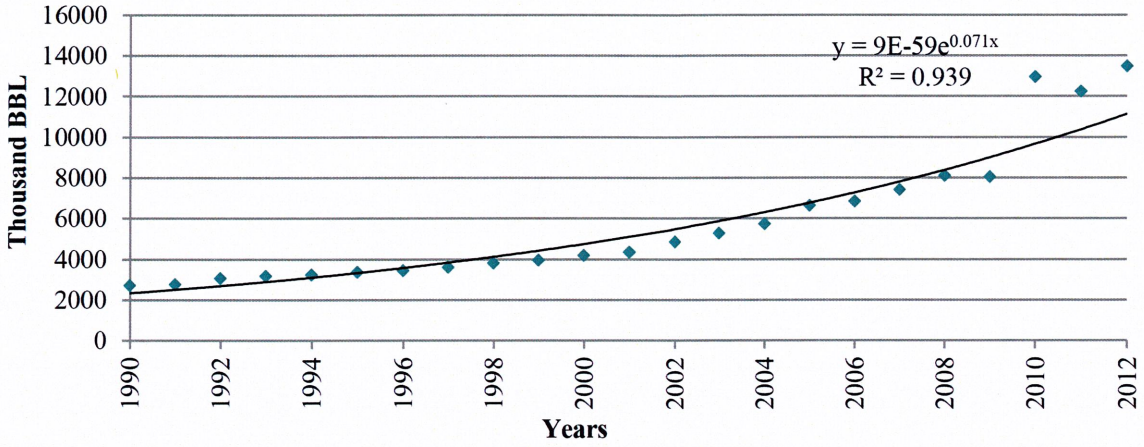


Figure 3.9: Total Fuel Consumption (in thousand BBL = 156 litters)

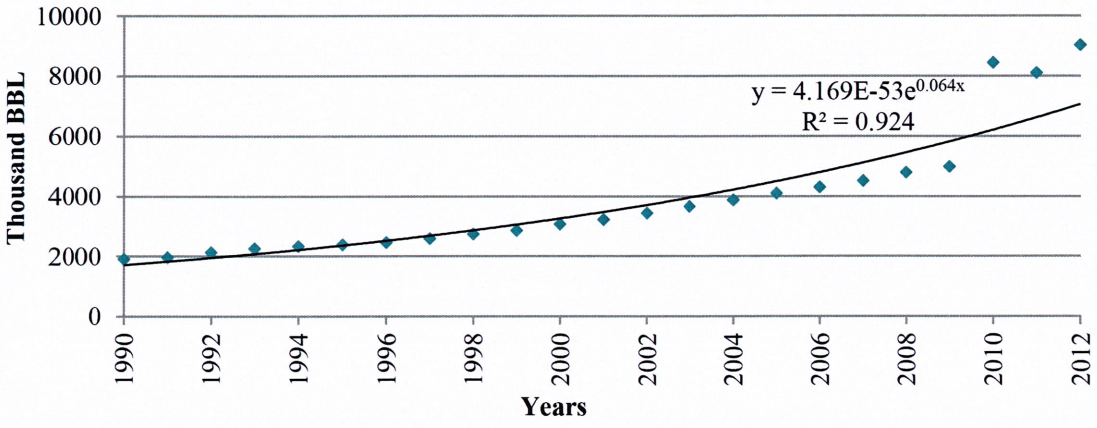


Figure 3.10: Fuel Consumption- Gasoline (in thousand BBL = 156 litters)

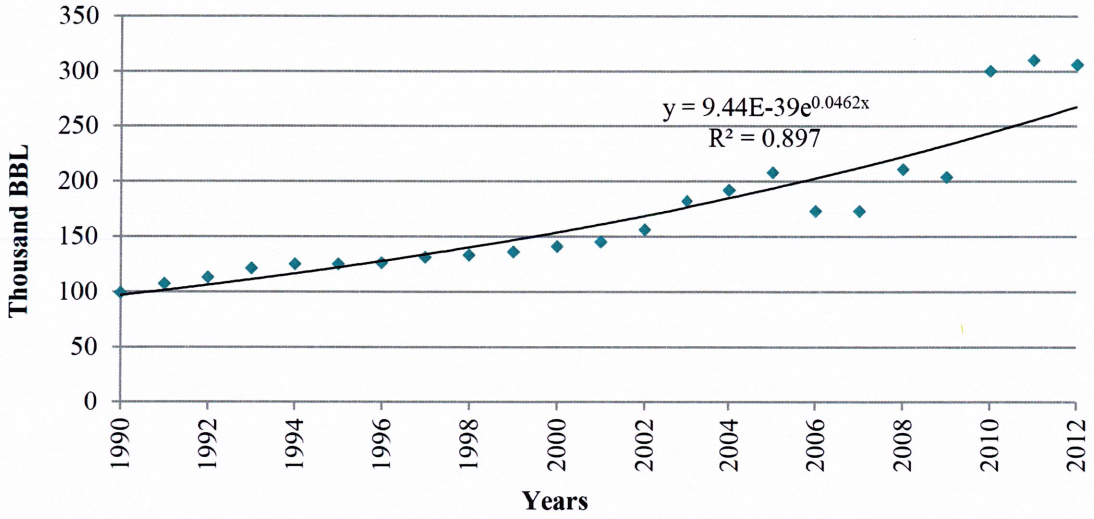


Figure 3.11: Fuel Consumption- Kerosene (in thousand BBL = 156 litters)

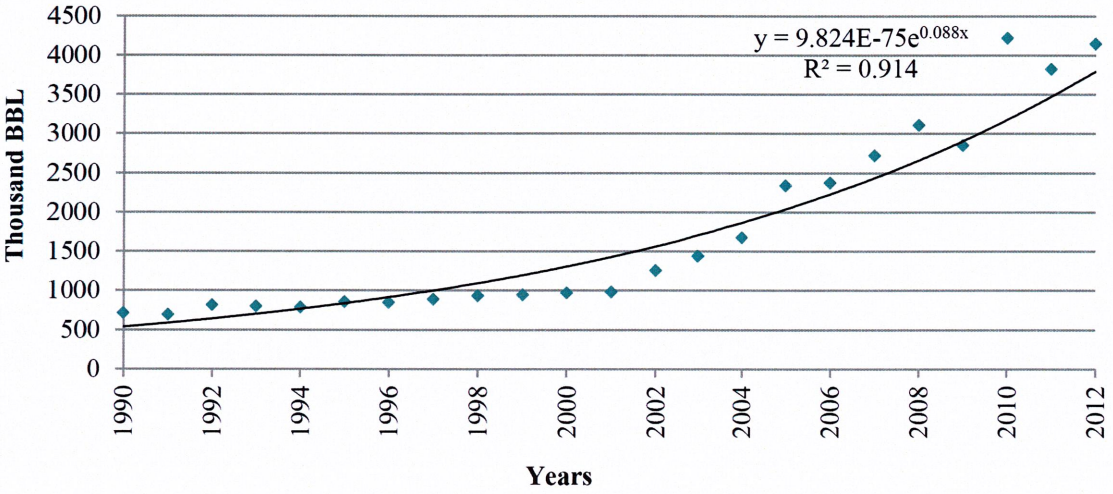


Figure 3.12: Fuel Consumption- Diesel (in thousand BBL = 156 litters)

The increasing in the fuel price will affect the use of the Mass Transit System by the time. It will have strong positive relationship.

3.2.8 Population Trend

The population trend has a great influence on the type of Mass Transit System that will be suitable to satisfy the necessary demand on various types of transportation systems. Table 3.8 shows the population trends in Bahrain as a whole, Manama and Muharraq for the years 1941 to 2011. It is growing through years. The population reached 1234571 by the end of 2011.

Table 3.8: Population of Bahrain (1941-2010)

Year	Whole Bahrain	Manama	Muharraq
1941	89970	-	-
1950	109650	-	-
1959	143135	-	-
1965	182203	79704	46373
1971	216078	89399	49540
1982	385000	121986	68964
1991	350798	136999	82855
2001	650604	163696	103576
2007	1046814	264741	167908
2011	1234571	329510	189114

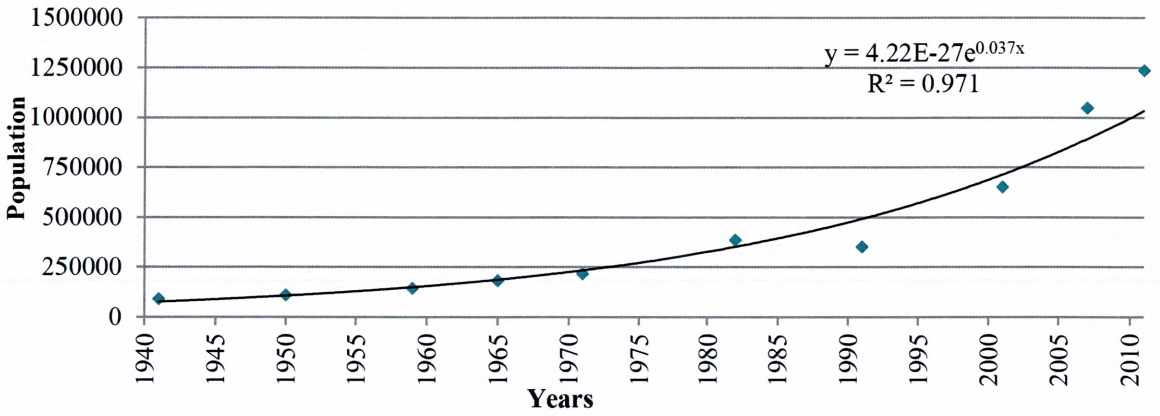


Figure 3.13: Population of Bahrain Country Wise (1940-2010)

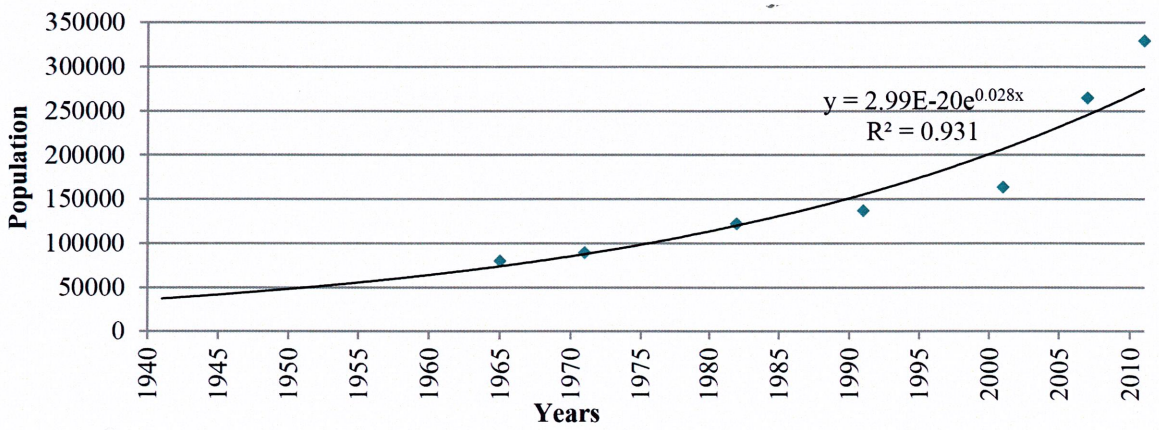


Figure 3.14: Population of Manama (1965-2010)

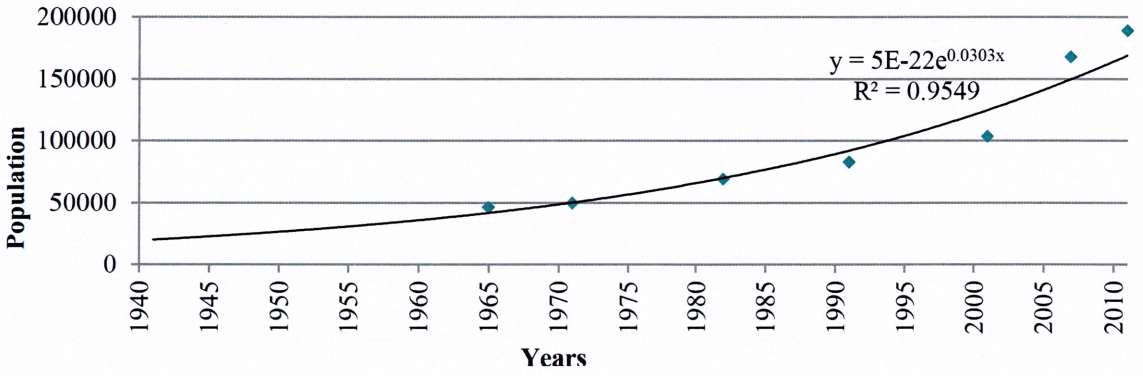


Figure 3.15: Population of Muharraq (1965-2010)

Table 3.9: Population by Governorate for the year 2011

Governorate	Population	Percentage of population
Muharraq	188579	16.07%
Capital	296427	25.27%
Northern	273105	23.28%
Central	314719	26.83%
Southern	100388	8.56%
Total	1173218	100%

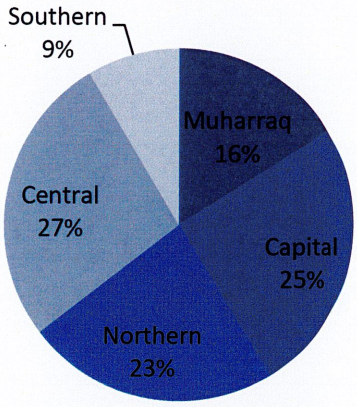


Figure 3.16: Population by Governorate 2011

Table 3.10: Population, Area, and density by Governorate for the year 2007

Governorate	Population		Area sq.km		Population Density
Capital	264741	25.29%	37.19	4.96%	7119
Muharaq	167908	16.04%	50.24	6.70%	3342
Northern	269762	25.77%	140.64	18.76%	1918
Central	271126	25.90%	84.56	11.28%	3206
Southern	73277	7.00%	437	58.30%	168
Total	1046814	100%	749.63	100%	1396

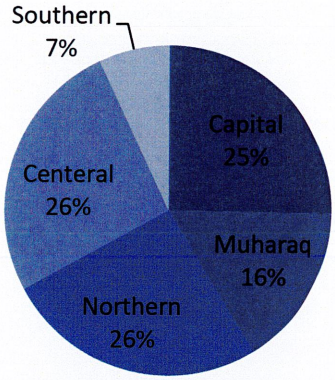


Figure 3.17: Population by Governorate

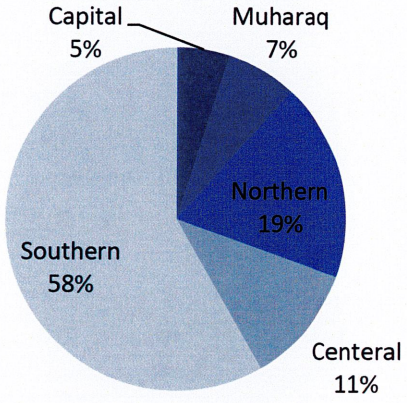


Figure 3.18: Area by Governorate

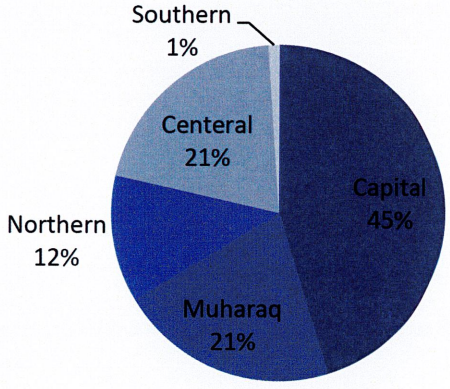


Figure 3.19: Density by Governorate

The populations of the various Governorates in Bahrain are increasing rapidly as been shown in Table 3.9 and Table 3.10, and Figure 3.17 to Figure 3.19. The population during the period from 2001 to 2011 has increased by more than 50%. The central governorate shows the highest population (271,126) and the southern showed the lowest population (73,277) as per 2007 records. According to 2001 and 2007 data, Manama showed the highest population density and the Southern Governorate the lowest. Although the Capital is the smallest governorate, it carries 25.3% of the total kingdom's population. The Southern is the biggest one and accommodates only 7% of the population.

3.2.9 Housing Development

Table 3.11 presents statistics development of housing units by governorate since 1965, which are considered to be a major traffic generator.

The urban development in Bahrain is also growing rapidly. As per 2011 data shown in Table 3.11, Manama holds 31% of the housing units in Bahrain, Muharraq holds 17% of the housing units.

During the last few years, lots of project, especially housing and commercial projects have been constructed. Accordingly, the urban development showed a significant increase which will obviously affect the traffic and increase the need for mobility.

Table 3.11: Housing units by governorates for the year 2011

Year	Whole Bahrain	Manama		Muharraq	
1965	23600	11996	50.83%	6768	28.68%
1971	31045	14042	45.23%	7256	23.37%
1981	52810	21050	39.86%	10260	19.43%
1991	83470	27968	33.51%	13834	16.57%
2001	105686	34210	32.37%	17388	16.45%
2011	151580	47179	31.12%	26257	17.32%

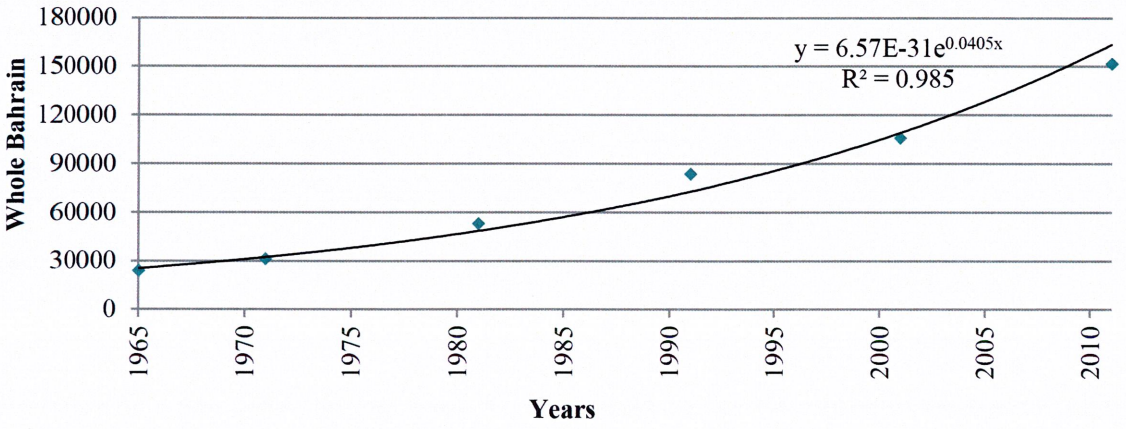


Figure 3.20: Development of Housing Units in Bahrain (1965-2010)

3.2.10 Land Use Development

Land use in Bahrain has been dictated by the geographical condition of its site. Opposite to the fertile land along the northern coast, the south is mostly deserted. Human settlements and agriculture went therefore hand in hand for long time. Overall, land use types were limited to 5 classes as shown in Table 3.12.

The land use for agriculture activities was increasing during the period from 1939 to 1969 and decreasing since 1969. Other types of land use are continuously increasing.

Table 3.12: Land Use by Types and Years in Hectare (based on Middle East Spatial Technology, 2007)

Land Use Type	1939	1956	1962	1969	1990	2000	2007
Agriculture	4620	6911	7321	8207	6887	4365	4042
Urban Development	562	1262	1441	2050	8159	10175	11543
Industrial	573	684	707	765	1403	2060	2568
Services	-	-	150	255	1140	1500	2570
Tourisms and Leisure	-	-	-	-	16	59	1038

3.2.11 Traffic Data (Total Daily and Peak hour Traffic)

The data about the traffic is very important criteria which can lead us to choose the ideal type of transportation mode that will satisfy the demand for transportation. The study handles the main road network all around Bahrain for 32 years (1980 – 2012).

The Study Area

It is necessary to delineate the study area boundaries and the automatic count sites. The main cities all around Bahrain and other attraction areas were selected as follows:

1. Manama
2. Muharraq
3. Buddaya
4. Sittra
5. Riffa
6. Isa Town
7. Hamad Town
8. King Fahad Causeway

Figure 3.21 shows the main cities and other attraction sites which includes this study.

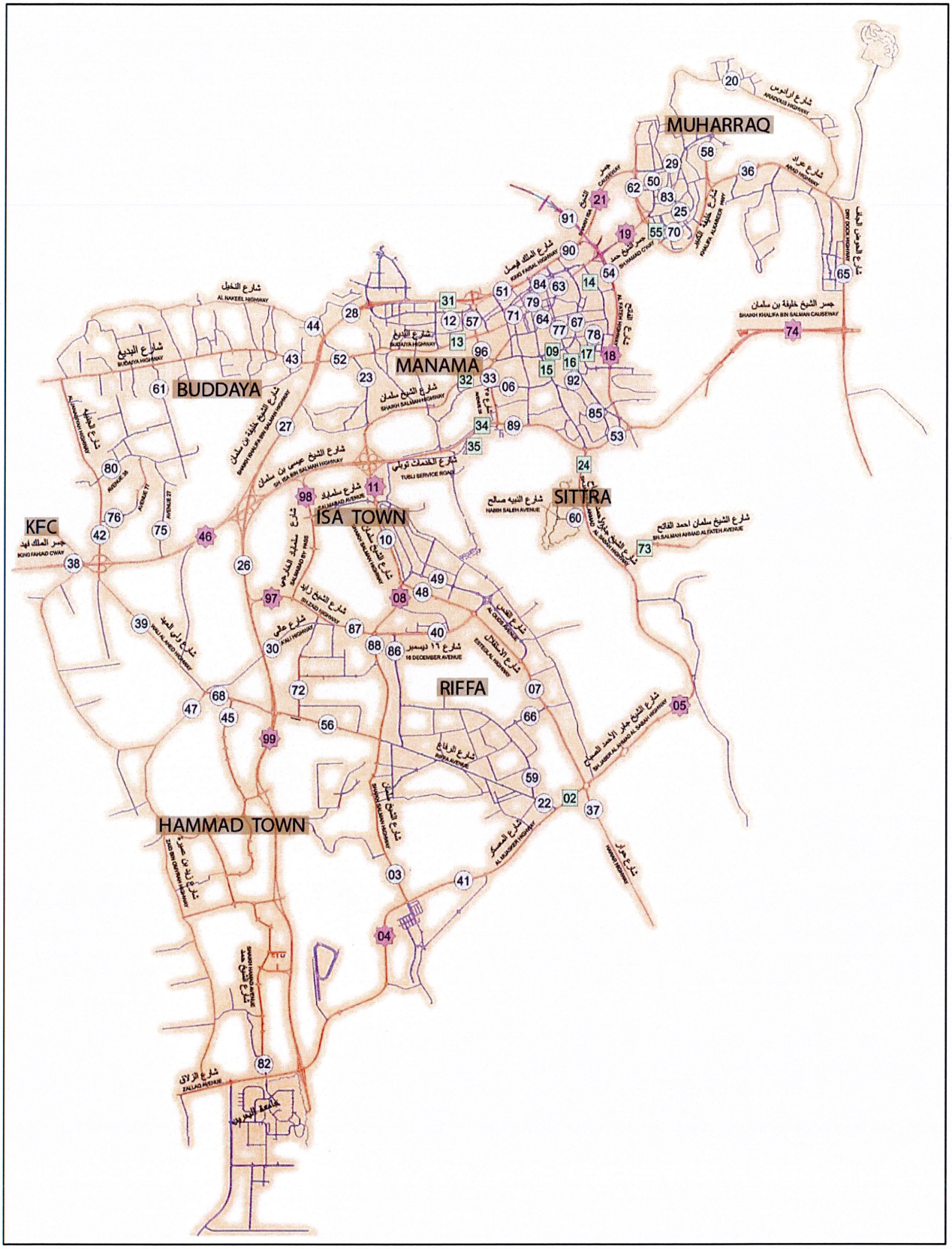


Figure 3.21: Main Cities and Road Network in Bahrain

Traffic flow between cities

The traffic flow between cities was calculated as the traffic travel between the attached cities, the cities were selected either geographically attached or by road network which connected it as follows:

1. Manama - Muharraq
2. Manama - Sittra
3. Manama - Isa Town
4. Manama - Buddaya
5. Isa Town - Riffa
6. Isa Town - King Fahad Causeway
7. Isa Town - Hammad Town
8. Riffa - Hammad Town
9. Hammad Town - King Fahad Causeway
10. Buddaya - King Fahad Causeway

The connected cities and the main concentration road network of the main automatic traffic sites are presented in Table 3.13. As can be seen from the table, 21 traffic count sites were considered in this study. These are gathered from Ministry of Works.

See Appendix (1) for traffic count data.

Table 3.13: The connected cities and main attractive location

Cities			Site No.	Location
1	Manama	Muharraq	19	SH HAMAD C.WAY
			21	SHAIKH ISA BIN SALMAN C.EWAY
			74	SH.KHALIFA CAUSEWAY
2	Manama	Sittra	24	MAJLIS AL TAWON HWY (NORTH NABIH SALEH)
3	Manama	Isa Town	11	SHAIKH SALMAN HIGHWAY (NORTH BAHRAIN GAS RDT)
			34	SH.ISA B.SALMAN HWY (NEAR NEW ZINJ)
			35	TUBLI SERVICE ROAD (NEAR PETROL STATION)
			98	SALMABAD BAYBASS HIGHWAY (NEAR SH.ISA BIN SALMAN HWY)
4	Manama	Buddaya	43	BUDAIYA HIGHWAY (NEAR AL QADAM)
			44	AL NAKEEL HWY (NEAR PETROL STATION)
5	Isa Town	Riffa	8	SHAIKH SALMAN HIGHWAY (SOUTH ISA TOWN GATE RDT)
			40	16 DECEBER HWY (NEAR BIN KHALDOON SCHOOL)
			87	SH. ZAYED HIGHWAY (WEST A'ALI RDT)
			97	SH. ZAYED HIGHWAY (NEAR SH.KHALIFA BIN S. HWY)
6	Isa Town	King Fahad Causeway	46	SAUDIA APPROACHED ROAD (EAST JANABIYA FLYOVER)
7	Isa Town	Hammad Town	26	SH. KHALIFA BIN SALMAN HWY (NEAR CAMAL CROSSING)
8	Riffa	Hammad Town	30	A'ALI - BURI AVE (WEST TANNAL)
			56	WALI AL AHED HIGHWAY (NEAR B.D.F.)
9	Hammad Town	King Fahad Causeway	39	WALI AL AHEDHWY (NEAR HAMALA)
10	Buddaya	King Fahad Causeway	42	JANABIYA HIGHWAY (NORTH FLYOVER)
			75	AVENUE 27 SAAR (NEAR SIBS HWY)

Analysis of Traffic Counts between the cities in terms of Total Daily Traffic and Peak Hour Traffic.

The collected vehicular traffic volumes over the past 32 years (1980 – 2012), were gathered for each area. The counts cover the traffic flow in both directions of traffic. The Total Daily Traffic (TDT), am Peak Hour (am Pk Hr) and pm Peak Hour (pm Pk Hr), were considered for the calculation of the total traffic flow. See Appendix (2) for southbound direction for all sites.

1- Manama – Muharraq

The traffic flow between Manama and Muharraq, as can be seen from Table 3.14 is continuously increasing since 1980. This is due to continues increase in population on limited land and limited public bus service. Therefore the number of vehicle will continue to increase if no proper action was considered towards more sustainable transportation. The average annual growth rate is 6% from year 1980 to year 2012.

Table 3.14: Total Daily Traffic, am Peak and pm Peak between Manama and Muharraq

	Total Daily Traffic				am Peak Hour				pm Peak Hour			
Site No. / Years	19	21	74	Total	19	21	74	Total	19	21	74	Total
1980	37096			**37096**								
1984	38000			**38000**								
1986	41000			**41000**								
1987	40400			**40400**								
1988	39400			**39400**								
1990	40200			**40200**								
1992	41553			**41553**								
1993	40631			**40631**								
1994	56506			**56506**								
1995	43710			**43710**								
1996	45711			**45711**								
1997	28308	11810		**40118**	2432	1456		**3888**	1933	893		**2826**
1998	29398	23672		**53070**	2381	2100		**4481**	1947	1517		**3464**
1999	29523	21512		**51035**	2520	1768		**4288**	1944	1330		**3274**
2003	32766	38179		**70945**	2063	2021		**4084**	1768	1899		**3667**
2004	35378	34576	8797	**78751**	2242	1995	685	**4922**	2179	2533	504	**5216**
2005	38181	30163	16790	**85134**	3904	3058	1076	**8038**	2438	1861	1516	**5815**
2006	33476	27754	14363	**75593**	3349	1437	1502	**6288**	2115	2499	963	**5577**
2007	34615	21718	15537	**71870**	3100	2050	1397	**6547**	2224	1352	1109	**4685**
2008	36198	24277	18124	**78599**	3435	1811	1693	**6939**	2227	1622	1375	**5224**
2010	45073	34085	24162	**103320**	2498	1824	1644	**5966**	3688	2334	1905	**7927**
2011	44592	33498	29107	**107197**	2539	1862	2045	**6446**	3646	3695	2206	**9547**
2012	44006	31241	32199	**107446**	2423	1813	2042	**6278**	4271	2373	2454	**9098**

*empty cell indicate no data were yet available, missing years means no data.

The TDT in 1980 was over 37,000, increased to 40,000 in 2000 in the same location, then to 107,000 in 2012. The latter is about three times the 1980 record and over twice that of 2000 record. In simple look; this means that in 12 years' time the record will pass the 210,000 record.

2- Manama – Sittra

As in the earlier case, the traffic between Manama and Sittra is continuously increasing; at a rate even more than Manama and Muhharaq (Table 3.15). This is probably due to several reasons, among which the economic issues is one of them since is Sittra becoming commercial area. Besides being the mid-point between Manama, Muharraq and other Southern cities. The average annual growth rate is 8% from year 1980 to year 2012.

Table 3.15: Total Daily Traffic, am Peak and pm Peak between Manama and Sittra

	Total Daily Traffic		am Peak Hour		pm Peak Hour	
Site No. / Years	24	Total	24	Total	24	Total
1980	17532	17532				
1984	10150	10150				
1987	17400	17400				
1988	17350	17350				
1990	19700	19700				
1991	21098	21098				
1992	24610	24610				
1993	24386	24386				
1994	25734	25734				
1995	25205	25205				
1996	22967	22967				
1997	24188	24188	1586	1586	1909	1909
1998	26163	26163	1840	1840	2057	2057
1999	31261	31261	1793	1793	1936	1936
2003	29083	29083	1814	1814	2040	2040
2004	25211	25211	1563	1563	1707	1707
2005	35470	35470	2345	2345	2414	2414
2006	34520	34520	2056	2056	2280	2280
2007	37733	37733	2465	2465	2557	2557
2008	39674	39674	2711	2711	2821	2821
2010	27585	27585	1768	1768	1798	1798
2011	26416	26416	1695	1695	2494	2494
2012	49630	49630	3266	3266	3712	3712

*empty cell indicate no data were yet available, missing years means no data.

The drop in the Total Daily Traffic counts during year 2010 and year 2011 is probably due to instability in that area.

3- Manama - Isa Town

The main educational area is in Isa Town and the surrounded area such as Aali. New Private school and colleges are open to cover the requirements of the students; therefore the traffic flow between Manama and Isa Town is becoming more and more since 1980 as it represent in Table 3.16. The average annual growth rate is 16% from year 1980 to year 2012.

Table 3.16: Total Daily Traffic, am Peak and pm Peak between Manama and Isa-Town

	Total Daily Traffic					am Peak Hour					pm Peak Hour				
Site No. / Years	11	34	35	98	Total	11	34	35	98	Total	11	34	35	98	Total
1980	34269				**34269**										
1984	2800	13250			**16050**										
1986		21000	7000		**28000**										
1987		19400	6800		**26200**										
1988	33250	22550	8300		**64100**										
1990		23600	7500		**31100**										
1991		23722	9221		**32943**										
1992	36085	25651	8450		**70186**										
1993	32637	25645	8706		**66988**	2218	1886	669		**4773**	2617	1933	743		**5293**
1994	40357	27188	8599		**76144**										
1995	38269	29051	10276		**77596**										
1996	23699	28715	11552		**63966**										
1997	49222	30472	12088		**91782**	3968	2667	769		**7404**	3586	2109	873		**6568**
1998	50078	38747	12566		**101391**		2866	801		**3667**		2658	870		**3528**
1999	50466	29866	13416		**93748**	3558	2371	818		**6747**	3373	1989	918		**6280**
2003	38179	35721	12536	5192	**91628**		2394	778		**3172**		2366	744		**3110**
2004	49953	33712	11644	5517	**100826**		1961	688		**2649**		2254	707		**2961**
2005	52676	40834	11283	8431	**113224**		2514	737		**3251**		2614	699		**3313**
2006	44687	38584	12102	9005	**104378**	3154	2344	722	680	**6900**	2919	2472	728	698	**6817**
2007		51998	17540		**69538**		4494	1660		**6154**		3880	1196		**5076**
2008		47226	24404		**71630**		3874	2369		**6243**		2960	1624		**4584**
2010	47229	57426	25564	12701	**142920**	3350	4551	1783	934	**10618**	3122	3812	1774	952	**9660**
2011	54900	58701	25273	14340	**153214**	4185	4061	1850	1058	**11154**	3566	3750	1604	1163	**10083**
2012	62381	68204	26644	24344	**181573**	4586	5129	2002	1971	**13688**	4072	4396	1736	1803	**12007**

*empty cell indicate no data were yet available, missing years means no data.

4- Manama – Buddaya

The average annual growth rate from year 1980 to year 2012 is 7% between Manama and Buddaya, it is gradually increasing due to the new housing project in the area which will increase the population, and therefore the number of vehicles will rise. See Table 3.16.

Table 3.17: Total Daily Traffic, am Peak and pm Peak between Manama and Buddaya

	Total Daily Traffic			am Peak Hour			pm Peak Hour		
Site No. / Years	43	44	Total	43	44	Total	43	44	Total
1980	16168	992	**17160**						
1984	17750		**17750**						
1987	18600		**18600**						
1988	15700	1000	**16700**						
1990	10900		**10900**						
1991	20770		**20770**						
1992	17089	1931	**19020**						
1993	23690	1974	**25664**	1956	51	**2007**	1743	76	**1819**
1994	21769	2211	**23980**						
1995	23061	2149	**25210**						
1996	22300	2529	**24829**						
1997	20271	2188	**22459**	1354	170	**1524**	1515	152	**1667**
1998	20136	2685	**22821**						
1999	23533	1014	**24547**	1494	111	**1605**	1600	72	**1672**
2003	35590	10738	**46328**						
2004	35944	6189	**42133**						
2005	39616	5047	**44663**						
2006	35268	8824	**44092**	2568	425	**2993**	2476	668	**3144**
2010	36205	7531	**43736**	2180	465	**2645**	2022	757	**2779**
2011	33072	5477	**38549**	2217	384	**2601**	2071	649	**2720**
2012	31824	5501	**37325**	2265	389	**2654**	2081	685	**2766**

*empty cell indicate no data were yet available, missing years means no data.

5- Isa Town – Riffa

The traffic flow between Isa Town and Riffa continuously increasing since 1980 due to increasing in number of population therefore the number of vehicular will increase as it shown in Table 3.18. The average annual growth rate is 9% from year 1980 to year 2012. New area is developing and new roads are opened to solve the traffic jam problem.

Table 3.18: Total Daily Traffic, am Peak and pm Peak between Isa-Town and Riffa

	Total Daily Traffic					am Peak Hour					pm Peak Hour				
Site No. / Years	8	40	87	97	Total	8	40	87	97	Total	8	40	87	97	Total
1980	24694	4618			**29312**										
1987	20200				**20200**										
1988	24200	4550			**28750**										
1991	20403				**20403**										
1992	22859	3443			**26302**										
1993	24259	6536			**30795**	1589	615			**2204**	1763	544			**2307**
1994	24791	7092			**31883**										
1995	24416	6211			**30627**										
1996	21840	7760			**29600**										
1997	25183	7396			**32579**	1772	738			**2510**	1835	637			**2472**
1998	23556	7693			**31249**										
1999	24450	8483			**32933**	1656	951			**2607**	1669	830			**2499**
2003	25661	13249	12813	8901	**60624**										
2004	28061	14097	14835	10125	**67118**										
2005	27905	18057	17237	14062	**77261**										
2006	23176	17002	14795	14062	**69035**	1617	1711	1103	1545	**5976**	1603	1509	943	1328	**5383**
2010	27612	22185	23920	9718	**83435**	2018	1830	2065	882	**6795**	2550	1910	1510	686	**6656**
2011	23035	16227	13615	14006	**66883**	1568	1111	1410	117	**4206**	1540	1148	906	1087	**4681**
2012	32703	20182	21018	12848	**86751**	3190	1403	1505	1177	**7275**	2542	1671	1597	1049	**6859**

*empty cell indicate no data were yet available, missing years means no data.

6- Isa Town - King Fahad Causeway

The number of vehicles arriving and departing from King Fahad Causeway is incessantly growing as represent in Table 3.19, therefore the traffic movement between Isa Town and King Fahad Causeway is rapidly rising. The average annual growth rate is 14% from year 1980 to year 2012.

Table 3.19: Total Daily Traffic, am Peak and pm Peak between Isa Town and King Fahad

	Total Daily Traffic		am Peak Hour		pm Peak Hour	
Site No. / Years	46	Total	46	Total	46	Total
1980	4812	**4812**				
1988	4700	**4700**				
1992	5623	**5623**				
1993	5923	**5923**				
1994	7873	**7873**				
1995	7230	**7230**				
1996	6605	**6605**				
1997	8511	**8511**	604	**604**	562	**562**
1998	9047	**9047**				
1999	8233	**8233**	576	**576**	518	**518**
2003	15382	**15382**				
2004	15551	**15551**				
2005	19972	**19972**				
2006	22205	**22205**	1745	**1745**	1496	**1496**
2010	31088	**31088**	2081	**2081**	2084	**2084**
2011	32615	**32615**	2170	**2170**	2284	**2284**
2012	29496	**29496**	1974	**1974**	2323	**2323**

*empty cell indicate no data were yet available, missing years means no data.

7- Isa Town - Hammad Town

Hammad Town is new cities therefore the available data is from 1990 as it shown in Table 3.20. The average annual growth rate from year 1980 to year 2012 between Isa Town and Hammad Town is high which 22%; the reason is to cover the needs of the residents since the facilities in Hammad Town was very limited.

Table 3.20: Total Daily Traffic, am Peak and pm Peak between Isa Town and Hammad Town

	Total Daily Traffic		am Peak Hour		pm Peak Hour	
Site No. / Years	26	Total	26	Total	26	Total
1990	8400	**8400**				
1994	12267	**12267**				
1995	13312	**13312**				
1996	12546	**12546**				
1997	15141	**15141**	1640	**1640**	1183	**1183**
1998	14260	**14260**				
1999	14125	**14125**	1216	**1216**	1042	**1042**
2003	24945	**24945**				
2004	24640	**24640**				
2005	47017	**47017**				
2006	33862	**33862**	2193	**2193**	2728	**2728**
2010	57768	**57768**	5525	**5525**	3924	**3924**
2011	59250	**59250**	5034	**5034**	3679	**3679**
2012	64189	**64189**	5971	**5971**	4927	**4927**

*empty cell indicate no data were yet available, missing years means no data.

8- Riffa - Hammad Town

The average annual growth rate from year 1980 to year 2012 is 19% between Riffa and Hammad Town as it shown in Table 3.21, it is gradually increasing due to the new housing project in the area which will increase the population, and therefore the number of vehicles will rise.

Table 3.21: Total Daily Traffic, am Peak and pm Peak between Riffa and Hammad Town

	Total Daily Traffic			am Peak Hour			pm Peak Hour		
Site No. / Years	30	56	Total	30	56	Total	30	56	Total
1988		7250	**7250**						
1990		11100	**11100**						
1991		10731	**10731**						
1995	1276	14156	**15432**						
1996	1592	13759	**15351**						
1997	1843	13100	**14943**	137	820	**957**	131	867	**998**
1998	1510	14860	**16370**						
1999	2380	13364	**15744**	293	629	**922**	164	708	**872**
2003	7979	24627	**32606**						
2004	7852	22018	**29870**						
2005	11061	32189	**43250**						
2006	9287	27088	**36375**	907	2499	**3406**	645	1691	**2336**
2010	5269	43837	**49106**	337	3280	**3617**	404	2957	**3361**
2011	5150	51815	**56965**	493	4533	**5026**	400	4126	**4526**
2012	5873	44229	**50102**	582	3461	**4043**	428	3571	**3999**

*empty cell indicate no data were yet available, missing years means no data.

9- Hammad Town - King Fahad Causeway

Hammad Town is nearest city to King Fahad Causeway, the traffic movement between Hammad Town and King Fahad Causeway is increasing due to the increase in number of vehicles arriving and departing King Fahad Causeway as it shown in Table 3.22. The average annual growth rate is 12% from year 1980 to year 2012.

Table 3.22: Total Daily Traffic, am Peak and pm Peak between Hammad Town and King Fahad Causeway

	Total Daily Traffic		am Peak Hour		pm Peak Hour	
Site No. / Years	39	Total	39	Total	39	Total
1980	6634	**6634**				
1986	10000	**10000**				
1988	6450	**6450**				
1990	11100	**11100**				
1992	4789	**4789**				
1993	7529	**7529**	854	**854**	535	**535**
1995	6060	**6060**				
1996	6832	**6832**				
1997	5928	**5928**	726	**726**	350	**350**
1998	6349	**6349**				
1999	9402	**9402**	729	**729**	636	**636**
2003	17152	**17152**				
2004	19224	**19224**				
2005	32189	**32189**				
2006	19392	**19392**	1480		1481	**1481**
2010	11807	**11807**	1050	**1050**	666	**666**
2011	10719	**10719**	912	**912**	644	**644**
2012	12336	**12336**	935	**935**	775	**775**

*empty cell indicate no data were yet available, missing years means no data.

10- Buddaya - King Fahad Causeway

The average annual growth rate from year 1980 to year 2012 is 21% between Buddaya and to King Fahad Causeway, it is high and it is increasing gradually every year as it shown in Table 3.23. New highways opened to link the cities and to minimize the traffic jam.

Table 3.23: Total Daily Traffic, am Peak and pm Peak between Buddaya and King Fahad Causeway

	Total Daily Traffic			am Peak Hour			pm Peak Hour		
Site No. / Years	42	75	Total	42	75	Total	42	75	Total
1980	3630		**3630**						
1984	2550		**2550**						
1988	3550		**3550**						
1990	4300		**4300**						
1991	4646		**4646**						
1992	5191		**5191**						
1994	7105		**7105**						
1995	7575		**7575**						
1996	7648		**7648**						
1997	7799		**7799**	419		**419**	613		**613**
1998	8570		**8570**						
1999	8465		**8465**	473		**473**	670		**670**
2003	14805		**14805**						
2004	16758		**16758**						
2005	20168		**20168**						
2006	14585		**14585**	901		**901**	1276		**1276**
2010	40703		**40703**	2296		**2296**	3005		**3005**
2011	18134		**18134**	1159		**1159**	1488		**1488**
2012	20064	10188	**30252**	1257	643	**1900**	1548	943	**2491**

*empty cell indicate no data were yet available, missing years means no data.

Growth Rates of Vehicles between Cities

Table 3.24 present the summary of the average annual growth rates between all cities and attractive areas.

Table 3.24: Summary of Average Annual Growth Rates between Cities

NO.	Cities		Average Annual Growth Rate
1	Manama	Muharraq	6.07%
2	Manama	Sittra	8.11%
3	Manama	Isa Town	16.26%
4	Manama	Buddaya	7.28%
5	Isa Town	Riffa	9.21%
6	Isa Town	King Fahad Causeway	14.24%
7	Isa Town	Hammad Town	21.73%
8	Riffa	Hammad Town	18.76%
9	Hammad Town	King Fahad Causeway	12.46%
10	Buddaya	King Fahad Causeway	20.93%

3.3 Management and Operation Related Data

3.3.1 Questionnaire

Public opinion and the way that the people react towards the Mass Transit System play an important role in proposing a successful system. This will also insure that the system will provide the optimum service for the people and can it attract them passivity.

For these reason a questionnaire have been specially designed to serve the goals. Arabic and English versions of the questionnaire are presented in Appendix (3).

Around 160 person of the public were targeted to fill in the questionnaires. It is distributed on shopping malls such as "City Center" and "Lulu hyper super market",furthermore, itspread in the Sooq Bukoarah and to some of the students at the University of Bahrain and at Arab Open University. The Microsoft Office Excel was using to collect the data, but the most analysis have been done in SPSS, which analysis all the data, categorize them, present them in different way like simple tables, pie charts and Cross tabulation.

The first part of the questionnaire covers personal information such as age, sex, nationality, living area, monthly income and occupation. The second part covers, working hours, ticketing price and the validity of the ticket for the proposed Mass Transit System.

Questionnaire Analysis

Sex Type:

Over fifty percent of the respondents were masculine (Figure 3.22). The presences of women in the local population were significant. This is due to relative early girl education in Bahrain compared to other countries in the area. The designer of transport system should study the general requirement of women and particular requirement of local women according to local culture and tradition. These requirements vary. It could be security especially during night time or privacy due to the culture and so on. These considerations would be success factor in designing a sustainable transport system.

Sex	Frequency	Percentage
Male	81	53.6
Female	70	46.4
Total	151	100.0

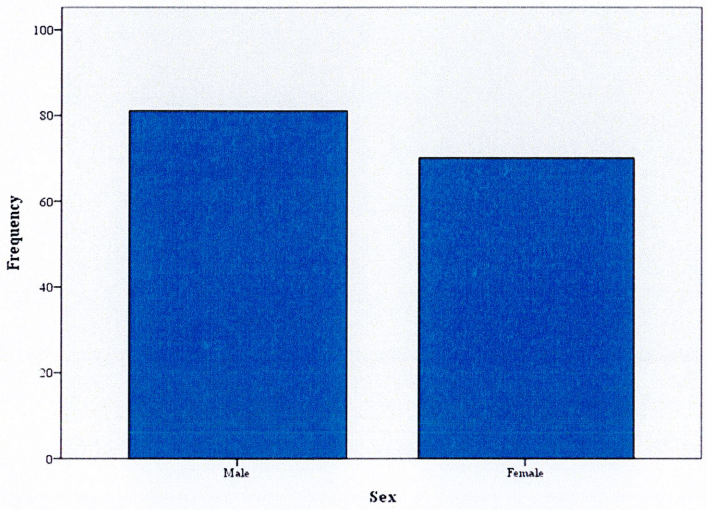


Figure 3.22: Analysis of respondents by sex type

Age:

The first age group in the sample that 33% of the respondents are from this age group is (24-40 years) and second highest percentage is 27% in the group of (41-50 years), (Figure 3.23). The proposed sustainable transport system should satisfy the user needs. At different ages the personal requirements, appearance and the social status, which are important for the local society, should be taken into consideration to prevent the failure of the proposed system.

Categorized Age	Frequency	Percent
0-18 years	3	2.0
19-23 years	34	22.5
24-40 years	50	33.1
41-50 years	41	27.2
51-60 years	19	12.6
60 years & more	4	2.6
Total	151	100.0

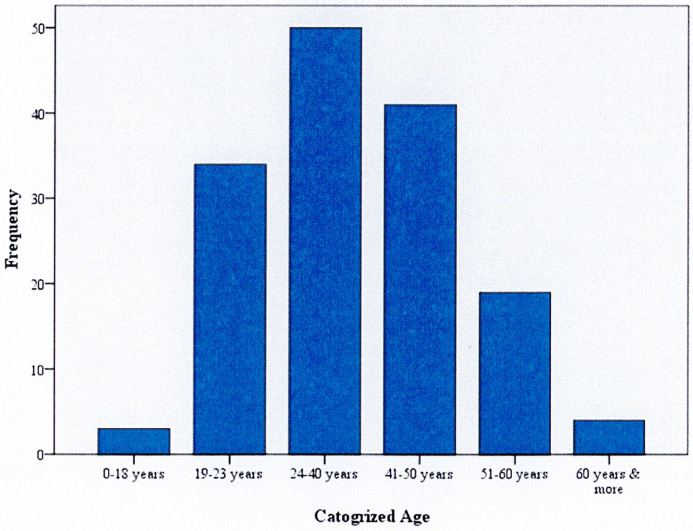


Figure 3.23: Analysis of respondents by age classification

RespondentNationality:

Bahrainis consisted around 48 percent of the respond nationality (Figure 3.24). The Saudi in Bahrain consisted of the next highest respondents around 34% either they are residents or tourists therefore their opinions should be considered. Careful attention should be considered the need of the proposed sustainable transport system; it should satisfy the user needs. It is expected that lots of Saudi people will be significant users for the mass transit system.

Nationality	Frequency	Percent
Saudi	51	33.8
Bahraini	72	47.7
Other Gulf	9	6.0
Other Arab	8	5.3
Asians	10	6.6
African	1	.7
Total	151	100.0

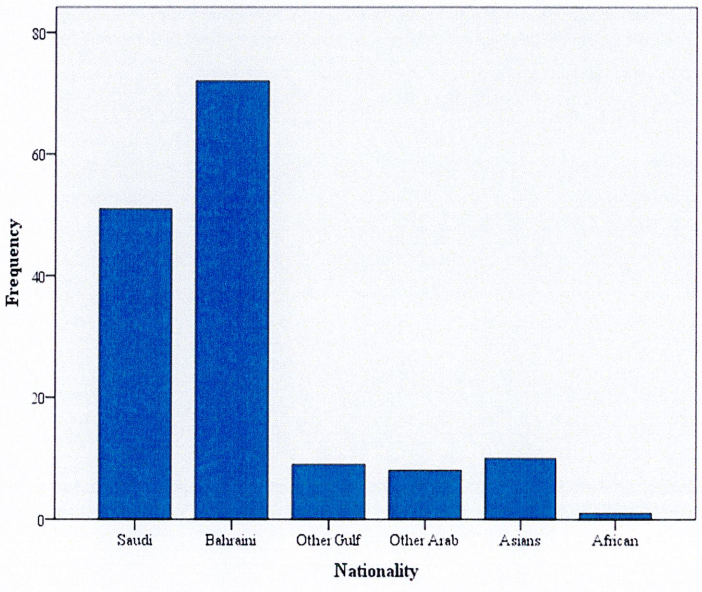


Figure 3.24: Analysis of respondents by nationality

Respondents Occupation:

Figure 3.25presents the distribution of the occupation of the respondents according to the classification shown in the questionnaire. Most of the replies came from other than listed occupations with 20.5% followed by education sector with 17.9%, then accountant and financial affairs sector with 16.5%.

Occupation	Frequency	Percent
Doctor	4	2.6
Engineer	10	6.6
Lawyer	1	.7
Accountant/Financial	18	11.9
Marketing	10	6.6
Teacher/Researcher	15	9.9
Student	27	17.9
Technician	9	6.0
Driver	2	1.3
Own Business	6	4.0
Other	31	20.5
Refined	8	5.3
Housewife	10	6.6
Total	151	100.0

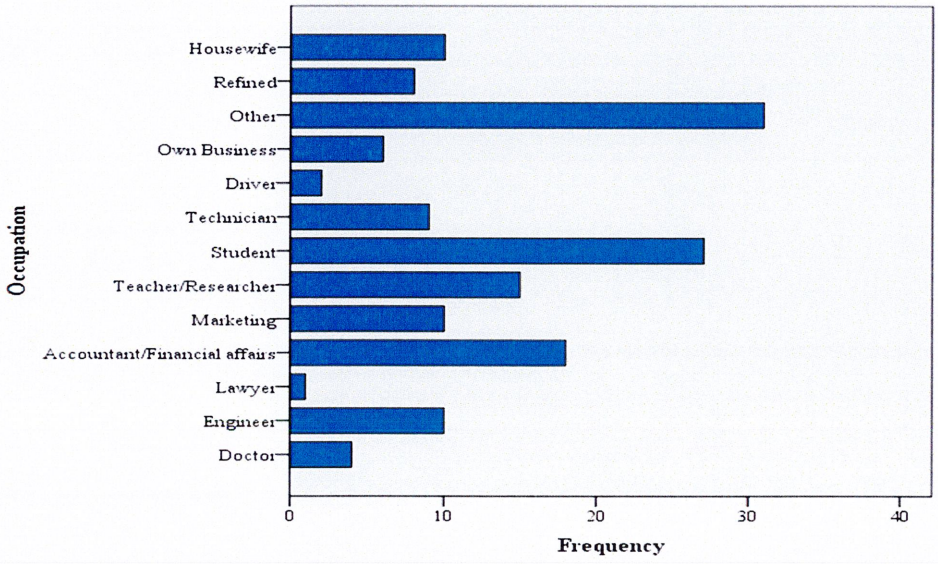


Figure 3.25: Analysis of respondents by respondents' occupation

Respondent Classified as per Driving License:

The majority of the sampled population owns a driving license (Figure 3.26). This quite acceptable since more than 60% of respondent were 21 years and more. The results highlight the strong dependence on private cars as a major mean of mobility. The majority of people depend on their own private cars due to the lack of suitable transport throughout the past years.

Driving License	Frequency	Percent
Yes	117	77.5
No	34	22.5
Total	151	100.0

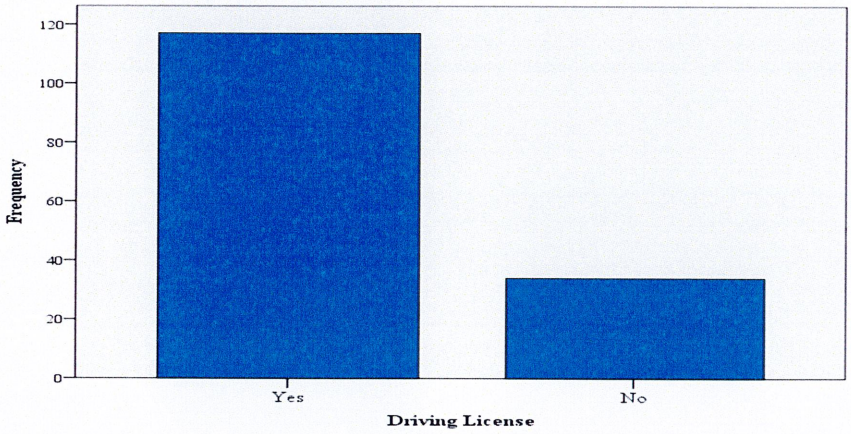


Figure 3.26: Analysis of respondents by driving license

Respondents' Car Ownership:

More than 75 percent of the respondents own a car (Figure 3.27). This finding reinforces the previous one. On the event of introducing a transport system, the target users would perceive the situation as giving up their cars. Unfortunately, the current culture seems not supportive of public transport.

Own Car	Frequency	Percent
Yes	115	76.2
No	36	23.8
Total	151	100.0

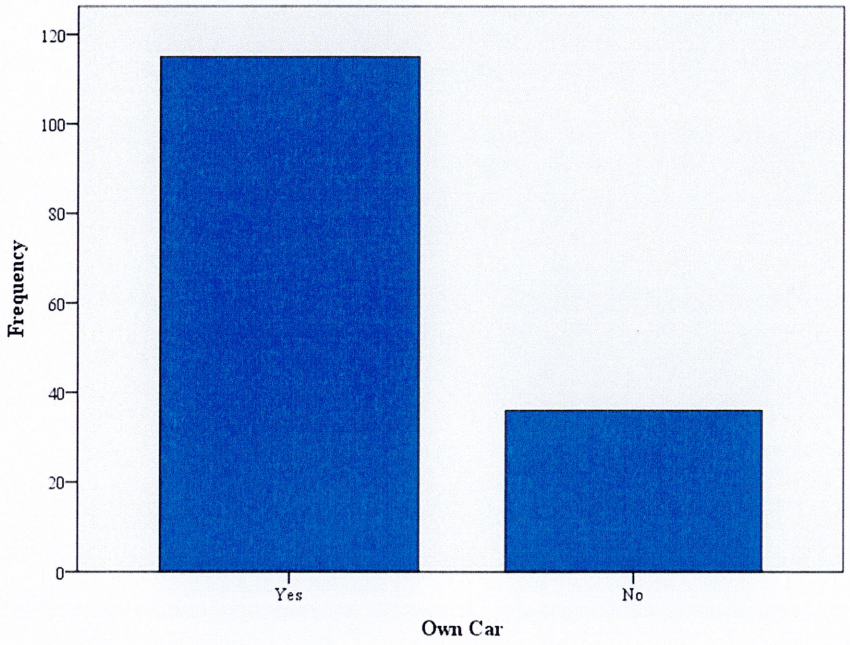


Figure 3.27: Analysis of respondents by car ownership

Respondents Level of Education:

More than 65 present of the Respondents were university graduates (Figure 3.28). Around 25 percent of the respondents were secondary school. The intended transport system should target the well-educated users since they are distinguishing the importance and advantages of the mass transit system.

Level of Education	Frequency	Percent
Illiterate	1	.7
Primary	4	2.6
Secondary	37	24.5
Graduate	100	66.2
Postgraduate	9	6.0
Total	151	100.0

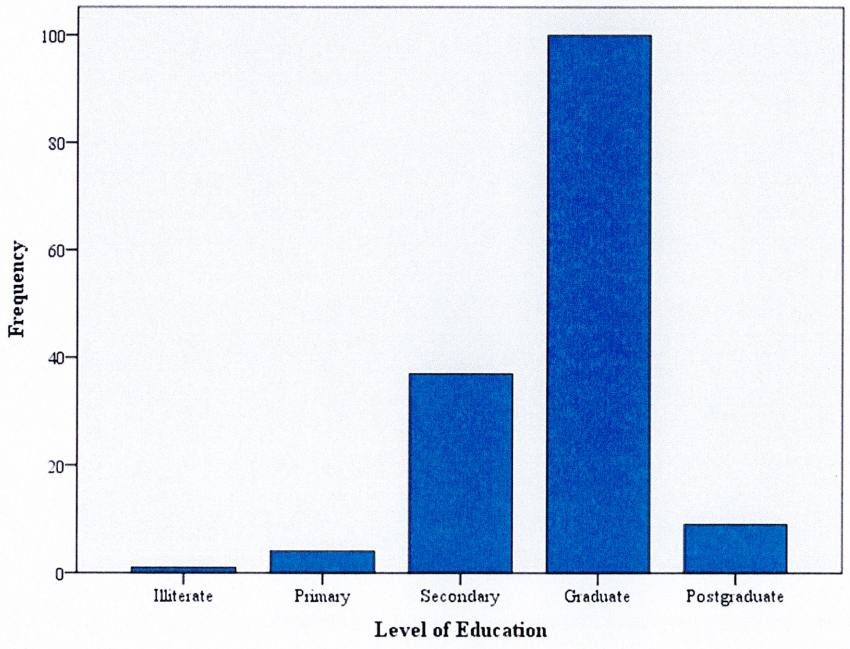


Figure 3.28: Analysis of respondents by level of education

Respondents' Monthly Income:

Most frequent of monthly income ranged from 500 to 750 BhD. This quite reasonable since large number of the respondents are university graduates students (Figure 3.29).

Respondents monthly income(BhD)	Frequency	Percent
0-300	24	15.9
300-800	54	35.8
800-1500	17	11.3
1500-2500	31	20.5
above 2500	25	16.6
Total	151	100.0

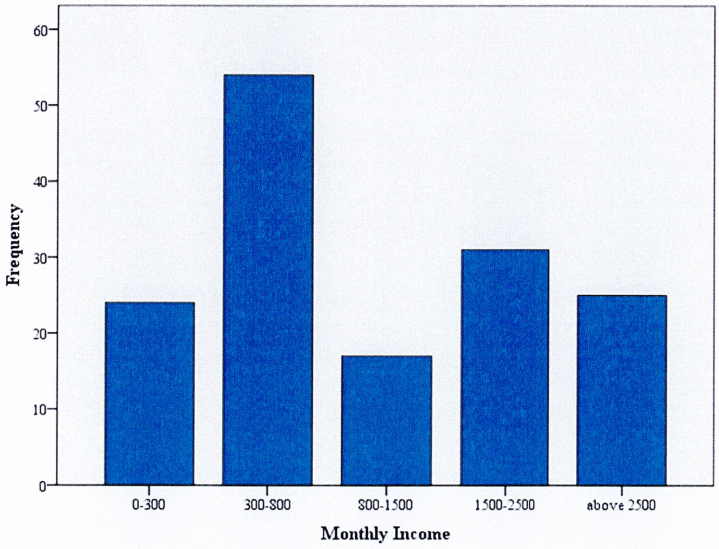


Figure 3.29: Analysis of respondentsas their monthly income

Respondents Living Area:

Most of the respondents were from the Muharaq and the Southern districts (Figure 3.30). The distribution of population is a very important criterion which indicates the most suitable transit system, since the population capacity controls the efficient type, the higher population the larger the capacity requirement of the system.

Living Area	Frequency	Percent
Capital	9	10.2
Northern	16	18.2
Southern	22	25.0
Muharraq	29	33.0
Middle	12	13.6
Total	88	100.0

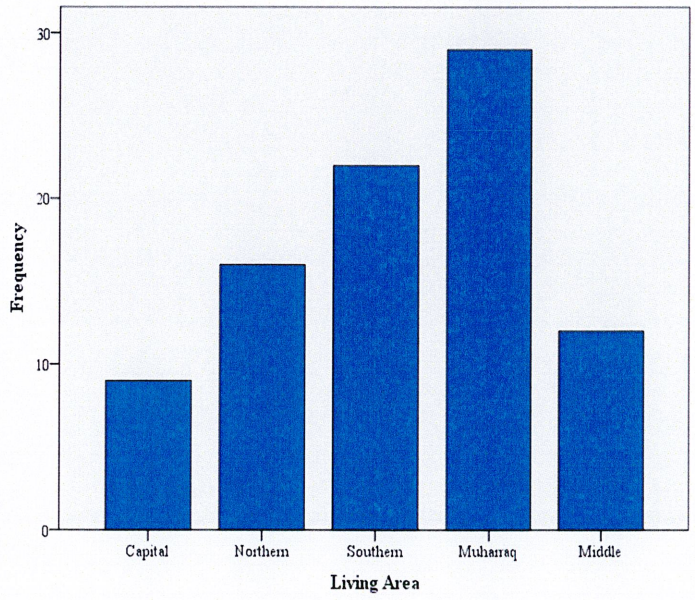


Figure 3.30: Analysis of respondents by living area

Number of Cars per House Hold:

Around 26% of the respondents have two cars in their houses, 18% have three cars, 14% have four and 19% have five or more cars (Figure 3.31). Nevertheless, around one-third of the respondents have one or two cars at home. The results again confirm the complete dependents on the personal car as a mode of transport. In other words, the result confirms being a car oriented societies.

NO. of Cars	Frequency	Percent
No car	9	6.0
1	25	16.8
2	39	26.2
3	27	18.1
4	21	14.1
5 & more	28	18.8
Total	149	100.0

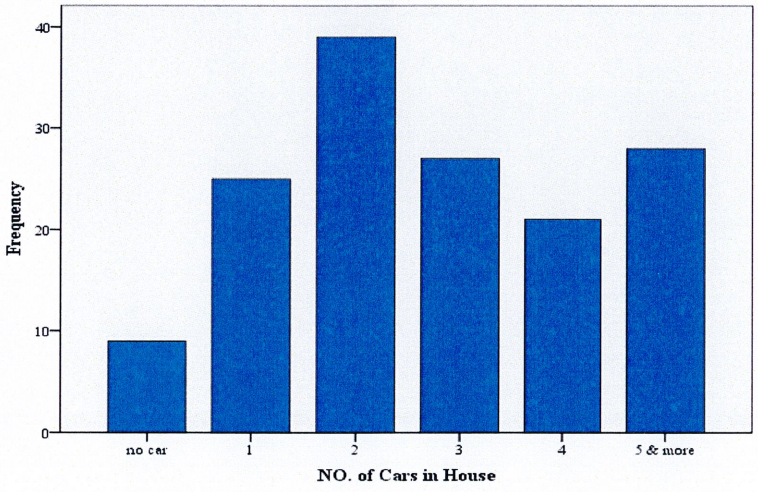


Figure 3.31:Analysis of respondents by number of cars in the house

Preferred Operating Hours for the Public Transport System:

More than 55% of the respondents prefer to have a system which operates 24hours a day. On the other hand, just over one-third prefer to have the system working from 5am to 12 mid night. Further studied should be considered to arrive to the best working hours which satisfy the people needs most and economical investment (Figure 3.32). In the time being, operation period of 5 am to 12 mid-night satisfies about 45% of the respondents. While starting time at 5 am is very close to the current time; end time is far more than that currently operating. Mass Transit System has their systems closed late night when the users are very limited.

Operating Hours of Public Transportation	Frequency	Percent
4am-6pm	13	8.6
6am-8pm	18	11.9
5am-12mid-night	36	23.8
24 hours	84	55.6
Total	151	100.0

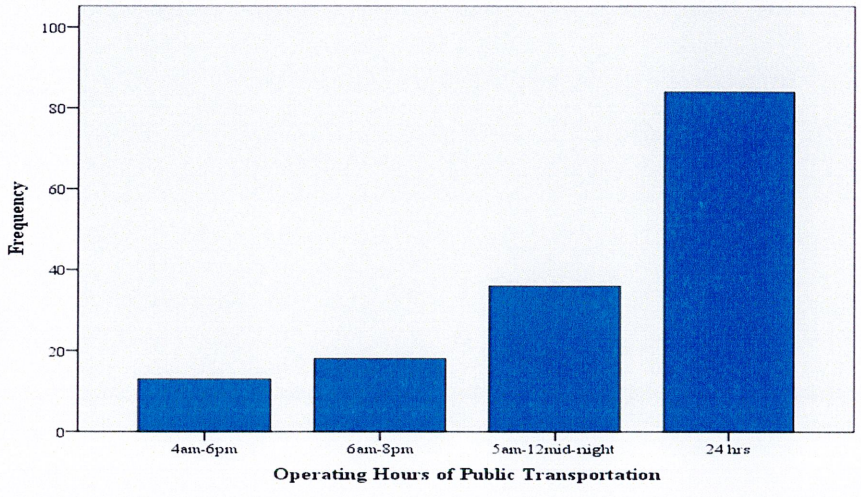


Figure 3.32: Analysis of respondents by preferred operating hours

Ticket Pricing System:

Around 40% of respondents prefer a fixed ticket price and around 60% prefer distance depend price system (Figure 3.33).

Ticket Pricing System	Frequency	Percent
Fixed price	62	41.1
Varying price to distance	89	58.9
Total	151	100.0

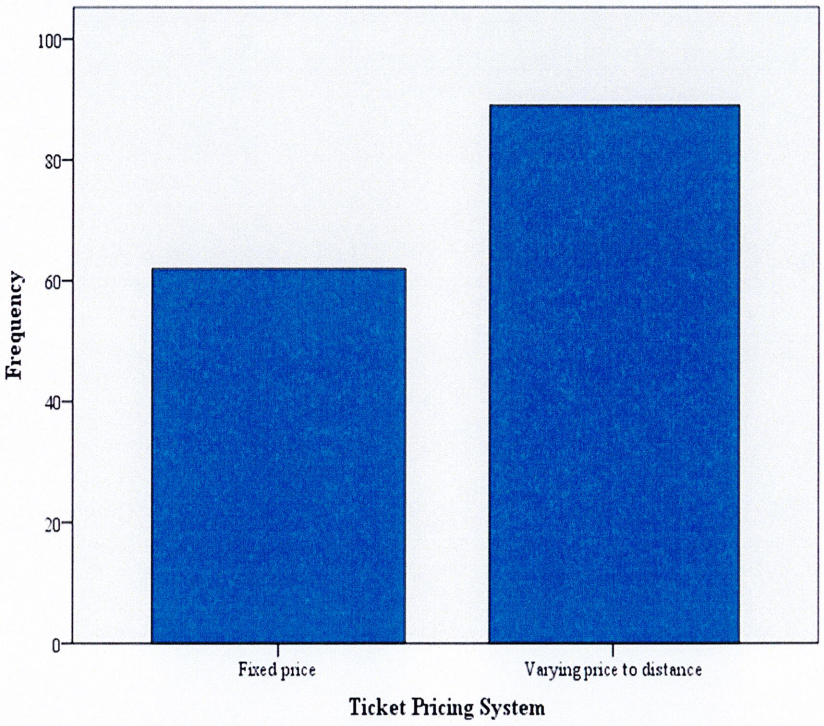


Figure 3.33: Analysis of respondentsby ticket pricing system

Ticket Validity Period for any Number of Trips:

55% of the respondents find that the validity of tickets of any number of trips to be for two hours. The second highest percentage of the respondents wants the ticket to be valid for only one entry which is 37% (Figure 3.34).

Validity of Tickets of any number of trips	Frequency	Percent
2 hours	83	55.0
1 hour	9	6.0
30 min.	1	.7
15 min.	2	1.3
One entry use	56	37.1
Total	151	100.0

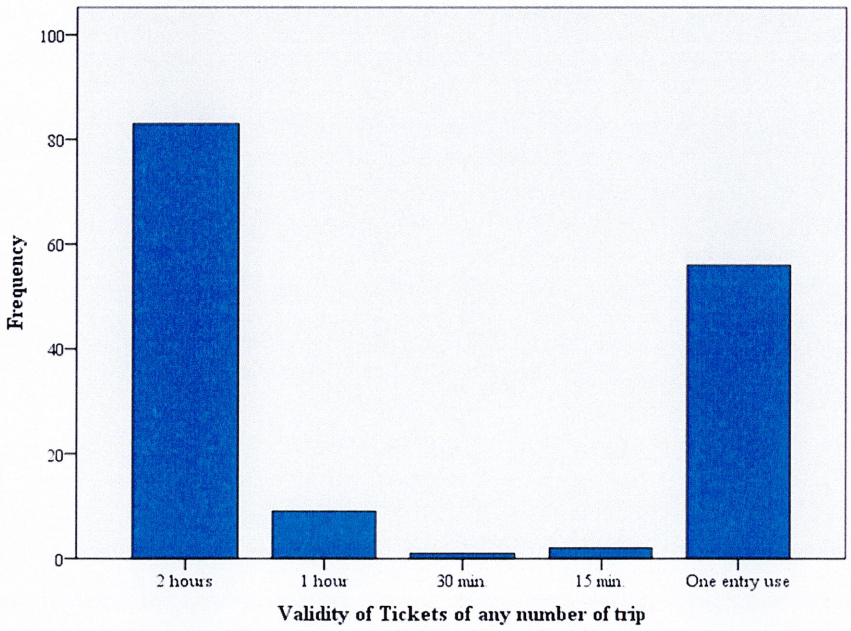


Figure 3.34: Analysis of respondents by Validity of tickets of any number of trips

Probability of Using Public Transportation System According to the Ticket Fare:

As shown in Figure 3.35,35% of the respondents have the tendency to use the public transport system all the time if the ticket price is 500 fils, while 30% of the respondents have the tendency to use the system all the time if the ticket price is 750 fils as can be seen from Figure 3.36.However, 27% of the respondents have the tendency to use the system for half of their daily trips if the ticket fare is 500 fils, while 26% of the respondents have the tendency it if the ticket price is 750 fils.

If the ticket price is 500 fils	Frequency	Percent
Using all the time	53	35.1
Using it 50%of the time	41	27.2
Using it 25%of the time	17	11.3
Using it for work only	19	12.6
Not using at all	21	13.9
Total	151	100.0

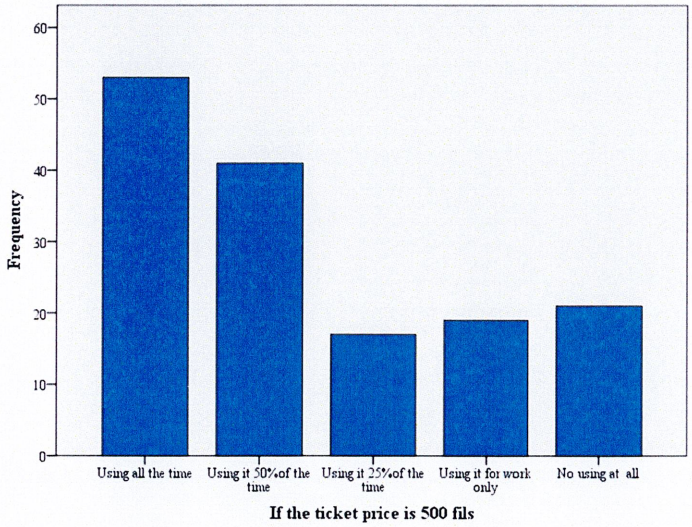


Figure 3.35: Probability of using the system if the ticket price is 500fils

If the ticket price is 750 fils	Frequency	Percent
Using all the time	45	29.8
Using it 50%of the time	39	25.8
Using it 25%of the time	20	13.2
Using it for work only	21	13.9
Not using at all	26	17.2
Total	151	100.0

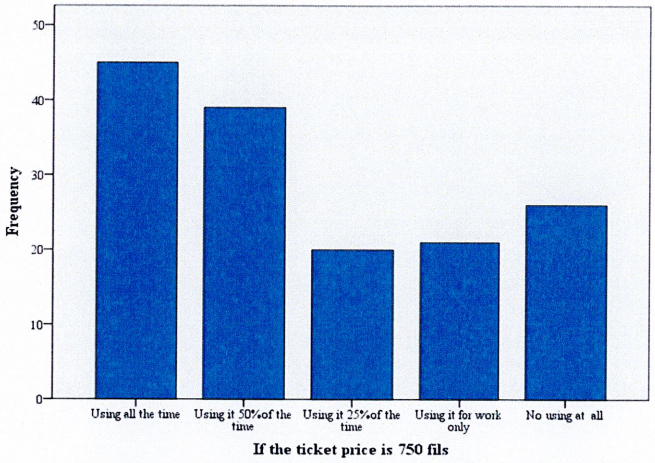


Figure 3.36: Probability of using the system if the ticket price is 750 fils

On the other hand, over half of the respondents will not be using the system at all if the ticket price per trip is one dinar as shown inFigure 3.37; yet 71% of the respondents will not be using the system at all if the ticket price is 1.5 dinar per trip (Figure 3.38).

This may create economical deficiencies. Very low fares will lead to uneconomical system, and relatively high fares may not attract sufficient users, consequently leads to failure of the system.

The results show that the people have the desire to use other means of transport if they are ideal. Further guidance to the people may change their idea and behavior toward using the mass transit system.

If the ticket price is 1 BD	Frequency	Percent
Using all the time	36	23.8
Using it 50%of the time	28	18.5
Using it 25%of the time	15	9.9
Using it for work only	20	13.2
Not using at all	52	34.4
Total	151	100.0

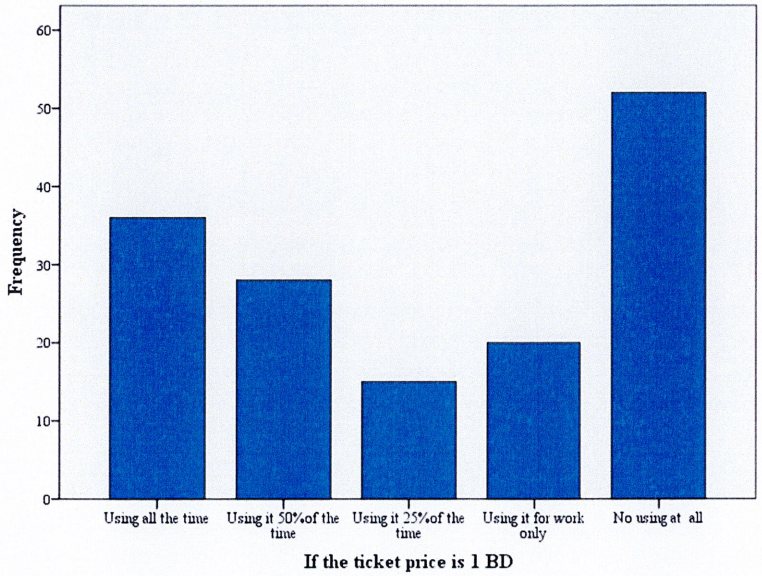


Figure 3.37: Probability of using the system if the ticket price is 1 BD

If the ticket price is 1.5 BD	Frequency	Percent
Using all the time	26	17.3
Using it 50%of the time	21	14.0
Using it 25%of the time	15	10.0
Using it for work only	17	11.3
No using at all	71	47.3
Total	150	100.0

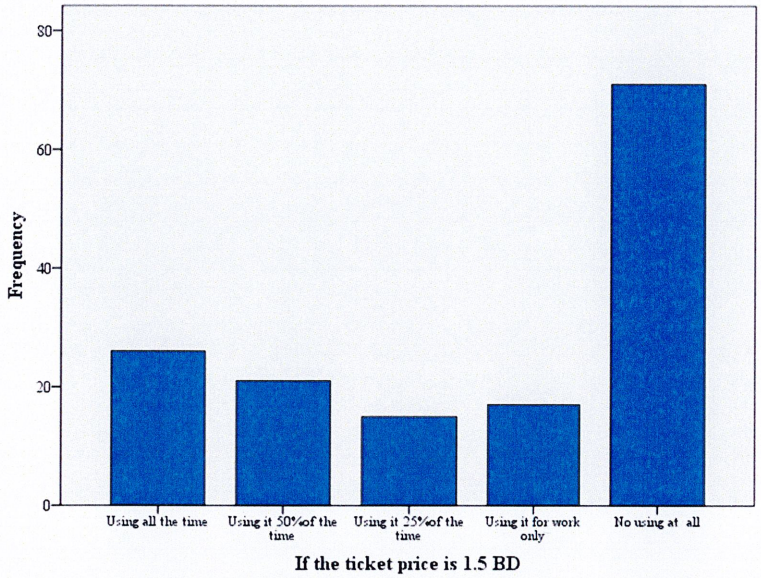


Figure 3.38: Probability of using the system if the ticket price is 1.5 BD

Concluding Remarks:

From the earlier analysis, one may conclude summarize as the following:

Working hours:

It looks that the most suitable operating hours is from 5am to 12 mid night, since it suite just under half of the users. Further studies should be considered to arrive to the best working hours which satisfy the people needs and economical requirements. In the time being, the above mentioned operating times will be used for this study.

Ticketing system:

The validity of tickets, for any number of trips, of two hours looks the most suitable for the system; since over 55% of the respondents will be satisfied, which means that the ticket could be used for round trips.

Ticket fare:

The ticket price of 500 fils and 750 fils are the most suitable fare rate to use for the system. Since most of the respondents find them acceptable for the current condition. However, one may keep the inflation rate for their suitability in the future.

3.3.2 Capacity and speed of the various modes of transport

The capacity and speed of each system will vary according to its type. Table 3.25 represent the capacity and speed of the mass transit system.

Table 3.25: Transit modes and its capacity and speed [7]

Type of mass transit system	Vehicle capacity	System capacity/day	Average speed
Suburban rail	< 800	16000-32000	40-60
Metro (rapid rail)	< 600	18000-36000	30-60
Light rail	150-250	8000-15000	25-35
Tram	100-200	4000-8000	15-20
Bus way	75-200	8000-15000	20-50
Bus lane	75-200	6000-12000	20-30
Local bus	75-150	4000-7000	15-20

CHAPTER 4

Results and Discussion: Future Prediction of Public Transport Growth

4.1 Introduction

4.2 Target Years

4.3 Future Prediction

4.4 Mode Choice Shift

CHAPTER 4

4. Results and Discussion: Future Prediction of Public Transport Growth

4.1 Introduction

From the previous data discussed in Chapter 3, the increase in population of Bahrain leads to an increase in housing units, educated and employed people. That increase mode leads to an increase in the private car ownership therefore increasing fuel consumption. All these development have a direct effect rising up the number of vehicle which will have an enormous environmental effect, as well it will generate a massive rising on the traffic, therefore, it is necessary to study the future prediction of the data and then base our calculation and estimation according to the result.

4.2 Target Years

As the 2030 vision is very popular here, the target year to predict the various needs for the Mass Transit System will be considered here. The base year to install and run the system is considered to be year 2017 to provide sufficient time to study and design the system.

4.3 Future Prediction

It is significant to base the study on the future prediction for the earlier data gathered, to follow and satisfy the various needs for the Mass Transit System in year 2030. The predicted data includes population, housing development, fuel consumption, vehicle population, arriving vehicles from King Fahad Causeway and public and private buses.

- ***Future Prediction of Population***

As it mention in chapter 3, the population trends are rapidly increasing, it will exceed 2 million by year 2030 as it shown in Figure 4.1. Increasing in population has a significant effect on the number of vehicles, thus will create more traffic jam.

The prediction can be explained by the following model:

Predicted Population = $4.22E\text{-}27 * e^{0.0370}$

Where x is the year of estimate, as 2030.

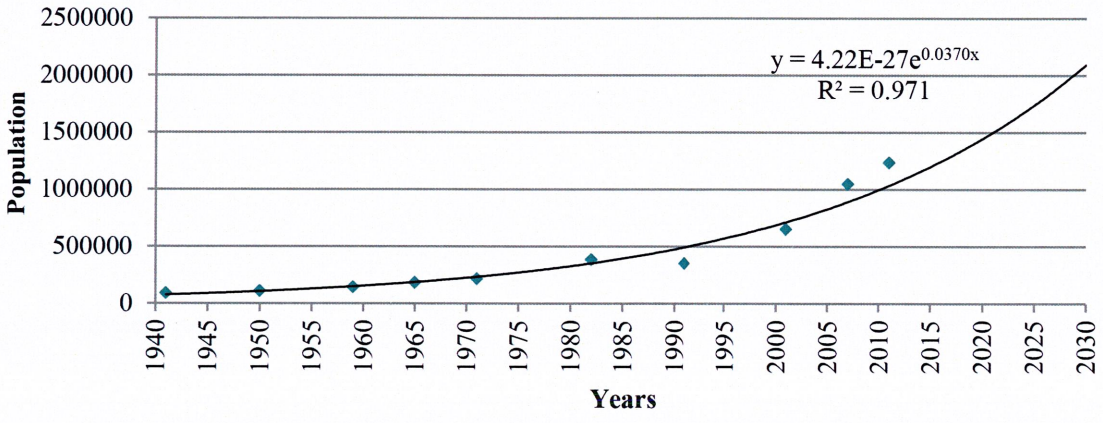


Figure 4.1: Future Prediction of Population for Bahrain as whole

- ***Future Development of Housing Units***

The housing units definitely will increase since the population is increasing; it will exceed 350,000 units by the year 2030 as shown in Figure 4.2 and explained be the developed exponential model. From the analysis of the questionnaire in chapter 3, (Figure 3.31), around 26% of the respondents' families own two cars or more and 19% have five or more cars. Such expansion will also increase by year 2030. It will create enormous negative influence on the road networking since it will not be growing at the same rate.

The prediction can be explained by the following model:

Predicted Housing Units = $6.57E\text{-}31 * e^{0.0405x}$

Where x is the year of estimate, as 2030.

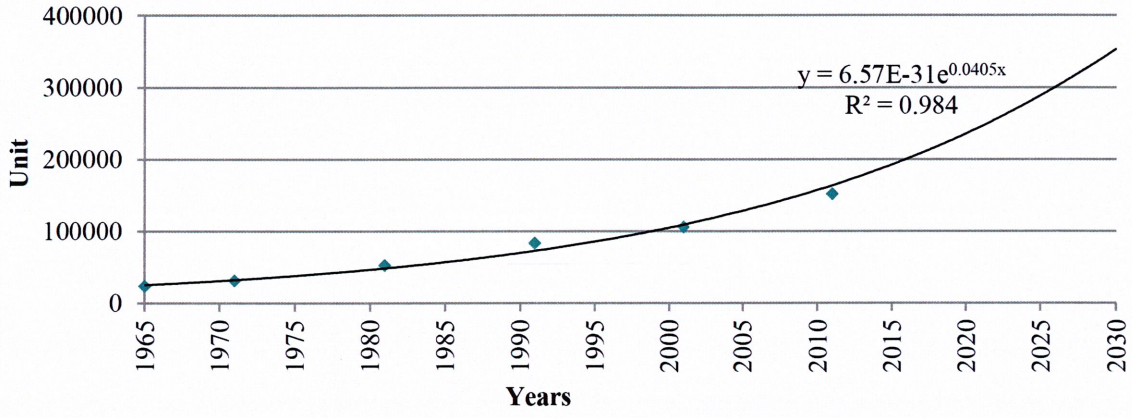


Figure 4.2: Future Development of Housing Units

- ***Future Prediction of Fuel Consumption***

The fuel consumption has a significant negative effect on the environment. The air and sound quality will surly deteriorate. The consumption of the fuel will reach 4,000,000 BBL by the year 2030 as shown in Figure 4.3. Partial shift towards the use of mass transit system will relatively control the consumption of the fuel gradually, with the time.

The prediction can be explained by the following model:

Predicted Fuel Consumption = $9.22E\text{-}59 * e^{0.071x}$

Where x is the year of estimate, as 2030.

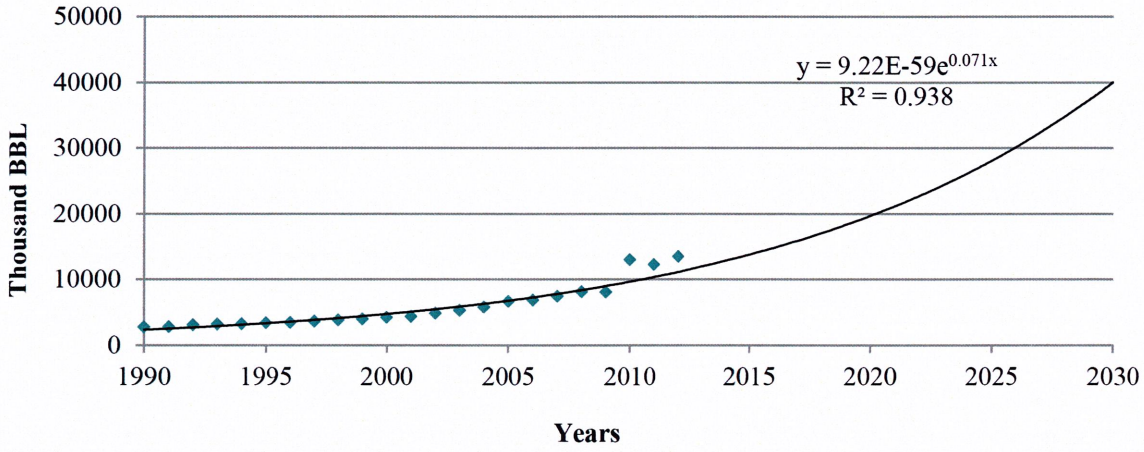


Figure 4.3: Future Prediction of Fuel Consumption (in thousand BBL = 156 litters)

- ***Vehicles Entering Bahrain through King Fahad Causeway***

Figure 4.4 present future prediction of yearly arriving vehicles through King Fahad Causeway, the number of vehicles will exceed 25 million by the year 2030, which will put more effect on the road.

The prediction can be explained by the following model:

Predicted Vehicles Entering Bahrain through KFC = $5.48E\text{-}83e^{0.102x}$

Where x is the year of estimate, as 2030.

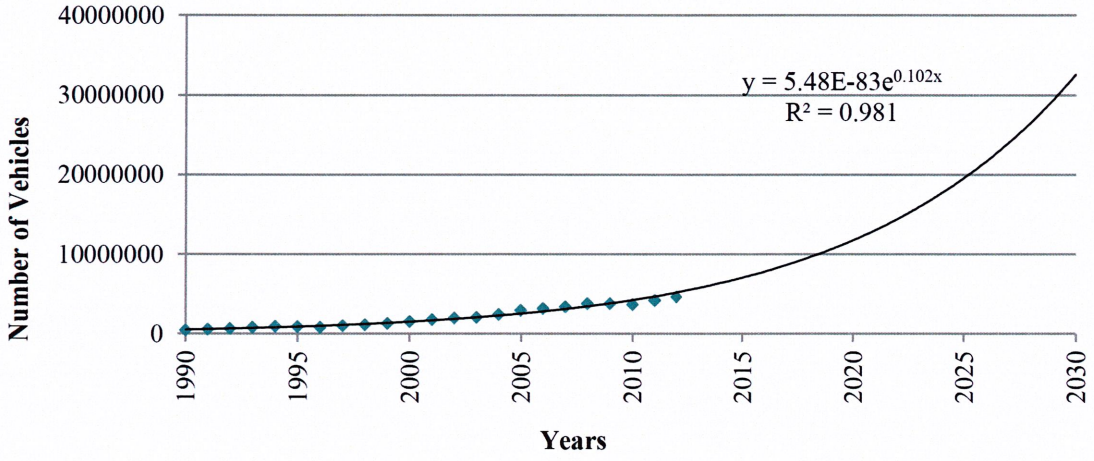


Figure 4.4: Vehicles Entering Bahrain through King Fahad Causeway

- ***Future Prediction of Vehicle Population***

The vehicle population is 500,000 in year 2012 as can been seen from Figure 4.5. The future prediction of total number of registered vehicles will exceed 1.5 million vehicles by year 2030 if no proper action is taken towards singular cars to more sustainable Mass Transit System, which is three times more than the current vehicle population. This figure is Continuous increase in number of vehicles has a significant negative effect on the road network and indicates the demand on transportation.

The prediction can be explained by the following model:

Predicted Vehicle Population = $8.29E\text{-}51e^{0.0638x}$

Where x is the year of estimate, as 2030.

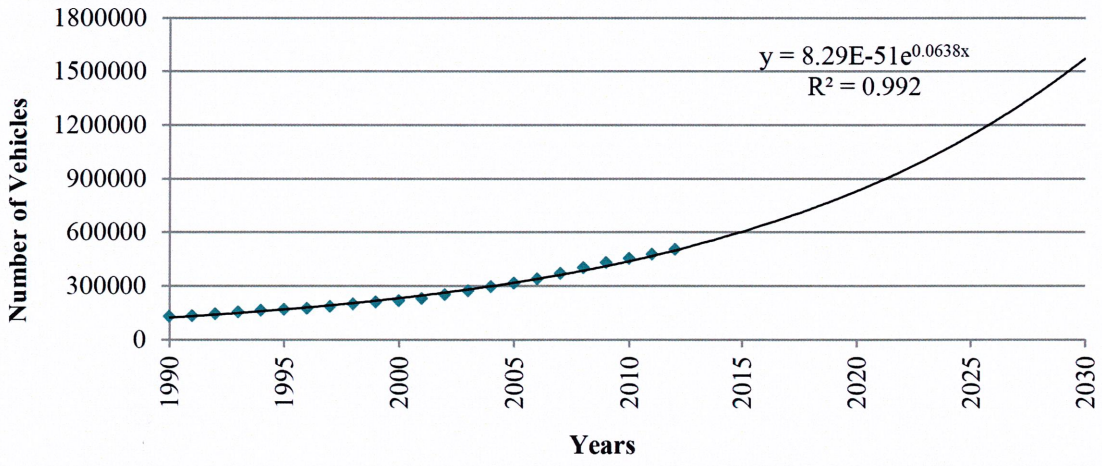


Figure 4.5: Future Prediction of Vehicles Population

- ***Future Prediction of Private Buses***

The private buses showed continuous increase. It is expected to reach 22,000 buses by year 2030, as shown in Figure 4.6. This is more than double of the current value. This designates the necessity of the Mass Transit System.

The prediction can be explained by the following model:

Predicted Private Bus = $4.162E\text{-}41 * e^{0.0507x}$

Where x is the year of estimate, as 2030.

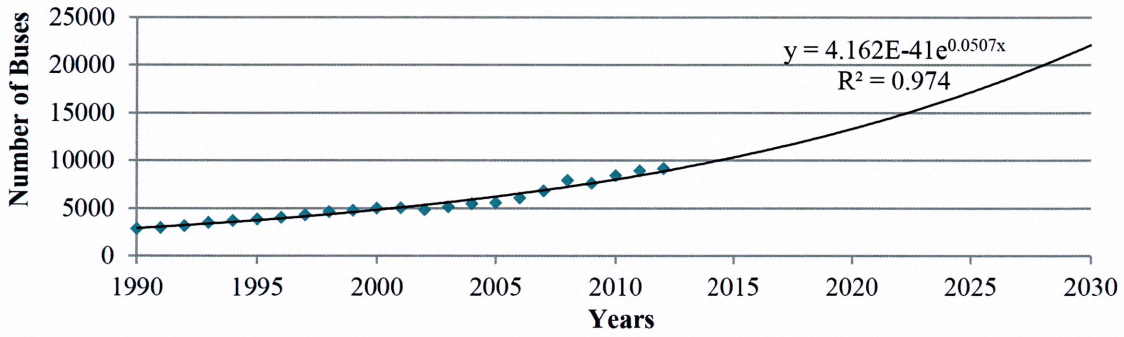


Figure 4.6: Future Prediction of Private Buses

- ***Future Prediction of Public Buses***

On the other hand, the number of public buses showed a rapid decreasing trend. It will drop to 95 buses by year 2030. Such a drop will affect the road network since public buses will diminish with the time according to the historical bus data.

The prediction can be explained by the following model:

Predicted Public Bus = 1.094E+15*e-0.015x

Where x is the year of estimate, as 2030.

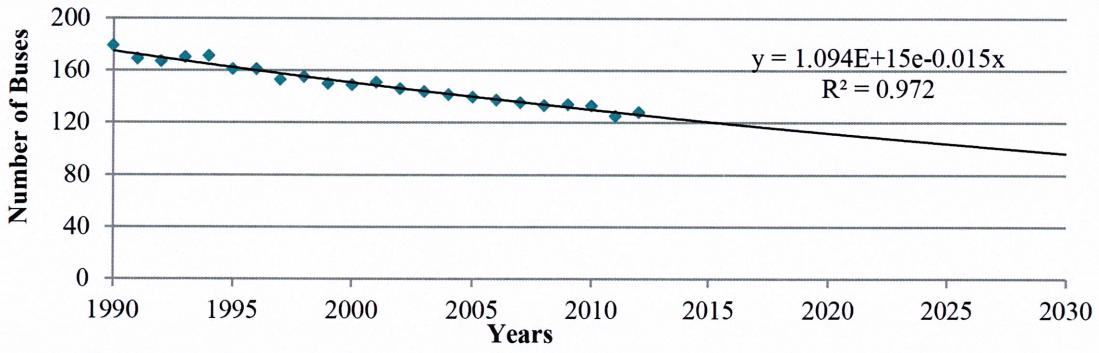


Figure 4.7: Future Prediction of Public Buses

4.4 Mode Choice Shift

Almost all the developed countries work on controlling the vehicles growth through provision of other transport modes; so as to encourage auto-users to transfer to other Mass Transit Systems.

London population is more than 2.5 million and 43% of the trips are public transport based, while the population in Sylvia is less than a million and 25% of the trips are public transportation.

Accordingly, Bahrain population is over a million, therefore the percentage rate of the Mass Transit System should not be lesser than 18%; preferable should be greater to meet future needs. According to similar countries the range is 18% to 35% [7]. Therefore three scenarios will be assumed for controlling future vehicles growth through 1.5%, 2% and 2.5% annual shift. As for the first scenario this means that each year, starting from a base year as 2017, 1.5% out-users will shift towards public transport. By the year 2030, the total shift of the passenger car users will reach 20% toward more sustainable Mass Transit System. Such gradual shift for the three scenarios can be seen from Figure 4.8 to Figure 4.10. Similarly, the earlier three scenarios are applied on vehicle population, arriving through King Fahad Causeway and for the private bus users.

The developed models are as follows:

1. $X = Y * (1 - 0.015)^n$
2. $X = Y * (1 - 0.02)^n$
3. $X = Y * (1 - 0.025)^n$

Where,

X is the number of vehicles shifted to MTS

Y is the future prediction

n = 1,2,3,...

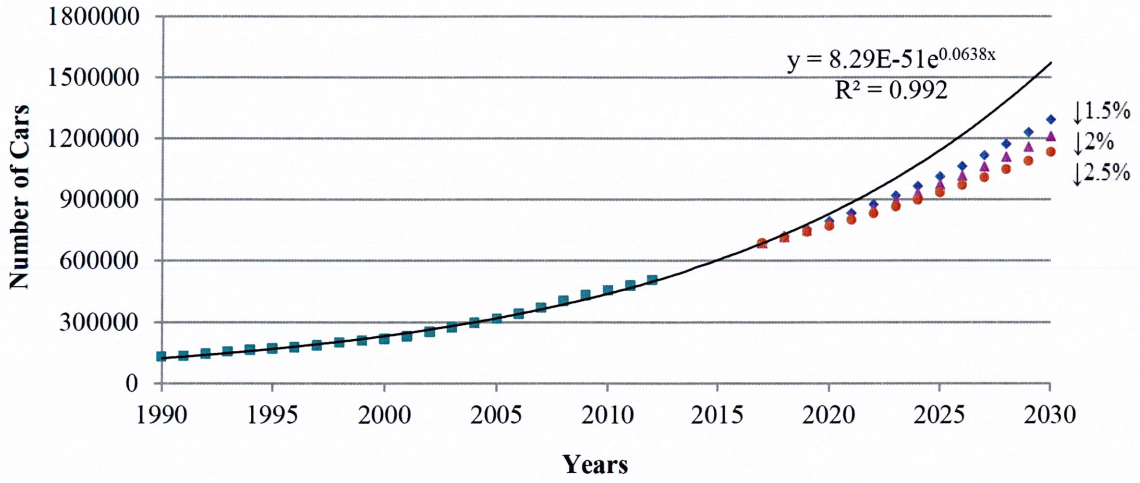


Figure 4.8: Future Prediction of Vehicles Population

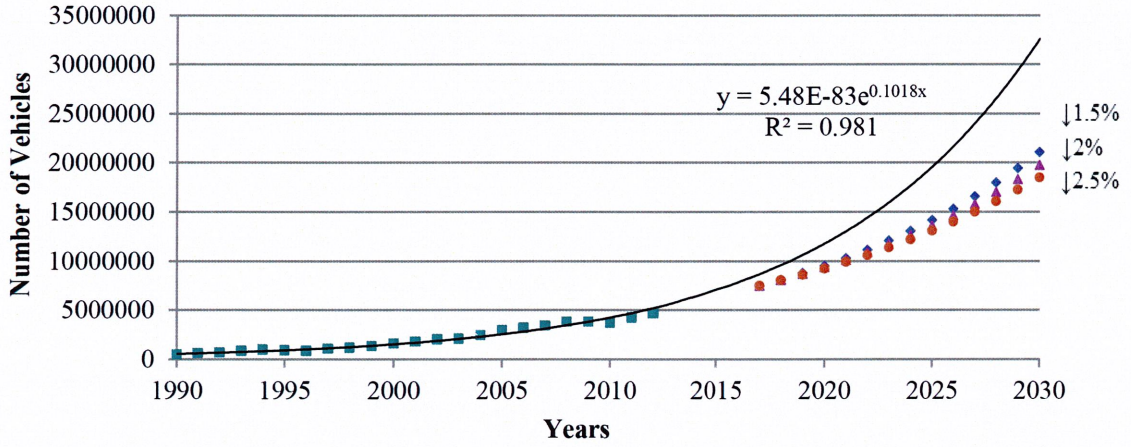


Figure 4.9: Vehicles Entering Bahrain through King Fahad Causeway

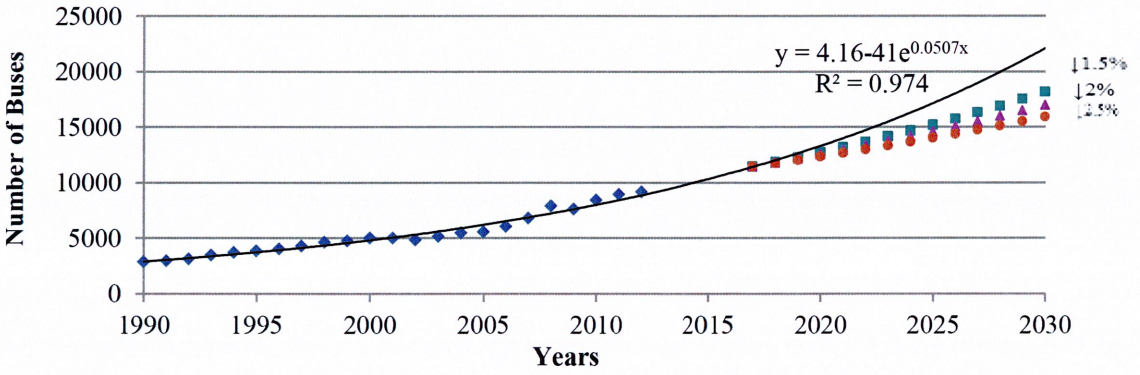


Figure 4.10: Future Prediction of Private Buses

Summary of Vehicle Shifting to Mass Transit System

Table 4.1 shows the total number of annual vehicles in year 2012, 2017 and 2030. It is summarize the total number of vehicles shifting to Mass Transit System. The predicted values for various annual percentage shifts for the year 2030 are presented according to the three scenarios which are 1.5%, 2% and 2.5%.

Table 4.1: Summery of Vehicles Shift to MTS by year 2030

Vehicles	Actual Year	Considered Year	Predicted Year	Predicted Values for Various Annual Percentage Shift for the year 2030		
	2012	2017	2030	1.5%	2.0%	2.5%
Registered Vehicles	505,149	686,001	1,572,991	1,292,401	1,209,665	1,131,843
Vehicle Shifting to MTS				280,590	363,326	441,148
Arriving Vehicles through KFC/year	4,647,046	7,468,781	25,647,133	1,072,197	19,723,219	18,454,353
Arriving Vehicles through KFC/day	12,732	20,462	70,266	57,732	54,036	50,560
Vehicle Shifting to MTS				12,534	16,230	19,706
Private Buses	9,176	11,430	22,105	18,162	16,999	15,906
Vehicle Shifting to MTS				3,943	5,106	6,199
Total Number of Vehicle	527,057	717,894	1,665,362	297,067	384,661	467,054
Percentage of Vehicle Shifting to MTS				18%	23%	28%

Concluding Remarks

The total predicted number of vehicles will be 1,665,362 by year 2030, while the total number of vehicle shifted to Mass Transit System in 1.5% scenario is 4,859,469, which is 18% decreasing in total vehicles number.

Accordingly in the other scenarios, the predicted number of vehicles shift in 2% is 6,292,345 which 23% and decreasing in the total vehicle numbers by the year 2030, and 28% on 2.5% scenario.

CHAPTER 5

Results and Discussion: Planning Network Design

5.1 Introduction

5.2 Defining the site on the map and mode selecting

5.3 Networking the system

CHAPTER 5

5. Results and Discussion: Planning Network Design

5.1 Introduction

From the data gathered and analyzed one may realize the importance of the provision of sustainable Mass Transit System in Bahrain for the entire governorate. It is worth mentioning that due to the variation in traffic, population and urban development between the various parts of Bahrain, the type of the Mass Transit System may also differ from one place to another. Three means of mass transit system are proposed here. These include metro, tram and Bus Rapid System (BRS). These will be assigned as per their capacities and speed.

5.2 Defining the site on the map and mode selecting

From automatic traffic count sites, the Total Daily Traffic (TDT) of vehicles was gathered for all the necessary sites. The earlier modes will be assigned to various routes as per as total daily traffic shown in Table 5.1. The routes with Total Daily Traffic more than 50,000 vehicles will require a metro system. Those in the range from 25,000 to 50,000 vehicles require tram system. Those with Total Daily Traffic between 5,000 to 25,000 vehicles will be classifies as bus rapid transit. Sites with lesser than 5000 vehicles will be covered with others means of transport as local buses, taxis and other private transportations services. However,

the earlier Total Daily Traffic rule may change in certain locations; according to the importance of the routes, the direction of the route, and attractions.

Table 5.1: Ranges of Classifying the total daily Traffic Flow of Vehicle

Type of vehicles	Range of Vehicles per day
Metro Sites	more than 50000
Tram Sites	from 25000 to 50000
Bus Rapid System (BRS) Sites	from 5000 to 25000
Local Buses, Taxi and Private Cars	Less than 5000

The traffic count sites in each city which provided from the Ministry of Works were surveyed and figured out as shown in Figure 5.1.

Total Daily Traffic for the various control sites as coordinated all over Bahrain by Ministry of Works can be seen in Table 5.2. It is arranged according to the previous classification range for Total Daily Traffic (Table 5.1).

Table 5.2: Traffic Count Sites in Various Part of Bahrain (2012)

Muharraq		
Site NO.	TDT	System
20	8555	BRS
25	12898	BRS
29	26633	Tram
36	27959	Tram
50	17203	BRS
58	12237	BRS
62	26225	Tram
65	25916	Tram
70	8800	BRS
83	10787	BRS

Sittra		
Site NO.	TDT	System
5	46371	Tram
24	49630	Tram
73	15956	BRS

Riffa		
Site NO.	TDT	System
7	36007	Tram
40	20182	BRS
48	30788	Tram
49	14987	BRS
59	22472	BRS
66	23988	BRS

Manama		
Site NO.	TDT	System
6	27653	Tram
9	32857	Tram
14	18859	BRS
16	16440	BRS
17	23140	BRS
23	23140	BRS
32	21506	BRS
33	29424	Tram
34	73941	Metro
35	26644	Tram
51	71203	Metro
52	27616	Tram
53	60002	Metro
63	17422	BRS
67	30298	Tram
77	22283	BRS
78	12310	BRS
79	16632	BRS
84	12220	BRS
85	12259	BRS
92	6483	BRS

Buddaya		
Site NO.	TDT	System
75	10188	BRS
76	5974	BRS
80	5599	BRS

Isa Town		
Site NO.	TDT	System
10	52769	Metro
11	67159	Metro
87	22157	BRS
97	19299	BRS
98	24344	BRS

Hamad Town		
Site NO.	TDT	System
45	26544	Tram
47	13780	BRS
68	26350	Tram
82	11939	BRS
99	49150	Metro

The classified mass transit system sites are presented in Figure 5.1. The marked sites present metro sites which carries a Total Daily Traffic more than 50,000 vehicles. The hatched sites present the tram sites with Total Daily Traffic from 25,000 to 50,000 vehicles. The doted sites indicate the bus rapid transit carrying Total Daily Traffic between 5,000 and 25,000. The total daily traffic for all other sites are less than 5,000 vehicles, taxis and other transportation mode could be suitable for the entire areas.

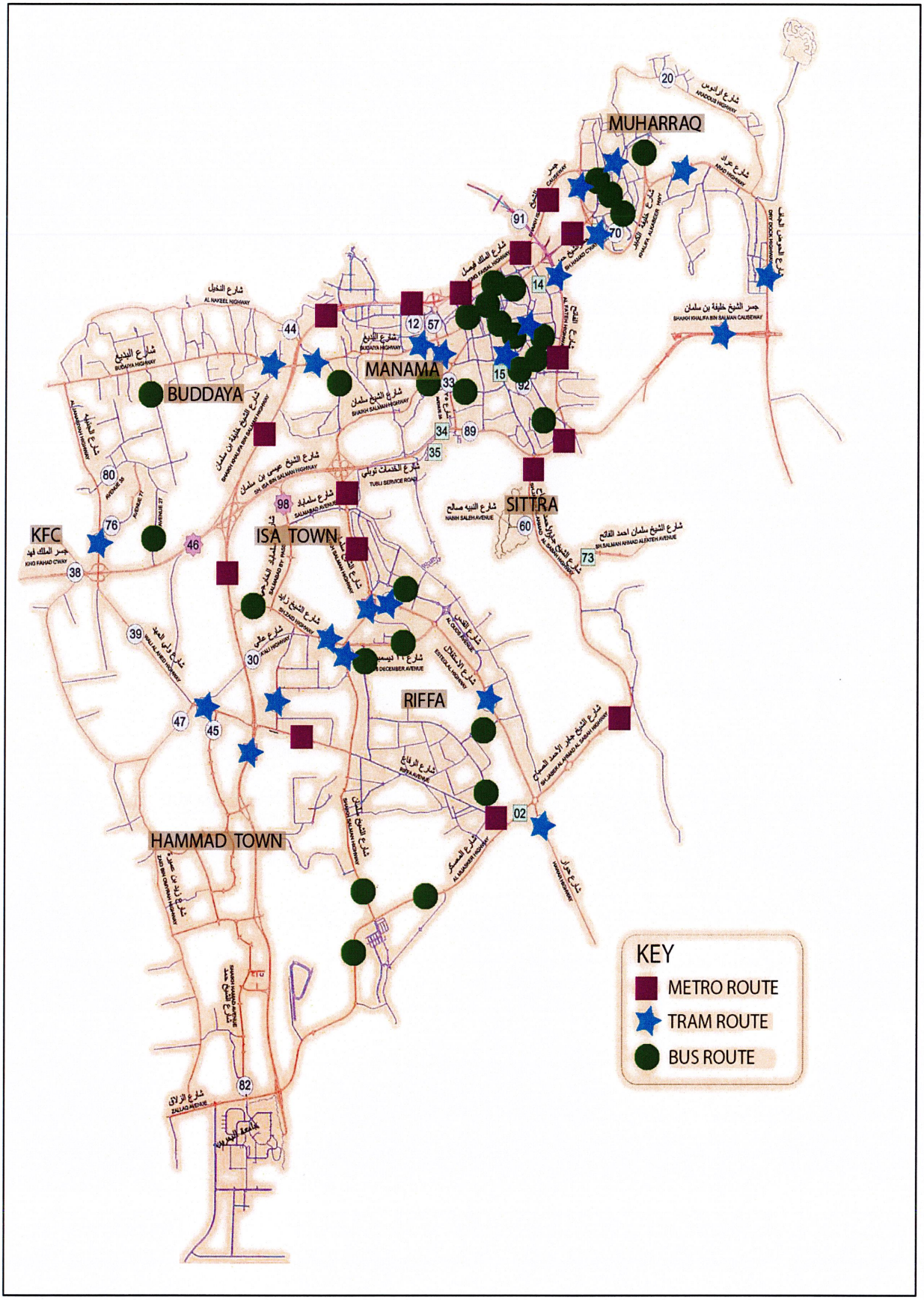


Figure 5.1: Classified Count Sites

5.3 Networking the system

5.3.1 Metro Routs:

According to the sites assigned for possible metro route on the traffic count and shown in Figure 5.1; two main metro routes are proposed. The first route covers the Northern area and the other is to the south of the first one. Both are in the heavily populated Northern part of Bahrain. The speed of the metro system is 60 kilometers per hour [7].

Metro One:

The rout for first metro, as shown in Figure 5.2 , is located in the northern part of the Kingdom of Bahrain. It covers mainly three areas; Muharaq area which includes Bahrain International Airport. The airport is important to be connected to the network since it plays an important economic role.

Moving towards the west, the route crosses to Manama area; which is the most congested area in Bahrain; since most of the governmental sectors, agencies and commercial shopping centers. Manama is capital of Bahrain and it holds 27% of the population, which sums to 329,510 as per 2011 statics and expected to reach 1,055,420 by year 2030.

The route is extending to reach King Fahad Causeway, a very important link to Saudi Arabia and an important attraction. The causeway accommodates a large number of entering and existing cars. The total length of the route is 55 kilometers. The total elapsed time to complete a full round trip is 55 minutes, inclusive of stops, based on average travel speed of 60 kph.

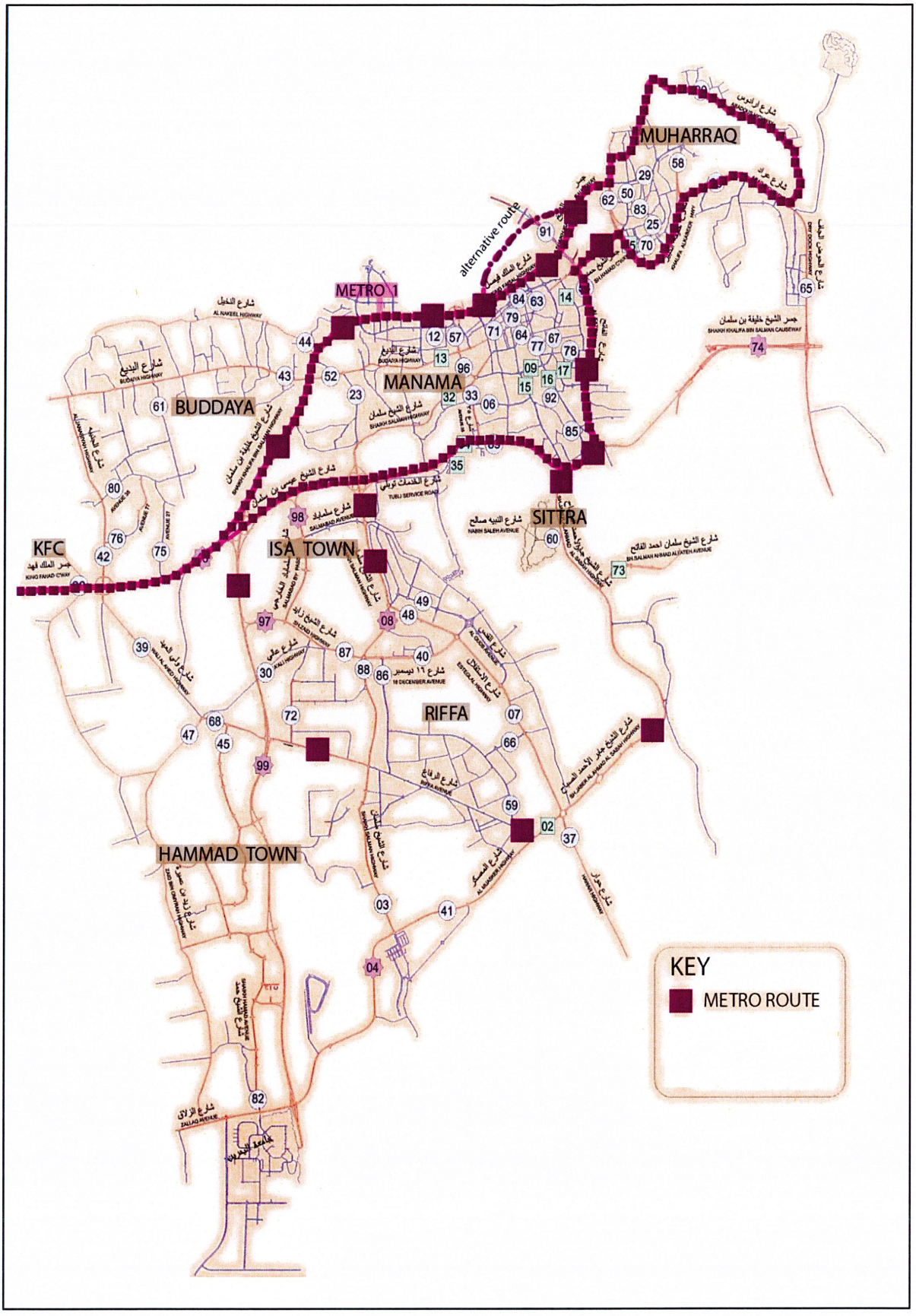


Figure 5.2: The First Metro Route from King Fahad Causeway to Muharraq

Metro Two:

The second proposed route for the metro is located in the central Bahrain. It is connected to the first route from the south side of the first metro; to northern side of the second one, as can be seen in Figure 5.3 . It mainly serves three areas, Sittra Island, Isa Town and Riffa City. These areas are located in the Central Governorate which accommodates the largest number of population. The total length of the route is 34 kilometers. The total elapsed time to complete round trip is 34 minutes; based on average travel speed of 60 kph.

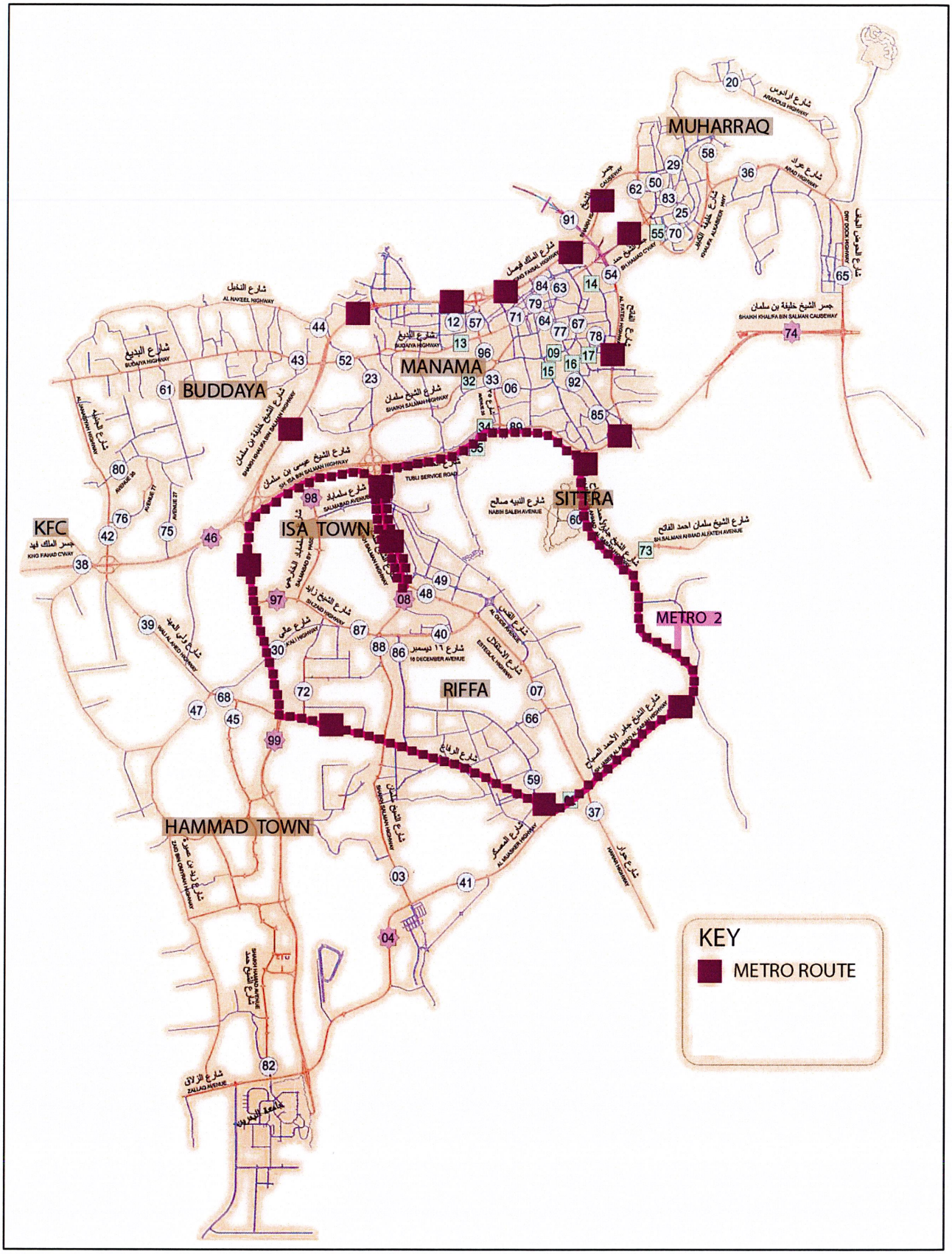


Figure 5.3: The Second Metro Route from Isa Town to Riffa and Sittra

5.3.2 Tram Routs:

Three main trams routes are proposed. They are designed according to the sites carrying traffic counts less than that for assigned for the metro. These were shown in Figure 5.1. The first route covers the northern area of Bahrain. The second route covers the central area and the last route covers the southern area of Bahrain reaching to Bahrain University. The average travel speed of the tram system is 20 kph.

Tram One:

The first tram rout is located in the northern part of the Kingdom of Bahrain, as shown in Figure 5.4. It covers mainly two areas, the central areas of Manama City and Buddaya. The future extension of this route proposed towards the east side which will connect Muhharaq and Sittra. The other future extension is in the west side which will be extended to cover King Fahad causeway. The length of the route is 19 kilometers. The total time for a full trip is 56 minutes considering the earlier average travel speed.

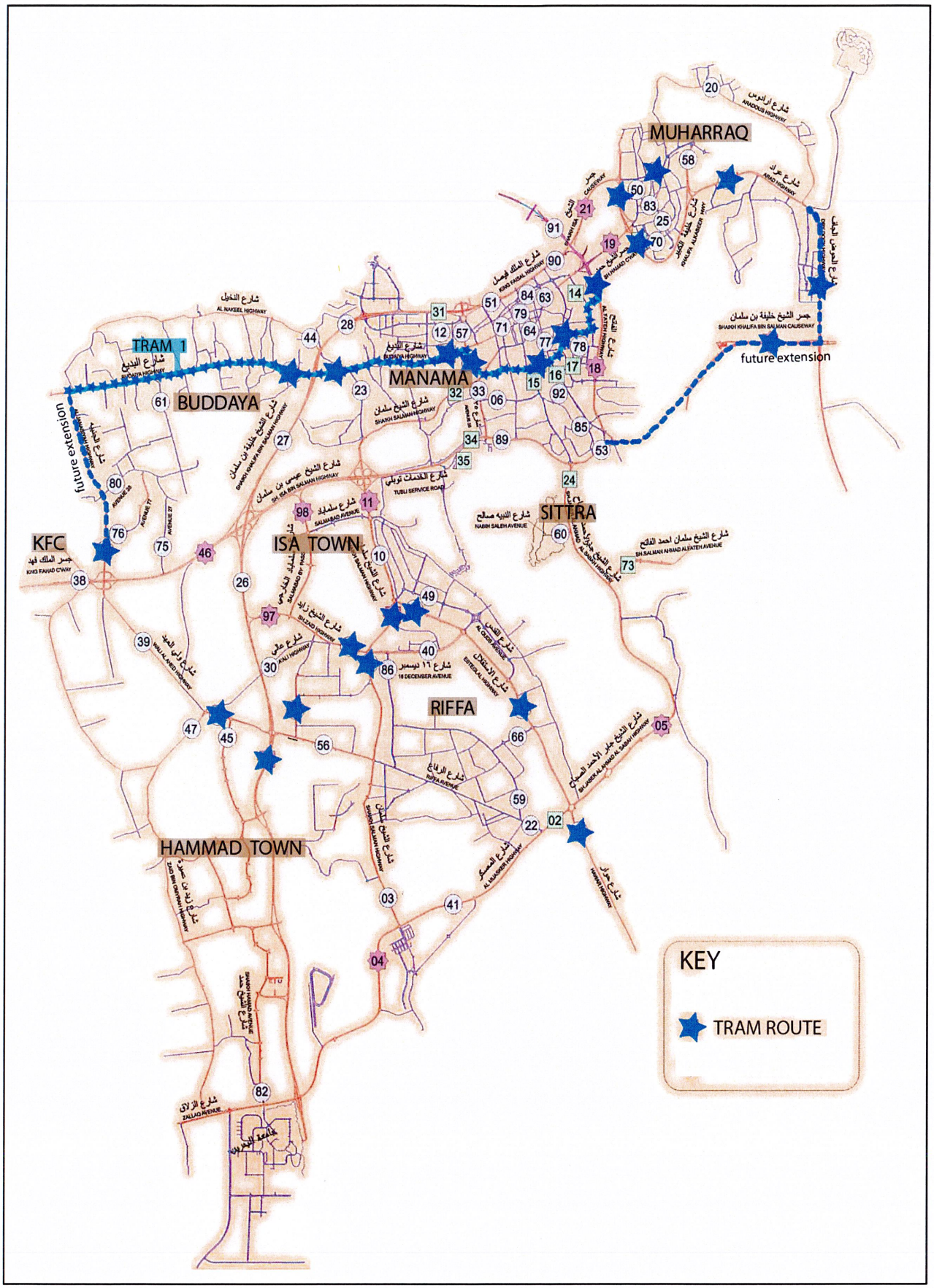


Figure 5.4: The First Tram Route from Buddaya to Manama

Tram Two:

The second tram route is located in the middle area of the Kingdom of Bahrain as shown in Figure 5.5. It covers the internal part of the Riffa area and Isa Town. The western part of the route is extended to be close to King Fahad Causeway. This route also extends to cover Hiwar Highway which led to State of Qatar in future. The total length of the route is 29 kilometers. The total time for a trip is 86 minutes based on average travel speed of 20 kph.

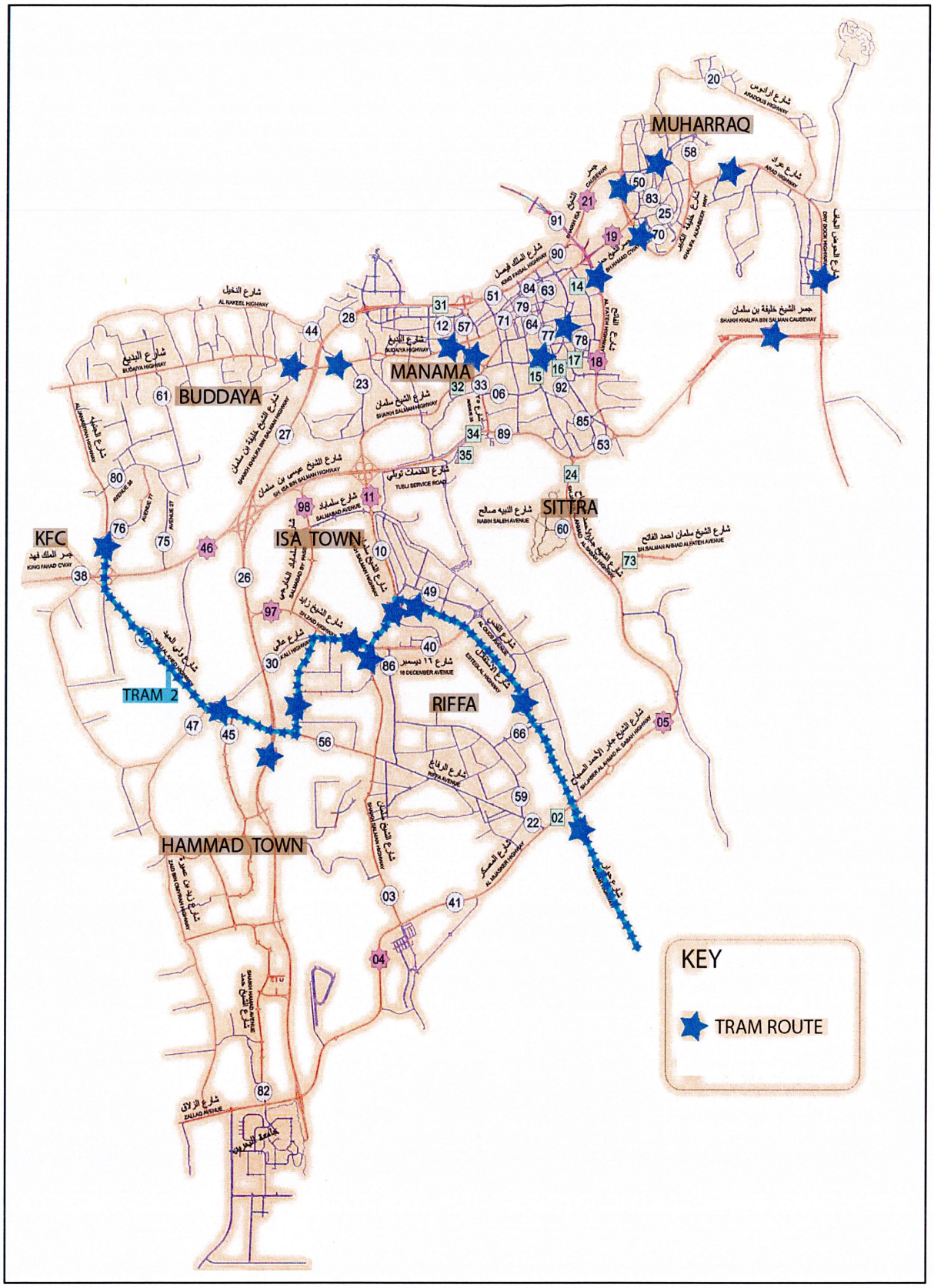


Figure 5.5: The Second Tram Route covers the internal part of Riffa and Isa Town reaching KFC

Tram Three:

The third tram route is located in the southern area of the Kingdom of Bahrain as shown in Figure 5.6. It covers the shortest length, among all the metro and tram routs, of 12 kilometers. It connects the middle area of the Kingdom to the southern area up to University of Bahrain passing through Hammad Town. The total time for a full trip is 35 minutes based on average travel speed of 20 kph.

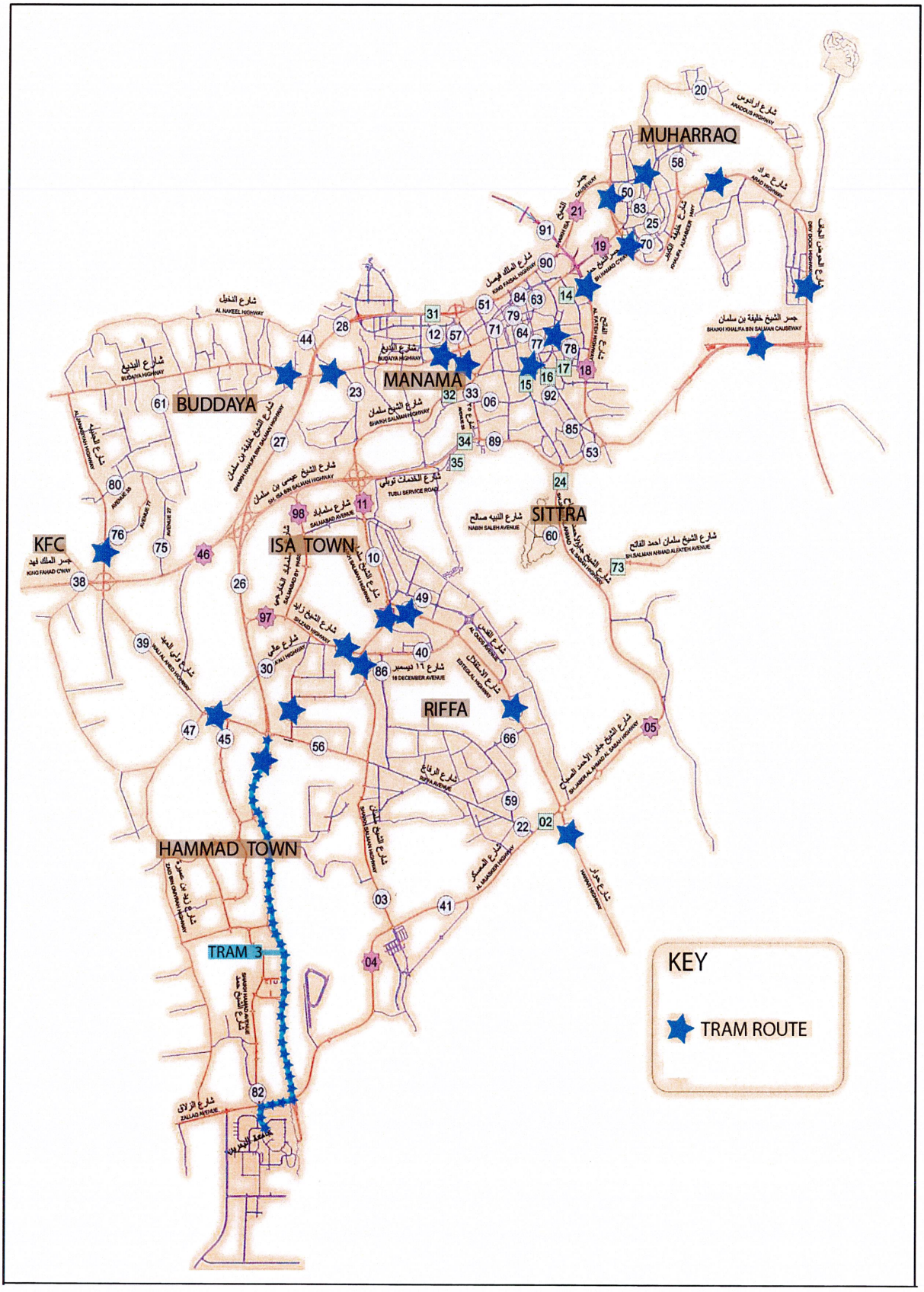


Figure 5.6: The Third Tram Route from Hammad Town to University of Bahrain

5.3.3 Rapid Bus Routes:

Eight main bus routes are considered according to the bus sites discussed earlier. These are based on the traffic counts shown in Figure 5.1. The first route covers the internal areas of Muharraq city. Two main routes covers Manama city, since they pass through congested area, the fourth route covers Buddaya city in the western side. The other four bus routes cover the middle area; which include Isa Town, Riffa and the southern area. The speed of the bus rapid system is 30 kph.

Bus One:

The first bus route is located in Muharaq city as shown in Figure 5.7. The length of the route is 8 kilometers and the total time for round trip is 36 minutes based on average travel speed of 30 kph.

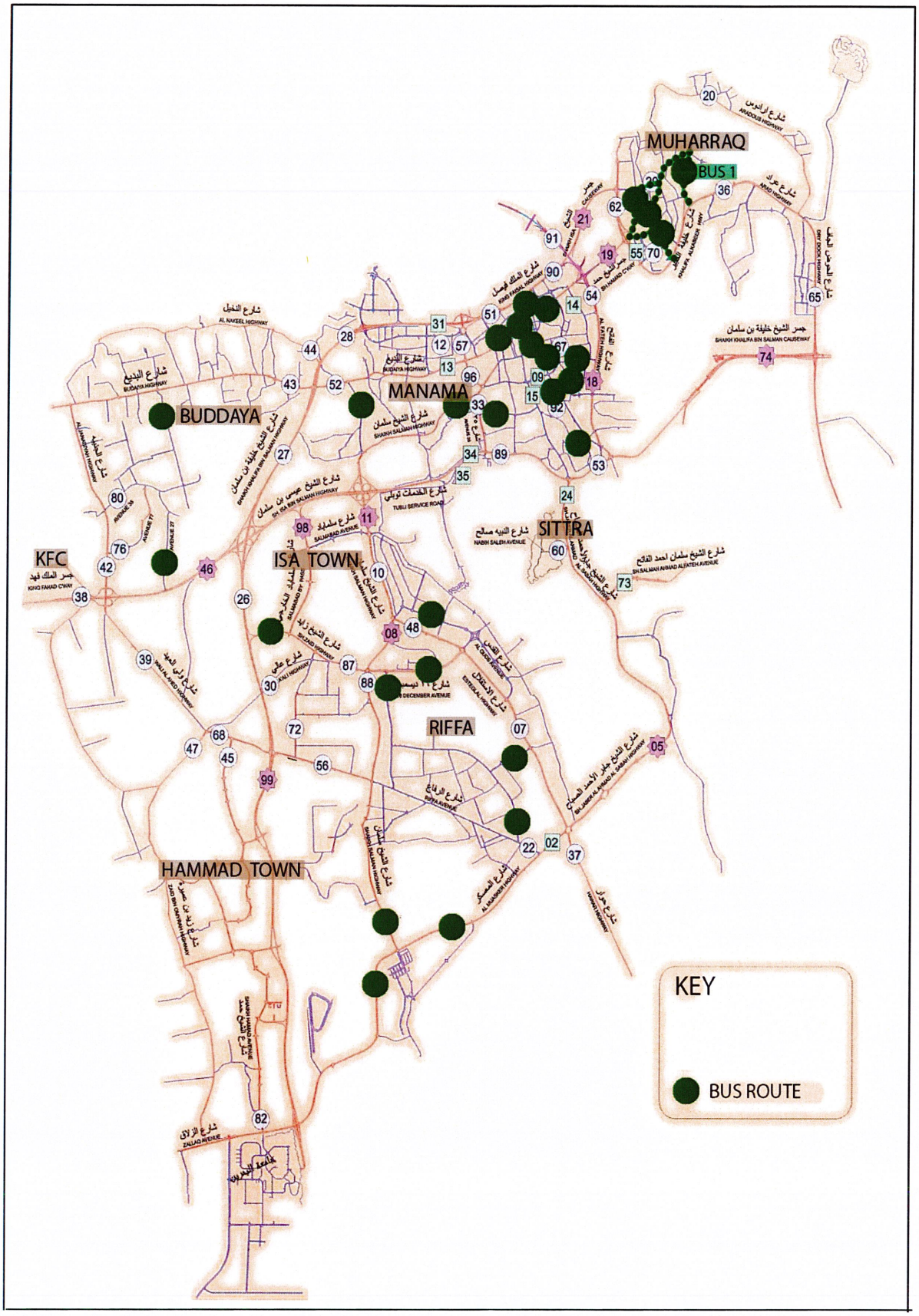


Figure 5.7: The First Bus Route in Muharraq

Bus Lines Two and Three:

The second and third bus routes are located in Manama city as shown in Figure 5.8. The length of the second bus route is 22 kilometers. The total elapsed time for round trip is 42 minutes based on average travel speed of 30 kph, while the length of the third bus route is 8 kilometers. The total time for a trip is 32 minutes based on average travel speed of 30 kph.

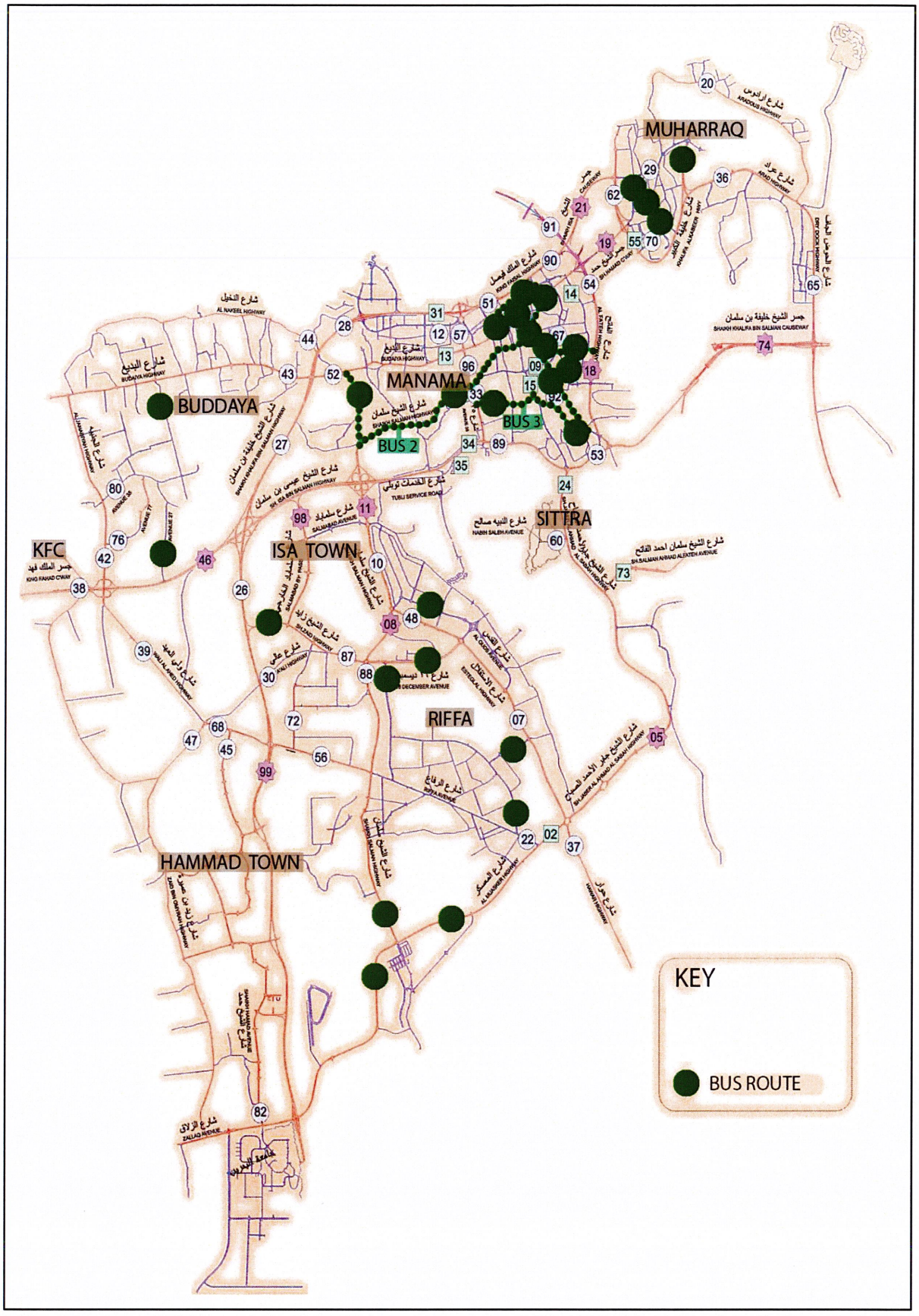


Figure 5.8: The Second and Third Bus Routes in Manama

Bus Rapid Transit Route Four:

The fourth bus route is located around Buddaya city as shown in Figure 5.9. The length of the route is 12 kilometers. The total time for round trip is 22 minutes based on average travel speed of 30 kph.

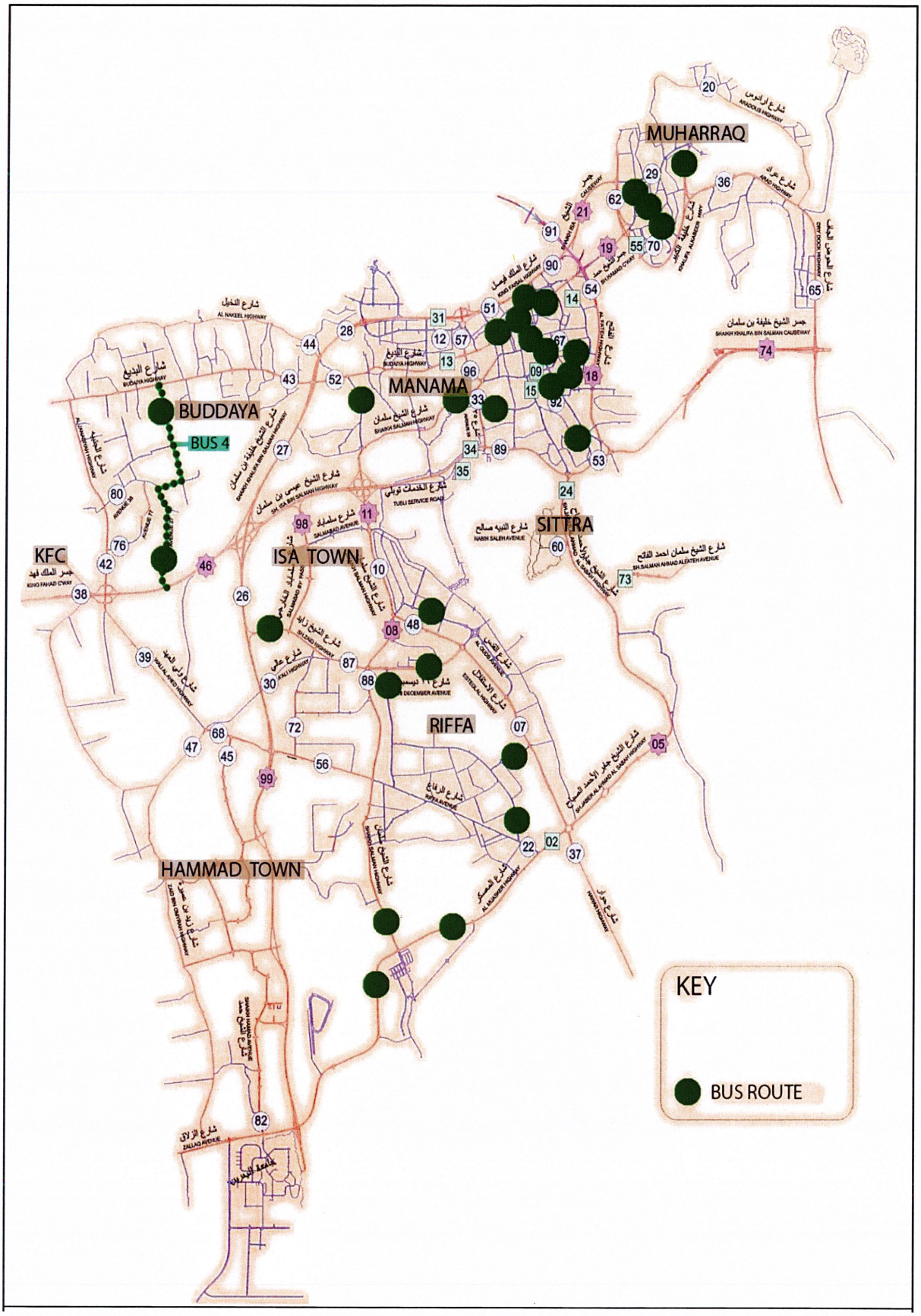


Figure 5.9: The Fourth Bus Route in Buddaya

Bus Lines Five, Six and Seven:

The fifth bus as shown in Figure 5.10 is located in Isa town. It covers 12 kilometers in one direction. The total time take for one round trip is 22 minutes.

The sixth and seventh bus routes are located in Riffa. The length of the sixth route is 22 kilometers. The corresponding total time for one round trip is 44 minutes based on average travel speed of 30 kph.

The length of the seventh bus route which located in Riffa area is 6 kilometers. The total round trip time is 12 minutes based on average travel speed of 30 kph. Those three routes are close to each other which can be also linked as one line together.

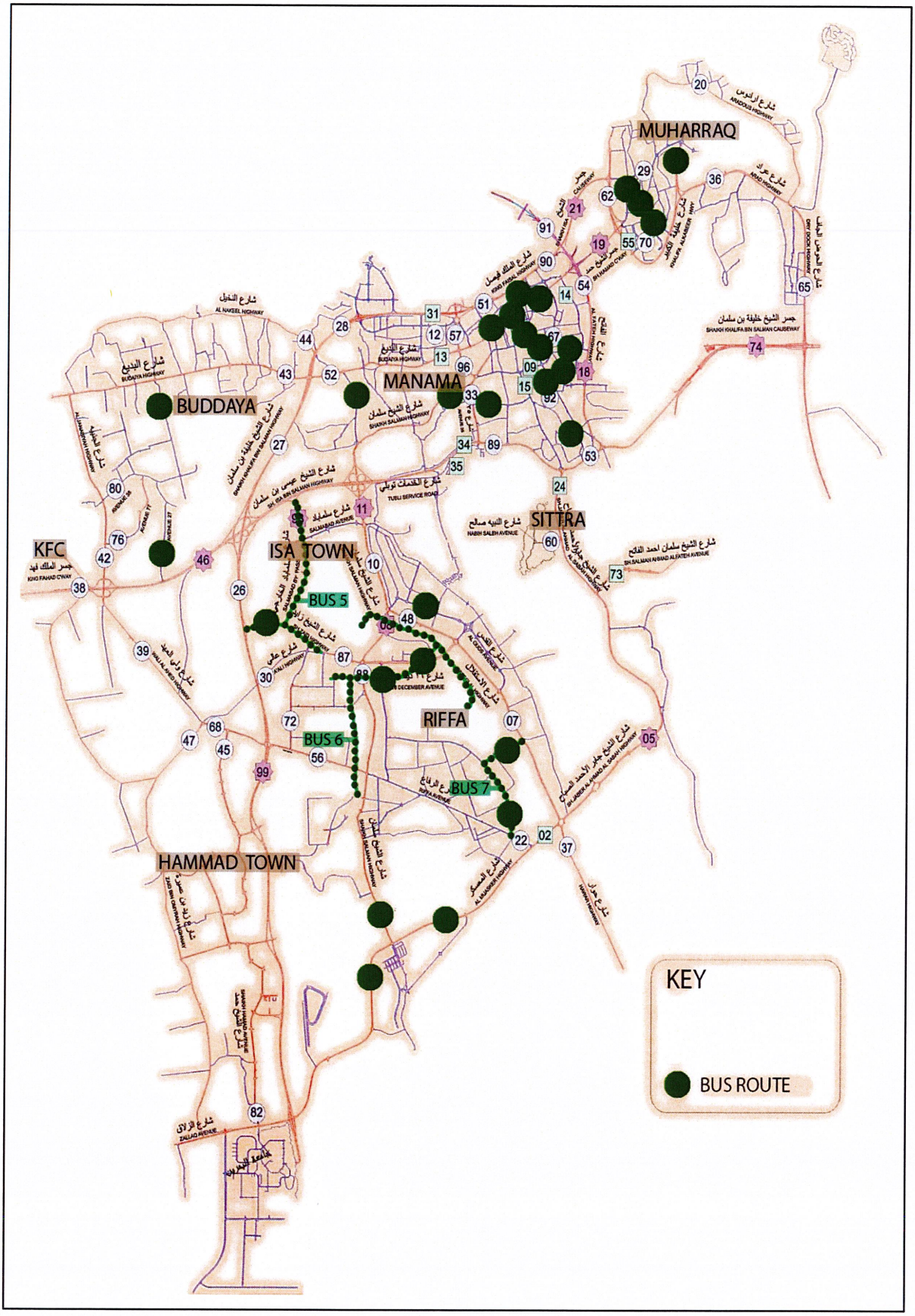


Figure 5.10: 5th, 6th and 7th Bus Routes in Isa Town and Riffa

Bus Eight:

The eighth bus route is located in the Southern region as shown in Figure 5.11. The length of the route is 11 kilometers. The correspond total round trip time covering 22 km, is 44 minutes based on average travel speed of 30 kph.

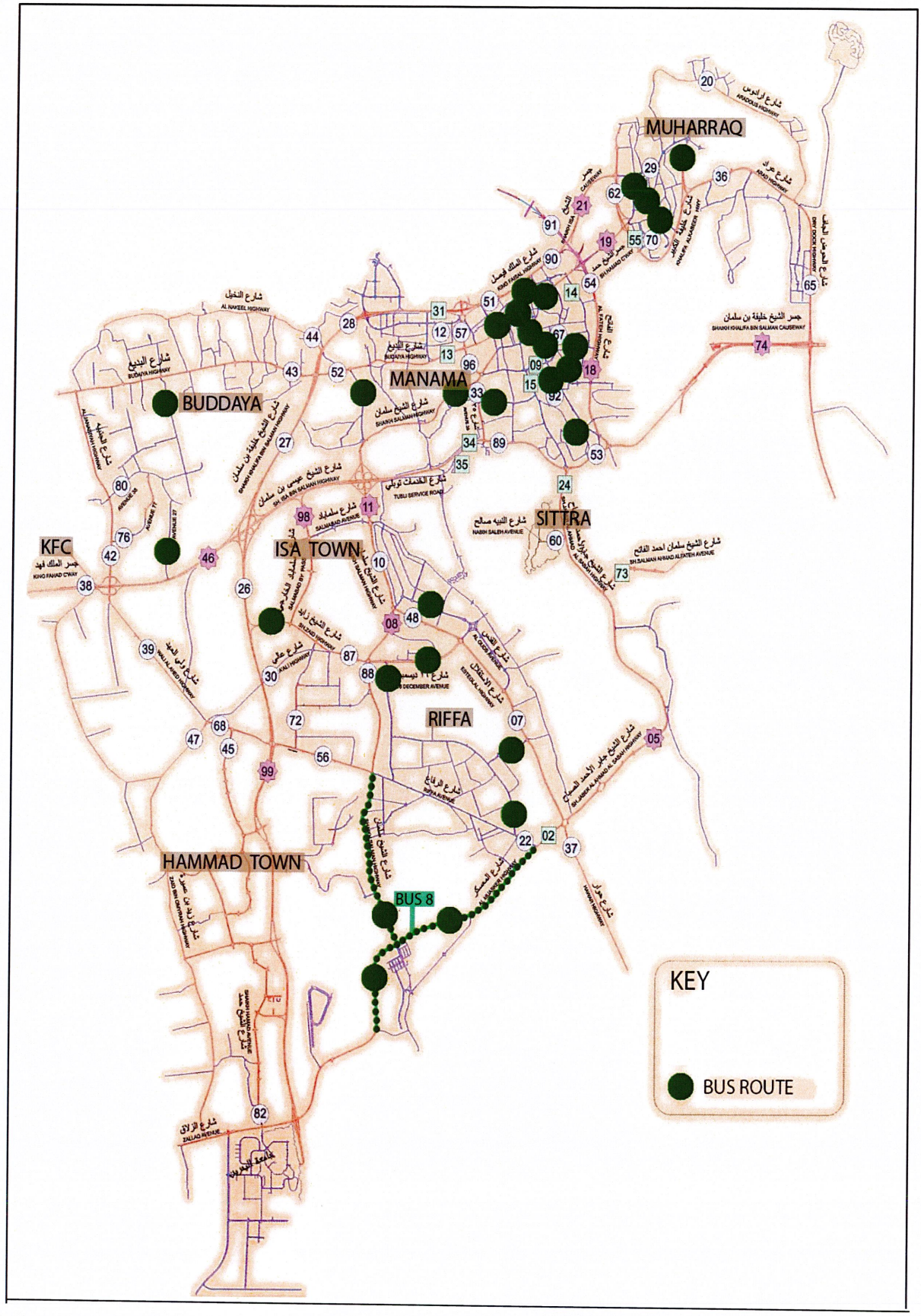


Figure 5.10: The Eighth Bus Route in Southern Area

Summary of proposed routes:

The proposed network includes two major metro routes, three tram routes and eight rapid bus routes.

Table 5.3 presents the details of the proposed Mass Transit Routes, route lengths average travel speed for each system. The total time for a trip for each route is calculated by dividing the route length on speed, Time = Distance/Speed.

Table 5.3: Mass Transit System Route Details

MTS	Route length (Km)	Average speed (kph)	Route trip Travel (min.)
Metro 1	55	60	55
Metro 2	34	60	34
Tram 1	19	20	56
Tram 2	29	20	86
Tram 3	12	20	35
Bus 1	4	30	9
Bus 2	11	30	42
Bus 3	8	30	32
Bus 4	6	30	22
Bus 5	6	30	22
Bus 6	11	30	44
Bus 7	3	30	12
Bus 8	11	30	44

Figure 5.12 presents the proposed routes of Mass Transit System modes all around Bahrain. Because the mass transit system covers the main corridors, therefore they cannot cover all the areas, it is equally important to integrate local busses, microbuses and taxis with the mass transit system so as to have a better integrated system to move the users to their final destination.

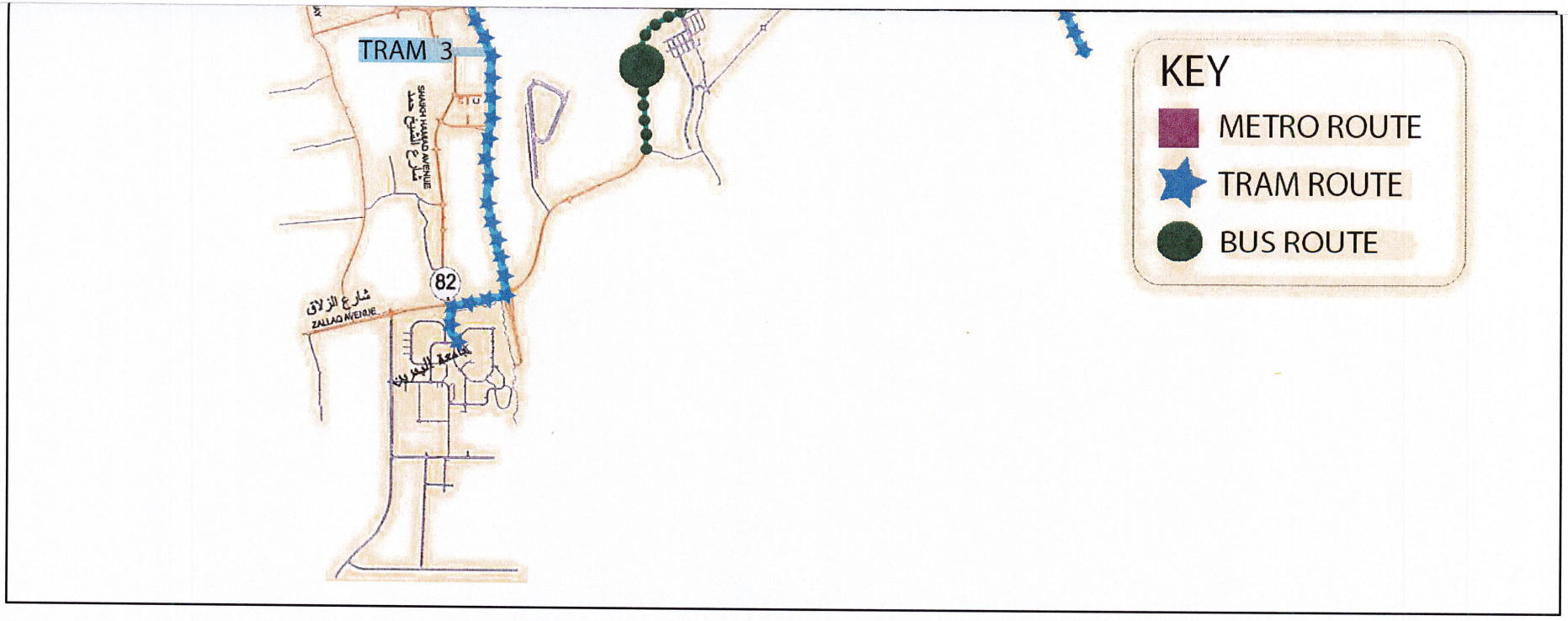


Figure 5.11: Proposed Mass Transit System Network Routs

CHAPTER 6

Results and Discussion: Managing and Operating Mass Transit Systems

6.1 Introduction

6.2 Estimated total number of riders and number of trips for each route

6.3 Operation time of the Mass Transit System

6.4 Management of Mass Transit System Routes

CHAPTER 6

6. Results and Discussion: Managing and Operating Mass Transit Systems

6.1 Introduction

As discussed in the previous chapter, 13 routes are proposed all around Bahrain. Table 5.3 summarized the proposed Mass Transit Routes in terms of details, distances, average travel speed and trip time. Further details are discussed in this chapter. These include predicted number of riders, headways and generated income of each routes.

6.2 Estimated total number of riders and number of trips for each route

The total number of vehicles flow in a year should be calculated to determine the number of riders in each rout.

As discussed in Chapter 4, the mode shift rate in vehicles will be used to estimate the number of users. This will be utilizing, based on first scenario, an annual shift to Mass Transit System of 1.5% (Table 4.1). This will lead to 18% by the year 2030. Two methods are considered to estimate the total number of riders. These are discussed next.

6.2.1 First Method (model based method)

The total number of riders is estimated considering the total number of registered vehicles, the number of public and private buses, and the arriving vehicles from King Fahad Causeway. These are considered for the year 2030. Which are predicted through the models developed in the earlier chapter (Chapter 4).

Table 6.1 shows the total number of riders' details. It is the summation of the following:

- Total number of registered vehicles shifted to Mass Transit System multiplying by the number of riders which assumed not less than two riders each vehicle.

  Number of riders (A) = Total number of registered vehicles shifted to MTS (B) * 2 *(assumed)*

- Total number of private and public buses shifted to Mass Transit System multiplying by the number of riders which assumed not less than two riders each vehicle.

  Number of riders (A) = Total number of private and public buses shifted to MTS (C) * 2 *(assumed)*

- The daily arriving vehicles from King Fahad Causeway shifted to Mass Transit System multiplying by 2.5 riders in each vehicles, which were calculate as the average of total yearly riders arriving from King Fahad Causeway for the last 10 years.

Number of riders (A) = T daily arriving vehicles from KFC shifted to MTS (D) * 2.5 *(calculated)*

- A safety factor of 20% was considered for other unknown and hidden data. The total number of riders shifted to Mass Transit System is 720,522 which will be distributed through the proposed routes.

Total (A) = [(B*2) + (C*2) + (D*2.5)]*20%

Table 6.1: Estimated total number of riders shifted to MTS by year 2030, based on the first method (model based method)

No. of Vehicles (B) Table 4.1)	Private Bus (C) (Table 4.1)	Public Bus (C)	No. of riders per vehicle	Daily vehicle arriving from KFC (D) (Table 4.1)	No. of riders entering per car	No. of riders (A)	Safety Factor (20%)	Total no. of riders (Total A)
280590	3943	17	2	12534	2.5	600,435	120,087	720,522

To calculate the total number of riders on each route; first of all, the total daily traffic flows between cities should be considered (Chapter 3 from Table 3.14 to Table 3.23). Secondly, the total number of vehicles between cities should be shifted to year 2030 as shown in Table 6.2.

Table 6.2: Total daily traffic flow shifted towards MTS between cities up to year 2030

	Cities		Total daily traffic on year 2012	Reference table	Total daily traffic shifted to 2030
1	Manama	Muharraq	107446	Table 3.14	248933
2	Manama	Sittra	49630	Table 3.15	68551
3	Manama	Isa Town	181573	Table 3.16	427782
4	Manama	Buddaya	37325	Table 3.17	93351
5	Isa Town	Riffa	86751	Table 3.18	320111
6	Isa Town	KFC	29496	Table 3.19	111231
7	Isa Town	Hammad Town	64189	Table 3.20	376921
8	Riffa	Hammad Town	50102	Table 3.21	250978
9	Hammad Town	KFC	12336	Table 3.22	30241
10	Buddaya	KFC	30252	Table 3.23	159677
		Total	**649100**		**2087776**

Table 6.3 present the total daily shifted traffic flow reduction using three possible scenarios of annual mode shift. The first scenario is to reduce the vehicles after the mode transfer to public transportation by 1.5% each year which sums to 18% by the year 2030 from a base year 2017 of the total daily traffic, the second scenario is 2% annual reduction which is sums to 23% of the total daily traffic flow by the year 2030 and the last scenario is to reduce the number of total vehicles by 28% which is correspondent to 2.5% annual mode shift.

The latter is determining through $= (1 + \mathrm{GR})^n = (1 + 0.025)^{2030-2017}$

$$= (1.025)^{13}$$

Table 6.3: Total number of daily traffic flows shifted to MTS between cities, using three different scenarios

	Cities		Total daily traffic shifted to 2030 (Table 6.2)	Scenario 1 (TDT shift)		Scenario 2 (TDT shift)		Scenario 3 (TDT shift)	
				18% shift 2030		23% shift 2030		28% shift 2030	
				1.5% annual mode shift	% of annual mode shift	2% annual mode shift	% of annual mode shift	2.5% annual mode shift	% of annual mode shift
1	Manama	Muharraq	248933	44405	12%	57498	12%	69814	12%
2	Manama	Sittra	68551	12228	3%	15834	3%	19225	3%
3	Manama	Isa Town	427782	76308	20%	98808	20%	119972	20%
4	Manama	Buddaya	93351	16652	4%	21562	4%	26181	4%
5	Isa Town	Riffa	320111	57101	15%	73938	15%	89776	15%
6	Isa Town	KFC	111231	19841	5%	25692	5%	31195	5%
7	Isa Town	Hammad-T	376921	67235	18%	87060	18%	105708	18%
8	Riffa	Hammad-T	250978	44769	12%	57970	12%	70387	12%
9	Hamma-T	KFC	30241	5394	1%	6985	1%	8481	1%
10	Buddaya	KFC	159677	28483	8%	36882	8%	44782	8%
Total			**2087776**	**372418**	**100%**	**482230**	**100%**	**585520**	**100%**

Each proposed route pass through couple of cities. Table 6.4 shows the adjusted percentage of traffic flow between cities. Metro two passes through the highest percentage (32%) of the traffic flow so it will generate the maximum number of riders.

Table 6.4: Adjusted percentage of traffic between cities of each route

MTS	Cities		% of reduction (Table 6.3)	Total % of reduction in each route	Adjusted % of each route
Metro 1	Manama	Muharraq	12%	27%	23%
	Manama	Buddaya	4%		
	Buddaya	King Fahad Causeway	8%		
	Manama	Sittra	3%		
Metro 2	Isa Town	King Fahad Causeway	5%	39%	32%
	Isa Town	Hammad Town	18%		
	Isa Town	Riffa	15%		
Tram 1	Manama	Muharraq	12%	16%	14%
	Manama	Buddaya	4%		
Tram 2	Isa Town	Hammad Town	18%	18%	15%
Tram 3	Isa Town	Riffa	15%	21%	17%
	Isa Town	King Fahad Causeway	5%		
Total			121%	121%	100%

The total number of riders as been computed in Table 6.1 is 720,522. It will be distributed all over the proposed routes according to the adjusted percentage of traffic flow between the cities, as been predicted in Table 6.4. The total number of riders in each proposed metro and tram routes is shown in Table 6.5.

Table 6.5: Total number of riders in each routs of Metros and Trams

MTS	Route length (km)	Speed (kph)	Route Time (min.)	Total no. of riders (Table 6.1)	Adjusted % of each route (Table 6.4)	Number of riders in each route
Metro 1	55	60	55	720,522	23	165,720
Metro 2	34	60	34		32	230,567
Tram 1	19	20	56		14	100,873
Tram 2	29	20	86		15	108,078
Tram 3	12	20	35		17	122,489
				Total	**100%**	**720,522**

Each bus route pass through several count sites as shown in Chapter 5, Figure 5.12. The total daily traffic of each bus route is shown in Table 6.6.

Table 6.6: Total daily Traffic flow of bus routes

Bus Route	Site no. (Figure 5.1)	TDT (MOW)	Total
Bus 1	25	12898	47206
	50	17203	
	58	11909	
	83	5196	
Bus 2	23	23140	120125
	32	20184	
	63	17422	
	64	14314	
	71	16213	
	79	16632	
	84	12220	
Bus 3	6	27563	87417
	16	16440	
	17	7658	
	77	12577	
	78	10920	
	85	12259	
Bus 4	75	10188	22097
	61	11909	
Bus 5	97	12848	37192
	98	24344	
Bus 6	9	19876	54331
	40	20182	
	49	14273	
Bus 7	59	22472	46460
	66	23988	
Bus 8	3	13375	50346
	4	18478	
	41	18493	
Total			465174

The percentages of total daily traffic flow of bus routes are shown Table 6.7 represent. The total daily traffic of the count sites pass through each route considered to determine the percentages.

Table 6.7: Percentage of traffic flow of bus routes

Route	TDT (Table 6.6)	Percentage
Bus 1	47206	10%
Bus 2	120125	26%
Bus 3	87417	19%
Bus 4	22097	5%
Bus 5	37192	8%
Bus 6	54331	12%
Bus 7	46460	10%
Bus 8	50346	11%
Total	465174	100%

20% from the total number of riders were assumed to be used by the bus routes. The rider will distributed according to the percentages of the traffic flow on each bus route. The calculations are shown in Table 6.7. Consequently, Table 6.8 shows the number of riders in each bus route. The highest number of riders consists in bus number two; which is located in Manama. The area is always a congested.

Table 6.8: Total number of riders in bus routes

MTS	Distance (km)	Speed (kph)	Root Time (min.)	Total no. of riders	20% from Total no. of riders	% of each route (Table 6.7)	Riders in each root
Bus 1	4.297	30	9	720,522	144,104	10%	14410
Bus 2	10.556	30	21			26%	37467
Bus 3	7.828	30	16			19%	25939
Bus 4	5.597	30	11			5%	7205
Bus 5	5.617	30	11			8%	11528
Bus 6	10.887	30	22			12%	17293
Bus 7	3.149	30	6			10%	14410
Bus 8	11.165	30	22			11%	15851

Number of trips

Table 6.9 shows the Mass Transit System routs details, the number of riders, capacity and number of trips of each route. The number of trips is determined by dividing the number of riders over the capacity.

Table 6.9: Detailed Mass transit system routes based on the First Method, in term of distance, speed, travel time, number of riders, capacity and number of trips

MTS	Distance (km)	Speed (kph)	Root Time (min.)	Riders in each route	Capacity	No. of trips
Metro 1	55	60	55	165720	600	276
Metro 2	34	60	34	230567	600	384
Tram 1	19	20	56	100873	220	459
Tram 2	29	20	86	108078	220	491
Tram 3	12	20	35	100873	220	557
Bus 1	4	30	9	14410	100	144
Bus 2	11	30	21	37467	100	375
Bus 3	8	30	16	25939	100	259
Bus 4	6	30	11	7205	100	72
Bus 5	6	30	11	11528	100	115
Bus 6	11	30	22	17293	100	173
Bus 7	3	30	6	14410	100	144
Bus 8	11	30	22	15851	100	159

6.2.2 Second Method (Percentage based method)

The second method in predicting the total number of riders is to fully consider the total daily traffic on each route for metros and trams. The number of riders for bus routes is assumed as a percentage of the total daily traffic of the nearest metro or/and tram routes. All the estimates are considered after the prediction for year 2030, is determined.

Table 6.10 show the total daily traffic for each route of metros and trams, the redaction of the number of vehicles based on the first scenario which is 1.5%.

Table 6.10: Total daily traffic of mass transit system routs based on the second method

MTS	Linking Cities		Total Daily Traffic considering 1.5% shift (Table 6.3)	TDT for each rout
Metro 1	Manama	Muharraq	44405	101,768
	Manama	Buddaya	16,652	
	Buddaya	KFC	28,483	
	Manama	Sittra	12,228	
Metro 2	Isa Town	KFC	19,841	144,178
	Isa Town	Hammad Town	67,235	
	Isa Town	Riffa	57,101	
Tram 1	Manama	Muharraq	44,405	61,057
	Manama	Buddaya	16,652	
Tram 2	Isa Town	Hammad Town	67,235	67,235
Tram 3	Isa Town	Riffa	57,101	76,943
	Isa Town	KFC	19,841	
Total			451,181	451,181

Table 6.11 show the mass transit system route details, number of riders, capacity of vehicles and numbers of trips of each route. A safety factor was also considered as 10% for other possible hidden users, as these coming from minor roads not considered in total daily traffic.

Table 6.11: Detailed Mass transit system routes based on Second Method, in term of distance, speed, travel time, number of riders

MTS	Distance (Km)	Speed (kph)	Route Time (hr.)	Route Time (min.)	TDT	Safety Factor 1.1	Average No. of riders per Car	Total number of Riders
Metro 1	54.789	60	0.913	55	101,768	111,945	2	223,890
Metro 2	34.207	60	0.570	34	144,178	158,596	2	317,191
Tram 1	18.588	20	0.929	56	61,057	67,162	2	134,325
Tram 2	28.809	20	1.440	86	67,235	73,959	2	147,917
Tram 3	11.671	20	0.584	35	76,943	84,637	2	169,274

Riders in bus route calculated as a 10% from the nearest metro or tram routes. As is shown in Table 6.12, all bus routes are affected by two other systems, bus one route which is located in Muharraq, is affected by only Metro one.

Table 6.12: Bus routes based on Second Method

MTS	Distance (Km)	Speed (kph)	Route Time (min.)	10% from effected routs	Total number of Riders
Bus 1	4.297	30	9	Metro 1	22,389
Bus 2	10.556	30	21	Metro 1, Tram 1	17,911
Bus 3	7.828	30	16	Metro 1, Tram 1	17,911
Bus 4	5.597	30	11	Metro 1, Tram 1	17,911
Bus 5	5.617	30	11	Metro 2, Tram 2	23,255
Bus 6	10.887	30	22	Metro 2, Tram 2	23,255
Bus 7	3.149	30	6	Metro 2, Tram 2	23,255
Bus 8	11.165	30	22	Metro 2, Tram3	15,180

Route details of the mass transit system can be shown in Table 6.13. The table includes the numbers of rider on each route, vessel capacity and number of trips. The highest number of trips exists in Tram number three.

Table 6.13: Detailed Mass transit system routes based on the Second Method, in term of distance, speed, travel time, number of riders, capacity and number of trips

MTS	Distance (Km)	Speed (kph)	Route Time (min.)	Riders in each root	Capacity	No. of trips
Metro 1	54.789	60	55	223,890	600	373
Metro 2	34.207	60	34	317,191	600	529
Tram 1	18.588	20	56	134,325	220	611
Tram 2	28.809	20	86	147,917	220	672
Tram 3	11.671	20	35	169,274	220	769
Bus 1	4.297	30	9	22,389	200	112
Bus 2	10.556	30	21	17,911	200	90
Bus 3	7.828	30	16	17,911	100	179
Bus 4	5.597	30	11	17,911	100	179
Bus 5	5.617	30	11	23,255	100	233
Bus 6	10.887	30	22	23,255	100	233
Bus 7	3.149	30	6	23,255	100	233
Bus 8	11.165	30	22	15,180	100	152

6.3 Operation time of the Mass Transit System

As been discussed earlier, in Chapter 3, around 50% of the respondents prefer to have a system working from 5am till 12 mid night, i.e. 19 working hours. Furthermore, the traffic count for each site for 24 hours is considered here. It is quite interesting to mention that traffic counts between 12 mid nights and 5 early mornings are very low. It represented less than 2% of the total daily traffic flow. This support the earlier conclusion regarding the operation period from 5 am to 12 mid-night, over 24 hours of operation.

6.4 Management of Mass Transit System Routes

Managing the mass transit routes has influence on the system performance. Three main concerns will be discussed in this suction; number of riders, number of trips, headway time between one arrival and another and the generated income for each route considering both methods of riders' estimate.

Metro 1:

ANALYSIS OF EXCLUDED OPERATING HOURS

Metro one is the longest route and covers 13 counting sites as shown in Table 6.14. The percentage of vehicle flow for each hour between 12:01 to 4:59, shows to add to less than total 24 hours flow for the five hours. As mentioned earlier, they are excluded from the system operating hours. The total percentage of traffic flow in the four excluded hours is 3.4%.

Table 6.14: Metro 1 route (Excluded hours)

Metro 1		TOTAL DAILY TRAFFIC FOR THE EXCLUDED HOURS				
TIME		0:00	1:00	2:00	3:00	4:00
SITE Number	18	714	396	446	103	224
	19	380	206	143	72	227
	21	362	209	157	57	97
	27	407	207	152	129	166
	28	266	240	154	185	227
	31	571	335	180	81	223
	34	565	325	192	157	216
	36	233	135	84	55	60
	51	1351	926	531	318	312
	53	132	54	30	25	44
	55	471	267	200	124	106
	89	401	223	126	121	203
	90	761	459	288	177	182
TOTAL		6614	3982	2683	1604	2287
		PERCENTAGE OF TOTAL DAILY TRAFFIC FOR THE EXCLUDED HOURS				
SITE Number	18	0.019	0.010	0.012	0.003	0.006
	19	0.011	0.006	0.004	0.002	0.007
	21	0.013	0.008	0.006	0.002	0.003
	27	0.008	0.004	0.003	0.003	0.003
	28	0.005	0.004	0.003	0.003	0.004
	31	0.010	0.006	0.003	0.001	0.004
	34	0.015	0.008	0.005	0.004	0.006
	36	0.012	0.007	0.004	0.003	0.003
	51	0.019	0.013	0.008	0.005	0.004
	53	0.006	0.002	0.001	0.001	0.002
	55	0.019	0.011	0.008	0.005	0.004
	89	0.011	0.006	0.003	0.003	0.006
	90	0.017	0.011	0.007	0.004	0.004
AVERAGE PERCENTAGE		1.26%	0.74%	0.51%	0.30%	0.43%
ADJUSTED PERCENTAGE		3.4%				

MASS TRANSIT SYSTEM'S OPERATING HOURS

The operation period of the mass transit system, i.e. from 5 am to 12 mid-night, holds the remaining percentages of the traffic flow during a day. This is 96.75%, as shown in Table 6.15, for the balance of 19 hours. The total daily traffic flow it is redistributed to get an adjusted percentages for the included hours.

Table 6.15: Metro 1 route (Total Daily Traffic for operating hours)

Metro 1		TOTAL DAILY TRAFFIC FOR THE OPERATION HOURS																			
TIME		**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**	**12:00**	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**	**TOTAL**
SITE Number	18	424	1273	2169	2160	2108	2071	2013	2119	2273	2078	2033	2282	2282	2242	2135	2074	1840	1576	1336	38371
	19	498	2774	2884	1919	1737	1740	1528	1447	1493	1354	1792	2108	1970	1995	1806	1855	1537	1195	816	33476
	21	402	1303	1334	1144	790	1004	1370	1472	2021	2470	1566	1451	1673	1743	1684	1740	1512	1213	980	27754
	27	659	2999	4703	3125	2415	2413	2477	2385	2800	2967	2741	3099	3212	2700	2676	2438	1995	1388	907	49160
	28	929	3703	5513	3929	2690	2854	2827	2609	2874	2914	2966	3369	3517	2954	2919	2569	2198	1532	990	54928
	31	468	4663	4530	3514	3169	3122	2967	2985	3326	3153	3483	3781	3721	3354	3063	2829	2673	2279	1635	60105
	34	861	2245	2195	2003	2128	2128	2056	2043	1963	1925	2202	2443	2331	2422	2333	2022	1624	1262	942	38583
	36	235	1388	1445	781	926	1012	1009	1011	1159	778	1085	1463	1484	1392	1265	1190	928	679	461	20258
	51	1052	2990	3956	2928	3239	4036	4034	3766	3791	3439	3570	4070	4486	4201	4194	4032	3784	3222	2195	70423
	53	368	1014	1274	852	866	1049	1172	1139	1072	1094	1051	1228	1299	1248	1190	987	879	573	3530	22170
	55	350	917	837	775	950	1023	1182	1346	1892	2173	1259	1374	1528	1572	1597	1535	1425	1176	908	24987
	89	1037	2423	2659	1994	1962	1276	1475	1930	1931	2001	1939	2244	2268	1939	1977	1945	1763	1409	1035	36281
	90	742	1885	2118	1844	1940	2263	2416	2420	2621	2505	2145	2491	2621	2694	2682	2519	2372	2037	1502	43684
TOTAL		**8025**	**29577**	**35617**	**26968**	**24920**	**25991**	**26526**	**26672**	**29216**	**28851**	**27832**	**31403**	**32392**	**30456**	**29521**	**27735**	**24530**	**19541**	**17237**	**503010**
		PERCENTAGE OF TOTAL DAILY TRAFFIC FOR THE OPERATION HOURS																			
SITE Number	18	0.011	0.033	0.057	0.056	0.055	0.054	0.052	0.055	0.059	0.054	0.053	0.059	0.059	0.058	0.056	0.054	0.048	0.041	0.035	0.042
	19	0.015	0.083	0.086	0.057	0.052	0.052	0.046	0.043	0.045	0.040	0.054	0.063	0.059	0.060	0.054	0.055	0.046	0.036	0.024	0.042
	21	0.014	0.047	0.048	0.041	0.028	0.036	0.049	0.053	0.073	0.089	0.056	0.052	0.060	0.063	0.061	0.063	0.054	0.044	0.035	0.042
	27	0.013	0.061	0.096	0.064	0.049	0.049	0.050	0.049	0.057	0.060	0.056	0.063	0.065	0.055	0.054	0.050	0.041	0.028	0.018	0.042
	28	0.017	0.067	0.100	0.072	0.049	0.052	0.051	0.047	0.052	0.053	0.054	0.061	0.064	0.054	0.053	0.047	0.040	0.028	0.018	0.042
	31	0.008	0.078	0.075	0.058	0.053	0.052	0.049	0.050	0.055	0.052	0.058	0.063	0.062	0.056	0.051	0.047	0.044	0.038	0.027	0.042
	34	0.022	0.058	0.057	0.052	0.055	0.055	0.053	0.053	0.051	0.050	0.057	0.063	0.060	0.063	0.060	0.052	0.042	0.033	0.024	0.042
	36	0.012	0.069	0.071	0.039	0.046	0.050	0.050	0.050	0.057	0.038	0.054	0.072	0.073	0.069	0.062	0.059	0.046	0.034	0.023	0.042
	51	0.015	0.042	0.056	0.042	0.046	0.057	0.057	0.053	0.054	0.049	0.051	0.058	0.064	0.060	0.060	0.057	0.054	0.046	0.031	0.042
	53	0.017	0.046	0.057	0.038	0.039	0.047	0.053	0.051	0.048	0.049	0.047	0.055	0.059	0.056	0.054	0.045	0.040	0.026	0.159	0.042
	55	0.014	0.037	0.033	0.031	0.038	0.041	0.047	0.054	0.076	0.087	0.050	0.055	0.061	0.063	0.064	0.061	0.057	0.047	0.036	0.042
	89	0.029	0.067	0.073	0.055	0.054	0.035	0.041	0.053	0.053	0.055	0.053	0.062	0.063	0.053	0.054	0.054	0.049	0.039	0.029	0.042
	90	0.017	0.043	0.048	0.042	0.044	0.052	0.055	0.055	0.060	0.057	0.049	0.057	0.060	0.062	0.061	0.058	0.054	0.047	0.034	0.042
AVERAGE PERCENTAGE		1.57%	5.62%	6.61%	4.98%	4.68%	4.87%	5.04%	5.13%	5.70%	5.66%	5.33%	6.04%	6.23%	5.93%	5.73%	5.39%	4.73%	3.73%	3.81%	**96.75%**
ADJ. PERCENTAGE		**1.62%**	**5.81%**	**6.83%**	**5.14%**	**4.84%**	**5.03%**	**5.21%**	**5.31%**	**5.89%**	**5.85%**	**5.50%**	**6.24%**	**6.44%**	**6.13%**	**5.92%**	**5.58%**	**4.89%**	**3.86%**	**3.94%**	**100.00%**

ADJUSTED NUMBER OF RIDERS AND TRIPS

As discussed previously (Table 6.5), the total number of daily riders in "metro one" is 165720 persons. This leads to a total number of trips of 276 trips (Table 6.9). The calculation was based on 19 hours' percentage of flow for the operation hours which is 96.75%. As a result the adjusted number of riders is 160157 in (Metro 1) route and 267 trips. The adjusted number of riders and trips distributed according to their adjusted percentage in each operation hour. These are summarized in (Table 6.16).

HEADWAY TIME AND NUMBER OF BUGGIES

The total round trip time for one trip in (Metro 1) is 55 minutes as it discussed previously in (Table 6.9). The corresponding headway time is the waiting period between one trip and another. The headway time is calculated by the dividing the total trip time for each route by the number of trips in each hour, as follows:

(Headway time = Route time/Number of trips)

The headway time should also be adjusted to suite the users. Accordingly the headway time is adjusted for each hour of the operation by either increasing or decreasing the number of connected buggies in each hour as shown in (Table 6.17).

Table 6.16: Adjusted number of riders and trips (Metro 1)

Metro 1	OPERATION HOURS																			
TIME	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**	**12:00**	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**	**TOTAL**
AVERAGE PERCENTAGE	1.57 %	5.62 %	6.61 %	4.98 %	4.68 %	4.87 %	5.04 %	5.13 %	5.70 %	5.66 %	5.33 %	6.04 %	6.23 %	5.93 %	5.73 %	5.39 %	4.73 %	3.73 %	3.81 %	96.75%
ADJUSTED PERCENTAGE	1.62 %	5.81 %	6.83 %	5.14 %	4.84 %	5.03 %	5.21 %	5.31 %	5.89 %	5.85 %	5.50 %	6.24 %	6.44 %	6.13 %	5.92 %	5.58 %	4.89 %	3.86 %	3.94 %	100.00 %
ADJ. N0. OF RIDERS	**160157**																			
NO. OF RIDERs	2592	9302	10941	8239	7749	8057	8343	8497	9429	9364	8815	9990	10308	9815	9483	8929	7826	6174	6303	160157
ADJUSTED N0. OF TRIPS	**267**																			
N0. OF TRIPS	4	16	18	14	13	13	14	14	16	16	15	17	17	16	16	15	13	10	11	267

Table 6.17: Headway time and number of buggies (Metro 1)

Metro 1	OPERATION HOURS																			
TIME	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**	**12:00**	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**	**TOTAL**
HEADWAY TIME (min)	13	4	3	4	4	4	4	4	3	4	4	3	3	3	3	4	4	5	5	82
NO. OF BUGGIE	1	2	3	2	2	2	2	2	3	2	2	3	3	3	3	2	2	1	2	42
ADJ. HEADWAY TIME (min)	13	7	9	8	8	8	8	8	10	7	7	10	10	10	10	7	8	5	10	165

Generated Income

As discussed earlier in Chapter 3 (Figure 3.35 and Figure 3.36), 35% of the respondents will use the public transport system all the time if the ticket price is 500 fils, while 30% of the respondents will use the system all the time if the ticket price is 750 fils. The latter holds the highest respondents. It is assumed that if the riders are going to use the ticket all the time for round trips the ticket price will become half the prescribed price. However, if the rider will be using the ticket to reach the work, for example, as only a single trip; the ticket price will be charged as a full ticket price, as shown in Table 6.18.

The generated income from (Metro 1) route for the various operating hours are shown in Table 6.19. The total daily income will sum up to BD 110834 if the ticket price is 750 fils for one day as shown in Table 6.19 . It is BD 68382 if the ticket price is 500 fils. The details for all other routes in Appendix (4).

Table 6.18: Ticketing price

	If ticket price is 500 fils per ride			If ticket price is 750 fils per ride		
	percentage from questionnaire	adjusted percentage	adjusted ticket price (BhD)	percentage from questionnaire	adjusted percentage	adjusted ticket price (BhD)
using the MTS all the time (round trip) half the price	35.1%	74%	0.316	29.8%	63%	0.512
using for work only (single trip) full the price	12.6%	26%		17.2%	37%	

Table 6.19: Income from (Metro 1) route

Metro 1	OPERATION HOURS																		
TIME	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**	**12:00**	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**	TOTAL
INCOME (750 FILS)	1794	6437	7572	5702	5362	5576	5773	5880	6525	6480	6101	6914	7133	6792	6563	6179	5416	4273	4362	110834
INCOME (500 FILS)	1107	3972	4672	3518	3308	3440	3562	3628	4026	3998	3764	4266	4401	4191	4049	3812	3342	2636	2691	68382

Summary of Results

1- Number of riders considering both methods

Table 3.20 to Table 6.21 summarize the of mass transit system network considering both methods for predicting the number of riders, using the three scenarios of annual percentage shift to Mass Transit System, i.e. 1.5% (Table 6.20), 2% (Table 6.21) and 2.5% (Table 6.22). The tables show the summary of number of riders, total number of trips in each route and the income on both ticketing system.

Table 6.20: Summary of Mass transit system routes, 1.5% reduction on both methods, in term of distance, speed, travel time, number of riders, number of trips and income

MTS	Distance Km	Speed kph	Route Time min.	Method 1				Method 2			
				Number of Riders	**Number of Trips**	**Income 750 fils**	**Income 500 fils**	**Number of Riders**	**Number of Trips**	**Income 750 fils**	**Income 500 fils**
Metro 1	55	60	55	165720	276	82038	50616	223890	373	110834	68382
Metro 2	34	60	34	230567	384	70594	114419	317191	529	97116	157406
Tram 1	19	20	56	100873	459	30505	49443	134325	611	40622	65839
Tram 2	29	20	86	108078	491	33067	53595	147917	672	45256	73350
Tram 3	12	20	35	122489	557	37981	61560	169274	769	52489	85073
Bus 1	4	30	9	14410	144	4397	7126	22389	112	6831	11071
Bus 2	11	30	21	37467	375	11439	18540	17911	90	5468	8863
Bus 3	8	30	16	25939	259	7759	12576	17911	179	5357	8683
Bus 4	6	30	11	7205	72	2225	3607	17911	179	5532	8966
Bus 5	6	30	11	11528	115	3602	5839	23255	233	7267	11778
Bus 6	11	30	22	17293	173	5363	8692	23255	233	7212	11690
Bus 7	3	30	6	14410	144	4395	7124	23255	233	7093	11496
Bus 8	11	30	22	15851	159	4848	7857	15180	152	4642	7524
			Total	**871,832**	**3608**	**298,213**	**400992**	**1,153,665**	**4363**	**395,718**	**530,123**

Table 6.21: Summary of Mass transit system routes, 2% reduction on both methods, in term of distance, speed, travel time, number of riders, number of trips and income

MTS	Distance Km	Speed Km/hr.	Route Time min.	Method 1				Method 2			
				Number of Riders	**Number of Trips**	**Income 750 fils**	**Income 500 fils**	**Number of Riders**	**Number of Trips**	**Income 750 fils**	**Income 500 fils**
Metro 1	55	60	55	214585	358	106228	65540	289906	483	143515	88546
Metro 2	34	60	34	298553	498	148156	91409	410719	685	203819	125752
Tram 1	19	20	56	130617	594	64022	39500	173932	791	85253	52599
Tram 2	29	20	86	139947	636	69398	42817	191533	871	94979	58600
Tram 3	12	20	35	158606	721	79712	49181	219187	996	110158	67965
Bus 1	4	30	9	18660	187	9227	5693	28991	145	14336	8845
Bus 2	11	30	21	48515	485	24007	14812	23192	116	11476	7080
Bus 3	8	30	16	33587	336	16284	10047	23192	232	11244	6937
Bus 4	6	30	11	9330	93	4670	2882	23192	232	11610	7163
Bus 5	6	30	11	14928	149	7560	4664	30113	301	15251	9409
Bus 6	11	30	22	22391	224	11255	6944	30113	301	15137	9339
Bus 7	3	30	6	18660	187	9224	5691	30113	301	14886	9184
Bus 8	11	30	22	20526	205	10174	6277	19656	197	9743	6011
			Total	**1,128,904**	**4672**	**559,918**	**345457**	**1,493,837**	**5650**	**741,405**	**457,431**

Table 6.22: Summary of Mass transit system routes, 2.5% reduction on both methods, in term of distance, speed, travel time, number of riders, number of trips and income

MTS	Distance Km	Speed Km/hr.	Route Time min.	Method 1				Method 2			
				Number of Riders	**Number of Trips**	**Income 750 fils**	**Income 500 fils**	**Number of Riders**	**Number of Trips**	**Income 750 fils**	**Income 500 fils**
Metro 1	55	60	55	260548	434	128981	79579	352003	587	174255	107511
Metro 2	34	60	34	362501	604	179891	110989	498693	831	247476	152687
Tram 1	19	20	56	158594	721	77735	47961	211187	960	103514	63866
Tram 2	29	20	86	169922	772	84263	51988	232558	1057	115323	71152
Tram 3	12	20	35	192579	875	96786	59715	266135	1210	133754	82523
Bus 1	4	30	9	22656	227	11203	6912	35200	176	17406	10739
Bus 2	11	30	21	58906	589	29149	17984	28159	141	13934	8597
Bus 3	8	30	16	40781	408	19771	12199	28159	282	13652	8423
Bus 4	6	30	11	11328	113	5671	3499	28159	282	14096	8697
Bus 5	6	30	11	18125	181	9180	5664	36563	366	18517	11425
Bus 6	11	30	22	27188	272	13666	8432	36563	366	18379	11339
Bus 7	3	30	6	22656	227	11200	6910	36563	366	18074	11151
Bus 8	11	30	22	24922	249	12353	7622	23866	239	11830	7299
			Total	**1,370,708**	**5673**	**679,848**	**419452**	**1,813,808**	**6860**	**900,209**	**555,410**

2- Daily and yearly income considering both methods

Table 6.23 and Table 6.24 shows the summaries of daily and yearly income of mass transit system network in both methods of calculation, the number of riders and trips in all scenarios of reduction percentages.

Table 6.23: Summary of Generated Income, Method 1, all scenarios

	Percentage annual shift to MTS		1.50%	2%	2.50%
Method 1	**Number of Riders During Year 2030**		871,832	1,128,904	1,370,708
	Number of Trips During Year 2030		3,608	4,672	5,673
	Income (BD) for ticket price 750 fils/year During Year 2030	Daily	298,213	559,918	679,848
		Yearly	108,847,652	204,369,901	248,144,694
	Income (BD) if ticket price 500 fils/year During Year 2030	Daily	400,992	345,457	419,452
		Yearly	146,362,111	126,091,973	153,100,108

Table 6.24: Summary of Income, Method 2, all scenarios

	Percentage annual shift to MTS		1.50%	2%	2.50%
Method 2	**Number of Riders During Year 2030**		1,153,665	1,493,837	1,813,808
	Number of Trips During Year 2030		4,363	5,650	6,860
	Income (BD) for ticket price 750 fils/year During Year 2030	Daily	395,718	741,405	900,209
		Yearly	144,437,082	270,612,797	328,576,416
	Income (BD) if ticket price 500 fils/year During Year 2030	Daily	530,123	457,431	457,431
		Yearly	193,494,716	166,962,460	166,962,460

CHAPTER 7

Conclusion and Recommendation

7.1 Conclusions

7.2 Recommendation

CHAPTER 7

7. Conclusion and Recommendation

7.1 Conclusions

The Importance of a Mass Transit System in Bahrain

The necessity of sustainable Mass Transit System in the Kingdom can be referred to the rapid increase in traffic all over the Kingdom and the corresponding traffic problems associated with it, such as traffic jams, high delays, cost and pollution. The vehicular daily trips and the vehicle population are expected to triple by the year 2030. Similarly, the population is expected to double by 2030 compared with the current figures. The rapid urban development and land use require sufficient means of mobility; which should provide sufficient support to such development. Consequently, the fuel consumption will also sharply increase, along with its negative cost and environment consequences. The current huge investment on road infrastructure also calls for proper investment in mass transit system. The insufficient public busses and poor quality and operation also call for drastic change in the system to change the behavior to become less auto dependence users. The public opinions confirm the necessity of better modes of public transit system.

Data Modeling and Future Prediction

The study also developed many models to predict the future growth in population, vehicles, total daily traffic and peak hour traffic on the important corridors and between the cities, fuel consumption based on available

historical data. As a result, a Microsoft Excel Spreadsheet is created to determine the necessary data for a target year of 2030.

Procedural Frame Work for Mass Transit System

A procedural framework is developed here for a mass transit system based on Microsoft Excel Spreadsheet. It covers the design of a network, the planning and management considering both Macro and micro level of data.

Vehicle Shifting to Mass Transit System

The annual percentage shifts in the users from vehicles to Mass Transit System are based on three scenarios. These include 1.5%, 2% and 2.5%. The predicted total daily traffic all over the Kingdom sums to 1.6 million by the year 2030. An annual 1.5% shift from cars to Mass Transit System, between 2017 (base year) and 2030 (target year) is around 5 million daily trips, which is 18% shift to mass transit system. An annual 2.5% shift will lead to 28% shift for the target year.

Planning Network Design

From the data gathered and analyzed, the study enhances the importance of the provision of sustainable mass transit system in Bahrain for the entire governorate. The study proposes routes for three modes of Mass Transit System, Metro, Tram and Bus rapid transit. They were assigned to various routes as per their capacities and average travel speed.

Estimated Total Number of Rider and Number of Trips for Each Route

Two methods are considered to estimate the total number of riders. The total number of registered vehicles, the current number of public and private buses, and the arriving vehicles from King Fahad Causeway are the basis of the first method. The total daily traffic on each considered route for the use of metro and tram is the basis of the second method. The number of riders for bus routes assumed as a percentage from the total daily traffic of the nearest metro or/and tram routes. All these number should be taken after the prediction on year 2030.

Three types of Mass Transit System are proposed. Metro will have two loops, the first route covers the Northern area and the other is to the south of the first one. Tram will be laid in three locations; the first route covers the northern area of Bahrain. The second route covers the central area and the last route covers the southern area of Bahrain reaching to Bahrain University. Bus Rapid Transit will have eight locations; the first route covers the internal areas of Muharraq city. Two main routes covers Manama city, the fourth route covers Buddaya city in the western side. The other four bus routes cover the middle area; which include Isa Town, Riffa and the southern area.

The total number of riders in the proposed network according to the first method is 871832; while the total number of rider in the second method is 1153665.

Generated Income

The generated daily income if the ticket price is 500 fils according to the first scenario (1.5%) is around BD 300,000 considering the first method while it is around BD 400,000 considering the second method.

If the ticket price is 750 fils, the generated daily income according to the first scenario (1.5%) is around BD 400,000 considering the first method while it is around BD 530,000 considering the second method.

7.2 Recommendations

1. In order to have sufficient system, proper advertisement and marketing should be considered to attract people to use the system and to change the road users' behavior toward such types of transportation modes.
2. Further studies to identify the best model for the system in terms of being elevated from the ground or underground should be carried out.
3. The system should encourage student utilize the system for the educational purpose. So that the new generations will be familiar to use the mass transit system.
4. The system should be properly considered the local, the culture and the tradition needs.
5. The available taxis and public busses should be integrated with the mass transit system.
6. Provisions of proper services as toilets, coffee shops, communication tool in the main stations are necessary.
7. Continuous electronic information system is necessary for the passengers' use. This should include arrival times, departure times and trip duration.
8. Ticket price to be around 500 to 750 fils for a validity period of 2 hours is acceptable by the users.
9. The system should prevent any headway of over 10 minutes between one arrival and another.

List of References

[1] http://en.wikipedia.org/wiki/Bahrain, 2014

[2] http://en.wikipedia.org/wiki/Public_transport, 2014

[3] Hashim Al-Madani (2001), Mass transport in Arab countries.

[4] C.Jotin khisty, B. Kent lall (1997 second edition) "transportation engineering an introduction".

[5] C.S. Papa costas. P.D. Prevedovros (2001 Second Edition) "Transportation Engineering and planning".

[6] C.Jotin khisty, B. Kent lall (1997 second edition) "transportation engineering an introduction" .

[7] Al Madani, H., "Mass Transit System in Arabic and Islamic Words: Potential and Requirements", 23rd Arab Engineering conference, 2009, Algeria.

[8] Daganzo, C. F., 2010. Public Transportation Systems: Basic Principles of System Design, Operations Planning and Real-Time Control. University of California at Berkeley.

[9] Belwal, R.and Belwal, S., (2010) Public Transportation Services in Oman: A Study of Public Perceptions. Journal of Public Transportation, 13(4).

[10] Satiennam, T., Fukuda, A. and Oshima, R., (2006) Strategies Enhancing Bus Rapid Transit Development In Asean. Graduate School of Science & Technology, Nihon University.

[11] Bertolini, L., Clercq, F.L., & Straatemeier, T. (2008) Editorial Urban transportation planning in transition. Transport Policy, 15, 69-72.

[12] Murray, A.T., Davis, R., Stimson, R.J., (1998) Public Transportation Access. Transpn Res., 3(5), 319-328.

[13] Traffic Accident Facts in Kingdom of Bahrain (1980-2012)

[14] Directorate of Statics, Central Informatics Organization, "Statistical Abstract", Years, 1981, 1991, 2001, 2011, Bahrain.

[15] Litman, T., (2014) Transit Price Elasticities and Cross-Elasticities. Journal of Public Transportation, 7(2).

Appendices

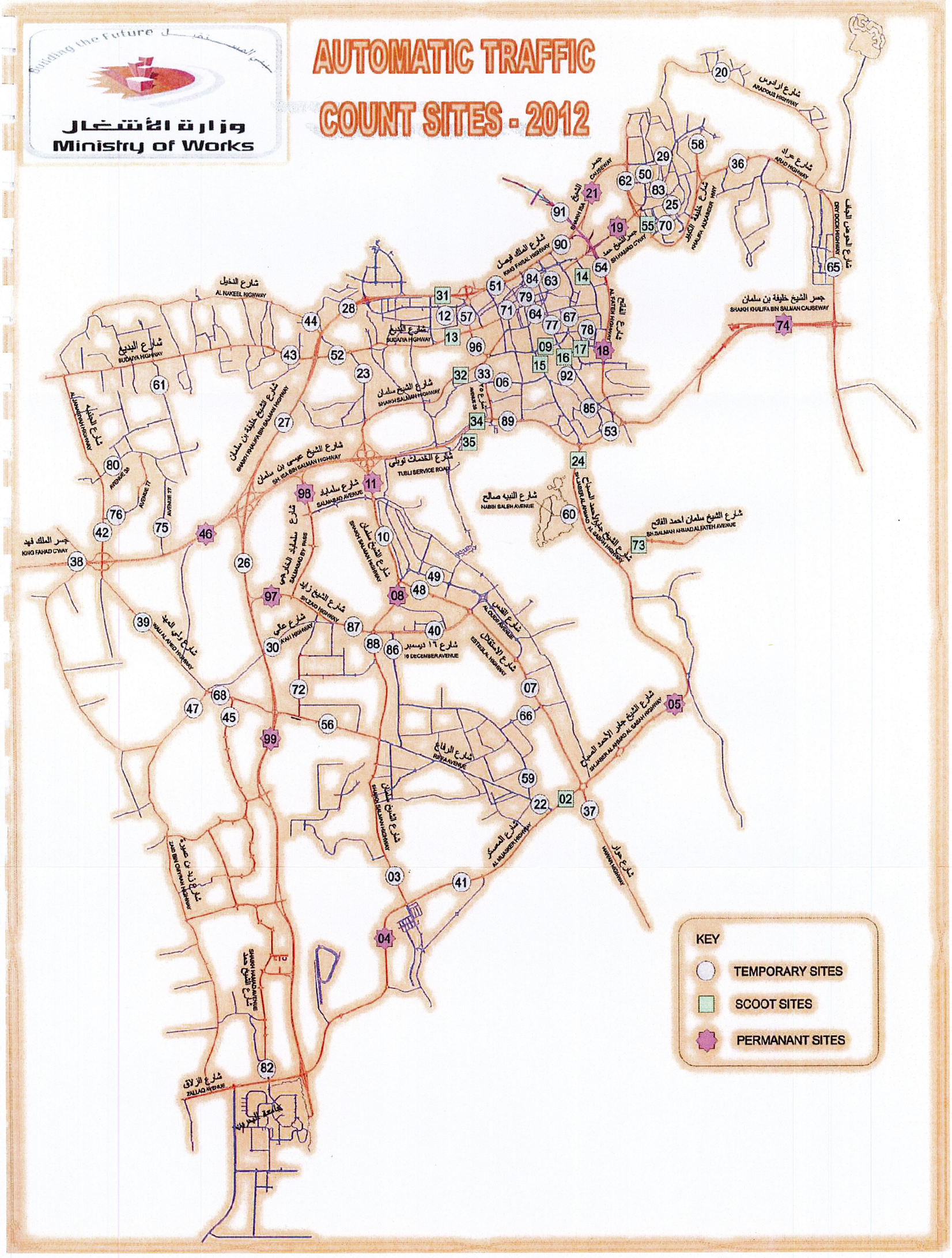
Appendix 1: Automatic Traffic Count Sites Data

Traffic Planning & Studies

Building the future

وزارة الأشغال
Ministry of Works

AUTOMATIC TRAFFIC COUNT SITES - 2012



AUTOMATIC TRAFFIC COUNT {1980 - 2006}

AVERAGE DAILY TRAFFIC FLOW, IN & OUT OF MANAMA CITY

SITE NO.	LOCATION	DIRECTIONS		1980	1984	1986	1987	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2003	2004	2005	2006
13	BUDAIYA HIGHWAY	D. (1)	EASTBOUND	18134	17850	23000	23500	16300	18400	15236	15450		18411	11285	16936	18688	22913	19993	24384	23183	24912	25302
	EAST TX.25	D. (2)	WESTBOUND	16612	19850	25600	21200	16700	21200	16529	16077		17890	16373	16830	18260	18760	18585	22996	21280	20756	21085
19	SH HAMAD C.WAY	D. (1)	WESTBOUND	37096	38000	41000	40400	39400	40200		41553	40631	56506	43710	45711	28308	29398	29523	32766	35378	38181	33476
		D. (2)	EASTBOUND	38288	38000	39000	40300	40000	39200		54929	49107	42798	44852	46270	33912	35037	35175	38215	40926	41592	36641
21	SHAIKH ISA CAUSEWAY	D. (1)	WESTBOUND													11810	23672	21512	38179	34576	30163	27754
		D. (2)	EASTBOUND													12164	18014	16183	38969	28440	26300	28322
24	MAJLIS AL TAWOON HIGHWAY	D. (1)	NORTHBOUND	17532	10150		17400	17350	19700	21098	24610	24386	25734	25205	22967	24188	26163	31261	29083	25211	35470	34520
	(NORTH X.42)	D. (2)	SOUTHBOUND	18155	10500		17000	18000	20900	20054	19839	21807	24017	22370	23442	23492	26060	27206	31632	29491	37904	35960
31	SH. KHALIFA BIN SALMAN HWY.	D. (1)	EASTBOUND	10353				9000		14005			20701	21269	12367	26869	28206	30283	40076		64316	60080
	NEAR SANABIS	D. (2)	WESTBOUND	9155				10150		16789			23104	22300	13670	28444	28750	32032	41309		48122	45205
32	SH. SALMAN HIGHWAY	D. (1)	EASTBOUND	19773	10700	19000		16750	18400	16856	18844	18767	18779	17971	56601	19726	18251	32137	33113	27676	33771	12723
	NEAR TS.26	D. (2)	WESTBOUND	16949	17650	17600		19600	21200	19495	21989	22697	17889	25839	20564	22810	20977	22727	24851	22173	27228	26743
34	SH.ISA B.SALMAN HIGHWAY	D. (1)	EASTBOUND		13250	21000	19400	22550	23600	23722	25651	25645	27188	29051	28715	30472	38747	29866	35721	33712	40834	38584
	NEAR TS.28	D. (2)	WESTBOUND		8200	18000	22900	17100	17800	17784	18730	17924	20873	21875	21364	22076	25025	23967	27531	26855	35502	34048
35	TUBLI SERVICE ROAD	D. (1)	EASTBOUND			7000	6800	8300	7500	9221	8450	8706	8599	10276	11552	12088	12566	13416	12536	11644	11283	12102
	NEAR TS.28	D. (2)	WESTBOUND			7300	9400	6650	7200	9982	11579	8736	9094	11002	12483	13259	13638	14692	16118	15660	17536	15086
74	SH.KHALIFA BIN SALMAN C.WAY.	D. (1)	WESTBOUND																	8797	16790	14363
		D. (2)	EASTBOUND																	10108	10108	15579

AUTOMATIC TRAFFIC COUNT { 1980 - 2006 }

SITE NO.	LOCATION	DIRECTIONS		1980	1984	1986	1987	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2003	2004	2005	2006
2	MUASKAR HIGHWAY	D. (1)	EASTBOUND						11300			12474	11956	12268	12293	12985	13264	14709	16846	19015	20608	12660
	NEAR ALBA RDT.	D. (2)	WESTBOUND						11800			12542	12375	12668	13061	13353	13872	14101	16117	19159	21622	17229
3	SHAIKH SALMAN HIGHWAY	D. (1)	NORTHBOUND	4140				4050			6663	1003	8117	8655	7523	7684	8120	7232	12738	14077	14169	10249
	NORTH AWALI RDT.	D. (2)	SOUTHBOUND	4282				4200			6202	8577	8142	9042	7994	8841	8727	7588	14569	15789	15329	12029
4	AL ZALAQ HEY	D. (1)	EASTBOUND	2934				3000			6235	6822	7372	7576	7245	8103	9424	7120	7287	8116	9681	12392
	EAST SAKAIR AVE	D. (2)	WESTBOUND	3057				3150			6290	6490	7304	7928	7422	6676	3533	8597	11913	12812	11864	13970
5	MAJLIS AL TOWN	D. (1)	EASTBOUND	12967		16500		13350	17400	16743		19732	17650	21551	20205	20050	25998	26236	29980	39346	41453	35351
	EAST MAMEER PELICAN	D. (2)	WESTBOUND	15977		18500		16350	18300	17530		20968	14093	21689	13793	24218	26993	27252	32827	41885	46626	25954
6	OMAN AVENUE	D. (1)	EASTBOUND												13214	12279	14180	14320	9545	18996	23400	17539
	WEST TS.22	D. (2)	WESTBOUND												6904	7165	7927	8255	12842	6553	16749	14098
7	ESTEGLAL HWY	D. (1)	NORTHBOUND	8571				8250			13591	13619	14249	15927	15835	17384	17799	16731	30686	26529	42258	30936
	NORTH SANAD RDT.	D. (2)	SOUTHBOUND	8517				8950			12750	16541	14689	14993	15461	16645	17841	19484	30954	35005	43927	24969
8	SHAIKH SALMAN HIGHWAY	D. (1)	NORTHBOUND	24694			20200	24200		20403	22859	24259	24791	24416	21840	25183	23556	24450	25661	28061	27905	23176
	SOUTH ISA TOWN GATE RDT.	D. (2)	SOUTHBOUND	22690			21900	22200		17724	15416	21305	17662	19424	21682	23474	22367	23745	26991	30471	30420	20345
9	SALMANIYA AVENUE	D. (1)	EASTBOUND											13355	14745	24386	24646	25591	32474	29626	28325	27837
	NEAR TS.6	D. (2)	WESTBOUND											17199	18004	22581	22921	25297	36462	35723	28622	27271
10	SHAIKH SALMAN HIGHWAY	D. (1)	NORTHBOUND																16205	46024	54849	27405
	SOUTH BAHRAIN GAS RDT.	D. (2)	SOUTHBOUND																16705	49115	59061	33715
11	SHAIKH SALMAN HIGHWAY	D. (1)	NORTHBOUND	34269	2800			33250			36085	32637	40357	38269	23699	49222	50078	50466	38179	49953	52676	44687
	NORTH BAHRAIN GAS RDT.	D. (2)	SOUTHBOUND	35814	28050			34750			33928	37185	34909	29905	31777	45813	47292	46112	38969	50344	64835	57793
13	BUDAIYA HIGHWAY	D. (1)	EASTBOUND	18134	17850	23000	23500	16300	18400	15236	15450		18411	11285	16936	18688	22913	19993	24384	23183	24912	25302
	EAST TX.25	D. (2)	WESTBOUND	16612	19850	25600	21200	16700	21200	16529	16077		17890	16373	16830	18260	18760	18585	22996	21280	20756	21085
14	EXHIBITIONS AVENUE	D. (1)	NORTHBOUND											11380	13240	15601	15816	15939	17351	15758	17501	18418
	NEAR IMMIGRATION & PASPORTS	D. (2)	SOUTHBOUND											11285	15612	17976	18576	24449	17816	18109	21668	19514
15	KUWAIT AVENUE	D. (1)	NORTHBOUND	8516	4850			17300					17492	20216	27790	21173	22935	22513	24378	22939	41289	25512
	SOUTH TS.6	D. (2)	SOUTHBOUND	17597	5250			8350					12622	12537	13140	13870	14467	14857	15356	14930	20095	18973
16	SH ISA AVENUE	D. (1)	NORTHBOUND	11785				8750		8333		11202	25684	11126	11082	11241	11685	11883	11849	11408	14328	15307
	SOUTH ANDALUS RDT.	D. (2)	SOUTHBOUND	8957				11550		686		11406	19671	10730	11369	12514	13561	13388	14448	14403	19466	15945
17	BANI OTBAH AVE	D. (1)	NORTHBOUND	6678				6350		5656	6125	7158	5955	5968	6026	5946	6248	6368	6865	6654	8060	14408
	NORTH TS.43	D. (2)	SOUTHBOUND	6510				6000		6743	7231	7578	6379	6024	6063	6627	6259	6484	7154	6700	8138	14197
18	ALFATEH HWY	D. (1)	NORTHBOUND	20110		25300		17000	27700	22129	22004	24223	26494	27034	31181	23221	32603	30270	36064	46051	34654	38471
	NEAR AL FATEH MOSQUS	D. (2)	SOUTHBOUND	18994		23000		19000	26100	21813	23413	23535	20559	25036	27859	17566	37826	36221	33740	42990	34234	37871
19	SH HAMAD C.WAY	D. (1)	WESTBOUND	37096	38000	41000	40400	39400	40200		41553	40631	56506	43710	45711	28308	29398	29523	32766	35378	38181	33476
		D. (2)	EASTBOUND	38288	38000	39000	40300	40000	39200		54929	49107	42798	44852	46270	33912	35037	35175	38215	40926	41592	36641
20	ARADOUS HWY. - NEAR AD DAIR	D. (1)	WESTBOUND	1819				1950			988	1826	3808	2661	3985	2971	4295	8272	6733	12705	25862	15522
	(NEAR SCHOOL)	D. (2)	EASTBOUND	2019				1800			2193	1758	3488	2641	3886	2887	4529	3903	6692	12513	18316	12759
21	SHAIKH ISA CAUSEWAY	D. (1)	WESTBOUND													11810	23672	21512	38179	34576	30163	27754
		D. (2)	EASTBOUND													12164	18014	16183	38969	28440	26300	28322
22	RIFFA AVENUE	D. (1)	WESTBOUND			6000	5000	7950	7800	8028	8178		8734	8785	8037	8564	9292	8669	10644	8435	16760	13218
	(NEAR MUASKAR HWY.)	D. (2)	EASTBOUND			7700	5700	7850	8400	8410	8326		8840	9069	7574	8982	8848	8294	8225	13464	16897	14071
23	SEHLA AVENUE	D. (1)	NORTHBOUND					12300		12407					14863	15836	17309	18162	19234	22402	25019	23541
	NORTH SEHLA RDT.	D. (2)	SOUTHBOUND					15050		13000					15760	16551	17073	14709	16846	19015	20608	18727
24	MAJLIS AL TAWOON HIGHWAY	D. (1)	NORTHBOUND	17532	10150		17400	17350	19700	21098	24610	24386	25734	25205	22967	24188	26163	31261	29083	25211	35470	34520
	(NORTH X.42)	D. (2)	SOUTHBOUND	18155	10500		17000	18000	20900	20054	19839	21807	24017	22370	23442	23492	26060	27206	31632	29491	37904	35960
25	SH.ISA AVENUE (MUHARRAQ)	D. (1)	NORTHBOUND													6130		5966	13933	13298	9596	7403

AUTOMATIC TRAFFIC COUNT (1980 - 2006)

SITE NO.	LOCATION	DIRECTIONS		1980	1984	1986	1987	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2003	2004	2005	2006
26	SH. KHALIFA BIN SALMAN HWY.	D. (1)	NORTHBOUND						8400				12267	13312	12546	15141	14260	14125	24945	24640	47017	33862
	NEAR CAMAL CROSSING	D. (2)	SOUTHBOUND						7900				12544	13498	12994	12707	14583	16448	24354	24054	43112	35179
27	SH. KHALIFA BIN SALMAN HWY.	D. (1)	NORTHBOUND					8850	13800	8177			10985	9065	11343	12509	13378	12634	38729	31178	57752	49133
	SOUTH BUDAIYA FLYOVER	D. (2)	SOUTHBOUND					11050	16900	720			12580	11247	13002	13750	15464	18656	40617	41067	58590	47979
28	SH. KHALIFA BIN SALMAN HWY.	D. (1)	NORTHBOUND					2850					16908	18984	18625	20560	21365	24009	49262	33159	52766	55125
	NORTH BUDAIYA FLYOVER	D. (2)	SOUTHBOUND					4050					21523	21056	7386	16450	23109	27227	53700	51638	49591	49611
29	AIRPORT AVENUE	D. (1)	WESTBOUND							12250	11495	13658	16042	14534	14936	16334	16772	17230	24614	26834	29646	25664
	EAST X.7	D. (2)	EASTBOUND							9689	10738	12018	11767	11802	11439	14875	14759	15536	14032	21738	27833	23881
30	A'ALI - BURI AVE.	D. (1)	EASTBOUND											1276	1592	1843	1510	2380	7979	7852	11061	9287
	WEST TANNAL	D. (2)	WESTBOUND											1300	1726	1329	2435	2225	4574	9379	12788	5651
31	SH. KHALIFA BIN SALMAN HWY.	D. (1)	EASTBOUND	10353				9000		14005			20701	21269	12367	26869	28206	30283	40076		64316	60080
	NEAR SANABIS	D. (2)	WESTBOUND	9155				10150		16789			23104	22300	13670	28444	28750	32032	41309		48122	45205
32	SH. SALMAN HIGHWAY	D. (1)	EASTBOUND	19773	10700	19000		16750	18400	16856	18844	18767	18779	17971	56601	19726	18251	32137	33113	27676	33771	12723
	NEAR TS.26	D. (2)	WESTBOUND	16949	17650	17600		19600	21200	19495	21989	22697	17889	25839	20564	22810	20977	22727	24851	22173	27228	26743
33	AVENUE 35	D. (1)	NORTHBOUND	15067	8600			17850			15875	7832	17758	16634	18158	19129	25193	20847	26642	26677	31219	25500
	(NEAR ZINJ)	D. (2)	SOUTHBOUND	18031	8400			14900			9935	12480	12470	13815	14077	14689	14979	15437	21560	22569	26506	20693
34	SH.ISA B.SALMAN HIGHWAY	D. (1)	EASTBOUND		13250	21000	19400	22550	23600	23722	25651	25645	27188	29051	28715	30472	38747	29866	35721	33712	40834	38584
	NEAR TS.28	D. (2)	WESTBOUND		8200	18000	22900	17100	17800	17784	18730	17924	20873	21875	21364	22076	25025	23967	27531	26855	35502	34048
35	TUBLI SERVICE ROAD	D. (1)	EASTBOUND			7000	6800	8300	7500	9221	8450	8706	8599	10276	11552	12088	12566	13416	12536	11644	11283	12102
	NEAR TS.28	D. (2)	WESTBOUND			7300	9400	6650	7200	9982	11579	8736	9094	11002	12483	13259	13638	14692	16118	15660	17536	15086
36	ARAD HIGWAY	D. (1)	WESTBOUND	14044			13700	13900			9694	8308	12946	13773	14826	15688	16346	16498	26191	26151	22792	20256
	EAST X.22	D. (2)	EASTBOUND	13973			13500	13850			9421	8424	12807	12438	14591	15163	15116	11439	26269	28471	27189	24256
37	HAWAR HIGHWAY	D. (1)	NORTHBOUND	5516			10100	5350	7000		6946		6118	5702	6821	6257	7191	7278	12010	13691	15295	14232
	NEAR ALBA RDT.	D. (2)	SOUTHBOUND	5225			10300	5050	6600		4031		6505	6316	7285	6731	7814	7681	18687	13932	13328	16299
38	KING FAHAD C.WAY	D. (1)	EASTBOUND	1766				1750			3120		3424	3142	2688	4242	4396	3976	7712	8256	9737	9095
	NEAR CAUSEWAY GATE	D. (2)	WESTBOUND	1874				1850			3238		3610	3335	2796	4571	4416	3829	6621	6323	9318	10538
39	WALI AL AHEDHWY.	D. (1)	NORTHBOUND	6634		10000		6450	11100		4789	7529		6060	6832	5928	6349	9402	17152	19224	32189	19392
	NEAR HAMALA	D. (2)	SOUTHBOUND	6132		9800		5950	8500		4606	5672	-	5924	5253	6195	6376	3856	22476	18656	24407	17320
40	16 DECEBER HWY.	D. (1)	EASTBOUND	4618				4550			3443	6536	7092	6211	7760	7396	7693	8483	13249	14097	18057	17002
	WEST TV. RDT.	D. (2)	WESTBOUND	4138				5000			5153	4303	7190	6594	7321	6827	7697	8529	12718	14020	18616	16096
41	MUASKAR HWY	D. (1)	NORTHBOUND	4299			3900	4200		4793	5162	5698	6035	6199	5143	5847	6820	7069	11686	10930	12977	12079
	SOUTH X.35	D. (2)	SOUTHBOUND	3866			3900	3800		4595	5561	5732	5452	6107	6025	5540	6570	6637	10978	6535	12778	12316
42	JANABIYA HIGHWAY	D. (1)	NORTHBOUND	3630	2550			3550	4300	4646	5191		7105	7575	7648	7799	8570	8465	14805	16758	20168	14585
	NORTH FLYOVER	D. (2)	SOUTHBOUND	3449	2530			3400	4000	4398	5801		6693	7208	7145	7443	7674	8093	12719	14322	16592	15554
43	BUDAIYA HIGHWAY	D. (1)	EASTBOUND	16168	17750		18600	15700	10900	20770	17089	23690	21769	23061	22300	20271	20136	23533	35590	35944	39616	35268
	NEAR AL QADAM	D. (2)	WESTBOUND	10946	10350		18500	11000	19200	21340	18353	23874	24375	23493	22792	24004	22081	24575	34288	33762	36698	31184
44	AL NAKEEL HWY.	D. (1)	EASTBOUND	992				1000			1931	1974	2211	2149	2529	2188	2685	1014	10738	6189	5047	8824
	NEAR PETROL STATION	D. (2)	WESTBOUND	687				700			1005	956	980	2387	1423	1635	1636	1781	6632	6389	11016	9792
45	SH.HAMAD AVENUE	D. (1)	NORTHBOUND	10113				10050			13288	15281	10990	15156	16247	11578	16887	16260	17216	16641	22407	17958
	(NORTH RDT. NO. 1 HAMAD TOWN)	D. (2)	SOUTHBOUND	10291				10200			12735	18725	14513	15506	17310	12566	15913	17311	28680	19463	23082	19948
46	SAUDIA APPROCHED ROAD	D. (1)	EASTBOUND	4812				4700			5623		7873	7230	6605	8511	9047	8233	15382	15551	19972	22205
	EAST JANABIYA FLYOVER	D. (2)	WESTBOUND	5389				5250			6523		3906	8315	6804	8799	9697	9077	17278	18189	22161	24056
47	ZAID BIN OMYRAH HWY.	D. (1)	NORTHBOUND					5600	5400	3692	3268	4384	4689	4663	5562	5505	3579	6246	18225	18230	16432	17382
	NEAR BURI RDT.	D. (2)	SOUTHBOUND					4300	3600	4153	5307	4513	4728	5119	4852	4545	2686	6068	18212	16973	20443	12399

AUTOMATIC TRAFFIC COUNT { 1980 - 2006 }

SITE NO.	LOCATION	DIRECTIONS		1980	1984	1986	1987	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2003	2004	2005	2006
48	ESTIGLAL HWY	D. (1)	WESTBOUND	9183				8450		8661	11307	13925	8046	10676	10681	11417	12469	11394	20100	22672	26011	16996
	EAST ISA TOWN GATE RDT.	D. (2)	EASTBOUND	8299				9350		9221	10575	14191	14136	11523	11599	11705	9464	13902	10806	24535	28536	23987
49	AL QUDS AVENUE	D. (1)	WESTBOUND	7567	10300	11300		5600		8513	7807	5820	5360	5906	6280	6587	6842	7855	14235	14302	16589	14653
	WEST X.34	D. (2)	EASTBOUND	5672	10250	13000		7500		12019	8644	6724	6500	7074	7304	7405	6176	8045	13377	12644	15909	14280
50	SH.SALMAN AVE. (MUHARRAQ)	D. (1)	NORTHBOUND								3513			14106	5666	7217	8359	9791	11236	11751	13734	11758
	NORTH PC.03	D. (2)	SOUTHBOUND								8351			13229	7400	10087	10071	7736	9664	12486	14869	15945
51	KING FAISAL HIGHWAY	D. (1)	EASTBOUND						36000		20438	38373	32896	35361	38017	40430	40056	41144	86140	103172	87202	70320
	EAST CENTRAL MARKET RDT.	D. (2)	WESTBOUND						27200		29753	28135	30158	28722	28558	32890	34952	31028	78484	85771	74933	29125
52	BUDAIYA HIGHWAY	D. (1)	EASTBOUND			19000										15032	21515	21678	22888	26805	20567	25761
	NEAR INT.HOSPITAL	D. (2)	WESTBOUND			17000										17934	19993	20243	26022	24310	23612	18368
53	SH.ISA BIN SALMAN HIGHWAY	D. (1)	EASTBOUND											20816	21277	21725	24915	22924	32510	31882	48721	18990
	EAST TS.24	D. (2)	WESTBOUND											17505	22659	23249	25975	23910	11926	33109	51172	35908
54	AL FATEH HIGHWAY	D. (1)	NORTHBOUND													29769		31792	12427	51000	35075	37928
	NORTH TS.13	D. (2)	SOUTHBOUND													22946		27567	38570	45406	44305	31923
55	KHALIFA AL KABEER HWY.	D. (1)	NORTHBOUND											25307	26404	23714	25183	25506	30596	27613	24436	24980
	NORTH TX.10	D. (2)	SOUTHBOUND											19600	19884	19517	20476	20694	27509	25273	23649	28652
56	WALI-AL AHED HIGHWAY	D. (1)	EASTBOUND					7250	11100	10731				14156	13759	13100	14860	13364	24627	22018	32189	27088
	NEAR B.D.F.	D. (2)	WESTBOUND					7750	9500	6592				12927	12774	11745	13887	12025	22028	23819	29882	24646
57	KING FAISAL HIGHWAY	D. (1)	NORTHBOUND											12473	12056	13992	14044		18165	17911	20476	9919
	NEAR FIRE STATION	D. (2)	SOUTHBOUND											11411	12935	14780	15551		21627	22264	17249	19861
58	KHALIFA AL KABEER HWY.	D. (1)	NORTHBOUND																13661	16326	14279	11616
	NEAR AIRPORT RDT.	D. (2)	SOUTHBOUND																13802	22907	11190	14430
59	UM AL NASSAN AVE.	D. (1)	WESTBOUND											5787	9222	10274	9891	9591	13189	13686	16420	14101
	WEST X.33	D. (2)	EASTBOUND											4704	9443	10577	9878	9760	13594	6473	16189	13443
60	NABIH SALEH AVENUE	D. (1)	EASTBOUND											1407	1641	1481	1873	1729	6259	5695	6957	2790
	NEAR POLICE STATION	D. (2)	WESTBOUND											1280	1485	1607	1673	1653	7048	7988	6119	5339
61	SAAR AVENUE	D. (1)	NORTHBOUND													7385	8753	8925	21291	20825	19788	17870
	NEAR PETROL STATION	D. (2)	SOUTHBOUND													7112	10738	6466	21691	23929	18596	19524
62	AL GHOSE HWY	D. (1)	SOUTHBOUND				16600	8650	16500			11345		14694	14694	6181	7856	7862	7648	14179	6069	12768
	NORTH X.8	D. (2)	NORTHBOUND				8700	15950	10800			18033		9020	9020	8731	18655	9502	10424	12462	12462	14492
63	ISA AL KABEER HWY.	D. (1)	NORTHBOUND											14131	12737	14785	14362	13152	34658	45042	37762	15488
	SOUTH TS.29	D. (2)	SOUTHBOUND											4572	13481	10182	10386	9787	33085	44479	44479	33254
64	ZUBARA AVENUE	D. (1)	EASTBOUND											4683	6534	5873		5424	9426	9257	10316	8912
	NEAR CHARCH																					
65	DRY DOUCK HWY	D. (1)	NORTHBOUND									2835	4407	2821	4758	5612	5844	4348	5599	6563	10506	13326
	NEAR PETROL STATION	D. (2)	SOUTHBOUND									2895	4862	3031	5194	3716	6341	6107	5977	6887	6887	12994
66	MAHZ00RA AVENUE	D. (1)	EASTBOUND											9017	9017	9785	10447	8295	18722	19671	10634	18456
	NEAR SANAD RDT.	D. (2)	WESTBOUND											9211	9211	10464	9757	10701	19082	20926	20926	19500
67	PALACE AVENUE	D. (1)	NORTHBOUND											21641	17674	15426	17995	16462	23179	25780	23816	17518
	NEAR POLICE STATION	D. (2)	SOUTHBOUND											16952	18993	15985	16403	16484	19537	36911	36911	11381
68	WALI AL AHED HIGHWAY	D. (1)	EASTBOUND											9201	10199	16867	12210	9282	23592	20623	26145	17348
	WEST HAMAD TWON RDT.	D. (2)	WESTBOUND											10041	11273	18154	13057	6771	21265	23429	23429	22665
69	BAGHDAD AVENUE	D. (1)	NORTHBOUND													7782		8671	16281	22457	25030	21291
	NEAR SCHOOL	D. (2)	SOUTHBOUND													5573		6850	20610	21751	21751	19499

AUTOMATIC TRAFFIC COUNT { 1980 - 2006 }

SITE NO.	LOCATION	DIRECTIONS		1980	1984	1986	1987	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2003	2004	2005	2006
70	A.RAHMAN ALFADEL HWY.	D. (1)	EASTBOUND											6007	7516	4974	7329	23221	29107	26971	21851	19468
	NEAR GARDEN	D. (2)	WESTBOUND											10030	8112	9416	7518	21160	32737	19389	19389	27501
71	SUWAIFYA AVENUE	D. (1)	NORTHBOUND											7283	7090	7996	8797	9247	14142	13212	14427	15754
	NEAR SCHOOL	D. (2)	SOUTHBOUND											10553	11070	8564	11630	22885	13689	11818	11818	12865
72	AVENUE 38 (A'ALI)	D. (1)	NORTHBOUND											5918	4785	4168	5619	7377	8740	8054	5955	7916
	NEAR X.60	D. (2)	SOUTHBOUND											6511	5355	6932	7828	8505	10531	11637	11637	12764
73	SH.SALMAN AL FATEH AVENUE	D. (1)	WESTBOUND											6307	6489	7098	8603	8526	12731	11823	16428	13585
	NEAR X.43	D. (2)	EASTBOUND											6281	4904	6390	8420	8506	7022	11209	11209	12802
74	SH.KHALIFA BIN SALMAN C.WAY.	D. (1)	WESTBOUND																	8797	16790	14363
		D. (2)	EASTBOUND																	10108	10108	15579
77	SH. ISA AVENUE	D. (1)	NORTHBOUND			13000					9854					11649		13741	32433	35133	33982	30569
	NORTH ANDALUS RDT.	D. (2)	SOUTHBOUND			14000					10887					10973		11660	30517	33337	33337	21890
78	SH. DUAIJ AVENUE	D. (1)	EASTBOUND													2924		2891	9995	5873	10837	43377
	WEST PALACE RDT.	D. (2)	WESTBOUND													4993		4475	9288	11270	11270	34581
79	SH HAMAD AVENUE (MANAMA)	D. (1)	NORTHBOUND											8874	10319	11007	11160	6438	11044	15344	16238	21015
	NORTH BUDAIYA HWY.																					
82	SH HAMAD AVENUE (HAMAD TWON	D. (1)	SOUTHBOUND								3455	3798	4130	4229	4400	4233	5033	5234	7972	7867	8976	8044
	SOUTH RDT. NO. 22	D. (2)	NORTHBOUND								3332	4113	4275	4373	4506	4397	4926	5311	9962	9738	9738	7389
83	SH. ABDULLA AVENUE (MUHARRAQ	D. (1)	WESTBOUND													9148	8428	5622	20903	27198	28299	18509
	EAST SH.SALMAN RDT.	D. (2)	EASTBOUND													3552	3980	6279	25908	22895	22895	19341
84	GOVERNMENT AVENUE	D. (1)	EASTBOUND											22327	24490	7110	25731	25457	16710	15921	10643	13054
	NEAR N.B.B.	D. (2)	WESTBOUND											9586	10942	9405	11039	9158	29708	29560	29560	27115
85	JUFFAIR AVENUE	D. (1)	EASTBOUND											7347	8155	6686	3863	9110	21964	26140	31704	26339
	NEAR POWER STATION	D. (2)	WESTBOUND											7381	7678	7074	11170	8079	27141	25334	25334	27396
86	MUHARRAQ AVENUE	D. (1)	NORTHBOUND											8741	7849	11247	11000	10777	6206	18817	22822	20564
	NEAR T.L.D.	D. (2)	SOUTHBOUND											8119	9808	9074	8567	8958	13214	15645	15645	17060
87	SH.ZAYED HIGHWAY	D. (1)	EASTBOUND																12813	14835	17237	14795
	WEST A'ALI RDT.	D. (2)	WESTBOUND																18141	20597	20597	21262
88	SH.SALMAN HIGHWAY	D. (1)	NORTHBOUND																12061	12773	8556	10555
	SOUTH A'ALI RDT.	D. (2)	SOUTHBOUND																12922	13098	13098	10559
89	SH.ISA BIN SALMAN HIGHWAY	D. (1)	EASTBOUND																34027	41563	48420	36282
	NEAR AL-AHLI CLUB	D. (2)	WESTBOUND																32042	38331	38331	35719
90	KING FAISAL HIGHWAY	D. (1)	EASTBOUND																59760	51415	54463	43686
	EAST PALACE AVENUE	D. (2)	WESTBOUND																51935	47120	47120	45948
92	OSAMA BIN ZAID AVENUE	D. (1)	EASTBOUND											8154	10639	7913	6509	10396	30391	9116	30097	25327
	NEAR BRITISH BANK	D. (2)	WESTBOUND											6005	7222	10547	7699	7373	29257	23560	23560	20542
96	KING FAISAL HIGHWAY	D. (1)	NORTHBOUND				25800						29268		17559	19241	20551	14949	32825	31043	33740	26081
	NORTH SALMANIYA RDT.	D. (2)	SOUTHBOUND				24700						27960		20697	20400	24501	24522	41919	41672	41672	33090
97	SH.ZAYED HIGHWAY	D. (1)	WESTBOUND																8901	10125	14062	15987
	NEAR SH.KHALIFA BIN SALMAN HW	D. (2)	EASTBOUND																2739	4574	4574	5984
98	SALMABAD BY PASS HWY.	D. (1)	NORTHBOUND																5192	5517	8431	9005
	NEAR SH.ISA NIN SALMAN HWY.	D. (2)	SOUTHBOUND																5314	6813	6813	11438
96	SH.KHALIFA BIN SALMAN HWY.	D. (1)	NORTHBOUND																	18043	23742	18753
	SOUTH WALI AL-AHED FLYOVER	D. (2)	SOUTHBOUND																	14771	22029	13954

24 HOURS AM & PM TRAFFIC FLOWS FOR 1997

SITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (1)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR	TOTAL DAILY FLOW DIRECTION (2)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR
2	MUASKAR HWY -NEAR ALBA RDT.	12985	1174	848	13353	802	1024
	THE HIGHHEST MONTH (DECEMBER)	NORTHBOUND	06.15-07.15	15.15-16.15	SOUTHBOUND	06.30-07.30	15.15-16.15
3	SHAIKH SALMAN HIGHWAY	7684	512	719	8841	718	677
	NORTH AWALI RDT.	NORTHBOUND	11:00-12:00	15:00-16:00	SOUTHBOUND	07:00-08:00	14:00-15:00
4	AL ZALAQ HEY	8103	808	570	6676	431	594
	EAST SAKAIR AVE	EASTBOUND	06:00-07:00	15:00-16:00	WESTBOUND	07:00-08:00	14:00-15:00
5	MAJLIS AL TOWN	20050	1792	1609	24218	1729	1728
	EAST MAMEER PELICAN	EASTBOUND	06:45-07:45	15:15-16:15	WESTBOUND	06:15-07:15	13:30-14:30
6	OMAN AVENUE	12279	875	973	7165	382	701
	WEST TS.22	EASTBOUND	06:45-07:45	15:45-16:45	WESTBOUND	11:00-12:00	13:15-14:15
7	ESTEGLAL HWY	17384	1094	1316	16645	1334	1159
	NORTH SANAD RDT.	NORTHBOUND	11:00-12:00	15:00-16:00	SOUTHBOUND	06:00-07:00	13:00-14:00
8	SHAIKH SALMAN HIGHWAY	25183	1772	1835	23474	1549	1587
	SOUTH ISA TOWN GATE RDT.	NORTHBOUND	10:00-11:00	15:15-16:15	SOUTHBOUND	10:45-11:45	13:00-14:00
9	SALMANIYA AVENUE (NEAR TS.6)	24386	1486	1606	22581	1308	1570
	THE HIGHHEST MONTH (DECEMBER)	EASTBOUND	06.45-07.45	18.30-19.30	WESTBOUND	11.00-12.00	12.45-13.45
11	SHAIKH SALMAN HIGHWAY	49222	3968	3586	45813	3516	3347
	NORTH BAHRAIN GAS RDT.	NORTHBOUND	07:00-08:00	16:00-17:00	SOUTHBOUND	07:00-08:00	13:00-14:00
13	BUDAIYA HWY - EAST X.25	18688	1570	1463	18260	1229	1520
	THE HIGHHEST MONTH (DECEMBER)	EASTBOUND	06.30-07.30	15.45-16.45	WESTBOUND	11.00-12.00	13.15-14.15
14	XHIBITIONS AVE.(NEAR I.&PASPORT	15601	952	986	17976	1281	1171
	THE HIGHHEST MONTH (NOVEMBER)	NORTHBOUND	10.30-11.30	12.15-13.15	SOUTHBOUND	10.45-11.45	17.45-18.45
15	KUWAIT AVENUE (SOUTH TS.6)	21173	1438	1592	13870	811	1019
	THE HIGHHEST MONTH (NOVEMBER)	NORTHBOUND	06.45-07.45	15.45-16.45	SOUTHBOUND	06.45-07.45	12.30-13.30
16	SH ISA AVE. (SOUTH ANDALUS RDT.)	11241	658	702	12514	756	893
	THE HIGHHEST MONTH (DECEMBER)	NORTHBOUND	10.15-11.15	12.30-13.30	SOUTHBOUND	11.00-12.00	12.30-13.30
17	BANI OTBAH AVE (NORTH TS.43)	5946	323	415	6627	430	421
	THE HIGHHEST MONTH (NOVEMBER)	NORTHBOUND	07.00-08.00	12.30-13.30	SOUTHBOUND	06.45-07.45	12.30-13.30
18	ALFATEH HWY	23221	1391	1449	17566	1129	1124
	NEAR AL FATEH MOSQUS	NORTHBOUND	07:15-08:15	17:45-18:45	SOUTHBOUND	06:30-07:30	12:45-13:45
19	SH HAMAD C.WAY	28308	2432	1933	33912	1843	2789
	THE HIGHHEST MONTH (DECEMBER)	WESTBOUND	6.30-7.30	15.15-16.15	EASTBOUND	11.00-12.00	13.30-14.30
20	ARADOUS HWY. - NEAR AD DAIR	2971	181	229	2887	169	189
	(NEAR SCHOOL)	WESTBOUND	07:00-08:00	18:00-19:00	EASTBOUND	11:00-12:00	17:00-18:00
	SHAIKH ISA BIN SALMAN CAUSEWAY	11810	1456	893	12164	660	1240
		SOUTHBOUND	06:30-07:30	15:30-16:30	NORTHBOUND	06:30-07:30	13:30-14:30
22	RIFFA AVENUE	8564	478	647	8982	916	567
	(NEAR MUASKAR HWY.)	WESTBOUND	11:00-12:00	15:00-16:00	EASTBOUND	06:00-07:00	16:00-17:00
23	SEHLA AVENUE	15836	1007	1214	16551	1355	1107
	NORTH SEHLA RDT.	NORTHBOUND	06:45-07:45	16:15-17:15	SOUTHBOUND	06:30-07:30	12:45-13:45
24	MAJLIS AL TAWON HWY.	24188	1586	1909	23492	1957	1621
	THE HIGHHEST MONTH (DECEMBER)	NORTHBOUND	06.45-07.45	15.30-16.30	SOUTHBOUND	6.30-7.30	13.30-14.30
25	SHAIKH ISA AVENUE (MUHARRAQ)	6130	382	517			
	SOUTH TSX.2	NORTHBOUND	10:15-11:15	20:15-21:15			
26	SH. KHALIFA BIN SALMAN HWY.	15141	1640	1183	12707	910	1186
	NEAR CAMAL CROSSING	NORTHBOUND	06:30-07:30	15:45-16:45	SOUTHBOUND	06:30-07:30	15:45-16:45
27	SH. KHALIFA BIN SALMAN HWY.	12509	1255	901	13750	1055	946
	SOUTH BUDAIYA FLYOVER	NORTHBOUND	07:00-08:00	17:00-18:00	SOUTHBOUND	06:00-07:00	14:00-15:00
28	SH. KHALIFA BIN SALMAN HWY.	20560	1922	1417	16450	870	1443
	NORTH BUDAIYA FLYOVER	NORTHBOUND	07:00-08:00	17:00-18:00	SOUTHBOUND	10:00-11:00	18:00-19:00
29	AIRPORT AVENUE	16334	1143	1062	14875	1253	1146
	EAST X.7	WESTBOUND	06:30-07:30	18:15-19:15	EASTBOUND	06:30-07:30	13:00-14:00
30	A'ALI - BURI AVE.	1843	137	131	1329	98	106
	WEST TANNAL	EASTBOUND	11:00-12:00	16:00-17:00	WESTBOUND	11:00-12:00	13:00-14:00
31	H. KHALIFA B. S. HWY.(NEAR SANABI	26869	2361	1832	28444	1583	2338
	THE HIGHHEST MONTH (DECEMBER)	EASTBOUND	06.45-07.45	15.45-16.45	WESTBOUND	11.00-12.00	13.30-14.30
32	SH. SALMAN HWY. - NEAR TS.26	19726	1379	1478	22810	1433	1513
	THE HIGHHEST MONTH (JUNE)	EASTBOUND	06.45-07.45	17.00-18.00	WESTBOUND	10.45-11.45	12.30-13.30
33	AVENUE 35	19129	1231	1426	14689	912	1014
	(NEAR ZINJ)	NORTHBOUND	10:00-11:00	17:00-18:00	SOUTHBOUND	11:00-12:00	12:00-13:00

24 HOURS AM & PM TRAFFIC FLOWS FOR 1997

SITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (1)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR	TOTAL DAILY FLOW DIRECTION (2)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR
34	SH.ISA B.SALMAN HWY. - NEAR TS.28	30472	2667	2109	22076	1277	1842
	THE HIGHHEST MONTH (NOVEMBER)	EASTBOUND	6.45-7.45	16.00-17.00	WESTBOUND	11.00-12.00	13.15-14.15
35	TUBLI SERVICE ROAD - NEAR TS.28	12088	769	873	13259	748	1062
	THE HIGHHEST MONTH (DECEMBER)	EASTBOUND	09.30-10.30	15.30-16.30	WESTBOUND	11.00-12.00	13.30-14.30
36	ARAD HIGWAY	15688	1630	1270	15163	799	1301
	EAST X.22	WESTBOUND	06:30-07:30	16:00-17:00	EASTBOUND	11:00-12:00	13:30-14:30
37	HAWAR HIGHWAY	6257	451	698	6731	1007	513
	NEAR ALBA RDT.	NORTHBOUND	11:00-12:00	15:00-16:00	SOUTHBOUND	06:00-07:00	14:00-15:00
38	KING FAHAD C.WAY	4242	238	237	4571	246	218
	NEAR CAUSEWAY GATE	EASTBOUND	08:00-09:00	12:00-13:00	WESTBOUND	04:00-05:00	12:00-13:00
39	WALI AL AHEDHWY.	5928	726	350	6195	391	554
	NEAR HAMALA	NORTHBOUND	06:00-07:00	17:00-18:00	SOUTHBOUND	10:00-11:00	13:00-14:00
40	16 DECEBER HWY.	7396	738	637	6827	733	625
	NEAR BIN KHALDOON SHCOOL	WESTBOUND	07:00-08:00	13:00-14:00	EASTBOUND	07:00-08:00	13:00-14:00
	MUASKAR HWY	5847	365	429	5540	330	373
	SOUTH X.35	NORTHBOUND	06:00-07:00	17:00-18:00	SOUTHBOUND	11:00-12:00	15:00-16:00
42	JANABIYA HIGHWAY	7799	419	613	7443	752	459
	NORTH FLYOVER	NORTHBOUND	10:00-11:00	13:00-14:00	SOUTHBOUND	06:00-07:00	16:00-17:00
43	BUDAIYA HIGHWAY	20271	1354	1515	24004	1409	1798
	NEAR AL QADAM	EASTBOUND	07:00-08:00	17:00-18:00	WESTBOUND	11:00-12:00	18:00-19:00
44	AL NAKEEL HWY.	2188	170	152	1635	86	123
	NEAR PETROL STATION	EASTBOUND	06:00-07:00	18:00-19:00	WESTBOUND	11:00-12:00	13:00-14:00
45	SH.HAMAD AVENUE	11578	705	786	12566	795	869
	(NORTH RDT. NO. 1 HAMAD TOWN)	NORTHBOUND	11:00-12:00	13:00-14:00	SOUTHBOUND	11:00-12:00	17:00-18:00
46	SAUDIA APPROCHED ROAD	8511	604	562	8799	578	533
	EAST JANABIYA FLYOVER	EASTBOUND	11:00-12:00	23:00-24:00	WESTBOUND	05:00-06:00	23:00-24:00
47	ZAID BIN OMYRAH HWY.	5505	375	453	4545	335	353
	NEAR BURI RDT.	NORTHBOUND	06:00-07:00	17:00-18:00	SOUTHBOUND	11:00-12:00	17:00-18:00
48	ESTIGLAL HWY	11417	870	821	11705	1030	917
	EAST ISA TOWN GATE RDT.	WESTBOUND	07:00-08:00	15:00-16:00	EASTBOUND	07:00-08:00	13:00-14:00
49	AL QUDS AVENUE	6587	382	501	7405	374	587
	WEST X.34	WESTBOUND	07:00-08:00	17:00-18:00	EASTBOUND	07:00-08:00	13:00-14:00
50	SH.SALMAN AVE. (MUHARRAQ)	7217	497	530	10087	694	714
	NORTH SH.SALMAN RDT.	SOUTHBOUND	10:00-11:00	16:00-17:00	NORTHBOUND	06:30-07:30	12:30-13:30
	KING FAISAL HIGHWAY	40430	3232	2708	32890	1896	2550
	EAST CENTRAL MARKET RDT.	EASTBOUND	07:00-08:00	16:45-17:45	WESTBOUND	06:30-07:30	13:30-14:30
52	BUDAIYA HIGHWAY	15032	988	1217	17934	1100	1292
	NEAR INT.HOSPITAL	EASTBOUND	10:15-11:15	15:30-16:30	WESTBOUND	10:45-11:45	16:15-17:15
53	SH.ISA BIN SALMAN HIGHWAY	21725	1471	1449	23249	1396	1719
	EAST TS.24	EASTBOUND	06:45-07:45	15:45-16:45	WESTBOUND	11:00-12:00	13:15-14:15
54	AL FATEH HIGHWAY	29769	1716	2093	22946	1469	1577
	NORTH TS.13	NORTHBOUND	07:00-08:00	13:30-14:30	SOUTHBOUND	06:30-07:30	12:30-13:30
55	HALIFA AL KABEER HWY. -NORTH X	23714	2091	1639	19517	989	1730
	THE HIGHHEST MONTH (DECEMBER)	NORTHBOUND	06.30-07.30	15.15-16.15	SOUTHBOUND	11.00-12.00	13.30-14.30
56	WALI AL AHED HIGHWAY	13100	820	867	11745	689	786
	NEAR B.D.F.	EASTBOUND	06:00-07:00	17:00-18:00	WESTBOUND	11:00-12:00	17:00-18:00
57	KING FAISAL HIGHWAY	13992	980	1009	14780	989	1119
	NEAR FIRE STATION	NORTHBOUND	07:00-08:00	16:15-17:15	SOUTHBOUND	11:00-12:00	13:00-14:00
59	UM AL NASSAN AVE.	10274	802	613	10577	818	803
	EAST TSX.37	WESTBOUND	07:00-08:00	22:00-23:00	EASTBOUND	07:00-08:00	22:00-23:00
60	NABIH SALEH AVENUE	1481	136	108	1607	111	141
	NEAR POLICE STATION	EASTBOUND	06:30-07:30	16:00-17:00	WESTBOUND	11:00-12:00	17:00-18:00
61	SAAR AVENUE	7385	618	566	7112	403	619
	NEAR PETROL STATION	NORTHBOUND	07:00-08:00	15:45-16:45	SOUTHBOUND	11:00-12:00	13:00-14:00
62	AL GHOSE HWY	6181	330	467	8731	663	630
	SOUTH TSX.20	SOUTHBOUND	10:00-11:00	17:00-18:00	NORTHBOUND	07:00-08:00	18:00-19:00
63	ISA AL KABEER HIGHWAY	14785	1002	916	10182	626	779
	BETWEEN TS.29 & TS.30	NORTHBOUND	10:30-11:30	12:30-13:30	SOUTHBOUND	11:00-12:00	18:00-19:00
64	ZUBARA AVENUE	5873	353	442			
	IN FROM WEST	EASTBOUND	10:45-11:45	18:30-19:30			

24 HOURS AM & PM TRAFFIC FLOWS FOR 1997

SITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (1)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR	TOTAL DAILY FLOW DIRECTION (2)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR
65	DRY DOUCK HWY	5612	365	449	3716	426	336
	NEAR PETROL STATION	WESTBOUND	06:00-07:00	17:00-18:00	EASTBOUND	06:00-07:00	13:00-14:00
66	MAHZ00RA AVENUE	9785	630	691	10464	553	776
	SOUTH SANAD RDT.	EASTBOUND	07:00-08:00	16:00-17:00	WESTBOUND	11:00-12:00	13:00-14:00
67	PALACE AVENUE	15426	927	973	15985	928	1041
	POLICE STATION	NORTHBOUND	11:00-12:00	17:00-18:00	SOUTHBOUND	11:00-12:00	12:30-13:30
68	WALI AL AHED HIGHWAY	16867	1551	1311	18154	956	1431
	NEAR BURI	EASTBOUND	06:00-07:00	16:00-17:00	WESTBOUND	11:00-12:00	14:00-15:00
69	BAGHDAD AVENUE	7782	499	546	5573	382	365
	NEAR GIRLS SCHOOL	NORTHBOUND	06:45-07:45	15:45-16:45	SOUTHBOUND	06:30-07:30	18:30-19:30
70	A.RAHMAN ALFADEL HIGHWAY	4974	339	321	9416	519	785
	NEAR GARDEN	SOUTHBOUND	06:30-07:30	15:15-16:15	NORTHBOUND	06:30-07:30	18:00-19:00
71	SUWAIFYA AVENUE	7996	746	600	8564	586	681
	NEAR HOTTEEN SCHOOL	NORTHBOUND	07:00-08:00	16:00-17:00	SOUTHBOUND	10:45-11:45	16:45-17:45
72	AVENUE 38 (A'ALI)	4168	256	326	6932	417	470
	NORTH TSX.60	NORTHBOUND	07:00-08:00	13:00-14:00	SOUTHBOUND	07:00-08:00	19:00-20:00
75	SH.SALMAN A. AL FATEH AVENUE	7098	621	603	6390	993	454
	EAST TSX.43	WESTBOUND	06:45-07:45	13:45-14:45	EASTBOUND	06:45-07:45	14:30-15:30
77	SHAIKH ISA AVENUE	9854	612	747	10887	636	851
	NEAR ANDALUS GARDEN	NORTHBOUND	10:30-11:30	17:15-18:15	SOUTHBOUND	11:00-12:00	19:15-20:15
78	SHAIKH DUAIJ AVENUE	2924	191	245	4993	263	380
	NORTH SH.HAMAD PALACE	EASTBOUND	06:30-07:30	12:30-13:30	WESTBOUND	10:45-11:45	18:30-19:30
79	SH HAMAD AVENUE (MANAMA)	11007	721	753			
	NORTH BUDAIYA HWY.	NORTHBOUND	07:45-08:45	15:30-16:30			
82	SH HAMAD AVENUE (HAMAD TWON)	4233	481	334	4397	220	393
	SOUTH RDT. NO.22	SOUTHBOUND	06:00-07:00	16:00-17:00	NORTHBOUND	11:00-12:00	14:00-15:00
83	HAIKH ABDULLA AVE. (MUHARRAQ	9148	477	1571	3552	185	598
	EAST SH.SALMAN RDT.	WESTBOUND	06:30-07:30	20:15-21:15	EASTBOUND	10:45-11:45	20:15-21:15
84	GOVERNMENT AVENUE	7110	581	502	9405	576	653
	NEAR NBB.	WESTBOUND	10:45-11:45	12:00-13:00	EASTBOUND	09:15-10:15	19:30-20:30
85	JUFFAIR AVENUE	6686	379	499	7074	395	527
	NEAR POWER STATION	EASTBOUND	11:00-12:00	20:00-21:00	WESTBOUND	11:00-12:00	19:00-20:00
86	MUHARRAQ AVENUE	11247	979	915	9074	825	729
	NEAR TLD.	NORTHBOUND	07:00-08:00	13:00-14:00	SOUTHBOUND	07:00-08:00	13:00-14:00
92	OSAMA BIN ZAID AVENUE	7913	481	518	10547	608	673
	NEAR BRITISH BANK	EASTBOUND	11:00-12:00	17:00-18:00	WESTBOUND	11:00-12:00	21:00-22:00
96	KING FAISAL HIGHWAY	19241	1267	1374	20400	1349	1477
	NORTH SALMANIYA RDT.	NORTHBOUND	11:00-12:00	16:30-17:30	SOUTHBOUND	11:00-12:00	12:30-13:30

24 HOURS AM & PM TRAFFIC FLOWS FOR 1999

SITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (1)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR	TOTAL DAILY FLOW DIRECTION (2)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR
2	UASKAR HWY -NEAR ALBA RE	14709	1248	920	14101	818	1047
	E HIGHEST MONTH (FEBRUAI	NORTHBOUND	06.15-07.15	16.30-17.30	SOUTHBOUND	11.00-12.00	15.15-16.15
3	SHAIKH SALMAN HIGHWAY	7232	446	495	7588	473	498
	NORTH AWALI RDT.	NORTHBOUND	09:30-10:30	12:00-13:00	SOUTHBOUND	10:45-11:45	13:00-14:00
4	AL ZALAQ HEY	712	849	712	8597	724	738
	EAST SAKAIR AVE	EASTBOUND	06.15-07.15	15:15-16:15	WESTBOUND	07:00-08:00	13:30-14:30
5	MAJLIS AL TOWN	26236	2352	1857	27252	1896	1955
	EAST MAMEER PELICAN	EASTBOUND	07:00-08:00	15:00-16:00	WESTBOUND	06:00-07:00	14:00-15:00
6	OMAN AVENUE	14320	1123	1062	8255	458	796
	WEST TS.22	EASTBOUND	06:45-07:45	16:00-17:00	WESTBOUND	11:00-12:00	13:15-14:15
7	ESTEGLAL HWY	16731	1163	1273	19484	1231	1201
	NORTH SANAD RDT.	NORTHBOUND	10:30-11:30	15:15-16:15	SOUTHBOUND	06.15-07.15	16:45-17:45
8	SHAIKH SALMAN HIGHWAY	24450	1656	1669	23745	1524	1684
	SOUTH ISA TOWN GATE RDT.	NORTHBOUND	09:15-10:15	15:00-16:00	SOUTHBOUND	10:30-11:30	13:30-14:30
9	LMANIYA AVENUE (NEAR TS	25591	1598	1717	25297	1471	1607
	THE HIGHEST MONTH (JUNE)	EASTBOUND	10.30-11.30	17.30-18.30	WESTBOUND	11.00-12.00	12.30-13.30
11	SHAIKH SALMAN HIGHWAY	50466	3558	3373	46112	3566	3333
	NORTH BAHRAIN GAS RDT.	NORTHBOUND	07:00-08:00	13:00-14:00	SOUTHBOUND	07:00-08:00	13:00-14:00
13	BUDAIYA HWY - EAST X.25	19993	1610	1423	18585	1137	1397
	THE HIGHHEST MONTH (JUNE	EASTBOUND	06.30-07.30	17.00-18.00	WESTBOUND	11.00-12.00	12.30-13.30
14	BITIONS AVE.(NEAR I.&PASP	15939	923	988	24449	1974	1913
	THE HIGHHEST MONTH (JUNE	NORTHBOUND	10.45-11.45	12.15-13.15	SOUTHBOUND	09.30-10.30	12.30-13.30
15	UWAIT AVENUE (SOUTH TS.6	22513	1405	1584	14857	880	987
	THE HIGHHEST MONTH (JUNE	NORTHBOUND	07.00-08.00	17.15-18.15	SOUTHBOUND	11.00-12.00	12.30-13.30
16	ISA AVE. (SOUTH ANDALUS RI	11883	670	752	13388	794	899
	THE HIGHHEST MONTH (OCTOB	NORTHBOUND	10.30-11.30	17.30-18.30	SOUTHBOUND	11.00-12.00	12.15-13.15
17	ANI OTBAH AVE (NORTH TS.4	6368	343	414	6484	391	402
	THE HIGHHEST MONTH (OCTOB	NORTHBOUND	10.30-11.30	16.30-17.30	SOUTHBOUND	06.30-07.30	12.45-13.45
18	ALFATEH HWY	30270	1728	2061	36221	2312	2465
	NEAR AL FATEH MOSQUS	NORTHBOUND	10:45-11:45	13:15-14:15	SOUTHBOUND	07.00-08.00	12:45-13:45
19	SH HAMAD C.WAY	29523	2520	1944	35175	1829	2814
	THE HIGHHEST MONTH (JUNE	WESTBOUND	06.30-07.30	17.00-18.00	EASTBOUND	11.00-12.00	13.30-14.30
20	RADOUS HWY. - NEAR AD DAI	8272	778	530	3903	222	347
	(NEAR SCHOOL)	WESTBOUND	06.30-07.30	17:45-18:45	EASTBOUND	06:15-07:15	13:00-14:00
21	IKH ISA BIN SALMAN CAUSEV	21512	1768	1330	16183	846	1434
		SOUTHBOUND	06:45-07:45	19:45-20:45	NORTHBOUND	10:45-11:45	13:30-14:30
22	RIFFA AVENUE	8669	718	589	8294	453	567
	(NEAR MUASKAR HWY.)	WESTBOUND	06:15-07:15	16:30-17:30	EASTBOUND	10.45-11.45	13.00-14.00
23	SEHLA AVENUE	18162	1099	1311	17596	1329	1130
	NORTH SEHLA RDT.	NORTHBOUND	07:00-08:00	16:00-17:00	SOUTHBOUND	06:30-07:30	12:30-13:30
24	MAJLIS AL TAWON HWY.	31261	1793	1936	27206	2214	1717
	THE HIGHHEST MONTH (JUNE	NORTHBOUND	06.45-07.45	16.45-17.45	SOUTHBOUND	06.30-07.30	13.30-14.30
25	AIKH ISA AVENUE (MUHARR/	5966	431	432			
	SOUTH TSX.2	NORTHBOUND	10:00-11:00	12:30-13:30			
26	H. KHALIFA BIN SALMAN HW	14125	1216	1042	16448	999	1457
	NEAR CAMAL CROSSING	NORTHBOUND	06:45-07:45	16:30-17:30	SOUTHBOUND	06:30-07:30	13:45-14:45
27	H. KHALIFA BIN SALMAN HW	12634	1032	855	18656	1163	1332
	SOUTH BUDAIYA FLYOVER	NORTHBOUND	07:00-08:00	17:00-18:00	SOUTHBOUND	06:30-07:30	13:30-14:30
28	H. KHALIFA BIN SALMAN HW	24009	2112	1575	27227	1311	2180
	NORTH BUDAIYA FLYOVER	NORTHBOUND	07:00-08:00	17:15-18:15	SOUTHBOUND	11:00-12:00	13.30-14.30
29	AIRPORT AVENUE	17230	942	1161	15536	906	1120
	EAST X.7	WESTBOUND	10:45-11:45	19:15-20:15	EASTBOUND	06:30-07:30	20:30-21:30
30	A'ALI - BURI AVE.	2380	293	164	2225	211	160
	WEST TANNAL	EASTBOUND	06:30-07:30	13:00-14:00	WESTBOUND	06:30-07:30	13:45-14:45
31	HALIFA B. S. HWY.(NEAR SAN	30283	2495	1949	32032	1987	2316
	THE HIGHHEST MONTH (JUNE	EASTBOUND	06.45-07.45	17.30-18.30	WESTBOUND	11.00-12.00	13.30-14.30
32	H. SALMAN HWY. - NEAR TS.2	32137	1816	1885	22727	1393	1543
	THE HIGHHEST MONTH (OCTOB	EASTBOUND	06.45-07.45	16.00-17.00	WESTBOUND	11.00-12.00	12.15-13.15
33	AVENUE 35	20847	1264	1515	15437	882	1066
	(NEAR ZINJ)	NORTHBOUND	07:00-08:00	16:45-17:45	SOUTHBOUND	11:00-12:00	12:30-13:30

24 HOURS AM & PM TRAFFIC FLOWS FOR 1999

SITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (1)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR	TOTAL DAILY FLOW DIRECTION (2)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR
34	ISA B.SALMAN HWY. - NEAR T	29866	2371	1989	23967	1317	1885
	THE HIGHHEST MONTH (MAY	EASTBOUND	06.45-07.45	17.00-18.00	WESTBOUND	10.45-11.45	13.15-14.15
35	BLI SERVICE ROAD - NEAR TS	13416	818	918	14692	792	1038
	THE HIGHHEST MONTH (JUNE	EASTBOUND	09.30-10.30	16.15-17.15	WESTBOUND	11.00-12.00	13.30-14.30
36	ARAD HIGWAY	16498	1270	1330	11439	611	808
	EAST X.22	WESTBOUND	06:30-07:30	17:15-18:15	EASTBOUND	06:15-07:15	17:30-18:30
37	HAWAR HIGHWAY	7278	596	908	7681	1142	590
	NEAR ALBA RDT.	NORTHBOUND	06.30-07.30	14:45-18:45	SOUTHBOUND	06:00-07:00	13:45-14:45
38	KING FAHAD C.WAY	3976	183	324	3829	187	233
	NEAR CAUSEWAY GATE	EASTBOUND	10:45-11:45	17:00-18:00	WESTBOUND	07:45-08:45	14:30-15:30
39	WALI AL AHEDHWY.	9402	729	636	3856	245	373
	NEAR HAMALA	NORTHBOUND	06:15-07:15	13:15-14:15	SOUTHBOUND	10:30-11:30	13:15-14:15
40	16 DECEBER HWY.	8483	951	830	8529	935	807
	NEAR BIN KHALDOON SHCOO	WESTBOUND	06:45-07:45	13:30-14:30	EASTBOUND	06.45-07.45	13.15-14.15
41	MUASKAR HWY	7069	544	562	6637	575	434
	SOUTH X.35	NORTHBOUND	06:15-07:15	15:00-16:00	SOUTHBOUND	06.30-07.30	13.30-14.30
42	JANABIYA HIGHWAY	8465	473	670	8093	802	519
	NORTH FLYOVER	NORTHBOUND	11:00-12:00	13:15-14:15	SOUTHBOUND	06:30-07:30	16:15-17:15
43	BUDAIYA HIGHWAY	23533	1494	1600	24575	1455	1849
	NEAR AL QADAM	EASTBOUND	09:30-10:30	16:30-17:30	WESTBOUND	11:00-12:00	12:45-13:45
44	AL NAKEEL HWY.	1014	111	72	1781	131	153
	NEAR PETROL STATION	EASTBOUND	06:15-07:15	15:45-16:45	WESTBOUND	06:15-07:15	18:00-19:00
45	SH.HAMAD AVENUE	16260	1116	1260	17311	879	1307
	ORTH RDT. NO. 1 HAMAD TOW	NORTHBOUND	06:00-07:00	16:15-17:15	SOUTHBOUND	11.00-12.00	13:30-14:30
46	SAUDIA APPROCHED ROAD	8233	576	518	9077	691	603
	EAST JANABIYA FLYOVER	EASTBOUND	06:15-07:15	13:45-14:45	WESTBOUND	06.30-07.30	16:45-17:45
47	ZAID BIN OMYRAH HWY.	6246	444	465	6068	411	466
	NEAR BURI RDT.	NORTHBOUND	06:15-07:15	16:30-17:30	SOUTHBOUND	10:45-11:45	17:30-18:30
48	ESTIGLAL HWY	11394	961	817	13902	1347	1061
	EAST ISA TOWN GATE RDT.	WESTBOUND	06:30-07:30	15:30-16:30	EASTBOUND	06:30-07:30	13:00-14:00
49	AL QUDS AVENUE	7855	489	606	8045	539	629
	WEST X.34	WESTBOUND	06:30-07:30	17:15-18:15	EASTBOUND	06:30-07:30	12:45-13:45
50	H.SALMAN AVE. (MUHARRAQ	9791	629	708	7736	524	586
	NORTH SH.SALMAN RDT.	SOUTHBOUND	06.30-07.30	13.00-14.00	NORTHBOUND	09:15-10:15	16:30-17:30
51	KING FAISAL HIGHWAY	41144	2933	2646	31028	1958	2591
	EAST CENTRAL MARKET RDT	EASTBOUND	07:00-08:00	12:30-13:30	WESTBOUND	06:30-07:30	13:30-14:30
52	BUDAIYA HIGHWAY	21678	1326	1652	20243	1206	1411
	NEAR INT.HOSPITAL	EASTBOUND	10:15-11:15	16:00-17:00	WESTBOUND	11:00-12:00	12:45-13:45
53	SH.ISA BIN SALMAN HIGHWAY	22924	1630	1486	23910	1448	1744
	EAST TS.24	EASTBOUND	06:45-07:45	17:30-18:30	WESTBOUND	11:00-12:00	13:15-14:15
54	AL FATEH HIGHWAY	31792	1699	2158	27567	1565	1816
	NORTH TS.13	NORTHBOUND	10:45-11:45	13:15-14:15	SOUTHBOUND	06:30-07:30	12:45-13:45
55	LIFA AL KABEER HWY. -NORT	25506	2162	1782	20694	1037	1727
	THE HIGHHEST MONTH (JUNE	NORTHBOUND	06.30-07.30	17.00-18.00	SOUTHBOUND	06.15-07.15	13.30-14.30
56	WALI AL AHED HIGHWAY	13364	843	962	12025	698	835
	NEAR B.D.F.	EASTBOUND	06:15-07:15	18.45-19.45	WESTBOUND	10:30-11:30	18:30-19:30
57	KING FAISAL HIGHWAY						
	NEAR FIRE STATION						
59	UM AL NASSAN AVE.	9591	538	696	9760	573	720
	EAST TSX.37	WESTBOUND	11:00-12:00	17:30-18:30	EASTBOUND	06:30-07:30	18:15-19:15
60	NABIH SALEH AVENUE	1729	155	151	1653	107	153
	NEAR POLICE STATION	EASTBOUND	06:30-07:30	19:00-20:00	WESTBOUND	11:00-12:00	18:00-19:00
61	SAAR AVENUE	8925	605	635	6466	354	511
	NEAR PETROL STATION	NORTHBOUND	07:00-08:00	15:30-16:30	SOUTHBOUND	11:00-12:00	13:00-14:00
62	AL GHOSE HWY	7862	388	523	9502	687	668
	SOUTH TSX.20	SOUTHBOUND	11:00-12:00	17:45-18:45	NORTHBOUND	06:30-07:30	17:45-18:45
63	ISA AL KABEER HIGHWAY	13152	882	777	9787	585	716
	BETWEEN TS.29 & TS.30	NORTHBOUND	10:15-11:15	12:00-13:00	SOUTHBOUND	11:00-12:00	12:30-13:30
64	ZI BARA AVENUE	5424	337	427			
	IN FROM WEST	EASTBOUND	07:00-08:00	12:30-13:30			

24 HOURS AM & PM TRAFFIC FLOWS FOR 1999

SITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (1)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR	TOTAL DAILY FLOW DIRECTION (2)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR
65	DRY DOUCK HWY NEAR PETROL STATION	4348 WESTBOUND	435 06:30-07:30	359 15:00-16:00	6107 EASTBOUND	734 06:15-07:15	443 13:00-14:00
66	MAHZOORA AVENUE SOUTH SANAD RDT.	8295 EASTBOUND	474 10:00-11:00	626 18:00-19:00	10701 WESTBOUND	612 11:00-12:00	792 20:00-21:00
67	PALACE AVENUE POLICE STATION	16462 NORTHBOUND	1029 10:15-11:15	1039 16:00-17:00	16484 SOUTHBOUND	969 11:00-12:00	1009 12:15-13:15
68	WALI AL AHED HIGHWAY NEAR BURI	9282 EASTBOUND	600 10:30-11:30	655 13:00-14:00	6771 WESTBOUND	344 06:15-07:15	575 16:30-17:30
69	BAGHDAD AVENUE NEAR GIRLS SCHOOL	8671 NORTHBOUND	535 06:45-07:45	648 16:00-17:00	6850 SOUTHBOUND	499 06:30-07:30	447 18:15-19:15
70	.RAHMAN ALFADEL HIGHWA NEAR GARDEN	1221 SOUTHBOUND	58 04:00-05:00	57 17:30-18:30	416 NORTHBOUND	21 03:30-04:30	20 21:45-22:45
71	SUWAIFYA AVENUE NEAR HOTTEEN SCHOOL	9247 NORTHBOUND	736 07:00-08:00	633 16:15-17:15	22885 SOUTHBOUND	1516 11:00-12:00	1541 12:45-13:45
72	AVENUE 38 (A'ALI) NORTH TSX.60	7377 NORTHBOUND	431 06:45-07:45	576 13:15-14:15	8505 SOUTHBOUND	591 06:45-07:45	594 13:45-14:45
73	.SALMAN A. AL FATEH AVEN EAST TSX.43	8526 WESTBOUND	743 06:45-07:45	684 13:45-14:45	8506 EASTBOUND	1106 06:45-07:45	607 14:30-15:30
77	SHAIKH ISA AVENUE NEAR ANDALUS GARDEN	13741 NORTHBOUND	853 07:00-08:00	849 12:30-13:30	11660 SOUTHBOUND	814 11:00-12:00	767 12:00-13:00
78	SHAIKH DUAIJ AVENUE NORTH SH.HAMAD PALACE	2891 EASTBOUND	223 06:30-07:30	233 12:45-13:45	4475 WESTBOUND	246 10:30-11:30	334 18:00-19:00
79	H HAMAD AVENUE (MANAMA NORTH BUDAIYA HWY.	6438 NORTHBOUND	393 11:00-12:00	510 12:30-13:30			
82	HAMAD AVENUE (HAMAD TW SOUTH RDT. NO.22	5234 SOUTHBOUND	860 06:15-07:15	338 15:45-16:45	5311 NORTHBOUND	285 06:45-07:45	543 13:45-14:45
83	KH ABDULLA AVE. (MUHARF EAST SH.SALMAN RDT.	5622 WESTBOUND	395 10:15-11:15	377 16:45-17:45	6279 EASTBOUND	379 11:00-12:00	539 17:45-18:45
84	GOVERNMENT AVENUE NEAR NBB.	25457 WESTBOUND	1735 10:45-11:45	1599 12:00-13:00	9158 EASTBOUND	633 09:00-10:00	657 16:15-17:15
85	JUFFAIR AVENUE NEAR POWER STATION	9110 EASTBOUND	685 06:45-07:45	670 28:00-21:00	8079 WESTBOUND	484 07:15-08:15	607 13:00-14:00
86	MUHARRAQ AVENUE NEAR TLD.	10777 NORTHBOUND	913 06:45-07:45	917 13:15-14:15	8958 SOUTHBOUND	861 06:45-07:45	803 13:30-14:30
92	OSAMA BIN ZAID AVENUE NEAR BRITISH BANK	10396 EASTBOUND	651 10:30-11:30	623 16:45-17:45	7373 WESTBOUND	420 11:00-12:00	497 12:45-13:45
96	KING FAISAL HIGHWAY NORTH SALMANIYA RDT.	14949 NORTHBOUND	1149 07:15-08:15	1247 18:15-19:15	24522 SOUTHBOUND	1549 06:45-07:45	1692 12:30-13:30

Key:

SCOOT SITES

PERMANENT SITES

TEMPORARY SITES



AUTOMATIC TRAFFIC COUNT (1980 - 1998)

SITE NO	LOCATION		DIRECTION	1980	1984	1986	1987	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	MUASKAR HIGHWAY	D. (1	NORTHBOUND						11300			12474	11956	12268	12293	12985	13264
	NEAR ALBA RDT.	D. (2	SOUTHBOUND						11800			12542	12375	12668	13061	13353	13872
3	SHAIKH SALMAN HIGHWAY	D. (1	NORTHBOUND	4140				4050			6663	1003	8117	8655	7523	7684	8120
	NORTH AWALI RDT.	D. (2	SOUTHBOUND	4282				4200			6202	8577	8142	9042	7994	8841	8727
4	AL ZALAQ HEY	D. (1	EASTBOUND	2934				3000			6235	6822	7372	7576	7245	8103	9424
	EAST SAKAIR AVE	D. (2	WESTBOUND	3057				3150			6290	6490	7304	7928	7422	6676	3533
5	MAJLIS AL TOWN	D. (1	EASTBOUND	12967		35000		13350	17400	16743		19732	17650	21551	20205	20050	25998
	EAST MAMEER PELICAN	D. (2	WESTBOUND	15977		D.1+D.2		16350	18300	17530		20968	14093	21689	13793	24218	26993
6	OMAN AVENUE	D. (1	EASTBOUND												13214	12279	14180
	WEST TS.22	D. (2	WESTBOUND												6904	7165	7927
7	ESTEGLAL HWY	D. (1	NORTHBOUND	8571				8250			13591	13619	14249	15927	15835	17384	17799
	NORTH SANAD RDT.	D. (2	SOUTHBOUND	8517				8950			12750	16541	14689	14993	15461	16645	17841
8	SHAIKH SALMAN HIGHWAY	D. (1	NORTHBOUND	24694			20200	24200		20403	22859	24259	24791	24416	21840	25183	23556
	SOUTH ISA TOWN GATE RDT.	D. (2	SOUTHBOUND	22690			21900	22200		17724	15416	21305	17662	19424	21682	23474	22367
9	SALMANIYA AVENUE	D. (1	EASTBOUND											13355	14745	24386	24646
	NEAR TS.6	D. (2	WESTBOUND											17199	18004	22581	22921
11	SHAIKH SALMAN HIGHWAY	D. (1	NORTHBOUND	34269	2800			33250			36085	32637	40357	38269	23699	49222	50078
	NORTH BAHRAIN GAS RDT.	D. (2	SOUTHBOUND	35814	28050			34750			33928	37185	34909	29905	31777	45813	47292
13	BUDAIYA HIGHWAY	D. (1	EASTBOUND	18134	17850	48600	23500	16300	18400	15236	15450		18411	11285	16936	18688	22913
	EAST TX.25	D. (2	WESTBOUND	16612	19850	D.1+D.2	21200	16700	21200	16529	16077		17890	16373	16830	18260	18760
14	EXHIBITIONS AVENUE	D. (1	NORTHBOUND											11380	13240	15601	15816
	NEAR IMMIGRATION & PASPORT	D. (2	SOUTHBOUND											11285	15612	17976	18576
15	KUWAIT AVENUE	D. (1	NORTHBOUND	8516	4850			17300					17492	20216	27790	21173	22935
	SOUTH TS.6	D. (2	SOUTHBOUND	17597	5250			8350					12622	12537	13140	13870	14467
16	SH ISA AVENUE	D. (1	NORTHBOUND	11785				8750		8333		11202	25684	11126	11082	11241	11685
	SOUTH ANDALUS RDT.	D. (2	SOUTHBOUND	8957				11550		686		11406	19671	10730	11369	12514	13561
17	BANI OTBAH AVE	D. (1	NORTHBOUND	6678				6350		5656	6125	7158	5955	5968	6026	5946	6248
	NORTH TS.43	D. (2	SOUTHBOUND	6510				6000		6743	7231	7578	6379	6024	6063	6627	6259
18	ALFATEH HWY	D. (1	NORTHBOUND	20110		48300		17000	27700	22129	22004	24223	26494	27034	31181	23221	32603
	NEAR AL FATEH MOSQUS	D. (2	SOUTHBOUND	18994		D.1+D.2		19000	26100	21813	23413	23535	20559	25036	27859	17566	37826
19	SH HAMAD C.WAY	D. (1	WESTBOUND	37096	38000	80000	40400	39400	40200		41553	40631	56506	43710	45711	28308	29398
		D. (2	EASTBOUND	38288	38000	D.1+D.2	40300	40000	39200		54929	49107	42798	44852	46270	33912	35037
20	ARADOUS HWY. - NEAR AD DAIR	D. (1	WESTBOUND	1819				1950			988	1826	3808	2661	3985	2971	4295
	(NEAR SCHOOL)	D. (2	EASTBOUND	2019				1800			2193	1758	3488	2641	3886	2887	4529
21	SHAIKH ISA CAUSEWAY	D. (1	SOUTHBOUND													11810	23672
		D. (2	NORTHBOUND													12164	18014
22	RIFFA AVENUE	D. (1	WESTBOUND			13700	5000	7950	7800	8028	8178		8734	8785	8037	8564	9292
	(NEAR MUASKAR HWY.)	D. (2	EASTBOUND			D.1+D.2	5700	7850	8400	8410	8326		8840	9069	7574	8982	8848
23	SEHLA AVENUE	D. (1	NORTHBOUND					12300		12407					14863	15836	17309
	NORTH SEHLA RDT.	D. (2	SOUTHBOUND					15050		13000					15760	16551	17073

AUTOMATIC TRAFFIC COUNT (1980 - 1998)

SITE NO.	LOCATION	DIRECTIONS		1980	1984	1986	1987	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998
24	MAJLIS AL TAWOON HIGHWAY	D. (1	NORTHBOUND	17532	10150		17400	17350	19700	21098	24610	24386	25734	25205	22967	24188	26163
	(NORTH X.42)	D. (2	SOUTHBOUND	18155	10500		17000	18000	20900	20054	19839	21807	24017	22370	23442	23492	26060
25	SH.ISA AVENUE (MUHARRAQ)	D. (1	NORTHBOUND													6130	
	SOUTH TSX.2																
26	SH. KHALIFA BIN SALMAN HWY.	D. (1	NORTHBOUND						8400				12267	13312	12546	15141	14260
	NEAR CAMAL CROSSING	D. (2	SOUTHBOUND						7900				12544	13498	12994	12707	14583
27	SH. KHALIFA BIN SALMAN HWY.	D. (1	NORTHBOUND					8850	13800	8177			10985	9065	11343	12509	13378
	SOUTH BUDAIYA FLYOVER	D. (2	SOUTHBOUND					11050	16900	720			12580	11247	13002	13750	15464
28	SH. KHALIFA BIN SALMAN HWY.	D. (1	NORTHBOUND					2850					16908	18984	18625	20560	21365
	NORTH BUDAIYA FLYOVER	D. (2	SOUTHBOUND					4050					21523	21056	7386	16450	23109
29	AIRPORT AVENUE	D. (1	WESTBOUND							12250	11495	13658	16042	14534	14936	16334	16772
	EAST X.7	D. (2	EASTBOUND							9689	10738	12018	11767	11802	11439	14875	14759
30	A'ALI - BURI AVE.	D. (1	EASTBOUND											1276	1592	1843	1510
	WEST TANNAL	D. (2	WESTBOUND											1300	1726	1329	2435
31	SH. KHALIFA BIN SALMAN HWY.	D. (1	EASTBOUND	10353				9000		14005			20701	21269	12367	26869	28206
	NEAR SANABIS	D. (2	WESTBOUND	9155				10150		16789			23104	22300	13670	28444	28750
32	SH. SALMAN HIGHWAY	D. (1	EASTBOUND	19773	10700	36600		16750	18400	16856	18844	18767	18779	17971	56601	19726	18251
	NEAR TS.26	D. (2	WESTBOUND	16949	17650	D.1+D.2		19600	21200	19495	21989	22697	17889	25839	20564	22810	20977
33	AVENUE 35	D. (1	NORTHBOUND	15067	8600			17850			15875	7832	17758	16634	18158	19129	25193
	(NEAR ZINJ)	D. (2	SOUTHBOUND	18031	8400			14900			9935	12480	12470	13815	14077	14689	14979
34	SH.ISA B.SALMAN HIGHWAY	D. (1	EASTBOUND		13250	39000	19400	22550	23600	23722	25651	25645	27188	29051	28715	30472	38747
	NEAR TS.28	D. (2	WESTBOUND		8200	D.1+D.2	22900	17100	17800	17784	18730	17924	20873	21875	21364	22076	25025
35	TUBLI SERVICE ROAD	D. (1	EASTBOUND			14300	6800	8300	7500	9221	8450	8706	8599	10276	11552	12088	12566
	NEAR TS.28	D. (2	WESTBOUND			D.1+D.2	9400	6650	7200	9982	11579	8736	9094	11002	12483	13259	13638
36	ARAD HIGWAY	D. (1	WESTBOUND	14044			13700	13900			9694	8308	12946	13773	14826	15688	16346
	EAST X.22	D. (2	EASTBOUND	13973			13500	13850			9421	8424	12807	12438	14591	15163	15116
37	HAWAR HIGHWAY	D. (1	NORTHBOUND	5516			10100	5350	7000		6946		6118	5702	6821	6257	7191
	NEAR ALBA RDT.	D. (2	SOUTHBOUND	5225			10300	5050	6600		4031		6505	6316	7285	6731	7814
38	KING FAHAD C.WAY	D. (1	EASTBOUND	1766				1750			3120		3424	3142	2688	4242	4396
	NEAR CAUSEWAY GATE	D. (2	WESTBOUND	1874				1850			3238		3610	3335	2796	4571	4416
39	WALI AL AHEDHWY.	D. (1	NORTHBOUND	6634		19800		6450	11100		4789	7529		6060	6832	5928	6349
	NEAR HAMALA	D. (2	SOUTHBOUND	6132		D.1+D.2		5950	8500		4606	5672		5924	5253	6195	6376
40	16 DECEBER HWY.	D. (1	WESTBOUND	4618				4550			3443	6536	7092	6211	7760	7396	7693
	WEST TV. RDT.	D. (2	EASTBOUND	4138				5000			5153	4303	7190	6594	7321	6827	7697
41	MUASKAR HWY	D. (1	NORTHBOUND	4299			3900	4200		4793	5162	5698	6035	6199	5143	5847	6820
	SOUTH X.35	D. (2	SOUTHBOUND	3866			3900	3800		4595	5561	5732	5452	6107	6025	5540	6570
42	JANABIYA HIGHWAY	D. (1	NORTHBOUND	3630	2550			3550	4300	4646	5191		7105	7575	7648	7799	8570
	NORTH FLYOVER	D. (2	SOUTHBOUND	3449	2530			3400	4000	4398	5801		6693	7208	7145	7443	7674
43	BUDAIYA HIGHWAY	D. (1	EASTBOUND	16168	17750		18600	15700	10900	20770	17089	23690	21769	23061	22300	20271	20136
	NEAR AL QADAM	D. (2	WESTBOUND	10946	10350		18500	11000	19200	21340	18353	23874	24375	23493	22792	24004	22081

AUTOMATIC TRAFFIC COUNT (1980 - 1998)

SR.NO.	LOCATION	DIRECTIONS		1980	1984	1986	1987	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998
44	AL NAKEEL HWY.	D. (1	EASTBOUND	992				1000			1931	1974	2211	2149	2529	2188	2685
	NEAR PETROL STATION	D. (2	WESTBOUND	687				700			1005	956	980	2387	1423	1635	1636
45	SH.HAMAD AVENUE	D. (1	NORTHBOUND	10113				10050			13288	15281	10990	15156	16247	11578	16887
	(NORTH RDT. NO. 1 HAMAD TOW	D. (2	SOUTHBOUND	10291				10200			12735	18725	14513	15506	17310	12566	15913
46	SAUDIA APPROCHED ROAD	D. (1	EASTBOUND	4812				4700			5623		7873	7230	6605	8511	9047
	EAST JANABIYA FLYOVER	D. (2	WESTBOUND	5389				5250			6523		3906	8315	6804	8799	9697
47	ZAID BIN OMYRAH HWY.	D. (1	NORTHBOUND					5600	5400	3692	3268	4384	4689	4663	5562	5505	3579
	NEAR BURI RDT.	D. (2	SOUTHBOUND					4300	3600	4153	5307	4513	4728	5119	4852	4545	2686
48	ESTIGLAL HWY	D. (1	WESTBOUND	9183				8450		8661	11307	13925	8046	10676	10681	11417	12469
	EAST ISA TOWN GATE RDT.	D. (2	EASTBOUND	8299				9350		9221	10575	14191	14136	11523	11599	11705	9464
49	AL QUDS AVENUE	D. (1	WESTBOUND	7567	10300	24300		5600		8513	7807	5820	5360	5906	6280	6587	6842
	WEST X.34	D. (2	EASTBOUND	5672	10250	D.1+D.2		7500		12019	8644	6724	6500	7074	7304	7405	6176
50	SH.SALMAN AVE. (MUHARRAQ)	D. (1	SOUTHBOUND								3513			14106	5666	7217	8359
	NORTH PC.03	D. (2	NORTHBOUND								8351			13229	7400	10087	10071
51	KING FAISAL HIGHWAY	D. (1	EASTBOUND						36000		20438	38373	32896	35361	38017	40430	40056
	EAST CENTRAL MARKET RDT.	D. (2	WESTBOUND						27200		29753	28135	30158	28722	28558	32890	34952
52	BUDAIYA HIGHWAY	D. (1	EASTBOUND			36000										15032	21515
	NEAR INT.HOSPITAL	D. (2	WESTBOUND			D.1+D.2										17934	19993
53	SH.ISA BIN SALMAN HIGHWAY	D. (1	EASTBOUND											20816	21277	21725	24915
	EAST TS.24	D. (2	WESTBOUND											17505	22659	23249	25975
54	AL FATEH HIGHWAY	D. (1	NORTHBOUND													29769	
	NORTH TS.13	D. (2	SOUTHBOUND													22946	
55	KHALIFA AL KABEER HWY.	D. (1	NORTHBOUND											25307	26404	23714	25183
	NORTH TX.10	D. (2	SOUTHBOUND											19600	19884	19517	20476
56	WALI AL AHED HIGHWAY	D. (1	EASTBOUND					7250	11100	10731				14156	13759	13100	14860
	NEAR B.D.F.	D. (2	WESTBOUND					7750	9500	6592				12927	12774	11745	13887
57	KING FAISAL HIGHWAY	D. (1	NORTHBOUND											12473	12056	13992	14044
	NEAR FIRE STATION	D. (2	SOUTHBOUND											11411	12935	14780	15551
59	UM AL NASSAN AVE.	D. (1	WESTBOUND											5787	9222	10274	9891
	WEST X.33	D. (2	EASTBOUND											4704	9443	10577	9878
60	NABIH SALEH AVENUE	D. (1	EASTBOUND											1407	1641	1481	1873
	NEAR POLICE STATION	D. (2	WESTBOUND											1280	1485	1607	1673
61	SAAR AVENUE	D. (1	NORTHBOUND													7385	8753
	NEAR PETROL STATION	D. (2	SOUTHBOUND													7112	10738
62	AL GHOSE HWY	D. (1	SOUTHBOUND				16600	8650	16500			11345		14694	14694	6181	7856
	NORTH X.8	D. (2	NORTHBOUND				8700	15950	10800			18033		9020	9020	8731	18655
63	ISA AL KABEER HWY.	D. (1	NORTHBOUND											14131	12737	14785	14362
	SOUTH TS.29	D. (2	SOUTHBOUND											4572	13481	10182	10386
64	ZUBARA AVENUE	D. (1	EASTBOUND											4683	6534	5873	
	NEAR CHARCH																
65	DRY DOUCK HWY	D. (1	WESTBOUND									2835	4407	2821	4758	5612	5844
	NEAR PETROL STATION	D. (2	EASTBOUND									2895	4862	3031	5194	3716	6341

AUTOMATIC TRAFFIC COUNT (1980 - 1998)

	LOCATION		DIRECTIONS	1980	1984	1986	1987	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998
66	MAHZOORA AVENUE	D. (1	EASTBOUND											9017	9017	9785	10447
	NEAR SANAD RDT.	D. (2	WESTBOUND											9211	9211	10464	9757
67	PALACE AVENUE	D. (1	NORTHBOUND											21641	17674	15426	17995
	NEAR POLICE STATION	D. (2	SOUTHBOUND											16952	18993	15985	16403
68	WALI AL AHED HIGHWAY	D. (1	EASTBOUND											9201	10199	16867	12210
	WEST HAMAD TWON RDT.	D. (2	WESTBOUND											10041	11273	18154	13057
69	BAGHDAD AVENUE	D. (1	NORTHBOUND													7782	
	NEAR SCHOOL	D. (2	SOUTHBOUND													5573	
70	A.RAHMAN ALFADEL HWY.	D. (1	SOUTHBOUND											6007	7516	4974	7329
	NEAR GARDEN	D. (2	NORTHBOUND											10030	8112	9416	7518
71	SUWAIFYA AVENUE	D. (1	NORTHBOUND											7283	7090	7996	8797
	NEAR SCHOOL	D. (2	SOUTHBOUND											10553	11070	8564	11630
72	AVENUE 38 (A'ALI)	D. (1	NORTHBOUND											5918	4785	4168	5619
	NEAR X.60	D. (2	SOUTHBOUND											6511	5355	6932	7828
73	SH.SALMAN AL FATEH AVENUE	D. (1	WESTBOUND											6307	6489	7098	8603
	NEAR X.43	D. (2	EASTBOUND											6281	4904	6390	8420
77	SH. ISA AVENUE	D. (1	NORTHBOUND			27000					9854					11649	
	NORTH ANDALUS RDT.	D. (2	SOUTHBOUND			D.1 + D.2					10887					10973	
78	SH. DUAIJ AVENUE	D. (1	EASTBOUND													2924	
	WEST PALACE RDT.	D. (2	WESTBOUND													4993	
79	SH HAMAD AVENUE (MANAMA)	D. (1	NORTHBOUND											8874	10319	11007	11160
	NORTH BUDAIYA HWY.																
82	SH HAMAD AVENUE (HAMAD TW	D. (1	SOUTHBOUND								3455	3798	4130	4229	4400	4233	5033
	SOUTH RDT. NO. 22	D. (2	NORTHBOUND								3332	4113	4275	4373	4506	4397	4926
83	SH. ABDULLA AVENUE (MUHARR	D. (1	WESTBOUND													9148	8428
	EAST SH.SALMAN RDT.	D. (2	EASTBOUND													3552	3980
84	GOVERNMENT AVENUE	D. (1	WESTBOUND											22327	24490	7110	25731
	NEAR N.B.B.	D. (2	EASTBOUND											9586	10942	9405	11039
85	JUFFAIR AVENUE	D. (1	EASTBOUND											7347	8155	6686	3863
	NEAR POWER STATION	D. (2	WESTBOUND											7381	7678	7074	11170
86	MUHARRAQ AVENUE	D. (1	NORTHBOUND											8741	7849	11247	11000
	NEAR T.L.D.	D. (2	SOUTHBOUND											8119	9808	9074	8567
92	OSAMA BIN ZAID AVENUE	D. (1	EASTBOUND											8154	10639	7913	6509
	NEAR BRITISH BANK	D. (2	WESTBOUND											6005	7222	10547	7699
96	KING FAISAL HIGHWAY	D. (1	NORTHBOUND				25800						29268		17559	19241	20551
	NORTH SALMANIYA RDT.	D. (2	SOUTHBOUND				24700						27960		20697	20400	24501

24 HOURS AM & PM TRAFFIC FLOWS FOR 1997

TE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (1)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR	TOTAL DAILY FLOW DIRECTION (2)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR
2	MUASKAR HWY -NEAR ALBA RDT.	12985	1174	848	13353	802	1024
	THE HIGHHEST MONTH (DECEMBER)	NORTHBOUND	06.15-07.15	15.15-16.15	SOUTHBOUND	06.30-07.30	15.15-16.15
3	SHAIKH SALMAN HIGHWAY	7684	512	719	8841	718	677
	NORTH AWALI RDT.	NORTHBOUND	11:00-12:00	15:00-16:00	SOUTHBOUND	07:00-08:00	14:00-15:00
4	AL ZALAQ HEY	8103	808	570	6676	431	594
	EAST SAKAIR AVE	EASTBOUND	06:00-07:00	15:00-16:00	WESTBOUND	07:00-08:00	14:00-15:00
5	MAJLIS AL TOWN	20050	1792	1609	24218	1729	1728
	EAST MAMEER PELICAN	EASTBOUND	06:45-07:45	15:15-16:15	WESTBOUND	06:15-07:15	13:30-14:30
6	OMAN AVENUE	12279	875	973	7165	382	701
	WEST TS.22	EASTBOUND	06:45-07:45	15:45-16:45	WESTBOUND	11:00-12:00	13:15-14:15
7	ESTEGLAL HWY	17384	1094	1316	16645	1334	1159
	NORTH SANAD RDT.	NORTHBOUND	11:00-12:00	15:00-16:00	SOUTHBOUND	06:00-07:00	13:00-14:00
8	SHAIKH SALMAN HIGHWAY	25183	1772	1835	23474	1549	1587
	SOUTH ISA TOWN GATE RDT.	NORTHBOUND	10:00-11:00	15:15-16:15	SOUTHBOUND	10:45-11:45	13:00-14:00
9	SALMANIYA AVENUE (NEAR TS.6)	24386	1486	1606	22581	1308	1570
	THE HIGHHEST MONTH (DECEMBER)	EASTBOUND	06.45-07.45	18.30-19.30	WESTBOUND	11.00-12.00	12.45-13.45
11	SHAIKH SALMAN HIGHWAY	49222	3968	3586	45813	3516	3347
	NORTH BAHRAIN GAS RDT.	NORTHBOUND	07:00-08:00	16:00-17:00	SOUTHBOUND	07:00-08:00	13:00-14:00
13	BUDAIYA HWY - EAST X.25	18688	1570	1463	18260	1229	1520
	THE HIGHHEST MONTH (DECEMBER)	EASTBOUND	06.30-07.30	15.45-16.45	WESTBOUND	11.00-12.00	13.15-14.15
14	XHIBITIONS AVE.(NEAR I.&PASPORT	15601	952	986	17976	1281	1171
	THE HIGHHEST MONTH (NOVEMBER)	NORTHBOUND	10.30-11.30	12.15-13.15	SOUTHBOUND	10.45-11.45	17.45-18.45
15	KUWAIT AVENUE (SOUTH TS.6)	21173	1438	1592	13870	811	1019
	THE HIGHHEST MONTH (NOVEMBER)	NORTHBOUND	06.45-07.45	15.45-16.45	SOUTHBOUND	06.45-07.45	12.30-13.30
16	SH ISA AVE. (SOUTH ANDALUS RDT.)	11241	658	702	12514	756	893
	THE HIGHHEST MONTH (DECEMBER)	NORTHBOUND	10.15-11.15	12.30-13.30	SOUTHBOUND	11.00-12.00	12.30-13.30
17	BANI OTBAH AVE (NORTH TS.43)	5946	323	415	6627	430	421
	THE HIGHHEST MONTH (NOVEMBER)	NORTHBOUND	07.00-08.00	12.30-13.30	SOUTHBOUND	06.45-07.45	12.30-13.30
18	ALFATEH HWY	23221	1391	1449	17566	1129	1124
	NEAR AL FATEH MOSQUS	NORTHBOUND	07:15-08:15	17:45-18:45	SOUTHBOUND	06:30-07:30	12:45-13:45
19	SH HAMAD C.WAY	28308	2432	1933	33912	1843	2789
	THE HIGHHEST MONTH (DECEMBER)	WESTBOUND	6.30-7.30	15.15-16.15	EASTBOUND	11.00-12.00	13.30-14.30
20	ARADOUS HWY. - NEAR AD DAIR	2971	181	229	2887	169	189
	(NEAR SCHOOL)	WESTBOUND	07:00-08:00	18:00-19:00	EASTBOUND	11:00-12:00	17:00-18:00
21	HAIKH ISA BIN SALMAN CAUSEWAY	11810	1456	893	12164	660	1240
		SOUTHBOUND	06:30-07:30	15:30-16:30	NORTHBOUND	06:30-07:30	13:30-14:30
22	RIFFA AVENUE	8564	478	647	8982	916	567
	(NEAR MUASKAR HWY.)	WESTBOUND	11:00-12:00	15:00-16:00	EASTBOUND	06:00-07:00	16:00-17:00
23	SEHLA AVENUE	15836	1007	1214	16551	1355	1107
	NORTH SEHLA RDT.	NORTHBOUND	06:45-07:45	16:15-17:15	SOUTHBOUND	06:30-07:30	12:45-13:45
24	MAJLIS AL TAWON HWY.	24188	1586	1909	23492	1957	1621
	THE HIGHHEST MONTH (DECEMBER)	NORTHBOUND	06.45-07.45	15.30-16.30	SOUTHBOUND	6.30-7.30	13.30-14.30
25	SHAIKH ISA AVENUE (MUHARRAQ)	6130	382	517			
	SOUTH TSX.2	NORTHBOUND	10:15-11:15	20:15-21:15			
26	SH. KHALIFA BIN SALMAN HWY.	15141	1640	1183	12707	910	1186
	NEAR CAMAL CROSSING	NORTHBOUND	06:30-07:30	15:45-16:45	SOUTHBOUND	06:30-07:30	15:45-16:45
27	SH. KHALIFA BIN SALMAN HWY.	12509	1255	901	13750	1055	946
	SOUTH BUDAIYA FLYOVER	NORTHBOUND	07:00-08:00	17:00-18:00	SOUTHBOUND	06:00-07:00	14:00-15:00
28	SH. KHALIFA BIN SALMAN HWY.	20560	1922	1417	16450	870	1443
	NORTH BUDAIYA FLYOVER	NORTHBOUND	07:00-08:00	17:00-18:00	SOUTHBOUND	10:00-11:00	18:00-19:00
29	AIRPORT AVENUE	16334	1143	1062	14875	1253	1146
	EAST X.7	WESTBOUND	06:30-07:30	18:15-19:15	EASTBOUND	06:30-07:30	13:00-14:00
30	A'ALI - BURI AVE.	1843	137	131	1329	98	106
	WEST TANNAL	EASTBOUND	11:00-12:00	16:00-17:00	WESTBOUND	11:00-12:00	13:00-14:00
31	H. KHALIFA B. S. HWY.(NEAR SANABI	26869	2361	1832	28444	1583	2338
	THE HIGHHEST MONTH (DECEMBER)	EASTBOUND	06.45-07.45	15.45-16.45	WESTBOUND	11.00-12.00	13.30-14.30
32	SH. SALMAN HWY. - NEAR TS.26	19726	1379	1478	22810	1433	1513
	THE HIGHHEST MONTH (JUNE)	EASTBOUND	06.45-07.45	17.00-18.00	WESTBOUND	10.45-11.45	12.30-13.30
33	AVENUE 35	19129	1231	1426	14689	912	1014
	(NEAR ZINJ)	NORTHBOUND	10:00-11:00	17:00-18:00	SOUTHBOUND	11:00-12:00	12:00-13:00

24 HOURS AM & PM TRAFFIC FLOWS FOR 1997

ITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (1)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR	TOTAL DAILY FLOW DIRECTION (2)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR
34	SH.ISA B.SALMAN HWY. - NEAR TS.28 THE HIGHHEST MONTH (NOVEMBER)	30472 EASTBOUND	2667 6.45-7.45	2109 16.00-17.00	22076 WESTBOUND	1277 11.00-12.00	1842 13.15-14.15
35	TUBLI SERVICE ROAD - NEAR TS.28 THE HIGHHEST MONTH (DECEMBER)	12088 EASTBOUND	769 09.30-10.30	873 15.30-16.30	13259 WESTBOUND	748 11.00-12.00	1062 13.30-14.30
36	ARAD HIGWAY EAST X.22	15688 WESTBOUND	1630 06:30-07:30	1270 16:00-17:00	15163 EASTBOUND	799 11:00-12:00	1301 13:30-14:30
37	HAWAR HIGHWAY NEAR ALBA RDT.	6257 NORTHBOUND	451 11:00-12:00	698 15:00-16:00	6731 SOUTHBOUND	1007 06:00-07:00	513 14:00-15:00
38	KING FAHAD C.WAY NEAR CAUSEWAY GATE	4242 EASTBOUND	238 08:00-09:00	237 12:00-13:00	4571 WESTBOUND	246 04:00-05:00	218 12:00-13:00
39	WALI AL AHEDHWY. NEAR HAMALA	5928 NORTHBOUND	726 06:00-07:00	350 17:00-18:00	6195 SOUTHBOUND	391 10:00-11:00	554 13:00-14:00
40	16 DECEBER HWY. NEAR BIN KHALDOON SHCOOL	7396 WESTBOUND	738 07:00-08:00	637 13:00-14:00	6827 EASTBOUND	733 07:00-08:00	625 13:00-14:00
41	MUASKAR HWY SOUTH X.35	5847 NORTHBOUND	365 06:00-07:00	429 17:00-18:00	5540 SOUTHBOUND	330 11:00-12:00	373 15:00-16:00
42	JANABIYA HIGHWAY NORTH FLYOVER	7799 NORTHBOUND	419 10:00-11:00	613 13:00-14:00	7443 SOUTHBOUND	752 06:00-07:00	459 16:00-17:00
43	BUDAIYA HIGHWAY NEAR AL QADAM	20271 EASTBOUND	1354 07:00-08:00	1515 17:00-18:00	24004 WESTBOUND	1409 11:00-12:00	1798 18:00-19:00
44	AL NAKEEL HWY. NEAR PETROL STATION	2188 EASTBOUND	170 06:00-07:00	152 18:00-19:00	1635 WESTBOUND	86 11:00-12:00	123 13:00-14:00
45	SH.HAMAD AVENUE (NORTH RDT. NO. 1 HAMAD TOWN)	11578 NORTHBOUND	705 11:00-12:00	786 13:00-14:00	12566 SOUTHBOUND	795 11:00-12:00	869 17:00-18:00
46	SAUDIA APPROCHED ROAD EAST JANABIYA FLYOVER	8511 EASTBOUND	604 11:00-12:00	562 23:00-24:00	8799 WESTBOUND	578 05:00-06:00	533 23:00-24:00
47	ZAID BIN OMYRAH HWY. NEAR BURI RDT.	5505 NORTHBOUND	375 06:00-07:00	453 17:00-18:00	4545 SOUTHBOUND	335 11:00-12:00	353 17:00-18:00
48	ESTIGLAL HWY EAST ISA TOWN GATE RDT.	11417 WESTBOUND	870 07:00-08:00	821 15:00-16:00	11705 EASTBOUND	1030 07:00-08:00	917 13:00-14:00
49	AL QUDS AVENUE WEST X.34	6587 WESTBOUND	382 07:00-08:00	501 17:00-18:00	7405 EASTBOUND	374 07:00-08:00	587 13:00-14:00
50	SH.SALMAN AVE. (MUHARRAQ) NORTH SH.SALMAN RDT.	7217 SOUTHBOUND	497 10:00-11:00	530 16:00-17:00	10087 NORTHBOUND	694 06:30-07:30	714 12:30-13:30
51	KING FAISAL HIGHWAY EAST CENTRAL MARKET RDT.	40430 EASTBOUND	3232 07:00-08:00	2708 16:45-17:45	32890 WESTBOUND	1896 06:30-07:30	2550 13:30-14:30
52	BUDAIYA HIGHWAY NEAR INT.HOSPITAL	15032 EASTBOUND	988 10:15-11:15	1217 15:30-16:30	17934 WESTBOUND	1100 10:45-11:45	1292 16:15-17:15
53	SH.ISA BIN SALMAN HIGHWAY EAST TS.24	21725 EASTBOUND	1471 06:45-07:45	1449 15:45-16:45	23249 WESTBOUND	1396 11:00-12:00	1719 13:15-14:15
54	AL FATEH HIGHWAY NORTH TS.13	29769 NORTHBOUND	1716 07:00-08:00	2093 13:30-14:30	22946 SOUTHBOUND	1469 06:30-07:30	1577 12:30-13:30
55	HALIFA AL KABEER HWY. -NORTH X THE HIGHHEST MONTH (DECEMBER)	23714 NORTHBOUND	2091 06.30-07.30	1639 15.15-16.15	19517 SOUTHBOUND	989 11.00-12.00	1730 13.30-14.30
56	WALI AL AHED HIGHWAY NEAR B.D.F.	13100 EASTBOUND	820 06:00-07:00	867 17:00-18:00	11745 WESTBOUND	689 11:00-12:00	786 17:00-18:00
57	KING FAISAL HIGHWAY NEAR FIRE STATION	13992 NORTHBOUND	980 07:00-08:00	1009 16:15-17:15	14780 SOUTHBOUND	989 11:00-12:00	1119 13:00-14:00
59	UM AL NASSAN AVE. EAST TSX.37	10274 WESTBOUND	802 07:00-08:00	613 22:00-23:00	10577 EASTBOUND	818 07:00-08:00	803 22:00-23:00
60	NABIH SALEH AVENUE NEAR POLICE STATION	1481 EASTBOUND	136 06:30-07:30	108 16:00-17:00	1607 WESTBOUND	111 11:00-12:00	141 17:00-18:00
61	SAAR AVENUE NEAR PETROL STATION	7385 NORTHBOUND	618 07:00-08:00	566 15:45-16:45	7112 SOUTHBOUND	403 11:00-12:00	619 13:00-14:00
62	AL GHOSE HWY SOUTH TSX.20	6181 SOUTHBOUND	330 10:00-11:00	467 17:00-18:00	8731 NORTHBOUND	663 07:00-08:00	630 18:00-19:00
63	ISA AL KABEER HIGHWAY BETWEEN TS.29 & TS.30	14785 NORTHBOUND	1002 10:30-11:30	916 12:30-13:30	10182 SOUTHBOUND	626 11:00-12:00	779 18:00-19:00
64	ZUBARA AVENUE IN FROM WEST	5873 EASTBOUND	353 10:45-11:45	442 18:30-19:30			



24 HOURS AM & PM TRAFFIC FLOWS FOR 1998

SITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (1)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR	TOTAL DAILY FLOW DIRECTION (2)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR
2	MUASKAR HWY -NEAR ALBA RDT.	13264	1189	867	13872	880	988
	THE HIGHEST MONTH (MARCH)	NORTHBOUND	06.15-07.15	16.45-17.45	SOUTHBOUND	06.30-07.30	15.15-16.15
3	SHAIKH SALMAN HIGHWAY	8120	435	653	8727	689	730
	NORTH AWALI RDT.	NORTHBOUND	06:30-07:30	17:15-18:15	SOUTHBOUND	06:45-07:45	13:30-14:30
4	AL ZALAQ HEY	9424	840	795	3533	298	375
	EAST SAKAIR AVE	EASTBOUND	06.15-07.15	17:15-18:15	WESTBOUND	07:00-08:00	13:30-14:30
5	MAJLIS AL TOWN	25998	2287	1768	26993	1808	1817
	EAST MAMEER PELICAN	EASTBOUND	07:00-08:00	15:00-16:00	WESTBOUND	06:00-07:00	14:00-15:00
6	OMAN AVENUE	14180	1092	1009	7927	439	764
	WEST TS.22	EASTBOUND	06:30-07:30	15:30-16:30	WESTBOUND	06:45-07:45	13:15-14:15
7	ESTEGLAL HWY	17799	1127	1342	17841	1364	1251
	NORTH SANAD RDT.	NORTHBOUND	06:45-07:45	15:30-16:30	SOUTHBOUND	06.30-07.30	13:30-14:30
8	SHAIKH SALMAN HIGHWAY	23556	1650	1548	22367	1450	1564
	SOUTH ISA TOWN GATE RDT.	NORTHBOUND	09:30-10:30	16:30-17:30	SOUTHBOUND	11:00-12:00	12:15-13:15
9	SALMANIYA AVENUE (NEAR TS.6)	24646	1548	1646	22921	1340	1581
	THE HIGHEST MONTH (MARCH)	EASTBOUND	06.45-07.45	19.30-20.30	WESTBOUND	06.45-07.45	13.00-14.00
10	SHAIKH SALMAN HIGHWAY	50078	3696	3346	47292	3351	3236
	NORTH BAHRAIN GAS RDT.	NORTHBOUND	07:00-08:00	16:00-17:00	SOUTHBOUND	07:00-08:00	13:00-14:00
13	BUDAIYA HWY - EAST X.25	22913	1770	1711	18760	1206	1489
	THE HIGHHEST MONTH (APRIL)	EASTBOUND	06.30-07.30	16.45-17.45	WESTBOUND	11.00-12.00	12.30-13.30
14	EXHIBITIONS AVE.(NEAR I.&PASPORT)	15816	920	976	18576	1263	1164
	THE HIGHHEST MONTH (JULY)	NORTHBOUND	10.45-11.45	18.00-19.00	SOUTHBOUND	10.45-11.45	17.45-18.45
15	KUWAIT AVENUE (SOUTH TS.6)	22935	1385	1645	14467	833	988
	THE HIGHHEST MONTH (APRIL)	NORTHBOUND	10.00-11.00	17.00-18.00	SOUTHBOUND	11.00-12.00	12.30-13.30
16	SH ISA AVE. (SOUTH ANDALUS RDT.)	11685	658	735	13561	792	906
	THE HIGHHEST MONTH (APRIL)	NORTHBOUND	10.15-11.15	17.15-18.15	SOUTHBOUND	11.00-12.00	20.00-21.00
17	BANI OTBAH AVE (NORTH TS.43)	6248	330	419	6259	378	390
	THE HIGHHEST MONTH (APRIL)	NORTHBOUND	11.00-12.00	17.30-18.30	SOUTHBOUND	06.45-07.45	12.30-13.30
18	ALFATEH HWY	32603	1755	2122	37826	2100	2461
	NEAR AL FATEH MOSQUS	NORTHBOUND	10:45-11:45	17:30-18:30	SOUTHBOUND	11.00-12.00	12:45-13:45
19	SH HAMAD C.WAY	29398	2381	1947	35037	1861	2678
	THE HIGHHEST MONTH (APRIL)	WESTBOUND	06.30-07.30	17.00-18.00	EASTBOUND	11.00-12.00	13.30-14.30
20	ARADOUS HWY. - NEAR AD DAIR	4295	451	291	4529	326	346
	(NEAR SCHOOL)	WESTBOUND	06.30-07.30	17:15-18:15	EASTBOUND	11:00-12:00	13:30-14:30
21	SHAIKH ISA BIN SALMAN CAUSEWAY	23672	2100	1517	18014	885	1414
		SOUTHBOUND	07:00-08:00	20:00-21:00	NORTHBOUND	06:00-07:00	13:00-14:00
22	RIFFA AVENUE	9292	1047	591	8848	504	725
	(NEAR MUASKAR HWY.)	WESTBOUND	06:15-07:15	16:00-17:00	EASTBOUND	11.00-12.00	13.30-14.30
23	SEHLA AVENUE	17309	1017	1338	17073	1329	1143
	NORTH SEHLA RDT.	NORTHBOUND	07:00-08:00	15:45-16:45	SOUTHBOUND	06:30-07:30	12:45-13:45
24	MAJLIS AL TAWON HWY.	26163	1840	2057	26060	2237	1787
	THE HIGHHEST MONTH (MARCH)	NORTHBOUND	06.45-07.45	15.30-16.30	SOUTHBOUND	06.30-07.30	13.30-14.30
25	SHAIKH ISA AVENUE (MUHARRAQ)						
	SOUTH TSX.2						
26	SH. KHALIFA BIN SALMAN HWY.	14260	1317	1045	14583	910	1190
	NEAR CAMAL CROSSING	NORTHBOUND	06:30-07:30	16:30-17:30	SOUTHBOUND	06:30-07:30	13:45-14:45
27	SH. KHALIFA BIN SALMAN HWY.	13378	1230	988	15464	1194	1155
	SOUTH BUDAIYA FLYOVER	NORTHBOUND	06:45-07:45	16:45-17:45	SOUTHBOUND	06:30-07:30	13:45-14:45
28	SH. KHALIFA BIN SALMAN HWY.	21365	1826	1528	23109	1218	1687
	NORTH BUDAIYA FLYOVER	NORTHBOUND	06:45-07:45	17:15-18:15	SOUTHBOUND	11:00-12:00	13.30-14.30
29	AIRPORT AVENUE	16772	1089	1064	14759	1141	1013
	EAST X.7	WESTBOUND	06:30-07:30	19:15-20:15	EASTBOUND	06:30-07:30	12:30-21:30
30	A'ALI - BURI AVE.	1510	175	103	2435	218	174
	WEST TANNAL	EASTBOUND	06:30-07:30	12:45-13:45	WESTBOUND	06:30-07:30	17:00-18:00
31	SH. KHALIFA B. S. HWY.(NEAR SANABIS)	28206	2445	1889	28750	1581	2157
	THE HIGHHEST MONTH (APRIL)	EASTBOUND	06.45-07.45	16.45-17.45	WESTBOUND	11.00-12.00	12.45-13.45
32	SH. SALMAN HWY. - NEAR TS.26	18251	1299	1170	20977	1305	1609
	THE HIGHHEST MONTH (JANUARY)	EASTBOUND	07.30-08.30	12.45-13.45	WESTBOUND	11.00-12.00	13.15-14.15
33	AVENUE 35	25193	1601	1811	14979	902	1119
	(NEAR ZINJ)	NORTHBOUND	07:15-08:15	16:45-17:45	SOUTHBOUND	11:00-12:00	12:30-13:30

24 HOURS AM & PM TRAFFIC FLOWS FOR 1998

SITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (1)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR	TOTAL DAILY FLOW DIRECTION (2)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR
34	SH.ISA B.SALMAN HWY. - NEAR TS.28	38747	2866	2658	25025	1436	1858
	THE HIGHHEST MONTH (JUNE)	EASTBOUND	06.45-07.45	17.00-18.00	WESTBOUND	11.00-12.00	13.15-14.15
35	TUBLI SERVICE ROAD - NEAR TS.28	12566	801	870	13638	765	1049
	THE HIGHHEST MONTH (MARCH)	EASTBOUND	09.30-10.30	15.30-16.30	WESTBOUND	11.00-12.00	13.30-14.30
36	ARAD HIGWAY	16346	1583	1282	15116	823	1252
	EAST X.22	WESTBOUND	06:30-07:30	17:30-18:30	EASTBOUND	11:00-12:00	13:45-14:45
37	HAWAR HIGHWAY	7191	558	821	7814	1157	594
	NEAR ALBA RDT.	NORTHBOUND	06.45-07.45	14:45-18:45	SOUTHBOUND	06:00-07:00	13:45-14:45
38	KING FAHAD C.WAY	4396	224	375	4416	218	298
	NEAR CAUSEWAY GATE	EASTBOUND	11:00-12:00	17:00-18:00	WESTBOUND	09:15-10:15	14:15-15:15
39	WALI AL AHEDHWY.	6349	655	401	6376	374	554
	NEAR HAMALA	NORTHBOUND	06:15-07:15	17:15-18:15	SOUTHBOUND	09:00-10:00	13:15-14:15
40	16 DECEBER HWY.	7693	991	828	7697	997	847
	NEAR BIN KHALDOON SHCOOL	WESTBOUND	06:30-07:30	13:15-14:15	EASTBOUND	06.45-07.45	13.30-14.30
41	MUASKAR HWY	6820	548	560	6570	615	471
	SOUTH X.35	NORTHBOUND	06:15-07:15	15:00-16:00	SOUTHBOUND	06.45-07.45	13.30-14.30
	JANABIYA HIGHWAY	8570	460	660	7674	851	483
	NORTH FLYOVER	NORTHBOUND	07:00-08:00	13:15-14:15	SOUTHBOUND	06:30-07:30	17:45-18:45
43	BUDAIYA HIGHWAY	20136	1334	1504	22081	1290	1773
	NEAR AL QADAM	EASTBOUND	07:00-08:00	16:00-17:00	WESTBOUND	11:00-12:00	18:00-19:00
44	AL NAKEEL HWY.	2685	261	186	1636	91	129
	NEAR PETROL STATION	EASTBOUND	06:30-07:30	15:45-16:45	WESTBOUND	11:00-12:00	18:00-19:00
45	SH.HAMAD AVENUE	16887	1584	1330	15913	791	1359
	(NORTH RDT. NO. 1 HAMAD TOWN)	NORTHBOUND	06:15-07:15	16:30-17:30	SOUTHBOUND	06.45-07.45	20:00-21:00
46	SAUDIA APPROCHED ROAD	9047	848	612	9697	737	646
	EAST JANABIYA FLYOVER	EASTBOUND	06:30-07:30	13:30-14:30	WESTBOUND	06.15-07.15	13:45-14:45
47	ZAID BIN OMYRAH HWY.	3579	204	277	2686	204	214
	NEAR BURI RDT.	NORTHBOUND	09:45-10:45	17:15-18:15	SOUTHBOUND	11:00-12:00	17:45-18:45
48	ESTIGLAL HWY	12469	1176	910	9464	923	711
	EAST ISA TOWN GATE RDT.	WESTBOUND	06:30-07:30	15:30-16:30	EASTBOUND	06:30-07:30	13:15-14:15
49	AL QUDS AVENUE	6842	458	551	6176	481	531
	WEST X.34	WESTBOUND	06:45-07:45	16:30-17:30	EASTBOUND	06:30-07:30	12:45-13:45
50	SH.SALMAN AVE. (MUHARRAQ)	8359	723	492	10071	790	589
	NORTH SH.SALMAN RDT.	SOUTHBOUND	06.30-07.30	15.00-16.00	NORTHBOUND	06:30-07:30	12:30-13:30
51	KING FAISAL HIGHWAY	40056	2820	2686	34952	1899	2487
	EAST CENTRAL MARKET RDT.	EASTBOUND	07:00-08:00	17:00-18:00	WESTBOUND	10:45-11:45	13:30-14:30
52	BUDAIYA HIGHWAY	21515	1309	1608	19993	1229	1430
	NEAR INT.HOSPITAL	EASTBOUND	07:15-08:15	15:45-16:45	WESTBOUND	11:00-12:00	13:00-14:00
53	SH.ISA BIN SALMAN HIGHWAY	24915	1910	1633	25975	1544	1808
	EAST TS.24	EASTBOUND	06:45-07:45	17:15-18:15	WESTBOUND	11:00-12:00	13:15-14:15
54	AL FATEH HIGHWAY						
	NORTH TS.13						
55	KHALIFA AL KABEER HWY. -NORTH X10	25183	2047	1760	20476	1013	1654
	THE HIGHHEST MONTH (APRIL)	NORTHBOUND	06.30-07.30	17.00-18.00	SOUTHBOUND	11.00-12.00	13.30-14.30
56	WALI AL AHED HIGHWAY	14860	1467	995	13887	924	1116
	NEAR B.D.F.	EASTBOUND	06:30-07:30	13.15-14.15	WESTBOUND	06:30-07:30	13:30-14:30
57	KING FAISAL HIGHWAY	14044	903	1007	15551	979	1138
	NEAR FIRE STATION	NORTHBOUND	10:15-11:15	16:30-17:30	SOUTHBOUND	11:00-12:00	12:45-13:45
59	UM AL NASSAN AVE.	9891	665	808	9878	865	698
	EAST TSX.37	WESTBOUND	06:30-07:30	13:00-14:00	EASTBOUND	06:30-07:30	12:45-13:45
60	NABIH SALEH AVENUE	1873	153	162	1673	110	155
	NEAR POLICE STATION	EASTBOUND	06:30-07:30	17:45-18:45	WESTBOUND	11:00-12:00	17:00-18:00
61	SAAR AVENUE	8753	715	654	10738	720	707
	NEAR PETROL STATION	NORTHBOUND	07:00-08:00	16:15-17:15	SOUTHBOUND	10:30-11:30	18:15-19:15
62	AL GHOSE HWY	7856	409	561	18655	1099	1332
	SOUTH TSX.20	SOUTHBOUND	06:30-07:30	19:30-20:30	NORTHBOUND	06:30-07:30	18:00-19:00
63	ISA AL KABEER HIGHWAY	14362	993	801	10386	631	793
	BETWEEN TS.29 & TS.30	NORTHBOUND	10:00-11:00	16:15-17:15	SOUTHBOUND	06:45-07:45	18:00-19:00
64	ZUBARA AVENUE						
	IN FROM WEST						

24 HOURS AM & PM TRAFFIC FLOWS FOR 1998

SITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (1)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR	TOTAL DAILY FLOW DIRECTION (2)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR
65	DRY DOUCK HWY	5844	502	506	6341	782	468
	NEAR PETROL STATION	WESTBOUND	06:30-07:30	16:45-17:45	EASTBOUND	06:15-07:15	13:15-14:15
66	MAHZOORA AVENUE	10447	898	748	9757	531	791
	SOUTH SANAD RDT.	EASTBOUND	06:30-07:30	16:15-17:15	WESTBOUND	11:00-12:00	13:30-14:30
67	PALACE AVENUE	17995	1132	1143	16403	932	1064
	POLICE STATION	NORTHBOUND	10:15-11:15	17:45-18:45	SOUTHBOUND	11:00-12:00	12:15-13:15
68	WALI AL AHED HIGHWAY	12210	722	823	13057	819	905
	NEAR BURI	EASTBOUND	10:45-11:45	13:00-14:00	WESTBOUND	06:15-07:15	17:00-18:00
69	BAGHDAD AVENUE						
	NEAR GIRLS SCHOOL						
70	A.RAHMAN ALFADEL HIGHWAY	7329	609	553	7518	385	636
	NEAR GARDEN	SOUTHBOUND	06:30-07:30	18:00-19:00	NORTHBOUND	06:30-07:30	18:15-19:15
71	SUWAIFYA AVENUE	8797	775	667	11630	815	1164
	NEAR HOTTEEN SCHOOL	NORTHBOUND	07:00-08:00	16:00-17:00	SOUTHBOUND	11:00-12:00	12:15-13:15
72	AVENUE 38 (A'ALI)	5619	333	406	7828	545	521
	NORTH TSX.60	NORTHBOUND	11:00-12:00	13:15-14:15	SOUTHBOUND	06:30-07:30	17:00-18:00
	SH.SALMAN A. AL FATEH AVENUE	8603	785	693	8420	1092	597
	EAST TSX.43	WESTBOUND	06:45-07:45	15:45-16:45	EASTBOUND	06:45-07:45	14:30-15:30
77	SHAIKH ISA AVENUE						
	NEAR ANDALUS GARDEN						
78	SHAIKH DUAIJ AVENUE						
	NORTH SH.HAMAD PALACE						
79	SH HAMAD AVENUE (MANAMA)	11160	719	718			
	NORTH BUDAIYA HWY.	NORTHBOUND	09:30-10:30	16:30-17:30			
82	SH HAMAD AVENUE (HAMAD TWON)	5033	255	517	4926	837	333
	SOUTH RDT. NO.22	SOUTHBOUND	06:45-07:45	13:45-14:45	NORTHBOUND	06:15-07:15	16:00-17:00
83	SHAIKH ABDULLA AVE. (MUHARRAQ)	8428	536	608	3980	263	307
	EAST SH.SALMAN RDT.	WESTBOUND	11:00-12:00	15:30-16:30	EASTBOUND	09:45-10:45	12:15-13:15
84	GOVERNMENT AVENUE	25731	1789	1648	11039	756	836
	NEAR NBB.	WESTBOUND	10:15-11:15	12:00-13:00	EASTBOUND	10:15-11:15	19:00-20:00
85	JUFFAIR AVENUE	3863	318	340	11170	695	870
	NEAR POWER STATION	EASTBOUND	07:00-08:00	18:00-19:00	WESTBOUND	11:00-12:00	12:30-13:30
86	MUHARRAQ AVENUE	11000	1098	956	8567	897	770
	NEAR TLD.	NORTHBOUND	06:45-07:45	13:15-14:15	SOUTHBOUND	06:45-07:45	13:30-14:30
92	OSAMA BIN ZAID AVENUE	9509	552	599	7699	420	474
	NEAR BRITISH BANK	EASTBOUND	09:15-10:15	16:45-17:45	WESTBOUND	11:00-12:00	21:15-22:15
96	KING FAISAL HIGHWAY	20551	1380	1405	24501	1599	1741
	NORTH SALMANIYA RDT.	NORTHBOUND	10:15-11:15	16:15-17:15	SOUTHBOUND	10:45-11:45	17:00-18:00

Key :

SCOOT SITES

PERMANENT SITES

TEMPORARY SITES

24 HOURS AM & PM TRAFFIC FLOWS FOR 2006 - 1

SITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (1)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR	TOTAL DAILY FLOW DIRECTION (2)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR
2	MUASKAR HIGHWAY -NEAR ALBA RDT.	12660 Eastbound	1143 AM PkHr (06:30 - 07:30)	1014 PM PkHr (13:15 - 14:15)	17229 Westbound	1341 AM PkHr (06:45 - 07:45)	1343 PM PkHr (15:30 - 16:30)
3	SHAIKH SALMAN HIGHWAY NORTH AWALI RDT.	10249 Northbound	1137 AM PkHr (06:30 - 07:30)	878 PM PkHr (13:30 - 14:30)	12029 Southbound	1061 AM PkHr (06:45 - 07:45)	1028 PM PkHr (13:15 - 14:15)
6	OMAN AVENUE WEST QADISIYA AVE.	17539 EASTBOUND	1069 AM PkHr (10:45 - 11:45)	1246 PM PkHr (18:15 - 19:15)	14098 WESTBOUND	954 AM PkHr (11:45 - 12:45)	1014 PM PkHr (12:30 - 13:30)
7	ESTEGLAL HWY NORTH SANAD RDT.	30936 Northbound	2079 AM PkHr (06:45 - 07:45)	2218 PM PkHr (15:15 - 16:15)	24969 Southbound	1575 AM PkHr (11:00 - 12:00)	1748 PM PkHr (13:15 - 14:15)
9	SALMANIYA AVENUE EAST KUWAIT AVE.	27837 Eastbound	1832 AM PkHr (07:00 - 08:00)	1627 PM PkHr (12:00 - 13:00)	27271 Westbound	1657 AM PkHr (06:30 - 07:30)	1609 PM PkHr (12:00 - 13:00)
10	SH.SALMAN HIGHWAY SOUTH BAH. GAS RDT.	27405 Northbound	2190 AM PkHr (07:00 - 08:00)	1606 PM PkHr (17:30 - 18:30)	33715 Southbound	2271 AM PkHr (06:15 - 07:15)	2025 PM PkHr (15:15 - 16:15)
13	BUDAIYA HIGHWAY NEAR BURHAMA V.	25302.4 EASTBOUND	1494.4 AM PkHr (11:00 - 12:00)	1707.2 PM PkHr (18:00 - 19:00)	21084.8 WESTBOUND	1417.6 AM PkHr (11:45 - 12:45)	1470.4 PM PkHr (13:15 - 14:15)
14	EXHIBITIONS AVENUE NEAR IMIGRATION	18418 Northbound	1138 AM PkHr (11:45 - 12:45)	1166 PM PkHr (13:00 - 14:00)	19514 Southbound	1349 AM PkHr (11:00 - 12:00)	1266 PM PkHr (16:00 - 17:00)
15	KUWAIT AVENUE NORTH OMAN AVE.	25512 Northbound	1689 AM PkHr (06:45 - 07:45)	1633 PM PkHr (16:15 - 17:15)	18973 Southbound	1169 AM PkHr (11:45 - 12:45)	1276 PM PkHr (13:00 - 14:00)
16	SH ISA AVENUE (SOUTH ANDALUS RDT.)	15307 Northbound	878 AM PkHr (10:30 - 11:30)	983 PM PkHr (17:45 - 18:45)	15945 Southbound	947 AM PkHr (11:45 - 12:45)	1022 PM PkHr (12:45 - 13:45)
17	BANI OTBAH AVENUE SOUTH PALACE RDT.	14408 Northbound	852 AM PkHr (11:30 - 12:30)	923 PM PkHr (12:45 - 13:45)	14197 Southbound	828 AM PkHr (11:30 - 12:30)	906 PM PkHr (12:45 - 13:45)

24 HOURS AM & PM TRAFFIC FLOWS FOR 2006 - 2

SITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR	TOTAL DAILY FLOW DIRECTION	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR
20	ARADOUS HWY. - NEAR AD DAIR (NEAR DAIR SCHOOL)	15522 WESTBOUND	1626 AM PkHr (06:15 - 07:15)	1216 PM PkHr (13:15 - 14:15)	12759 EASTBOUND	1351 AM PkHr (06:15 - 07:15)	991 PM PkHr (13:00 - 14:00)
22	RIFFA AVENUE (NEAR MUASKAR HWY.)	13218 Westbound	1342 AM PkHr (06:15 - 07:15)	835 PM PkHr (13:00 - 14:00)	14071 Eastbound	799 AM PkHr (11:45 - 12:45)	1088 PM PkHr (13:00 - 14:00)
23	SEHLA AVENUE NORTH SEHLA RDT.	23541 Northbound	1626 AM PkHr (06:30 - 07:30)	1622 PM PkHr (17:00 - 18:00)	18727 Southbound	1227 AM PkHr (06:15 - 07:15)	1191 PM PkHr (17:45 - 18:45)
24	MAJLIS AL TAWON HWY. NORTH NABIH SALEH	33862 Northbound	2193 AM PkHr (06:30 - 07:30)	2728 PM PkHr (15:45 - 16:45)	35179 Southbound	2185 AM PkHr (11:45 - 12:45)	2828 PM PkHr (13:45 - 14:45)
25	SHAIKH ISA AVENUE (MUH) SOUTH SH.ABDU. AVE.	7403 Northbound	653 AM PkHr (06:30 - 07:30)	609 PM PkHr (12:45 - 13:45)			
26	SH. KHALIFA BIN SALMAN HWY. NEAR CAMAL CROSSING	33862 Northbound	2193 AM PkHr (06:30 - 07:30)	2728 PM PkHr (15:45 - 16:45)	35179 Southbound	2185 AM PkHr (11:45 - 12:45)	2828 PM PkHr (13:45 - 14:45)
27	SH. KHALIFA BIN SALMAN HWY. SOUTH BUDAIYA FLYOVER	23541 Northbound	1626 AM PkHr (06:30 - 07:30)	1622 PM PkHr (17:00 - 18:00)	18727 Southbound	1227 AM PkHr (06:15 - 07:15)	1191 PM PkHr (17:45 - 18:45)
28	SH. KHALIFA BIN SALMAN HWY. NORTH BUDAIYA FLYOVER	55125 Eastbound	5513 AM PkHr (07:00 - 08:00)	3518 PM PkHr (17:00 - 18:00)	49611 Westbound	3172 AM PkHr (06:30 - 07:30)	3883 PM PkHr (13:30 - 14:30)
29	AIRPORT AVENUE NEAR BUSAYTEEN	25664 Westbound	1537 AM PkHr (06:30 - 07:30)	1757 PM PkHr (18:45 - 19:45)	23881 Eastbound	1496 AM PkHr (06:30 - 07:30)	1811 PM PkHr (13:15 - 14:15)
30	A'ALI - BURI AVE. WEST TANNAL	9287 Eastbound	907 AM PkHr (06:15 - 07:15)	645 PM PkHr (13:00 - 14:00)	5651 Westbound	497 AM PkHr (06:15 - 07:15)	446 PM PkHr (12:45 - 13:45)
31	SH. KHALIFA B. S. HIGHWAY .(NEAR SANABIS)	60080 EASTBOUND	5204 AM PkHr (06:30 - 07:30)	3805 PM PkHr (16:30 - 17:30)	45205 WESTBOUND	2726 AM PkHr (11:45 - 12:45)	3462 PM PkHr (13:30 - 14:30)
32	SH. SALMAN HIGHWAY NEAR ZAYANI GARAGE	12723 EASTBOUND	1111 AM PkHr (06:30 - 07:30)	1047 PM PkHr (17:15 - 18:15)	26743 WESTBOUND	1623 AM PkHr (07:15 - 08:15)	1900 PM PkHr (13:30 - 14:30)

24 HOUR AM & PM TRAFFIC FLOWS FOR 6 - 3

SL. NO	LOCATION	TOTAL DAILY FLOW - 2 DIRECTION (2)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR	TOTAL DAILY FLOW - 2 DIRECTION (2)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR
33	HIGHWAY 35 (NEAR ZINJ)	25500 Northbound	1609 AM PkHr (09:15 - 10:15)	1712 PM PkHr (16:15 - 17:15)	20693 Southbound	1302 AM PkHr (11:45 - 12:45)	1355 PM PkHr (13:00 - 14:00)
34	SH.ISA B.SALMAN HWY. NEAR NEW ZINJ	38584 EASTBOUND	2344 AM PkHr (06:30 - 07:30)	2472 PM PkHr (18:15 - 19:15)	34048 WESTBOUND	1971 AM PkHr (11:45 - 12:45)	2390 PM PkHr (13:30 - 14:30)
35	TUBLI SERVICE ROAD NEAR PETROL STATION	12102 EASTBOUND	721.6 AM PkHr (06:15 - 07:15)	728 PM PkHr (13:30 - 14:30)	15086 WESTBOUND	870 AM PkHr (11:45 - 12:45)	1066 PM PkHr (13:30 - 14:30)
36	ARAD HIGWAY EAST X.22- AVE.40	20256 WESTBOUND	2055 AM PkHr (06:30 - 07:30)	1485 PM PkHr (17:00 - 18:00)	24256 Eastbound	1320 AM PkHr (06:30 - 07:30)	2151 PM PkHr (13:15 - 14:15)
37	HAWAR HIGHWAY NEAR RIFFA POWER S.	14232 Northbound	1034 AM PkHr (06:30 - 07:30)	1363 PM PkHr (15:00 - 16:00)	16299 Southbound	1845 AM PkHr (05:45 - 06:45)	1177 PM PkHr (14:00 - 15:00)
38	KING FAHAD C.WAY WEST JANABIYA FLYOVER	9095 Eastbound	435 AM PkHr (11:45 - 12:45)	749 PM PkHr (18:15 - 19:15)	10538 Westbound	629 AM PkHr (06:45 - 07:45)	652 PM PkHr (15:15 - 16:15)
39	WALI AL AHEDHWY. NEAR HAMALA	19392 Northbound	1480 AM PkHr (06:00 - 07:00)	1481 PM PkHr (13:00 - 14:00)	17320 Southbound	1210 AM PkHr (06:15 - 07:15)	1324 PM PkHr (13:00 - 14:00)
40	16 DECEBER HWY. NEAR BIN KHALDOON SCHOOL	17002 Eastbound	1711 AM PkHr (06:45 - 07:45)	1509 PM PkHr (13:15 - 14:15)	16096 Westbound	1277 AM PkHr (06:30 - 07:30)	1099 PM PkHr (13:30 - 14:30)
41	MUASKAR HWY NEAR PETROL STATION	12079 Eastbound	962 AM PkHr (06:30 - 07:30)	1136 PM PkHr (13:45 - 14:45)	12316 Westbound	1389 AM PkHr (06:45 - 07:45)	837 PM PkHr (13:30 - 14:30)
42	JANABIYA HIGHWAY NORTH FLYOVER	14585 Northbound	901 AM PkHr (11:45 - 12:45)	1276 PM PkHr (13:00 - 14:00)	15554 Southbound	1737 AM PkHr (06:30 - 07:30)	1069 PM PkHr (16:30 - 17:30)
43	MUHARRAQ HIGHWAY NEAR AL QADEM	9205 Eastbound	1076 AM PkHr (06:30 - 07:30)	1179 PM PkHr (16:00 - 17:00)	9183 Westbound	1001 AM PkHr (11:45 - 12:45)	1249 PM PkHr (13:30 - 14:30)
44	AL NAKEEL HWY. NEAR PETROL STATION	8824 EASTBOUND	425 AM PkHr (06:15 - 07:15)	668 PM PkHr (13:15 - 14:15)	9792 WESTBOUND	670 AM PkHr (06:15 - 07:15)	749 PM PkHr (13:15 - 14:15)
45	SH.HAMAD AVENUE (NORTH RDT. NO. 1 HAMAD T.)	17958 Northbound	1625 AM PkHr (06:15 - 07:15)	1483 PM PkHr (16:00 - 17:00)	15945 Southbound	947 AM PkHr (11:45 - 12:45)	1022 PM PkHr (12:45 - 13:45)
46	SALMABAD PETROL CHILD ROAD NEAR JANABIYA FLYOVER	22315 WESTBOUND	1745 AM PkHr (06:30 - 07:30)	1496 PM PkHr (16:00 - 17:00)	24056 WESTBOUND	1401 AM PkHr (06:45 - 07:45)	1561 PM PkHr (13:30 - 14:30)
47	ZAID BIN OMYRAH HWY.	17382	1037	1207	12399	794	933

24 HOUR AM & PM TRAFFIC FLOWS FOR 2006 - 4

SITE NO.	LOCATION	TOTAL 24 HOUR TRAFFIC	AM PEAK HOUR	PM PEAK HOUR	TOTAL 24 HOUR TRAFFIC	AM PEAK HOUR	PM PEAK HOUR
48	ESTIGLAL HWY EAST ISA TOWN GATE RDT.	16996 Westbound	1778 AM PkHr (06:30 - 07:30)	1213 PM PkHr (14:45 - 15:45)	23987 Eastbound	2222 AM PkHr (06:45 - 07:45)	1663 PM PkHr (14:00 - 15:00)
49	AL QUDS AVENUE NEAR ELECTRICITY OFFIC	14653 Westbound	919 AM PkHr (11:00 - 12:00)	1123 PM PkHr (17:15 - 18:15)	14280 Eastbound	972 AM PkHr (06:30 - 07:30)	1046 PM PkHr (20:30 - 21:30)
50	SH.SALMAN AVE. (MUHARRAQ) NORTH SH.SALMAN RDT.	11758 Northbound	914 AM PkHr (06:30 - 07:30)	861 PM PkHr (16:00 - 17:00)	15945 Southbound	947 AM PkHr (11:45 - 12:45)	1022 PM PkHr (12:45 - 13:45)
51	KING FAISAL HIGHWAY EAST CENTRAL MARKET RDT.	70320 EASTBOUND	4093 AM PkHr (10:30 - 11:30)	4547 PM PkHr (17:30 - 18:30)	59125 WESTBOUND	3456 AM PkHr (11:45 - 12:45)	4103 PM PkHr (13:30 - 14:30)
52	BUDAIYA HIGHWAY NEAR INT.HOSPITAL	25761 EASTBOUND	1693 AM PkHr (06:15 - 07:15)	1662 PM PkHr (16:30 - 17:30)	18368 WESTBOUND	1162 AM PkHr (11:45 - 12:45)	1312 PM PkHr (17:45 - 18:45)
53	SH.ISA BIN SALMAN HIGHWAY EAST TS.24 - ALFATEH HWY.	18990 Eastbound	1287 AM PkHr (06:45 - 07:45)	1320 PM PkHr (17:30 - 18:30)	35908 Westbound	2096 AM PkHr (11:30 - 12:30)	2495 PM PkHr (13:15 - 14:15)
54	AL FATEH HIGHWAY SOUTH DIPOLOMATIC JUNC.	37928 Northbound	2068 AM PkHr (11:00 - 12:00)	2480 PM PkHr (13:30 - 14:30)	31923 Southbound	1927 AM PkHr (10:45 - 11:45)	2108 PM PkHr (18:45 - 19:45)
55	KHALIFA AL KABEER HWY. SOUTH FLYOVER	24980 Northbound	1288 AM PkHr (11:45 - 12:45)	2341 PM PkHr (13:45 - 14:45)	28652 Southbound	2616 AM PkHr (06:30 - 07:30)	1878 PM PkHr (18:30 - 19:30)
56	WALI AL AHED HIGHWAY NEAR B.D.F.	27088 Eastbound	2499 AM PkHr (06:30 - 07:30)	1691 PM PkHr (18:45 - 19:45)	24646 Westbound	1490 AM PkHr (11:45 - 12:45)	1784 PM PkHr (13:15 - 14:15)
57	KING FAISAL HIGHWAY NEAR FIRE STATION	9919 Northbound	791 AM PkHr (10:15 - 11:15)	643 PM PkHr (16:45 - 17:45)	19861 Southbound	1328 AM PkHr (11:45 - 12:45)	1439 PM PkHr (12:45 - 13:45)
58	KHALIFA AL KABEER HWY. NEAR AIRPORT RDT.	11616 Northbound	1146 AM PkHr (06:45 - 07:45)	852 PM PkHr (18:30 - 19:30)	14430 Southbound	1005 AM PkHr (06:30 - 07:30)	1083 PM PkHr (13:15 - 14:15)
59	UM AL NASSAN AVE. EAST TSX.37- RIFFA AVE.	14101 Westbound	969 AM PkHr (06:30 - 07:30)	1161 PM PkHr (13:00 - 14:00)	13443 Eastbound	1158 AM PkHr (06:30 - 07:30)	1015 PM PkHr (13:15 - 14:15)
60	NABIH SALEH AVENUE NEAR POLICE STATION	2790 EASTBOUND	241 AM PkHr (06:15 - 07:15)	230 PM PkHr (13:00 - 14:00)	5339 WESTBOUND	417 AM PkHr (06:30 - 07:30)	517 PM PkHr (13:15 - 14:15)
61	SAAR AVENUE NEAR PETROL STATION	17870 Northbound	1470 AM PkHr (06:45 - 07:45)	1397 PM PkHr (13:00 - 14:00)	19524 Southbound	1486 AM PkHr (06:45 - 07:45)	1361 PM PkHr (13:00 - 14:00)
62	AL GHOSE HWY NORTH FLYOVER	12768 Northbound	740 AM PkHr (06:30 - 07:30)	1064 PM PkHr (13:45 - 14:45)	14492 Southbound	1624 AM PkHr (06:30 - 07:30)	1092 PM PkHr (13:00 - 14:00)

24 HOUR AM & PM TRAFFIC FLOWS FOR 2016

SHEET NO	LOCATION	24 HOUR TRAFFIC FLOW DIRECTION	AM PEAK HOUR TRAFFIC FLOW	PM PEAK HOUR TRAFFIC FLOW	OPPOSITE DIRECTION TRAFFIC FLOW	AM TURNING PEAK HOUR TRAFFIC FLOW	PM TURNING PEAK HOUR TRAFFIC FLOW
63	ISA AL KABEER HIGHWAY BETWEEN TS.29 & TS.30	15488 Northbound	1040 AM PkHr (11:30 - 12:30)	1029 PM PkHr (12:15 - 13:15)	33254 Southbound	2254 AM PkHr (07:00 - 08:00)	2130 PM PkHr (13:00 - 14:00)
64	ZUBARA AVENUE IN FROM WEST	8912 EASTBOUND	554 AM PkHr (11:45 - 12:45)	656 PM PkHr (12:45 - 13:45)			
65	DRY DOUCK HWY NEAR PETROL STATION	13326 Northbound	724 AM PkHr (06:30 - 07:30)	1070 PM PkHr (13:45 - 14:45)	12994 Southbound	1269 AM PkHr (06:15 - 07:15)	806 PM PkHr (16:30 - 17:30)
66	MAHZ00RA AVENUE SOUTH SANAD RDT.	18456 Eastbound	1140 AM PkHr (06:45 - 07:45)	1276 PM PkHr (17:00 - 18:00)	19500 Westbound	998 AM PkHr (11:45 - 12:45)	1356 PM PkHr (19:45 - 20:45)
67	PALACE AVENUE POLICE STATION	17518 Northbound	1028 AM PkHr (07:30 - 08:30)	1080 PM PkHr (15:45 - 16:45)	11381 Southbound	665 AM PkHr (06:45 - 07:45)	725 PM PkHr (12:30 - 13:30)
68	WALI AL AHED HIGHWAY NEAR BURI	17348 EASTBOUND	931 AM PkHr (09:00 - 10:00)	1313 PM PkHr (19:45 - 20:45)	22665 WESTBOUND	1341 AM PkHr (06:15 - 07:15)	1679 PM PkHr (17:00 - 18:00)
69	BAGHDAD AVENUE NEAR GIRLS SCHOOL	21291 Northbound	1459 AM PkHr (06:30 - 07:30)	1524 PM PkHr (13:15 - 14:15)	19499 Southbound	1270 AM PkHr (06:30 - 07:30)	1367 PM PkHr (15:45 - 16:45)
70	A.RAHMAN ALFADEL HIGHWAY NEAR ALHALAH CLUB	19468 EASTBOUND	1115 AM PkHr (11:45 - 12:45)	1391 PM PkHr (17:00 - 18:00)	27501 WESTBOUND	1624 AM PkHr (06:30 - 07:30)	1934 PM PkHr (18:30 - 19:30)
71	SUWAIFYA AVENUE NEAR HOTTEEN SCHOOL	15754 Northbound	1229 AM PkHr (10:45 - 11:45)	1109 PM PkHr (17:30 - 18:30)	12865 Southbound	1002 AM PkHr (11:45 - 12:45)	1030 PM PkHr (12:00 - 13:00)
72	AVENUE 38 (A'ALI) NORTH TSX.60	7916 Northbound	446 AM PkHr (11:45 - 12:45)	549 PM PkHr (13:00 - 14:00)	12764 Southbound	769 AM PkHr (11:45 - 12:45)	858 PM PkHr (13:00 - 14:00)
[illegible]	SULSALMANIA AL FATEH AVENUE	15585 [illegible]	[illegible]	[illegible]	2[illegible]	[illegible]	[illegible]
[illegible]	SHEIKH A[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
77	SHAIKH ISA AVENUE NEAR ANDALUS GARDEN	30569 Northbound	1793 AM PkHr (10:45 - 11:45)	1948 PM PkHr (18:00 - 19:00)	21890 Southbound	1344 AM PkHr (11:00 - 12:00)	1407 PM PkHr (12:30 - 13:30)
78	SHAIKH DUAIJ AVENUE NORTH SH.HAMAD PALACE	43377 EASTBOUND	2753 AM PkHr (06:45 - 07:45)	3107 PM PkHr (13:00 - 14:00)	34581 WESTBOUND	1999 AM PkHr (06:45 - 07:45)	2524 PM PkHr (13:00 - 14:00)
79	SH HAMAD AVENUE (MANAMA) NO[illegible]BUD[illegible]HW[illegible]	21015 EA[illegible]UND	1349 M P[illegible]1:45[illegible]5)	1310 [illegible]kHr[illegible]- 13			

24 HOURS AM & PM TRAFFIC FLOWS FOR 2006

SITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (A)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR	TOTAL DAILY FLOW DIRECTION (B)	MORNING PEAK VEHICLES HOUR	EVENING PEAK VEHICLES HOUR
82	SH HAMAD AVENUE (HAMAD T.) SOUTH RDT. NO.22	8044 Southbound	1022 AM PkHr (06:15 - 07:15)	489 PM PkHr (12:45 - 13:45)	7389 Northbound	423 AM PkHr (11:45 - 12:45)	788 PM PkHr (13:45 - 14:45)
83	SHAIKH ABDULLA AVE. (MUH) EAST SH.SALMAN RDT.	18509 WESTBOUND	1105 AM PkHr (11:15 - 12:15)	1274 PM PkHr (18:45 - 19:45)	19341 EASTBOUND	1133 AM PkHr (06:30 - 07:30)	1310 PM PkHr (17:45 - 18:45)
84	GOVERNMENT AVENUE NEAR NBB.	13054 Eastbound	947 AM PkHr (11:45 - 12:45)	996 PM PkHr (12:15 - 13:15)	27115 Westbound	1758 AM PkHr (11:30 - 12:30)	1703 PM PkHr (12:00 - 13:00)
85	JUFFAIR AVENUE NEAR POWER STATION	26339 EASTBOUND	1759 AM PkHr (06:45 - 07:45)	1874 PM PkHr (13:15 - 14:15)	27396 WESTBOUND	1824 AM PkHr (06:45 - 07:45)	1939 PM PkHr (13:15 - 14:15)
86	MUHARRAQ AVENUE NEAR TLD.	20564 Northbound	2014 AM PkHr (06:45 - 07:45)	1797 PM PkHr (13:15 - 14:15)	17060 Southbound	1911 AM PkHr (06:45 - 07:45)	1408 PM PkHr (13:30 - 14:30)
87	SH. ZAYED HIGHWAY WEST A'ALI RDT.	14795 Eastbound	1103 AM PkHr (06:30 - 07:30)	943 PM PkHr (16:15 - 17:15)	21262 Westbound	1377 AM PkHr (11:30 - 12:30)	1537 PM PkHr (13:45 - 14:45)
88	SH.SALMAN HIGHWAY SOUTH A'ALI RDT.	10555 Northbound	637 AM PkHr (09:30 - 10:30)	697 PM PkHr (13:15 - 14:15)	10559 Southbound	641 AM PkHr (11:30 - 12:30)	687 PM PkHr (19:00 - 20:00)
89	SH. ISA BIN SALMAN HWY. NEAR AL AHLI CLUB	36282 EASTBOUND	2769 AM PkHr (06:30 - 07:30)	2333 PM PkHr (16:45 - 17:45)	35719 WESTBOUND	2113 AM PkHr (11:45 - 12:45)	2992 PM PkHr (13:30 - 14:30)
90	KING FAISAL HIGHWAY EAST PALACE AVE.	43686 EASTBOUND	2416 AM PkHr (11:00 - 12:00)	2736 PM PkHr (17:30 - 18:30)	45948 WESTBOUND	2659 AM PkHr (07:30 - 08:30)	2977 PM PkHr (13:30 - 14:30)
92	OSAMA BIN ZAID AVENUE NEAR BRITISH BANK	25327 EASTBOUND	1639 AM PkHr (11:00 - 12:00)	1612 PM PkHr (17:30 - 18:30)	20542 WESTBOUND	1360 AM PkHr (11:00 - 12:00)	1292 PM PkHr (12:00 - 13:00)
96	KING FAISAL HIGHWAY NORTH SALMANIYA RDT.	26081 Northbound	1799 AM PkHr (10:00 - 11:00)	1742 PM PkHr (19:45 - 20:45)	33090 Southbound	2079 AM PkHr (11:00 - 12:00)	2224 PM PkHr (18:00 - 19:00)
9	SH. ZAYED HIGHWAY NEAR SH.KHALIFA BIN S.HWY.	15987 WESTBOUND	1545 AM PkHr (06:45 - 07:45)	1328 PM PkHr (14:00 - 15:00)	5984 EASTBOUND	667 AM PkHr (06:30 - 07:30)	435 PM PkHr (15:30 - 16:30)
98	SHAIKH ABDULLA AVE. (MUH) EAST SH.SALMAN RDT.	9005 WESTBOUND	780 AM PkHr (11:15 - 12:15)	1033 PM PkHr (18:45 - 19:45)	9488 EASTBOUND	1047 AM PkHr (06:30 - 07:30)	900 PM PkHr (17:45 - 18:45)
99	SOUTH A'ALI DIRECTIONAL OVER	Northbound	AM PkHr (06:15 - 07:15)	PM PkHr (15:45 - 16:45)	Southbound	AM PkHr (11:45 - 12:45)	PM PkHr (13:30 - 14:30)

Key : SCOOT SITES PERMANENT SITES TEMPORARY SITES

24 HOURS AM & PM TRAFFIC FLOWS FOR 2012 - 1

SITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (1)	MORNING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	EVENING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	TOTAL DAILY FLOW DIRECTION (2)	MORNING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	EVENING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	TOTAL BOTH DIRECTION
2	MUASKAR HIGHWAY NEAR ALBA RDT.	24680 Eastbound	1844 (06:30 - 07:30)	58%	1502 (13:15 - 14:15)	66%	25617 Westbound	1443 (11:00 - 12:00)	67%	1656 (17:00 - 18:00)	62%	50297
3	SHAIKH SALMAN HIGHWAY NORTH AWALI RDT.	13375 Northbound	1248 (06:30 - 07:30)	72%	991 (13:15 - 14:15)	77%	17862 Southbound	1501 (06:30 - 07:30)	66%	1266 (13:30 - 14:30)	71%	31237
4	AL ZALAQ HEY EAST SAKAIR AVE	18478 Eastbound	2738 (06:15 - 07:15)	59%	1096 (15:30 - 16:30)	83%	19589 Westbound	1150 (10:30 - 11:30)	83%	1776 (13:30 - 14:30)	73%	38067
5	MAJLIS AL TOWN EAST MAMEER PELICAN	46371 Eastbound	3448 (06:45 - 07:45)	48%	3142 (15:45 - 16:45)	52%	49014 Westbound	3082 (11:45 - 12:45)	53%	3280 (12:15 - 13:15)	50%	95385
6	OMAN AVENUE WEST QADISIYA AVE.	27563 Eastbound	2261 (06:30 - 07:30)	49%	2282 (16:30 - 17:30)	48%	13848 Westbound	891 (11:45 - 12:45)	80%	1201 (13:30 - 14:30)	73%	41411
7	ESTEGLAL HWY NORTH SANAD RDT.	36007 Northbound	2469 (06:45 - 07:45)	63%	2504 (15:30 - 16:30)	62%	35771 Southbound	2378 (07:30 - 08:30)	64%	2202 (14:00 - 15:00)	67%	71778
8	SHAIKH SALMAN HIGHWAY SOUTH ISA TOWN GATE RDT.	32703 Northbound	3190 (07:00 - 08:00)	52%	2542 (13:45 - 14:45)	61%	34783 Southbound	2389 (06:15 - 07:15)	64%	2358 (18:30 - 19:30)	64%	67486
9	SALMANIYA AVENUE EAST KUWAIT AVE.	32857 Eastbound	2031 (06:30 - 07:30)	54%	2021 (13:00 - 14:00)	54%	30823 Westbound	2116 (06:45 - 07:45)	52%	1790 (12:45 - 13:45)	59%	63680
10	SH.SALMAN HIGHWAY SOUTH BAH. GAS RDT.	49160 Northbound	3689 (06:30 - 07:30)	44%	3214 (14:15 - 15:15)	51%	52769 Southbound	4017 (06:30 - 07:30)	39%	3804 (13:00 - 14:00)	42%	101929
11	SHAIKH SALMAN HIGHWAY NORTH BAHRAIN GAS RDT.	62381 Northbound	4586 (06:30 - 07:30)	48%	4072 (14:00 - 15:00)	54%	67159 Southbound	5058 (06:45 - 07:45)	43%	4254 (14:00 - 15:00)	52%	129540
12	AVENUE 28 (Sanabis) WEST CENTRAL MARKET RDT.	**Street Closed**										
13	BUDAIYA HIGHWAY NEAR BURHAMA V.	29099 Eastbound	2419 (06:45 - 07:45)	63%	1988 (16:30 - 17:30)	70%	20907 Westbound	1553 (08:30 - 09:30)	76%	1514 (13:30 - 14:30)	77%	50006
14	EXHIBITIONS AVENUE NEAR IMIGRATION	14476 Northbound	777 (10:00 - 11:00)	29%	887 (13:15 - 14:15)	19%	18859 Southbound	1405 (11:15 - 12:15)	-28%	1357 (12:30 - 13:30)	-23%	33335
15	KUWAIT AVENUE NORTH OMAN AVE.	31258 Northbound	2213 (09:30 - 10:30)	50%	2134 (16:30 - 17:30)	52%	20179 Southbound	1214 (11:00 - 12:00)	72%	1415 (13:30 - 14:30)	68%	51437
16	SH ISA AVENUE (SOUTH ANDALUS RDT.)	16440 Northbound	1062 (07:15 - 08:15)	76%	1226 (17:15 - 18:15)	72%	14803 Southbound	964 (06:45 - 07:45)	78%	1007 (13:45 - 14:45)	77%	31243
17	BANI OTBAH AVENUE SOUTH PALACE RDT.	7658 Northbound	462 (07:00 - 08:00)	58%	483 (15:30 - 16:30)	56%	9400 Southbound	578 (07:15 - 08:15)	47%	606 (14:00 - 15:00)	45%	17058
18	ALFATEH HWY NEAR AL FATEH MOSQUS	51884 Northbound	3208 (10:00 - 11:00)	51%	3359 (18:45 - 19:45)	49%	40568 Southbound	2354 (06:30 - 07:30)	64%	2406 (16:15 - 17:15)	64%	92452

24 HOURS AM & PM TRAFFIC FLOWS FOR 2012 - 2

SITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (1)	MORNING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	EVENING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	TOTAL DAILY FLOW DIRECTION (2)	MORNING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	EVENING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	TOTAL BOTH DIRECTION
19	SH HAMAD C.WAY	44006 Eastbound	2423 (11:45 - 12:45)	63%	4271 (13:45 - 14:45)	35%	41307 Westbound	3968 (06:30 - 07:30)	40%	2317 (15:45 - 16:45)	65%	85313
20	ARADOUS HWY. - NEAR AD DAIR (NEAR DAIR SCHOOL)	8555 Eastbound	880 (06:15 - 07:15)	20%	572 (16:30 - 17:30)	48%	8084 Westbound	603 (06:30 - 07:30)	45%	626 (14:00 - 15:00)	43%	16639
21	SHAIKH ISA BIN SALMAN C.EWAY	31241 Eastbound	1813 (11:45 - 12:45)	73%	2373 (13:15 - 14:15)	64%	40078 Westbound	3816 (07:00 - 08:00)	42%	2426 (15:45 - 16:45)	63%	71319
22	RIFFA AVENUE (NEAR MUASKAR HWY.)	20035 Eastbound	1178 (11:45 - 12:45)	73%	1380 (18:30 - 19:30)	69%	20675 Westbound	1915 (06:15 - 07:15)	56%	1253 (19:00 - 20:00)	72%	40710
23	SEHLA AVENUE NORTH SEHLA RDT.	23140 Northbound	1617 (06:45 - 07:45)	63%	1740 (15:45 - 16:45)	60%	20253 Southbound	1498 (06:30 - 07:30)	66%	1554 (12:45 - 13:45)	65%	43393
24	MAJLIS AL TAWON HWY. NORTH NABIH SALEH	49630 Northbound	3263 (07:00 - 08:00)	51%	3712 (16:15 - 17:15)	44%	50751 Southbound	4387 (07:15 - 08:15)	34%	3404 (14:00 - 15:00)	48%	100381
25	SHAIKH ISA AVENUE (MUH) SOUTH SH.ABDU. AVE.	12898 Northbound	1091 (11:00 - 12:00)	1%	1054 (18:45 - 19:45)	4%	ONE WAY					12898
26	SH. KHALIFA BIN SALMAN HWY. NEAR CAMAL CROSSING	64189 Northbound	5971 (06:45 - 07:45)	10%	4927 (15:30 - 16:30)	25%	47668 Southbound	3118 (07:15 - 08:15)	53%	4543 (14:00 - 15:00)	31%	111857
27	SH. KHALIFA BIN SALMAN HWY. SOUTH BUDAIYA FLYOVER	71995 Northbound	6141 (07:15 - 08:15)	7%	4444 (15:45 - 16:45)	33%	70731 Southbound	4082 (11:45 - 12:45)	38%	5184 (13:45 - 14:45)	21%	142726
28	SH. KHALIFA BIN SALMAN HWY. NORTH BUDAIYA FLYOVER	57587 Eastbound	4991 (07:45 - 08:45)	24%	4131 (18:45 - 19:45)	37%	42633 Westbound	3973 (11:00 - 12:00)	40%	4736 (17:30 - 18:30)	28%	100220
29	AIRPORT AVENUE NEAR BUSAYTEEN	23817 Eastbound	1398 (06:30 - 07:30)	68%	1552 (20:15 - 21:15)	65%	26633 Westbound	1479 (06:30 - 07:30)	66%	1700 (17:00 - 18:00)	61%	50450
30	A'ALI - BURI AVE. WEST TANNAL	5873 Eastbound	582 (06:30 - 07:30)	47%	428 (13:00 - 14:00)	61%	7924 Westbound	581 (09:45 - 10:45)	47%	594 (13:30 - 14:30)	46%	13797
31	SH. KHALIFA B. S. HIGHWAY .(NEAR SANABIS)	66197 Eastbound	5037 (07:45 - 08:45)	24%	3961 (15:45 - 16:45)	40%	64465 Westbound	4023 (07:15 - 08:15)	39%	4739 (14:00 - 15:00)	28%	130662
32	SH. SALMAN HIGHWAY NEAR ZAYANI GARAGE	20184 Eastbound	1542 (06:30 - 07:30)	65%	1499 (16:30 - 17:30)	66%	21506 Westbound	1574 (10:45 - 11:45)	64%	1691 (12:45 - 13:45)	62%	41690

24 HOURS AM & PM TRAFFIC FLOWS FOR 2012 - 3

SITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (1)	MORNING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	EVENING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	TOTAL DAILY FLOW DIRECTION (2)	MORNING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	EVENING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	TOTAL BOTH DIRECTION
33	HIGHWAY 35 (NEAR ZINJ)	29424 Northbound	2425 (07:00 - 08:00)	63%	1788 (16:00 - 17:00)	73%	26562 Southbound	1724 (11:15 - 12:15)	74%	1995 (16:30 - 17:30)	70%	55986
34	SH.ISA B.SALMAN HWY. NEAR NEW ZINJ	68204 Eastbound	5129 (06:15 - 07:15)	22%	4396 (15:45 - 16:45)	33%	73941 Westbound	4965 (07:00 - 08:00)	25%	5439 (13:45 - 14:45)	18%	142145
35	TUBLI SERVICE ROAD NEAR PETROL STATION	26644 Eastbound	2002 (06:45 - 07:45)	55%	1736 (15:45 - 16:45)	61%	22759 Westbound	1393 (11:00 - 12:00)	68%	1741 (14:00 - 15:00)	60%	49403
36	ARAD HIGWAY EAST X.22- AVE.40	27959 Eastbound	1601 (06:45 - 07:45)	76%	2029 (14:15 - 15:15)	69%	26382 Westbound	2028 (06:30 - 07:30)	69%	1816 (16:45 - 17:45)	72%	54341
37	HAWAR HIGHWAY NEAR RIFFA POWER S.	22054 Northbound	1479 (09:45 - 10:45)	66%	2278 (14:45 - 15:45)	48%	21415 Southbound	2253 (05:30 - 06:30)	49%	1389 (12:45 - 13:45)	68%	43469
38	KING FAHAD C.WAY WEST JANABIYA FLYOVER	11338 Eastbound	528 (11:45 - 12:45)	88%	952 (17:15 - 18:15)	78%	13994 Westbound	1314 (06:30 - 07:30)	70%	824 (15:30 - 16:30)	81%	25332
39	WALI AL AHEDHWY. NEAR HAMALA	12336 Northbound	935 (07:00 - 08:00)	15%	775 (16:00 - 17:00)	30%	9906 Southbound	650 (09:15 - 10:15)	41%	795 (13:00 - 14:00)	28%	22242
40	16 DECEBER HWY. NEAR BIN KHALDOON SCHOOL	20182 Eastbound	1403 (06:45 - 07:45)	79%	1671 (13:00 - 14:00)	75%	18412 Westbound	1237 (11:45 - 12:45)	81%	1488 (13:30 - 14:30)	77%	38594
41	MUASKAR HWY NEAR PETROL STATION	18493 Eastbound	1172 (06:30 - 07:30)	73%	1184 (13:45 - 14:45)	73%	19032 Westbound	1657 (06:15 - 07:15)	62%	1090 (12:45 - 13:45)	75%	37525
42	JANABIYA HIGHWAY NORTH FLYOVER	20064 Northbound	1257 (11:45 - 12:45)	71%	1548 (13:45 - 14:45)	65%	22447 Southbound	2762 (06:30 - 07:30)	37%	1418 (15:30 - 16:30)	68%	42511
43	BUDAIYA HIGHWAY NEAR AL QADAM	31824 Eastbound	2265 (08:30 - 09:30)	49%	2081 (15:30 - 16:30)	53%	31537 Westbound	2077 (11:15 - 12:15)	53%	2393 (12:45 - 13:45)	46%	63361
44	AL NAKEEL HWY. NEAR PETROL STATION	5501 Eastbound	389 (11:45 - 12:45)	65%	685 (13:00 - 14:00)	38%	5982 Westbound	546 (06:00 - 07:00)	50%	411 (16:00 - 17:00)	63%	11483
45	SH.HAMAD AVENUE (NORTH RDT. NO. 1 HAMAD T.)	17464 Northbound	1168 (06:15 - 07:15)	73%	1152 (15:30 - 16:30)	74%	26544 Southbound	1634 (11:45 - 12:45)	63%	1785 (12:30 - 13:30)	59%	44008
46	SAUDIA APPROACHED ROAD EAST JANABIYA FLYOVER	29496 Eastbound	1974 (06:45 - 07:45)	70%	2323 (13:15 - 14:15)	65%	36813 Westbound	2401 (06:45 - 07:45)	64%	2822 (14:00 - 15:00)	57%	66309
47	ZAID BIN OMYRAH HWY. NEAR BURI RDT.	13780 Eastbound	921 (07:45 - 08:45)	16%	962 (16:30 - 17:30)	13%	5746 Westbound	487 (11:15 - 12:15)	56%	504 (12:45 - 13:45)	54%	19526

24 HOURS AM & PM TRAFFIC FLOWS FOR 2012 - 4

SITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (1)	MORNING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	EVENING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	TOTAL DAILY FLOW DIRECTION (2)	MORNING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	EVENING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	TOTAL BOTH DIRECTION
48	ESTEGLAL HWY EAST ISA TOWN GATE RDT.	30788 Eastbound	3066 (06:45 - 07:45)	54%	2148 (13:00 - 14:00)	67%	27254 Westbound	2534 (06:30 - 07:30)	62%	1778 (15:30 - 16:30)	73%	58042
49	AL QUDS AVENUE NEAR ELECTRICITY OFFIC	14273 Eastbound	871 (06:30 - 07:30)	80%	1019 (18:00 - 19:00)	77%	14987 Westbound	967 (06:45 - 07:45)	78%	1099 (17:00 - 18:00)	75%	29260
50	SH.SALMAN AVE. (MUHARRAQ) NORTH SH.SALMAN RDT.	17203 Northbound	970 (11:00 - 12:00)	78%	1217 (13:15 - 14:15)	72%	16074 Southbound	1241 (06:15 - 07:15)	72%	1064 (16:30 - 17:30)	76%	33277
51	KING FAISAL HIGHWAY EAST CENTRAL MARKET RDT.	62530 Eastbound	4682 (10:15 - 11:15)	29%	4476 (13:00 - 14:00)	32%	71203 Westbound	4601 (07:15 - 08:15)	30%	5119 (14:15 - 15:15)	22%	133733
52	BUDAIYA HIGHWAY NEAR INT.HOSPITAL	27616 Eastbound	1791 (06:15 - 07:15)	59%	2188 (15:30 - 16:30)	50%	24365 Westbound	1759 (07:15 - 08:15)	60%	1869 (17:15 - 18:15)	58%	51981
53	SH.ISA BIN SALMAN HIGHWAY EAST TS.24 - ALFATEH HWY.	60002 Eastbound	3912 (06:00 - 07:00)	41%	4301 (13:45 - 14:45)	35%	56201 Westbound	3459 (06:30 - 07:30)	48%	3522 (16:45 - 17:45)	47%	116203
54	AL FATEH HIGHWAY SOUTH DIPOLOMATIC JUNC.	39280 Northbound	2324 (07:00 - 08:00)	65%	2992 (13:45 - 14:45)	55%	34853 Southbound	2432 (11:00 - 12:00)	63%	2439 (17:00 - 18:00)	63%	74133
55	KHALIFA AL KABEER HWY. SOUTH FLYOVER	36390 Northbound	3330 (07:00 - 08:00)	50%	2248 (16:00 - 17:00)	66%	36117 Southbound	1937 (06:30 - 07:30)	71%	2949 (14:00 - 15:00)	55%	72507
56	WALI AL AHED HIGHWAY NEAR B.D.F.	44229 Eastbound	3461 (06:15 - 07:15)	21%	3571 (17:30 - 18:30)	19%	37160 Westbound	2328 (07:15 - 08:15)	47%	2277 (12:45 - 13:45)	48%	81389
57	KING FAISAL HIGHWAY NEAR FIRE STATION	**Street Closed**										
58	KHALIFA AL KABEER HWY. NEAR AIRPORT RDT.	11909 Northbound	1220 (06:30 - 07:30)	82%	814 (18:30 - 19:30)	88%	12237 Southbound	944 (06:30 - 07:30)	86%	890 (20:30 - 21:30)	87%	24146
59	UM AL NASSAN AVE. EAST TSX.37- RIFFA AVE.	22472 Eastbound	1339 (11:45 - 12:45)	70%	1594 (19:00 - 20:00)	64%	21455 Westbound	1374 (06:15 - 07:15)	69%	1467 (18:15 - 19:15)	67%	43927
60	NABIH SALEH AVENUE NEAR POLICE STATION	3489 Eastbound	289 (11:45 - 12:45)	74%	548 (13:15 - 14:15)	50%	2111 Westbound	148 (11:45 - 12:45)	87%	295 (13:30 - 14:30)	73%	5600
61	SAAR AVENUE NEAR PETROL STATION	11909 Northbound	768 (11:30 - 12:30)	30%	777 (14:30 - 15:30)	29%	11304 Southbound	743 (06:30 - 07:30)	32%	790 (12:45 - 13:45)	28%	23213
62	AL GHOSE HWY NORTH FLYOVER	26225 Northbound	2203 (06:30 - 07:30)	50%	1881 (13:15 - 14:15)	57%	21227 Southbound	1382 (06:30 - 07:30)	69%	1555 (15:15 - 16:15)	65%	47452

24 HOURS AM & PM TRAFFIC FLOWS FOR 2012 - 5

SITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (1)	MORNING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	EVENING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	TOTAL DAILY FLOW DIRECTION (2)	MORNING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	EVENING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	TOTAL BOTH DIRECTION
63	ISA AL KABEER HIGHWAY BETWEEN TS.29 & TS.30	17422 Northbound	1265 (07:45 - 08:45)	-15%	1077 (13:30 - 14:30)	2%	11904 Southbound	726 (11:45 - 12:45)	34%	890 (17:15 - 18:15)	19%	29326
64	ZUBARA AVENUE IN FROM WEST	14314 Eastbound	1482 (07:15 - 08:15)	-35%	1499 (19:00 - 20:00)	-36%	ONE WAY					14314
65	DRY DOUCK HWY NEAR PETROL STATION	25916 Northbound	1379 (11:30 - 12:30)	79%	2152 (13:45 - 14:45)	67%	24195 Southbound	3087 (06:30 - 07:30)	53%	1287 (12:00 - 13:00)	81%	50111
66	MAHZ00RA AVENUE SOUTH SANAD RDT.	23988 Eastbound	1739 (06:30 - 07:30)	60%	1524 (16:00 - 17:00)	65%	25171 Westbound	1386 (06:30 - 07:30)	69%	1708 (12:30 - 13:30)	61%	49159
67	PALACE AVENUE POLICE STATION	30298 Northbound	1685 (10:15 - 11:15)	62%	1966 (17:15 - 18:15)	55%	19534 Southbound	1242 (06:45 - 07:45)	72%	1183 (12:15 - 13:15)	73%	49832
68	WALI AL AHED HIGHWAY NEAR BURI	26350 Eastbound	1606 (11:45 - 12:45)	64%	1678 (12:30 - 13:30)	62%	26376 Westbound	1659 (09:45 - 10:45)	62%	1687 (15:45 - 16:45)	62%	52726
69	BAGHDAD AVENUE NEAR GIRLS SCHOOL	8258 Northbound	487 (07:30 - 08:30)	56%	637 (17:15 - 18:15)	42%	7778 Southbound	428 (11:45 - 12:45)	61%	548 (13:30 - 14:30)	50%	16036
70	A.RAHMAN ALFADEL HIGHWAY NEAR ALHALAH CLUB	6221 Eastbound	383 (11:45 - 12:45)	65%	454 (12:30 - 13:30)	59%	8800 Westbound	794 (06:45 - 07:45)	28%	542 (16:00 - 17:00)	51%	15021
71	SUWAIFYA AVENUE NEAR HOTTEEN SCHOOL	16213 Northbound	1688 (06:45 - 07:45)	62%	974 (12:00 - 13:00)	78%	23407 Southbound	2052 (11:00 - 12:00)	53%	1878 (12:30 - 13:30)	57%	39620
72	AVENUE 38 (A'ALI) NORTH TSX.60	**Street Closed**										
73	SH.SALMAN A. AL FATEH AVENUE EAST TSX.43	14968 Eastbound	1503 (06:45 - 07:45)	66%	1072 (14:15 - 15:15)	76%	15956 Westbound	1199 (08:45 - 09:45)	73%	1263 (14:00 - 15:00)	71%	30924
74	SH.KHALIFA CAUSEWAY	32199 Eastbound	2042 (05:30 - 06:30)	69%	2454 (13:45 - 14:45)	63%	32698 Westbound	3096 (06:15 - 07:15)	53%	2229 (16:30 - 17:30)	66%	64897
75	Avenue 27 Saar Near SIBS Highway	10188 Northbound	643 (06:45 - 07:45)	42%	943 (13:30 - 14:30)	14%	2563 Southbound	347 (06:45 - 07:45)	68%	169 (16:45 - 17:45)	85%	12751
76	Avenu 77 Near Janabiya Hwy	3611 Northbound	227 (07:45 - 08:45)	79%	268 (17:00 - 18:00)	76%	5974 Southbound	630 (06:45 - 07:45)	43%	453 (15:30 - 16:30)	59%	9585
77	SHAIKH ISA AVENUE NEAR ANDALUS GARDEN	12577 Northbound	840 (06:45 - 07:45)	81%	933 (18:15 - 19:15)	79%	22283 Southbound	1549 (06:45 - 07:45)	65%	1753 (18:15 - 19:15)	60%	34860
78	SHAIKH DUAIJ AVENUE NORTH SH.HAMAD PALACE	10920 Eastbound	763 (07:00 - 08:00)	83%	888 (20:30 - 21:30)	80%	12310 Westbound	1130 (06:30 - 07:30)	74%	772 (20:30 - 21:30)	82%	23230
79	SH HAMAD AVENUE (MANAMA) NORTH BUDAIYA HWY.	16632 Northbound	1400 (09:15 - 10:15)	-27%	1197 (16:45 - 17:45)	-9%	ONE WAY					16632

24 HOURS AM & PM TRAFFIC FLOWS FOR 2012 - 6

SITE NO.	LOCATION	TOTAL DAILY FLOW DIRECTION (1)	MORNING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	EVENING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	TOTAL DAILY FLOW DIRECTION (2)	MORNING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	EVENING PEAK VEHICLES IN HOUR	SPARE CAPACITY IN HOUR	TOTAL BOTH DIRECTION
80	AVENUE 35 SAAR NEAR JANABIYA HWY	5599 Northbound	479 (06:45 - 07:45)	56%	394 (13:00 - 14:00)	64%	4948 Southbound	336 (06:45 - 07:45)	69%	362 (16:30 - 17:30)	67%	10547
82	SH HAMAD AVENUE (HAMAD T.) SOUTH RDT. NO.22	11362 Northbound	666 (10:45 - 11:45)	85%	1030 (13:45 - 14:45)	77%	11939 Southbound	1538 (06:15 - 07:15)	65%	790 (15:30 - 16:30)	82%	23301
83	SHAIKH ABDULLA AVE. (MUH) EAST SH.SALMAN RDT.	5196 Eastbound	326 (11:00 - 12:00)	70%	404 (13:45 - 14:45)	63%	10787 Westbound	885 (06:30 - 07:30)	20%	680 (15:45 - 16:45)	38%	15983
84	GOVERNMENT AVENUE NEAR NBB.	12220 Eastbound	903 (11:45 - 12:45)	79%	1063 (15:00 - 16:00)	76%	26511 Westbound	1956 (07:15 - 08:15)	56%	1627 (12:15 - 13:15)	63%	38731
85	JUFFAIR AVENUE NEAR POWER STATION	12259 Eastbound	837 (06:45 - 07:45)	81%	823 (16:15 - 17:15)	81%	7958 Westbound	541 (07:15 - 08:15)	88%	612 (13:30 - 14:30)	86%	20217
86	MUHARRAQ AVENUE NEAR TLD.	19876 Northbound	1536 (07:45 - 08:45)	77%	1881 (13:00 - 14:00)	72%	15148 Southbound	1363 (07:00 - 08:00)	79%	1364 (13:30 - 14:30)	79%	35024
87	SH. ZAYED HIGHWAY WEST A'ALI RDT.	21018 Eastbound	1505 (08:30 - 09:30)	66%	1597 (12:30 - 13:30)	64%	22157 Westbound	1626 (08:00 - 09:00)	63%	1808 (13:30 - 14:30)	59%	43175
88	SH.SALMAN HIGHWAY SOUTH A'ALI RDT.	16873 Northbound	1247 (06:45 - 07:45)	72%	1185 (13:15 - 14:15)	73%	24145 Southbound	1641 (06:30 - 07:30)	63%	1664 (13:45 - 14:45)	62%	41018
89	SH. ISA BIN SALMAN HWY. NEAR AL AHLI CLUB	55410 Eastbound	3464 (11:30 - 12:30)	48%	3897 (13:45 - 14:45)	41%	67095 Westbound	4118 (07:00 - 08:00)	38%	5126 (14:00 - 15:00)	22%	122505
90	KING FAISAL HIGHWAY EAST PALACE AVE.	56783 Eastbound	3658 (07:45 - 08:45)	45%	3640 (16:00 - 17:00)	45%	43419 Westbound	3421 (07:00 - 08:00)	48%	2981 (15:15 - 16:15)	55%	100202
92	OSAMA BIN ZAID AVENUE NEAR BRITISH BANK	6483 Eastbound	616 (07:30 - 08:30)	44%	490 (15:00 - 16:00)	55%	5199 Westbound	530 (11:15 - 12:15)	52%	468 (13:45 - 14:45)	57%	11682
96	KING FAISAL HIGHWAY NORTH SALMANIYA RDT.	21976 Northbound	1634 (07:30 - 08:30)	63%	1376 (17:00 - 18:00)	69%	31448 Southbound	2293 (10:30 - 11:30)	48%	2164 (12:30 - 13:30)	51%	53424
97	SH. ZAYED HIGHWAY NEAR SH.KHALIFA BIN S. HWY.	12848 Eastbound	1177 (06:30 - 07:30)	73%	1049 (15:00 - 16:00)	76%	19299 Westbound	1805 (06:45 - 07:45)	59%	1492 (14:15 - 15:15)	66%	32147
98	SALMABAD BAYBASS HIGHWAY NEAR SH.ISA BIN SALMAN HWY.	24344 Northbound	1971 (06:45 - 07:45)	55%	1803 (16:15 - 17:15)	59%	17921 Southbound	1425 (06:30 - 07:30)	68%	1499 (15:15 - 16:15)	66%	42265
99	SH. KHALIFA BIN SALMAN HWY. SOUTH WALI ALAHED FLYOVER	49150 Northbound	4141 (06:30 - 07:30)	37%	4507 (15:30 - 16:30)	32%	48631 Southbound	3197 (07:15 - 08:15)	52%	3862 (13:45 - 14:45)	41%	97781

Key :

SCOOT SITES

PERMANENT SITES

TEMPORARY SI

Appendix 2: Total Daily Traffic between Cities (southbound – westbound)

1- Manama and Muharraq

TDT, AM Pk Hr and PM Pk Hr between Manama and Muharraq (southbound - westbound)												
	Total Daily Traffic				**AM Peak Hour**				**PM Peak Hour**			
Site No. / Years	**19**	**21**	**74**	**Total**	**19**	**21**	**74**	**Total**	**19**	**21**	**74**	**Total**
1980	38288			**38288**								
1984	38000			**38000**								
1986	39000			**39000**								
1987	40300			**40300**								
1988	40000			**40000**								
1990	39200			**39200**								
1992	54929			**54929**								
1993	49107			**49107**								
1994	42798			**42798**								
1995	44852			**44852**								
1996	46270			**46270**								
1997	33912	12164		**46076**	1843	660		**2503**	2789	1240		**4029**
1998	35037	18014		**53051**	1861	885		**2746**	2678	1414		**4092**
1999	35175	16183		**51358**	1829	846		**2675**	2814	1434		**4248**
2003	38215	38969		**77184**	1601	1993		**3594**	2417	1973		**4390**
2004	40926	28440	10108	**79474**	2010	1554	524	**4088**	2829	2394	702	**5925**
2005	41592	26300	10108	**78000**	2364	1478	1620	**5462**	3631	2357	1058	**7046**
2006	36641	28322	15579	**80542**	2036	2788	1083	**5907**	3169	1829	1440	**6438**
2007	38503	27940	15999	**82442**	2183	2788	997	**5968**	2864	1764	1344	**5972**
2008	29466	20708	24904	**75078**	2026	1346	1346	**4718**	1764	1764	1764	**5292**
2010	44146	41209	22140	**107495**	4046	3561	2015	**9622**	3688	2334	1905	**7927**
2011	35845	39653	29012	**104510**	3166	4024	2964	**10154**	2395	2552	1974	**6921**
2012	41307	40078	32698	**114083**	3968	3816	3696	**11480**	2317	2426	2229	**6972**

*empty cell indicate no data were yet available.

2- Manama and Sittra

TDT, AM Pk Hr and PM Pk Hr between Manama and Sittra (southbound - westbound)						
	Total Daily Traffic		**AM Peak Hour**		**PM Peak Hour**	
Site No. / Years	**24**	**Total**	**24**	**24**	**Total**	**24**
1980	18155	**18155**				
1984	10500	**10500**				
1987	17000	**17000**				
1988	18000	**18000**				
1990	20900	**20900**				
1991	20054	**20054**				
1992	19839	**19839**				
1993	21807	**21807**				
1994	24017	**24017**				
1995	22370	**22370**				
1996	23442	**23442**				
1997	23492	**23492**	1957	**1957**	1621	**1621**
1998	26060	**26060**	2237	**2237**	1787	**1787**
1999	27206	**27206**	2214	**2214**	1717	**1717**
2003	31632	**31632**	2209	**2209**	1992	**1992**
2004	29491	**29491**	1871	**1871**	1767	**1767**
2005	37904	**37904**	3231	**3231**	2510	**2510**
2006	35960	**35960**	2414	**2414**	2293	**2293**
2007	39509	**39509**	2799	**2799**	2431	**2431**
2008	30050	**30050**	2276	**2276**	1855	**1855**
2010	35650	**35650**	2772	**2772**	1798	**1798**
2011	32372	**32372**	2682	**2682**	1985	**1985**
2012	50751	**50751**	4387	**4387**	3404	**3404**

*empty cell indicate no data were yet available.

3- Manama and Isa Town

TDT, AM Pk Hr and PM Pk Hr between Manama and Isa Town (southbound - westbound)															
	Total Daily Traffic					**AM Peak Hour**					**PM Peak Hour**				
Site No. / Years	**11**	**34**	**35**	**98**	**Total**	**11**	**34**	**35**	**98**	**Total**	**11**	**34**	**35**	**98**	**Total**
1980	35814				**35814**										
1984	28050	8200			**36250**										
1986		18000	7300		**25300**										
1987		22900	9400		**32300**										
1988	34750	17100	6650		**58500**										
1990		17800	7200		**25000**										
1991		17784	9982		**27766**										
1992	33928	18730	11579		**64237**										
1993	37185	17924	8736		**63845**	2391	1130	540		**4061**	2665	1472	732		**4869**
1994	34909	20873	9094		**64876**										
1995	29905	21875	11002		**62782**										
1996	31777	21364	12483		**65624**										
1997	45813	22076	13259		**81148**	3516	1277	748		**5541**	3347	1842	1062		**6251**
1998	47292	25025	13638		**85955**		1436	765		**2201**		1858	1049		**2907**
1999	46112	23967	14692		**84771**	3566	1317	792		**5675**	3333	1885	1038		**6256**
2003	38969	27531	16118	5314	**87932**		1469	851		**2320**		1926	1109		**3035**
2004	50344	26855	15660	6813	**99672**		1407	807		**2214**		1770	1003		**2773**
2005	64835	35502	17536	6813	**124686**		2182	1039		**3221**		2590	1265		**3855**
2006	57793	34048	15086	11439	**118366**	3701	1971	870	1437	**7979**	3625	2390	1066	906	**7987**
2007		406854	16825		**423679**		2235	1001		**3236**		2662	1143		**3805**
2008		40205	19681		**59886**		2360	1143		**3503**		2612	1385		**3997**
2010	56567	45703	20701	21671	**144642**	3683	2621	1199	1877	**9380**	3122	3812	1774	952	**9660**
2011	78849	57320	21706	18149	**176024**	5443	3300	1369	1596	**11708**	5389	4116	1576	1376	**12457**
2012	67159	73941	22759	17921	**181780**	5058	4965	1393	1425	**12841**	4254	5439	1741	1499	**12933**

*empty cell indicate no data were yet available.

4- Manama and Buddaya

TDT, AM Pk Hr and PM Pk Hr between Manama and Buddaya (southbound - westbound)									
	Total Daily Traffic			**AM Peak Hour**			**PM Peak Hour**		
Site No. / Years	**43**	**44**	**Total**	**43**	**44**	**Total**	**43**	**44**	**Total**
1980	10946	687	**11633**						
1984	10350		**10350**						
1987	18500		**18500**						
1988	11000	700	**11700**						
1990	19200		**19200**						
1991	21340		**21340**						
1992	18353	1005	**19358**						
1993	23874	956	**24830**	1391	228	**1619**	1888	150	**2038**
1994	24375	980	**25355**						
1995	23493	2387	**25880**						
1996	22792	1423	**24215**						
1997	24004	1635	**25639**	1409	86	**1495**	1798	123	**1921**
1998	22081	1636	**23717**						
1999	24575	1781	**26356**	1455	131	**1586**	1849	153	**2002**
2003	34288	6632	**40920**						
2004	33762	6389	**40151**						
2005	36698	11016	**47714**						
2006	31184	9792	**40976**	1184	670	**1854**	1911	749	**2660**
2010	48898	7404	**56302**	2314	705	**3019**	2022	757	**2779**
2011	18995	5986	**24981**	2011	622	**2633**	1236	412	**1648**
2012	31537	5982	**37519**	2077	546	**2623**	2393	411	**2804**

*empty cell indicate no data were yet available.

5- Manama and Riffa

TDT, AM Pk Hr and PM Pk Hr between Manama and Riffa (southbound - westbound)															
	Total Daily Traffic					**AM Peak Hour**					**PM Peak Hour**				
Site No. / Years	**8**	**40**	**87**	**8**	**40**	**87**	**8**	**40**	**87**	**8**	**40**	**87**	**8**	**40**	**total**
1980	22690	4138			**26828**										
1987	21900				**21900**										
1988	22200	5000			**27200**										
1991	17724				**17724**										
1992	15416	5153			**20569**										
1993	21305	4303			**25608**	1360	400			**1760**	1439	426			**1865**
1994	17662	7190			**24852**										
1995	19424	6594			**26018**										
1996	21682	7321			**29003**										
1997	23474	6827			**30301**	1549	733			**2282**	1587	625			**2212**
1998	22367	7697			**30064**										
1999	23745	8529			**32274**	1524	935			**2459**	1684	807			**2491**
2003	26991	12718	18141	2739	**60589**										
2004	30471	14020	20597	4574	**69662**										
2005	30420	18616	20597	4574	**74207**										
2006	20345	16096	21262	5984	**63687**	1556	1277	1377	667	**4877**	1538	1099	1537	435	**4609**
2010	24379	20002	26360	23614	**94355**	1769	1424	1733	1780	**6706**	2550	1910	1510	686	**6656**
2011	28824	25523	22734	20730	**97811**	1847	2135	2056	1703	**7741**	1952	1681	1519	1632	**6784**
2012	34783	18412	22157	19299	**94651**	2389	1237	1626	1805	**7057**	2358	1488	1808	1492	**7146**

*empty cell indicate no data were yet available.

6- Isa Town and King Fahad Causeway

TDT, AM Pk Hr and PM Pk Hr between Isa Town and King Fahad Causeway (southbound - westbound)						
	Total Daily Traffic		**AM Peak Hour**		**PM Peak Hour**	
Site No. / Years	**46**	**Total**	**46**	**Total**	**46**	**Total**
1980	5389	**5389**				
1988	5250	**5250**				
1992	6523	**6523**				
1993	6523	**6523**				
1994	3906	**3906**				
1995	8315	**8315**				
1996	6804	**6804**				
1997	8799	**8799**	578	**578**	533	**533**
1998	9697	**9697**				
1999	9077	**9077**	691	**691**	601	**601**
2003	17278	**17278**				
2004	18189	**18189**				
2005	22161	**22161**				
2006	24056	**24056**	1495	**1495**	1761	**1761**
2010	35288	**35288**	2309	**2309**	2084	**2084**
2011	35703	**35703**	2399	**2399**	2575	**2575**
2012	36813	**36813**	2401	**2401**	2822	**2822**

*empty cell indicate no data were yet available.

7- Isa Town and Hammad Town

TDT, AM Pk Hr and PM Pk Hr between Isa Town and Hammad Town (southbound - westbound)						
	Total Daily Traffic		**AM Peak Hour**		**PM Peak Hour**	
Site No. / Years	**26**	**Total**	**26**	**Total**	**26**	**Total**
1990	7900	**7900**				
1994	12544	**12544**				
1995	13498	**13498**				
1996	12994	**12994**				
1997	12707	**12707**	910	**910**	1186	**1186**
1998	14583	**14583**				
1999	16448	**16448**	999	**999**	1457	**1457**
2003	24354	**24354**				
2004	24054	**24054**				
2005	43112	**43112**				
2006	35179	**35179**	2185	**2185**	2828	**2828**
2010	53951	**53951**	3562	**3562**	3924	**3924**
2011	48631	**48631**	2675	**2675**	3708	**3708**
2012	47668	**47668**	3118	**3118**	4543	**4543**

*empty cell indicate no data were yet available.

8- Riffa and Hammad Town

TDT, AM Pk Hr and PM Pk Hr between Riffa and Hammad Town (southbound - westbound)									
	Total Daily Traffic			**AM Peak Hour**			**PM Peak Hour**		
Site No. / **Years**	**30**	**56**	**Total**	**30**	**56**	**Total**	**30**	**56**	**Total**
1988		7750	**7750**						
1990		9500	**9500**						
1991		6592	**6592**						
1995	1300	12927	**14227**						
1996	1726	12774	**14500**						
1997	1329	11745	**13074**	98	689	**787**	106	786	**892**
1998	2435	13887	**16322**						
1999	2225	12025	**14250**	211	524	**735**	160	586	**746**
2003	4574	22028	**26602**						
2004	9379	23919	**33298**						
2005	12788	29882	**42670**						
2006	5651	24646	**30297**	497	1490	**1987**	446	1784	**2230**
2010	5630	31189	**36819**	367	2418	**2785**	404	2967	**3371**
2011	7230	37514	**44744**	554	2448	**3002**	572	2423	**2995**
2012	7924	35160	**43084**	581	2328	**2909**	594	2277	**2871**

*empty cell indicate no data were yet available.

9- Hammad Town and King Fahad Causeway

TDT, AM Pk Hr and PM Pk Hr between Hammad Town and King Fahad Causeway (southbound - westbound)						
	Total Daily Traffic		**AM Peak Hour**		**PM Peak Hour**	
Site No. / Years	**39**	**Total**	**39**	**Total**	**39**	**Total**
1980	6132	**6132**				
1986	9800	**9800**				
1988	5950	**5950**				
1990	8500	**8500**				
1992	4606	**4606**				
1993	5672	**5672**	461	**461**	747	**747**
1995	5924	**5924**				
1996	5253	**5253**				
1997	6195	**6195**	391	**391**	554	**554**
1998	6376	**6376**				
1999	3856	**3856**	245	**245**	373	**373**
2003	22476	**22476**				
2004	18656	**18656**				
2005	24407	**24407**				
2006	17320	**17320**	1210	**1210**	1324	**1324**
2010	11524	**11524**	713	**713**	666	**666**
2011	10733	**10733**	603	**603**	874	**874**
2012	9906	**9906**	650	**650**	795	**795**

*empty cell indicate no data were yet available.

10- Buddaya Town and King Fahad Causeway

TDT, AM Pk Hr and PM Pk Hr between Buddaya and King Fahad Causeway (southbound - westbound)									
	Total Daily Traffic			**AM Peak Hour**			**PM Peak Hour**		
Site No. / Years	**42**	**75**	**Total**	**42**	**75**	**Total**	**42**	**75**	**Total**
1980	3449		**3449**						
1984	2530		**2530**						
1988	3400		**3400**						
1990	4000		**4000**						
1991	4398		**4398**						
1992	5801		**5801**						
1994	6693		**6693**						
1995	7208		**7208**						
1996	7145		**7145**						
1997	7443		**7443**	752		**752**	459		**459**
1998	7674		**7674**						
1999	8093		**8093**	802		**802**	512		**512**
2003	12719		**12719**						
2004	14322		**14322**						
2005	16592		**16592**						
2006	15554		**15554**	1737		**1737**	1069		**1069**
2010	23737		**23737**	1984		**1984**	3005		**3005**
2011	18995		**18995**	2011		**2011**	1236		**1236**
2012	22447	2563	**25010**	2762	347	**3109**	1418	169	**1587**

*empty cell indicate no data were yet available.

Appendix 3: Questionnaire

Arabic version

مملكة البحرين
جامعة البحرين
كلية الهندسة
قسم الهندسة الميكانيكية

استبانة حول وسائل النقل الجماهيرية في البحرين

تهدف هذه الاستبانة ألى دراسة امكانية استحداث وسائل نقل جماهيرية في مملكة البحرين (ميترة او ترام او باصات عامة). وسوف يتم التعامل مع هذه الاستبانة بشكل احترافي ولن تستخدم الا لغرض البحث العلمي.

المعلومات الشخصية

1- العمر: ----

2- الجنس: ☐ ذكر ☐ انثى

3- الجنسية: ----------

4- الوظيفة ومكان العمل: -------

5- هل لديك رخصة قيادة؟ ☐ نعم ☐ لا

6- عدد سنوات خبرة القيادة: ----------

7- هل لديك سيارة؟ ☐ نعم ☐ لا

8- المستوى التعليمي: ☐ غير متعلم ☐ ابتدائي ☐ ثانوي ☐ جامعي ☐ ماجستير وما فوق

9- الدخل الشهري (بالدينار البحريني): ☐ 0-200 ☐ 200-500 ☐ 500-750 ☐ 750-1000 ☐ 1000-1500 ☐ اكثر من 1500

10- منطقة السكن (مع ذكر رقم المجمع): ☐ العاصمة ☐ المنطقة الشمالية ☐ المنطقة الجنوبية ☐ المحرق ☐ المنطقة الوسطى ☐ رقم المجمع

11- عدد افراد الاسرة: ☐ (1-3) ☐ (4-6) ☐ (7-9) ☐ (10 و أكثر)

12- عدد السيارات في العائلة ☐ لا يوجد ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 و أكثر

حول وسيلة النقل المقترحة

لو افترضنا ان البحرين بصدد انشاء وسائل نقل جماهيرية حديثة (ترام او مترو مثلا) بحيث يقوم هذاالنظام بربط بين المحطات والمناطق الرئيسية والحيوية في البحرين، ويتم وصل المناطق الفرعية بنظام مواصلات فرعي كالحافلات الصغيرة وسيارات الاجرة، ما هو رأيك في:

1- ساعات العمل:

☐ 6 صباحا-4 مساءا ☐ 6 صباحا-8 مساءا ☐ 5صباحا-12 منتصف الليل ☐ 24 ساعة

2- نظام تسعير التذاكر:

☐ سعر ثابت ☐ السعر بحسب مسافة الرحلة

3- مدة صلاحية التذكرة وامكانية تكرار استخدامها خلال:

☐ ساعتين ☐ ساعة ☐ 30 دقيقة

☐ 15 دقيقة ☐ 10 دقائق ☐ استخدام لمرة واحدة فقط

4- إذا كنت تؤمن بمبدأ تطوير شبكة المواصلات العامة، ما هي احتمالية استخدامك للمواصلات بحسب اسعار التذاكر المتاحة (تذكرة دخول فقط):

a) *اذا كان سعر التذكرة 500 فلس:*

☐ استخدمه في جميع الاوقات.
☐ استخدمه بنسبة 50% من التنقلات.
☐ استخدمه بنسبة 25% من التنقلات.
☐ استخدمه للعمل فقط.
☐ لا استخدمه.

c) *اذا كان سعر التذكرة دينار واحد:*

☐ استخدمه في جميع الاوقات.
☐ استخدمه بنسبة 50% من التنقلات.
☐ استخدمه بنسبة 25% من التنقلات.
☐ استخدمه للعمل فقط.
☐ لا استخدمه.

b)اذا كان سعر التذكرة 750 فلس:

☐ استخدمه في جميع الاوقات.
☐ استخدمه بنسبة 50% من التنقلات.
☐ استخدمه بنسبة 25% من التنقلات.
☐ استخدمه للعمل فقط.
☐ لا استخدمه.

d) *اذا كان سعر التذكرة دينار ونصف:*

☐ استخدمه في جميع الاوقات.
☐ استخدمه بنسبة 50% من التنقلات.
☐ استخدمه بنسبة 25% من التنقلات.
☐ استخدمه للعمل فقط.
☐ لا استخدمه.

English version

KINGDOM OF BAHRAIN
UNIVERSITY OF BAHRAIN
COLLEGE OF ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING

A questionnaire on public transpiration system in Bahrain

The goal of this questioner is to explore the mode shift towards the use of public transport in Bahrain as metro, tram, bus ... etc. All the personal details will only be used for the purpose of the research and will be used confidentially.

PERSONAL DETAILS

1- Age: ----------

2- Gender: ☐ Male ☐ Female

3- Nationality: ----------

4- Job & work Place: ---------

5- Do you have a driving license? ☐ Yes ☐ No

6- Years of driving experience: ----------

7- Do you have a car? ☐ Yes ☐ No

8- Level of education: ☐ Illiterate ☐ Primary ☐ Secondary ☐ Graduate ☐ Postgraduate

9- Monthly Income (BhD): ☐ 0-200 ☐ 200-500 ☐ 500-750 ☐ 750-1000 ☐ 1000-1500 ☐ above 1500

10- Living Area (mention the block number):
☐ Capital ☐ Northern ☐ Southern ☐ Muharraq ☐ Middle ☐ Block No.

11- Number of family number: ☐ (1-3) ☐ (4-6) ☐ (7-9) ☐ (10 & more)

12- Number of cars in the house: ☐ No car ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 & more

MEAN OF TRANSPORT

If Bahrain is supposed to develop Public transportation network to link stations and main and important areas and villages.

What is your opinion on:

1- Working hours of the public transport system:

☐ 6am-4pm ☐ 6am-8pm ☐ 5am-12mid night ☐ 24 hr.

2- Ticket pricing system:

☐ Fixed price ☐ Varying price as per travelled distance

3- Validity of the tickets for the earlier selected fare for the use of any number of trips within :

☐ 2 hours ☐ 1 hour ☐ 30 min.
☐ 15 min. ☐ 10 min ☐ one entry use only

4- If you believe that the developed public transportation system is ideal, what is the probability of using it according to the ticket fare (per entering person):

a) *if the ticket price is 500 fills:*

☐ Using it all the time.
☐ Using it 50% of the time.
☐ Using it 25% of the time.
☐ Using it for work only.
☐ Not using it at all.

b) *if the ticket price is 750 fills:*

☐ Using it all the time.
☐ Using it 50% of the time.
☐ Using it 25% of the time.
☐ Using it for work only.
☐ Not using it at all.

c) *if the ticket price is one dinar:*

☐ Using it all the time.
☐ Using it 50% of the time.
☐ Using it 25% of the time.
☐ Using it for work only.
☐ Not using it at all.

d) *if the ticket price is 1.5 dinar:*

☐ Using it all the time.
☐ Using it 50% of the time.
☐ Using it 25% of the time.
☐ Using it for work only.
☐ Not using it at all.

Appendix 4: Detailed of others Routes

1- Metro 1 (see chapter 6)

2- Metro 2

(Excluded hours)

Metro 2		EXCLUDED HOURS				
TIME		0.00	1.00	2.00	3.00	4.00
SITE NO.	5	380	178	117	60	161
	10	289	158	82	81	182
	11	449	239	115	59	213
	22	127	67	40	33	83
	24	477	270	195	163	248
	26	316	167	101	91	115
	34	565	325	192	157	216
	35	200	114	77	53	75
	56	334	174	93	74	123
	89	401	223	126	121	203
TOTAL		3538	1915	1138	892	1619
		PERCENTAGE OF EXCLUDED HOURS				
SITE NO.	5	0.009	0.004	0.003	0.001	0.004
	10	0.011	0.006	0.003	0.003	0.007
	11	0.010	0.005	0.003	0.001	0.005
	22	0.010	0.005	0.003	0.002	0.006
	24	0.014	0.008	0.006	0.005	0.007
	26	0.009	0.005	0.003	0.003	0.003
	34	0.015	0.008	0.005	0.004	0.006
	35	0.017	0.009	0.006	0.004	0.006
	56	0.012	0.006	0.003	0.003	0.005
	89	0.011	0.006	0.003	0.003	0.006
AVERAGE PERCENTAGE		1.17%	0.64%	0.38%	0.30%	0.54%
ADJUSTED PERCENTAGE		3.12%				

(Total Daily Traffic for operating hours)

Metro 2		TDT OF OPERATING HOURS																		
TIME		5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
SITE NO.	5	434	1975	2745	2073	1904	2236	2215	2126	2078	1898	2279	2295	2165	1859	1657	1385	1265	1060	8065	42610
	10	627	1690	2190	1699	1491	1439	1395	1443	1394	1561	1565	1525	1545	1534	1461	1455	1123	871	605	27405
	11	451	2609	2954	2465	2523	2554	2403	2360	2414	2252	2517	2850	2846	2684	2619	2502	2025	1473	1111	44687
	22	382	1319	1024	625	524	549	600	719	835	682	702	748	728	723	706	676	595	482	250	13219
	24	978	1730	1754	1698	1973	2037	2003	2011	1888	1874	2149	2277	2134	2184	1794	1400	1262	1134	888	34521
	26	536	1845	2050	1412	1493	1656	1653	1644	2114	1926	2225	2676	2353	2161	2180	1865	1488	1133	663	33863
	34	861	2245	2195	2003	2128	2128	2056	2043	1963	1925	2202	2443	2331	2422	2333	2022	1624	1262	942	38583
	35	307	720	645	650	680	640	696	685	715	693	686	600	626	630	578	675	584	453	322	12104
	56	549	2259	1931	1347	1417	1164	1306	1448	1638	1225	1215	1505	1627	1674	1632	1395	1257	1011	691	27089
	89	1037	2423	2659	1994	1962	1276	1475	1930	1931	2001	1939	2244	2268	1939	1977	1945	1763	1409	1035	36281
TOTAL		6162	18815	20147	15966	16095	15679	15802	16409	16970	16037	17479	19163	18623	17810	16937	15320	12986	10288	14572	310362
		PERCENTAGE OF TDT OF OPERATING HOURS																			
SITE NO.	5	0.010	0.046	0.064	0.049	0.045	0.052	0.052	0.050	0.049	0.045	0.053	0.054	0.051	0.044	0.039	0.033	0.030	0.025	0.189	0.042
	10	0.023	0.062	0.080	0.062	0.054	0.053	0.051	0.053	0.051	0.057	0.057	0.056	0.056	0.056	0.053	0.053	0.041	0.032	0.022	0.042
	11	0.010	0.058	0.066	0.055	0.056	0.057	0.054	0.053	0.054	0.050	0.056	0.064	0.064	0.060	0.059	0.056	0.045	0.033	0.025	0.042
	22	0.029	0.100	0.077	0.047	0.040	0.042	0.045	0.054	0.063	0.052	0.053	0.057	0.055	0.055	0.053	0.051	0.045	0.036	0.019	0.042
	24	0.028	0.050	0.051	0.049	0.057	0.059	0.058	0.058	0.055	0.054	0.062	0.066	0.062	0.063	0.052	0.041	0.037	0.033	0.026	0.042
	26	0.016	0.054	0.061	0.042	0.044	0.049	0.049	0.049	0.062	0.057	0.066	0.079	0.069	0.064	0.064	0.055	0.044	0.033	0.020	0.042
	34	0.022	0.058	0.057	0.052	0.055	0.055	0.053	0.053	0.051	0.050	0.057	0.063	0.060	0.063	0.060	0.052	0.042	0.033	0.024	0.042
	35	0.025	0.059	0.053	0.054	0.056	0.053	0.058	0.057	0.059	0.057	0.057	0.050	0.052	0.052	0.048	0.056	0.048	0.037	0.027	0.042
	56	0.020	0.083	0.071	0.050	0.052	0.043	0.048	0.053	0.060	0.045	0.045	0.056	0.060	0.062	0.060	0.051	0.046	0.037	0.026	0.042
	89	0.029	0.067	0.073	0.055	0.054	0.035	0.041	0.053	0.053	0.055	0.053	0.062	0.063	0.053	0.054	0.054	0.049	0.039	0.029	0.042
AVERAGE PERCENTAGE		2.13%	6.39%	6.54%	5.14%	5.14%	4.98%	5.09%	5.33%	5.58%	5.22%	5.60%	6.05%	5.92%	5.72%	5.44%	5.02%	4.27%	3.39%	4.05%	96.97%
ADJUSTED PERCENTAGE		2.19%	6.59%	6.74%	5.30%	5.30%	5.13%	5.24%	5.49%	5.75%	5.38%	5.78%	6.24%	6.10%	5.89%	5.60%	5.17%	4.40%	3.49%	4.18%	100%

(Number of riders, trips, headway times and income of both methods)

	Metro 2	OPERATING HOURS																		
	TIME	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
METHOD 1	ADJUSTED TOTAL N0. OF RIDERS	223372																			
	NO. OF RIDERS IN EACH HOURS	4900	14710	15064	11846	11843	11465	11714	12271	12843	12028	12900	13939	13635	13164	12520	11555	9832	7801	9340	223372
	ADJUSTED TOTAL N0. OF TRIPS	372																			
	N0. OF TRIPS IN EACH HOUR	8.167	24.517	25.107	19.743	19.739	19.109	19.523	20.452	21.406	20.046	21.500	23.232	22.725	21.940	20.866	19.258	16.386	13.002	15.567	372.286
	HEADWAY TIME	4.188	1.395	1.362	1.733	1.733	1.790	1.752	1.673	1.598	1.706	1.591	1.472	1.505	1.559	1.639	1.776	2.088	2.631	2.197	35.390
	NO. OF BUGGIE (max. 9)	2	7	7	5	5	5	5	5	6	5	6	6	6	6	6	6	6	3	4	101
	MODIFIED HEADWAY TIME	8.38	9.77	9.54	8.66	8.67	8.95	8.76	8.36	9.59	8.53	9.55	8.83	9.03	9.35	9.84	10.66	12.53	7.89	8.79	175.67
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	1549	4649	4761	3744	3743	3623	3702	3878	4059	3801	4077	4405	4309	4160	3957	3652	3107	2466	2952	70594
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	2510	7535	7717	6068	6066	5873	6000	6286	6579	6161	6608	7140	6984	6743	6413	5919	5036	3996	4784	114419
METHOD 2	ADJUSTED TOTAL N0. OF RIDERS	307293																			
	NO. OF RIDERS IN EACH HOURS	6741	20237	20724	16296	16293	15773	16115	16882	17669	16547	17746	19176	18758	18110	17223	15896	13525	10732	12849	307293
	ADJUSTED TOTAL N0. OF TRIPS	512.15																			
	N0. OF TRIPS IN EACH HOUR	11.24	33.73	34.54	27.16	27.15	26.29	26.86	28.14	29.45	27.58	29.58	31.96	31.26	30.18	28.71	26.49	22.54	17.89	21.41	512.15
	HEADWAY TIME	3.04	1.01	0.99	1.26	1.26	1.30	1.27	1.22	1.16	1.24	1.16	1.07	1.09	1.13	1.19	1.29	1.52	1.91	1.60	25.73
	NO. OF BUGGIE (max. 9)	3.00	9.00	9.00	7.00	7.00	7.00	7.00	8.00	8.00	8.00	8.00	9.00	9.00	8.00	8.00	7.00	6.00	5.00	6.00	139.00
	MODIFIED HEADWAY TIME	9.133	9.128	8.913	8.816	8.818	9.109	8.915	9.726	9.293	9.923	9.252	9.633	9.847	9.066	9.533	9.038	9.105	9.562	9.584	176.395
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	2131	6396	6550	5150	5149	4985	5093	5335	5584	5229	5608	6060	5928	5723	5443	5024	4275	3392	4061	97116
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	3453	10366	10616	8348	8346	8079	8255	8647	9051	8476	9090	9823	9609	9277	8822	8142	6928	5497	6582	157406

3- Tram 1

(Excluded hours)

Tram 1		EXCLUDED HOURS				
TIME		0.00	1.00	2.00	3.00	4.00
SITE NO.	9	420	240	179	110	140
	13	328	154	80	56	106
	43	397	189	102	117	209
	52	309	142	71	76	138
	54	944	519	464	238	217
	67	337	214	261	128	104
	96	366	194	126	130	249
TOTAL		3101	1652	1283	855	1163
SITE NO.	9	0.015	0.009	0.006	0.004	0.005
	13	0.013	0.006	0.003	0.002	0.004
	43	0.011	0.005	0.003	0.003	0.006
	52	0.012	0.006	0.003	0.003	0.005
	54	0.024	0.013	0.012	0.006	0.006
	67	0.020	0.013	0.016	0.008	0.006
	96	0.014	0.007	0.005	0.005	0.010
AVERAGE PERCENTAGE		1.57%	0.84%	0.68%	0.45%	0.60%
ADJUSTED PERCENTAGE		4.31%				

(Total Daily Traffic for operating hours)

Tram 1		OPERATING HOURS																		
TIME		5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
SITE NO.	9	592	1327	1833	1412	1624	1626	1623	1627	1443	1492	1620	1554	1560	1526	1466	1332	1302	1082	727	27857
	13	440	1082	1486	1334	1459	1469	1494	1379	1286	1120	1478	1702	1552	1707	1578	1248	1035	1029	600	25202
	43	820	2371	2516	1805	1632	1710	1579	1713	1957	1604	1999	2475	2271	1775	2042	1943	1695	1406	943	35270
	52	592	1676	1611	1468	1360	1123	1270	1359	1452	1216	1428	1639	1654	1370	1519	1330	1207	1042	710	25762
	54	530	1104	1669	1473	1631	1904	3067	2072	2364	2238	1812	2014	2298	2377	2323	2244	2104	1839	1482	38927
	67	235	679	961	940	782	941	988	977	955	773	863	1075	1075	1036	1020	1012	195	714	534	16799
	96	548	877	1021	1070	1300	1799	1733	1525	1538	1463	1331	1541	1594	1499	1577	1741	1323	921	620	26086
TOTAL		3757	9116	11097	9502	9788	10572	11754	10652	10995	9906	10531	12000	12004	11290	11525	10850	8861	8033	5616	195903
SITE NO.	9	0.021	0.048	0.066	0.051	0.058	0.058	0.058	0.058	0.052	0.054	0.058	0.056	0.056	0.055	0.053	0.048	0.047	0.039	0.026	0.042
	13	0.017	0.043	0.059	0.053	0.058	0.058	0.059	0.055	0.051	0.044	0.059	0.068	0.062	0.068	0.063	0.050	0.041	0.041	0.024	0.042
	43	0.023	0.067	0.071	0.051	0.046	0.048	0.045	0.049	0.055	0.045	0.057	0.070	0.064	0.050	0.058	0.055	0.048	0.040	0.027	0.042
	52	0.023	0.065	0.063	0.057	0.053	0.044	0.049	0.053	0.056	0.047	0.055	0.064	0.064	0.053	0.059	0.052	0.047	0.040	0.028	0.042
	54	0.014	0.028	0.043	0.038	0.042	0.049	0.079	0.053	0.061	0.057	0.047	0.052	0.059	0.061	0.060	0.058	0.054	0.047	0.038	0.042
	67	0.014	0.040	0.057	0.056	0.047	0.056	0.059	0.058	0.057	0.046	0.051	0.064	0.064	0.062	0.061	0.060	0.012	0.043	0.032	0.042
	96	0.021	0.034	0.039	0.041	0.050	0.069	0.066	0.058	0.059	0.056	0.051	0.059	0.061	0.057	0.060	0.067	0.051	0.035	0.024	0.042
AVERAGE PERCENTAGE		1.91 %	4.65 %	5.68 %	4.95 %	5.05 %	5.47 %	5.94 %	5.49 %	5.59 %	5.00 %	5.40 %	6.17 %	6.15 %	5.80 %	5.90 %	5.55 %	4.27 %	4.07 %	2.83 %	95.87%
ADJUSTED PERCENTAGE		1.99 %	4.85 %	5.93 %	5.16 %	5.27 %	5.70 %	6.19 %	5.73 %	5.83 %	5.22 %	5.63 %	6.44 %	6.41 %	6.05 %	6.15 %	5.79 %	4.46 %	4.25 %	2.95 %	100.00 %

(Number of riders, trips, headway times and income of both methods)

	Tram 1	OPERATING HOURS																		
	TIME	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
METHOD 1	ADJUSTED TOTAL N0. OF RIDERS	96524																			
	NO. OF RIDERS IN EACH HOURS	1921	4678	5723	4985	5085	5504	5978	5527	5627	5038	5435	6213	6189	5843	5940	5591	4302	4100	2845	96524
	ADJUSTED TOTAL N0. OF TRIPS	439																			
	N0. OF TRIPS IN EACH HOUR	9	21	26	23	23	25	27	25	26	23	25	28	28	27	27	25	20	19	13	439
	HEADWAY TIME	6	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	4	50
	NO. OF BUGGIE (max. 6)	1	4	4	4	4	4	5	4	4	4	4	5	5	5	5	4	3	3	2	74
	MODIFIED HEADWAY TIME	6	10	9	10	10	9	10	9	9	10	9	10	10	10	10	9	9	9	9	176
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	607	1479	1809	1576	1607	1739	1889	1747	1778	1592	1718	1963	1956	1847	1877	1767	1360	1296	899	30505
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	984	2396	2931	2554	2605	2819	3062	2831	2882	2581	2784	3182	3170	2993	3043	2864	2204	2100	1458	49443
METHOD 2	ADJUSTED TOTAL N0. OF RIDERS	128534																			
	NO. OF RIDERS IN EACH HOURS	2558	6230	7620	6639	6772	7329	7961	7361	7493	6709	7237	8273	8242	7780	7909	7445	5729	5459	3789	128534
	ADJUSTED TOTAL N0. OF TRIPS	584																			
	N0. OF TRIPS IN EACH HOUR	12	28	35	30	31	33	36	33	34	30	33	38	37	35	36	34	26	25	17	584
	HEADWAY TIME	5	2	2	2	2	2	2	2	2	2	2	1	1	2	2	2	2	2	3	37
	NO. OF BUGGIE (max. 6)	2	5	6	5	5	6	6	6	6	5	6	6	6	6	6	6	4	4	3	99
	MODIFIED HEADWAY TIME	10	10	10	9	9	10	9	10	10	9	10	9	9	9	9	10	9	9	10	180
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	808	1969	2408	2098	2140	2316	2516	2326	2368	2120	2287	2615	2605	2459	2500	2353	1810	1725	1198	40622
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	1310	3191	3903	3400	3469	3754	4078	3770	3838	3437	3707	4238	4222	3985	4051	3813	2934	2796	1941	65839

4- Tram 2

(Excluded hours)

Tram 2		EXCLUDED HOURS				
TIME		0.00	1.00	2.00	3.00	4.00
SITE NO.	7	310	160	95	83	176
	8	229	114	65	72	129
	37	69	47	37	34	132
	42	160	73	44	25	37
	48	195	137	68	60	112
	68	212	101	51	62	95
	72	166	79	45	37	38
	87	180	88	49	38	87
	88	156	85	53	55	63
TOTAL		1341	711	405	373	719
SITE NO.	7	0.010	0.005	0.003	0.003	0.006
	8	0.010	0.005	0.003	0.003	0.006
	37	0.005	0.003	0.003	0.002	0.009
	42	0.011	0.005	0.003	0.002	0.003
	48	0.011	0.008	0.004	0.004	0.007
	68	0.012	0.006	0.003	0.004	0.005
	72	0.021	0.010	0.006	0.005	0.005
	87	0.012	0.006	0.003	0.003	0.006
	88	0.015	0.008	0.005	0.005	0.006
AVERAGE PERCENTAGE		1.20%	0.63%	0.36%	0.33%	0.58%
ADJUSTED PERCENTAGE		3.19%				

(Total Daily Traffic for operating hours)

Tram 2		OPERATING HOURS																		
TIME		5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
SITE NO.	7	652	1345	2036	1415	1768	1659	1856	1844	1732	1815	2155	2079	2084	1777	1600	1414	1212	1008	661	30936
	8	386	1070	1367	1078	1125	1232	1560	1313	1509	1398	1243	1301	1383	1279	1401	1362	1376	736	453	23181
	37	357	833	869	649	795	867	973	913	927	1006	1363	1064	1013	687	491	287	247	369	205	14234
	42	176	495	754	647	564	647	724	962	1275	968	812	948	970	924	860	827	748	566	380	14586
	48	546	1449	1648	1243	1213	1190	1121	1104	1177	1153	1111	857	720	531	470	320	323	157	91	16996
	68	427	767	808	851	931	915	638	815	1015	666	725	995	1113	1081	1173	1295	1158	896	562	17352
	72	96	255	390	323	332	364	428	454	550	247	415	485	498	501	486	481	441	369	260	7740
	87	376	938	1063	858	939	838	813	838	881	729	741	937	871	730	722	682	608	483	307	14796
	88	182	458	621	526	588	613	608	608	660	592	579	652	637	596	591	524	489	380	237	10553
TOTAL		2640	6214	7872	6206	6728	6874	7300	7405	8185	7253	7824	7729	7781	6780	6481	5986	5505	4101	2612	125025
SITE NO.	7	0.021	0.043	0.066	0.046	0.057	0.054	0.060	0.060	0.056	0.059	0.070	0.067	0.067	0.057	0.052	0.046	0.039	0.033	0.021	0.042
	8	0.017	0.046	0.059	0.047	0.049	0.053	0.067	0.057	0.065	0.060	0.054	0.056	0.060	0.055	0.060	0.059	0.059	0.032	0.020	0.042
	37	0.025	0.059	0.061	0.046	0.056	0.061	0.068	0.064	0.065	0.071	0.096	0.075	0.071	0.048	0.034	0.020	0.017	0.026	0.014	0.042
	42	0.012	0.034	0.052	0.044	0.039	0.044	0.050	0.066	0.087	0.066	0.056	0.065	0.067	0.063	0.059	0.057	0.051	0.039	0.026	0.042
	48	0.032	0.085	0.097	0.073	0.071	0.070	0.066	0.065	0.069	0.068	0.065	0.050	0.042	0.031	0.028	0.019	0.019	0.009	0.005	0.042
	68	0.025	0.044	0.047	0.049	0.054	0.053	0.037	0.047	0.058	0.038	0.042	0.057	0.064	0.062	0.068	0.075	0.067	0.052	0.032	0.042
	72	0.012	0.033	0.050	0.042	0.043	0.047	0.055	0.059	0.071	0.032	0.054	0.063	0.064	0.065	0.063	0.062	0.057	0.048	0.034	0.042
	87	0.025	0.063	0.072	0.058	0.063	0.057	0.055	0.057	0.060	0.049	0.050	0.063	0.059	0.049	0.049	0.046	0.041	0.033	0.021	0.042
	88	0.017	0.043	0.059	0.050	0.056	0.058	0.058	0.058	0.063	0.056	0.055	0.062	0.060	0.056	0.056	0.050	0.046	0.036	0.022	0.042
AVERAGE PERCENTAGE		2.07%	5.01%	6.25%	5.04%	5.41%	5.52%	5.73%	5.90%	6.61%	5.55%	6.00%	6.21%	6.16%	5.43%	5.21%	4.81%	4.41%	3.40%	2.18%	96.91%
ADJUSTED PERCENTAGE		2.14%	5.17%	6.45%	5.20%	5.59%	5.69%	5.91%	6.09%	6.82%	5.73%	6.20%	6.40%	6.36%	5.60%	5.37%	4.96%	4.56%	3.51%	2.25%	100%

(Number of riders, trips, headway times and income of both methods)

	Tram 2	INCLUDED HOURS																		
	TIME	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
METHOD 1	ADJUSTED TOTAL N0. OF RIDERS	104629.52																			
	NO. OF RIDERS IN EACH HOURS	2239	5414	6744	5446	5846	5957	6189	6372	7132	5992	6483	6701	6655	5858	5620	5191	4766	3674	2350	104630
	ADJUSTED TOTAL N0. OF TRIPS	475.59																			
	N0. OF TRIPS IN EACH HOUR	10	25	31	25	27	27	28	29	32	27	29	30	30	27	26	24	22	17	11	475.59
	HEADWAY TIME	8.49	3.51	2.82	3.49	3.25	3.19	3.07	2.98	2.67	3.17	2.93	2.84	2.86	3.25	3.38	3.66	3.99	5.18	8.09	72.83
	NO. OF BUGGIE (max. 6)	1.00	2.00	3.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00	2.00	2.00	2.00	1.00	47.00
	MODIFIED HEADWAY TIME	8.49	7.02	8.46	6.98	9.76	9.58	9.22	8.95	8.00	9.52	8.80	8.51	8.57	9.74	6.77	7.33	7.98	10.35	8.09	162.11
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	708	1711	2131	1721	1848	1883	1956	2014	2254	1894	2049	2118	2103	1851	1776	1640	1506	1161	743	33067
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	1147	2773	3454	2789	2994	3051	3170	3264	3653	3070	3321	3433	3409	3001	2879	2659	2442	1882	1204	53595
METHOD 2	ADJUSTED TOTAL N0. OF RIDERS	143197.21																			
	NO. OF RIDERS IN EACH HOURS	3065	7410	9229	7453	8001	8153	8470	8721	9761	8201	8873	9172	9109	8017	7691	7104	6523	5028	3216	143197
	ADJUSTED TOTAL N0. OF TRIPS	650.90																			
	N0. OF TRIPS IN EACH HOUR	14	34	42	34	36	37	38	40	44	37	40	42	41	36	35	32	30	23	15	650.9
	HEADWAY TIME	6.20	2.57	2.06	2.55	2.38	2.33	2.24	2.18	1.95	2.32	2.14	2.07	2.09	2.37	2.47	2.68	2.91	3.78	5.91	53.21
	NO. OF BUGGIE (max. 6)	1.00	3.00	4.00	3.00	4.00	4.00	4.00	4.00	5.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00	3.00	2.00	1.00	65.00
	MODIFIED HEADWAY TIME	6.20	7.70	8.24	7.65	9.51	9.33	8.98	8.72	9.74	9.27	8.57	8.29	8.35	9.49	9.89	8.03	8.74	7.56	5.91	160.18
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	969	2342	2917	2355	2529	2576	2677	2756	3085	2592	2804	2899	2879	2534	2431	2245	2062	1589	1017	45256
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	1570	3795	4728	3818	4098	4176	4339	4467	5000	4201	4545	4698	4666	4107	3940	3639	3341	2576	1648	73350

5- Tram 3

(Excluded hours)

Tram 3		EXCLUDED HOURS				
TIME		0.00	1.00	2.00	3.00	4.00
SITE NO.	99	147	69	41	36	54
TOTAL		147	69	41	36	54
SITE NO.	99	0.008	0.004	0.002	0.002	0.003
AVERAGE PERCENTAGE		0.78%	0.37%	0.22%	0.19%	0.29%
ADJUSTED PERCENTAGE		1.89%				

(Total Daily Traffic for operating hours)

Tram 3		OPERATING HOURS																		
TIME		5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
SITE NO.	99	356	1446	1219	668	688	771	840	813	1233	1077	1397	1624	1283	1242	1161	930	726	566	367	18754
TOTAL		356	1446	1219	668	688	771	840	813	1233	1077	1397	1624	1283	1242	1161	930	726	566	367	18754
SITE NO.	99	0.019	0.077	0.065	0.036	0.037	0.041	0.045	0.043	0.066	0.057	0.074	0.087	0.068	0.066	0.062	0.050	0.039	0.030	0.020	0.042
AVERAGE PERCENTAGE		1.90%	7.71%	6.50%	3.56%	3.67%	4.11%	4.48%	4.34%	6.57%	5.74%	7.45%	8.66%	6.84%	6.62%	6.19%	4.96%	3.87%	3.02%	1.96%	98.15%
ADJUSTED PERCENTAGE		1.93%	7.86%	6.62%	3.63%	3.74%	4.19%	4.56%	4.42%	6.70%	5.85%	7.59%	8.82%	6.97%	6.75%	6.31%	5.05%	3.94%	3.07%	1.99%	100.00%

(Number of riders, trips, headway times and income of both methods)

	Tram 3	OPARATING HOURS																		
	TIME	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
METHOD 1	ADJUSTED TOTAL N0. OF RIDERS	120179.68																			
	NO. OF RIDERS IN EACH HOURS	2,324	9,441	7,959	4,361	4,492	5,034	5,484	5,308	8,050	7,032	9,121	10,603	8,377	8,109	7,580	6,072	4,740	3,695	2,396	120,180
	ADJUSTED TOTAL N0. OF TRIPS	546.27																			
	N0. OF TRIPS IN EACH HOUR	11	43	36	20	20	23	25	24	37	32	41	48	38	37	34	28	22	17	11	546
	HEADWAY TIME	3	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1	2	2	3	28
	NO. OF BUGGIE (max. 6)	3	10	10	7	5	6	7	7	10	9	11	12	11	9	10	8	6	5	3	149
	MODIFIED HEADWAY TIME	10	8	10	12	9	9	10	10	10	10	9	9	10	9	10	10	10	10	10	184
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	735	2984	2515	1378	1420	1591	1733	1678	2544	2222	2883	3351	2647	2563	2396	1919	1498	1168	757	37981
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	1191	4836	4077	2234	2301	2579	2809	2719	4124	3602	4672	5431	4291	4154	3883	3110	2428	1893	1227	61560
METHOD 2	ADJUSTED TOTAL N0. OF RIDERS	166083																			
	NO. OF RIDERS IN EACH HOURS	3212	13047	10999	6027	6208	6957	7579	7336	11125	9718	12605	14653	11576	11206	10475	8391	6551	5107	3311	166083
	ADJUSTED TOTAL N0. OF TRIPS	755																			
	N0. OF TRIPS IN EACH HOUR	15	59	50	27	28	32	34	33	51	44	57	67	53	51	48	38	30	23	15	755
	HEADWAY TIME	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	20
	NO. OF BUGGIE (max. 6)	4	15	14	8	8	8	9	9	13	10	13	14	15	15	14	11	8	6	4	198
	MODIFIED HEADWAY TIME	10	9	10	10	10	9	9	9	9	8	8	7	10	10	10	10	9	9	9	177
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	1015	4123	3476	1905	1962	2199	2395	2318	3516	3071	3984	4631	3659	3542	3311	2652	2070	1614	1047	52489
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	1645	6683	5634	3087	3180	3563	3882	3758	5699	4978	6457	7506	5930	5740	5366	4298	3355	2616	1696	85073

6- Bus 1

(Excluded hours)

Bus 1		EXCLUDED HOURS				
TIME		0.00	1.00	2.00	3.00	4.00
SITE NO.	25	105	67	40	25	42
	50	99	59	38	29	47
	58	172	85	55	40	60
	83	270	153	106	66	101
TOTAL		646	364	239	160	250
SITE NO.	25	0.014	0.009	0.005	0.003	0.006
	50	0.008	0.005	0.003	0.002	0.004
	58	0.015	0.007	0.005	0.003	0.005
	83	0.015	0.008	0.006	0.004	0.005
AVERAGE PERCENTAGE		1.30%	0.74%	0.48%	0.32%	0.51%
ADJUSTED PERCENTAGE		3.46%				

(Total Daily Traffic for operating hours)

Bus 1		OPERATING HOURS																		
TIME		5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
SITE NO.	25	138	502	492	330	292	381	294	448	578	347	340	489	409	303	365	269	446	448	255	7405
	50	182	598	738	530	583	637	715	685	729	476	551	860	839	782	717	685	556	395	228	11758
	58	198	759	965	489	445	479	458	482	598	408	447	636	802	833	830	803	701	485	387	11617
	83	341	848	853	749	838	891	1082	1065	1100	816	812	1173	1257	1239	1232	1225	1083	754	458	18512
TOTAL		859	2707	3048	2098	2158	2388	2549	2680	3005	2047	2150	3158	3307	3157	3144	2982	2786	2082	1328	49292
SITE NO.	25	0.019	0.068	0.066	0.045	0.039	0.051	0.040	0.060	0.078	0.047	0.046	0.066	0.055	0.041	0.049	0.036	0.060	0.060	0.034	0.042
	50	0.015	0.051	0.063	0.045	0.050	0.054	0.061	0.058	0.062	0.040	0.047	0.073	0.071	0.067	0.061	0.058	0.047	0.034	0.019	0.042
	58	0.017	0.065	0.083	0.042	0.038	0.041	0.039	0.041	0.051	0.035	0.038	0.055	0.069	0.072	0.071	0.069	0.060	0.042	0.033	0.042
	83	0.018	0.046	0.046	0.040	0.045	0.048	0.058	0.058	0.059	0.044	0.044	0.063	0.068	0.067	0.067	0.066	0.059	0.041	0.025	0.042
AVERAGE PERCENTAGE		1.74%	5.74%	6.46%	4.30%	4.31%	4.87%	4.96%	5.44%	6.27%	4.16%	4.38%	6.43%	6.59%	6.15%	6.21%	5.75%	5.66%	4.41%	2.80%	96.65%
ADJUSTED PERCENTAGE		1.80%	5.94%	6.68%	4.45%	4.46%	5.04%	5.13%	5.63%	6.49%	4.31%	4.53%	6.65%	6.82%	6.36%	6.42%	5.95%	5.85%	4.57%	2.89%	100.00 %

(Number of riders, trips, headway times and income of both methods)

Bus 1	INCLUDED HOURS																			
TIME	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
ADJUSTED TOTAL N0. OF RIDERS	13911.45																			
NO. OF RIDERS IN EACH HOURS	250	827	930	620	621	702	714	784	903	599	630	926	948	885	893	827	815	635	403	13,911
ADJUSTED TOTAL N0. OF TRIPS	139.11																			
N0. OF TRIPS IN EACH HOUR	3	8	9	6	6	7	7	8	9	6	6	9	9	9	9	8	8	6	4	139
HEADWAY TIME	3.43	1.04	0.92	1.39	1.38	1.22	1.20	1.10	0.95	1.43	1.36	0.93	0.91	0.97	0.96	1.04	1.06	1.35	2.13	24.79
NO. OF BUSES	3	9	10	7	7	8	8	9	10	7	6	9	10	10	10	9	9	7	4	152
MODIFIED HEADWAY TIME	10.30	9.35	9.24	9.71	9.69	9.80	9.63	9.87	9.52	10.04	8.18	8.35	9.06	9.71	9.62	9.35	9.50	9.47	8.54	178.93
INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	79.13	261.32	293.80	195.82	196.27	221.74	225.60	247.66	285.38	189.39	199.14	292.59	299.68	279.82	282.33	261.42	257.42	200.80	127.23	4396.54
INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	128.25	423.55	476.19	317.38	318.11	359.40	365.66	401.40	462.55	306.97	322.77	474.23	485.72	453.53	457.60	423.71	417.22	325.45	206.22	7125.92
ADJUSTED TOTAL N0. OF RIDERS	21613.70																			
NO. OF RIDERS IN EACH HOURS	389	1,285	1,444	963	965	1,090	1,109	1,218	1,403	931	979	1,438	1,473	1,376	1,388	1,285	1,265	987	625	21,614
ADJUSTED TOTAL N0. OF TRIPS	108.07																			
N0. OF TRIPS IN EACH HOUR	2	6	7	5	5	5	6	6	7	5	5	7	7	7	7	6	6	5	3	108
HEADWAY TIME	4.42	1.34	1.19	1.79	1.78	1.58	1.55	1.41	1.23	1.85	1.76	1.19	1.17	1.25	1.24	1.34	1.36	1.74	2.75	31.91
NO. OF BUSES	2	7	8	5	5	6	6	7	7	5	5	8	8	8	8	7	7	5	3	117
MODIFIED HEADWAY TIME	8.84	9.37	9.52	8.93	8.91	9.46	9.30	9.88	8.58	9.23	8.78	9.56	9.33	10.00	9.91	9.36	9.51	8.71	8.24	175.40
INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	122.93	406.01	456.46	304.24	304.94	344.51	350.51	384.78	443.39	294.25	309.40	454.58	465.60	434.75	438.65	406.16	399.94	311.97	197.67	6830.75
INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	199.25	658.05	739.84	493.10	494.24	558.39	568.11	623.65	718.64	476.92	501.48	736.79	754.65	704.64	710.96	658.30	648.22	505.65	320.39	11071.27

7- Bus 2

(Excluded hours)

Bus 2		EXCLUDED HOURS				
TIME		0.00	1.00	2.00	3.00	4.00
SITE NO.	23	219	103	64	55	83
	32	79	37	25	31	86
	63	272	151	159	88	110
	64	128	78	57	31	50
	71	65	37	34	70	245
	79	244	135	134	94	184
	84	136	92	98	54	41
TOTAL		1143	633	571	423	799
SITE NO.	23	0.009	0.004	0.003	0.002	0.004
	32	0.006	0.003	0.002	0.002	0.007
	63	0.018	0.010	0.010	0.006	0.007
	64	0.014	0.009	0.006	0.003	0.006
	71	0.004	0.002	0.002	0.004	0.016
	79	0.012	0.006	0.006	0.004	0.009
	84	0.010	0.007	0.008	0.004	0.003
AVERAGE PERCENTAGE		1.05%	0.59%	0.53%	0.39%	0.72%
ADJUSTED PERCENTAGE		3.40%				

(Total Daily Traffic for operating hours)

Bus 2		OPERATING HOURS																			
TIME		5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
SITE NO.	23	391	1193	1531	1186	1236	1142	1209	1340	1466	1234	1347	1538	1622	1378	1424	1287	1106	846	545	23545
	32	281	891	1001	859	682	648	828	681	672	587	618	760	1005	743	725	601	445	278	161	12724
	63	347	706	888	749	726	894	1004	1004	875	816	826	929	906	756	804	799	693	576	409	15487
	64	146	332	490	459	349	483	543	590	601	462	500	527	632	535	540	468	379	317	213	8910
	71	302	704	1190	1066	962	1097	1143	974	800	575	689	901	1099	987	827	856	634	319	178	15754
	79	510	860	1319	1234	1049	1146	1342	1310	1179	1050	1137	1135	1180	1130	1240	1213	1024	713	456	21018
	84	75	288	733	664	669	860	877	960	899	742	735	836	797	888	777	663	526	388	258	13056
TOTAL		2052	4974	7152	6217	5673	6270	6946	6859	6492	5466	5852	6626	7241	6417	6337	5887	4807	3437	2220	110494
SITE NO.	23	0.017	0.051	0.065	0.050	0.052	0.049	0.051	0.057	0.062	0.052	0.057	0.065	0.069	0.059	0.060	0.055	0.047	0.036	0.023	0.042
	32	0.022	0.070	0.079	0.068	0.054	0.051	0.065	0.054	0.053	0.046	0.049	0.060	0.079	0.058	0.057	0.047	0.035	0.022	0.013	0.042
	63	0.022	0.046	0.057	0.048	0.047	0.058	0.065	0.065	0.056	0.053	0.053	0.060	0.059	0.049	0.052	0.052	0.045	0.037	0.026	0.042
	64	0.016	0.037	0.055	0.052	0.039	0.054	0.061	0.066	0.067	0.052	0.056	0.059	0.071	0.060	0.061	0.053	0.043	0.036	0.024	0.042
	71	0.019	0.045	0.076	0.068	0.061	0.070	0.073	0.062	0.051	0.036	0.044	0.057	0.070	0.063	0.052	0.054	0.040	0.020	0.011	0.042
	79	0.024	0.041	0.063	0.059	0.050	0.055	0.064	0.062	0.056	0.050	0.054	0.054	0.056	0.054	0.059	0.058	0.049	0.034	0.022	0.042
	84	0.006	0.022	0.056	0.051	0.051	0.066	0.067	0.074	0.069	0.057	0.056	0.064	0.061	0.068	0.060	0.051	0.040	0.030	0.020	0.042
AVERAGE PERCENTAGE		1.81%	4.45 %	6.44%	5.64%	5.06 %	5.73%	6.37%	6.27%	5.93%	4.95%	5.28%	5.99%	6.63%	5.86%	5.73%	5.27%	4.26%	3.06%	1.98%	96.71%
ADJUSTED PERCENTAGE		1.87%	4.60 %	6.65%	5.83%	5.23 %	5.93%	6.58%	6.49%	6.13%	5.12%	5.46%	6.20%	6.86%	6.06%	5.92%	5.45%	4.41%	3.17%	2.05%	100.00 %

(Number of riders, trips, headway times and income of both methods)

	Bus 2	OPERATING HOURS																			
	TIME	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
METHOD 1	ADJUSTED TOTAL N0. OF RIDERS	36194.19																			
	NO. OF RIDERS IN EACH HOURS	677	1664	2408	2112	1894	2146	2383	2348	2217	1852	1975	2242	2482	2193	2144	1972	1596	1146	742	36194
	ADJUSTED TOTAL N0. OF TRIPS	361.94																			
	N0. OF TRIPS IN EACH HOUR	7	17	24	21	19	21	24	23	22	19	20	22	25	22	21	20	16	11	7	362
	HEADWAY TIME	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	3	24
	NO. OF BUSES	3	8	9	10	9	9	10	10	10	9	9	10	11	10	10	9	7	5	3	161
	MODIFIED HEADWAY TIME	9	10	8	10	10	9	9	9	10	10	10	9	9	10	10	10	9	9	9	178
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	214	526	761	667	599	678	753	742	701	585	624	709	784	693	678	623	504	362	235	11,439
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	347	852	1,234	1,082	970	1,099	1,221	1,203	1,136	949	1,012	1,149	1,271	1,123	1,098	1,010	817	587	380	18,540
METHOD 2	ADJUSTED TOTAL N0. OF RIDERS	17302.20																			
	NO. OF RIDERS IN EACH HOURS	324	795	1151	1009	906	1026	1139	1122	1060	885	944	1072	1187	1048	1025	943	763	548	355	17302
	ADJUSTED TOTAL N0. OF TRIPS	86.51																			
	N0. OF TRIPS IN EACH HOUR	2	4	6	5	5	5	6	6	5	4	5	5	6	5	5	5	4	3	2	87
	HEADWAY TIME	13	5	4	4	5	4	4	4	4	5	4	4	4	4	4	4	6	8	12	101
	NO. OF BUSES	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	34
	MODIFIED HEADWAY TIME	13	11	7	8	9	8	7	8	8	10	9	8	7	8	8	9	6	8	12	164
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	102	251	364	319	286	324	360	355	335	280	298	339	375	331	324	298	241	173	112	5,468
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	166	407	590	517	464	525	584	575	543	453	484	549	608	537	525	483	391	281	182	8,863

8- Bus 3

(Excluded hours)

Bus 3		EXCLUDED HOURS				
TIME		0.00	1.00	2.00	3.00	4.00
SITE NO.	6	153	90	38	27	55
	16	391	275	297	101	72
	17	345	188	159	69	59
	77	596	384	387	187	156
	78	950	591	609	318	266
	85	380	178	151	96	93
TOTAL		2815	1706	1641	798	701
SITE NO.	6	0.009	0.005	0.002	0.002	0.003
	16	0.026	0.018	0.019	0.007	0.005
	17	0.024	0.013	0.011	0.005	0.004
	77	0.019	0.013	0.013	0.006	0.005
	78	0.022	0.014	0.014	0.007	0.006
	85	0.014	0.007	0.006	0.004	0.004
AVERAGE PERCENTAGE		1.90%	1.15%	1.08%	0.50%	0.44%
ADJUSTED PERCENTAGE		5.35%				

(Total Daily Traffic for operating hours)

Bus 3		OPERATING HOURS																		
TIME		5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
SITE NO.	6	185	761	1014	937	968	1045	1058	1029	1089	861	963	1195	1195	1244	1185	960	705	493	290	17540
	16	155	394	670	662	803	855	860	853	865	729	796	931	976	964	931	841	742	645	501	15309
	17	186	466	671	515	640	757	830	875	916	776	784	850	876	888	843	788	731	679	518	14409
	77	515	1296	1748	1343	1360	1619	1775	1824	1716	1411	1435	1699	1821	1948	1834	1628	1661	1287	943	30573
	78	675	1935	2464	1628	1688	2134	2537	2512	3106	2270	1950	2462	2635	2485	2523	2432	2138	1736	1334	43378
	85	317	1095	1664	1114	1062	1227	1572	1658	1861	1598	1330	1530	1711	1794	1687	1487	1248	904	586	26343
TOTAL		2033	5947	8231	6199	6521	7637	8632	8751	9553	7645	7258	8667	9214	9323	9003	8136	7225	5744	4172	147552
SITE NO.	6	0.011	0.043	0.058	0.053	0.055	0.060	0.060	0.059	0.062	0.049	0.055	0.068	0.068	0.071	0.068	0.055	0.040	0.028	0.017	0.04
	16	0.010	0.026	0.044	0.043	0.052	0.056	0.056	0.056	0.057	0.048	0.052	0.061	0.064	0.063	0.061	0.055	0.048	0.042	0.033	0.04
	17	0.013	0.032	0.047	0.036	0.044	0.053	0.058	0.061	0.064	0.054	0.054	0.059	0.061	0.062	0.059	0.055	0.051	0.047	0.036	0.04
	77	0.017	0.042	0.057	0.044	0.044	0.053	0.058	0.060	0.056	0.046	0.047	0.056	0.060	0.064	0.060	0.053	0.054	0.042	0.031	0.04
	78	0.016	0.045	0.057	0.038	0.039	0.049	0.058	0.058	0.072	0.052	0.045	0.057	0.061	0.057	0.058	0.056	0.049	0.040	0.031	0.04
	85	0.012	0.042	0.063	0.042	0.040	0.047	0.060	0.063	0.071	0.061	0.050	0.058	0.065	0.068	0.064	0.056	0.047	0.034	0.022	0.04
AVERAGE PERCENTAGE		0.013	0.038	0.054	0.043	0.046	0.053	0.058	0.059	0.063	0.052	0.051	0.060	0.063	0.064	0.062	0.055	0.048	0.039	0.028	94.92%
ADJUSTED PERCENTAGE		0.014	0.040	0.057	0.045	0.048	0.056	0.062	0.062	0.067	0.054	0.053	0.063	0.066	0.068	0.065	0.058	0.051	0.041	0.030	100.00%

(Number of riders, trips, headway times and income of both methods)

		INCLUDED HOURS																		
	TIME	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
METHOD 1	ADJUSTED TOTAL N0. OF RIDERS	24550																			
	NO. OF RIDERS IN EACH HOURS	336	992	1,402	1,104	1,189	1,365	1,510	1,533	1,640	1,335	1,309	1,545	1,629	1,658	1,591	1,423	1,252	1,008	729	24,550
	ADJUSTED TOTAL N0. OF TRIPS	246																			
	N0. OF TRIPS IN EACH HOUR	3	10	14	11	12	14	15	15	16	13	13	15	16	17	16	14	13	10	7	246
	HEADWAY TIME	5	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	27
	NO. OF BUSES	2	6	7	7	7	7	10	10	10	8	8	10	10	10	10	9	8	6	4	149
	MODIFIED HEADWAY TIME	9	9	8	10	9	8	10	10	10	9	10	10	10	9	10	10	10	9	9	180
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	106	313	443	349	376	431	477	484	518	422	414	488	515	524	503	450	396	319	230	7759
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	172	508	718	566	609	699	774	785	840	684	671	791	835	849	815	729	641	516	373	12576
METHOD 2	ADJUSTED TOTAL N0. OF RIDERS	16952																			
	NO. OF RIDERS IN EACH HOURS	232	685	968	762	821	943	1043	1059	1133	922	904	1067	1125	1145	1099	983	864	696	503	16952
	ADJUSTED TOTAL N0. OF TRIPS	170																			
	N0. OF TRIPS IN EACH HOUR	2	7	10	8	8	9	10	11	11	9	9	11	11	11	11	10	9	7	5	170
	HEADWAY TIME	7	2	2	2	2	2	2	1	1	2	2	1	1	1	1	2	2	2	3	38
	NO. OF BUSES	1	4	6	5	5	6	6	7	7	6	6	7	7	7	6	6	5	4	3	104
	MODIFIED HEADWAY TIME	7	9	10	10	10	10	9	10	10	10	10	10	10	10	9	10	9	9	9	180
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	73	216	306	241	259	298	330	335	358	291	286	337	356	362	347	311	273	220	159	5357
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	119	351	496	391	420	483	534	542	580	472	463	546	576	586	563	503	443	356	258	8683

9- Bus 4

(Excluded hours)

Bus 4		EXCLUDED HOURS				
TIME		0.00	1.00	2.00	3.00	4.00
SITE NO.	61	189	79	49	46	68
	75	174	64	34	31	53
TOTAL		363	143	83	77	121
SITE NO.	61	0.011	0.004	0.003	0.003	0.004
	75	0.010	0.004	0.002	0.002	0.003
AVERAGE PERCENTAGE		1.03%	0.40%	0.23%	0.22%	0.34%
ADJUSTED PERCENTAGE		2.27%				

(Total Daily Traffic for operating hours)

Bus 4		OPERATION HOURS																			
TIME		5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
SITE NO.	61	261	943	1424	1049	887	753	904	1231	1396	977	1032	1107	981	972	971	883	747	572	351	17872
	75	246	928	1409	1034	872	738	889	1216	1381	962	1017	1092	966	957	956	868	732	557	336	17512
TOTAL		507	1871	2833	2083	1759	1491	1793	2447	2777	1939	2049	2199	1947	1929	1927	1751	1479	1129	687	35384
SITE NO.	61	0.015	0.053	0.080	0.059	0.050	0.042	0.051	0.069	0.078	0.055	0.058	0.062	0.055	0.054	0.054	0.049	0.042	0.032	0.020	0.042
	75	0.014	0.053	0.080	0.059	0.050	0.042	0.051	0.069	0.079	0.055	0.058	0.062	0.055	0.055	0.055	0.050	0.042	0.032	0.019	0.042
AVERAGE PERCENTAGE		1.43%	5.29%	8.01%	5.89%	4.97%	4.21%	5.07%	6.92%	7.85%	5.48%	5.79%	6.21%	5.50%	5.45%	5.45%	4.95%	4.18%	3.19%	1.94%	97.78%
ADJUSTED PERCENTAGE		1.47%	5.41%	8.19%	6.02%	5.08%	4.31%	5.18%	7.07%	8.03%	5.60%	5.92%	6.36%	5.63%	5.58%	5.57%	5.06%	4.27%	3.26%	1.99%	100%

(Number of riders, trips, headway times and income of both methods)

	Bus 4	OPERATING HOURS																			
	TIME	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
METHOD 1	ADJUSTED TOTAL N0. OF RIDERS	7041.47																			
	NO. OF RIDERS IN EACH HOURS	103	381	577	424	358	303	365	498	565	395	417	448	396	393	392	356	301	230	140	7,041
	ADJUSTED TOTAL N0. OF TRIPS	70.41																			
	N0. OF TRIPS IN EACH HOUR	1	4	6	4	4	3	4	5	6	4	4	4	4	4	4	4	3	2	1	70
	HEADWAY TIME	11	3	2	3	3	4	3	2	2	3	3	3	3	3	3	3	4	5	8	69
	NO. OF BUSES	1	3	5	3	3	2	3	4	5	3	3	4	3	3	3	3	2	2	1	56
	MODIFIED HEADWAY TIME	11	9	10	8	9	7	9	9	10	9	8	10	8	9	9	9	7	10	8	169
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	33	120	182	134	113	96	115	157	179	125	132	141	125	124	124	113	95	73	44	2225
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	53	195	295	217	183	155	187	255	290	202	214	229	203	201	201	183	154	118	72	3607
METHOD 2	ADJUSTED TOTAL N0. OF RIDERS	17503.66																			
	NO. OF RIDERS IN EACH HOURS	256	947	1433	1054	890	754	907	1238	1405	981	1037	1113	985	976	975	886	748	571	348	17504
	ADJUSTED TOTAL N0. OF TRIPS	175.04																			
	N0. OF TRIPS IN EACH HOUR	3	9	14	11	9	8	9	12	14	10	10	11	10	10	10	9	7	6	3	175
	HEADWAY TIME	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	3	28
	NO. OF BUSES	2	8	11	9	7	7	8	11	11	9	9	10	8	8	8	7	6	5	3	147
	MODIFIED HEADWAY TIME	9	9	9	10	9	10	10	10	9	10	10	10	9	9	9	9	9	10	10	179
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	81	299	453	333	281	238	287	391	444	310	328	352	311	308	308	280	236	181	110	5532
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	131	485	734	540	456	386	465	634	720	503	531	570	505	500	499	454	383	293	178	8966

10- Bus 5

(Excluded hours)

Bus 5		EXCLUDED HOURS				
TIME		0.00	1.00	2.00	3.00	4.00
SITE NO.	97	42	22	13	42	21
	98	29	14	9	41	29
TOTAL		71	36	22	83	50
SITE NO.	97	0.003	0.001	0.001	0.003	0.001
	98	0.003	0.002	0.001	0.005	0.003
AVERAGE PERCENTAGE		0.29%	0.15%	0.09%	0.36%	0.23%
ADJUSTED PERCENTAGE		1.13%				

(Total Daily Traffic for operating hours)

Bus 5		OPERATING HOURS																		
TIME		5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
SITE NO.	97	365	1077	1516	945	859	832	803	868	1041	1328	1036	1056	1045	820	780	666	420	230	162	15989
	98	372	680	572	500	566	588	588	592	586	536	644	680	587	487	378	226	157	91	53	9005
TOTAL		737	1757	2088	1445	1425	1420	1391	1460	1627	1864	1680	1736	1632	1307	1158	892	577	321	215	24994
SITE NO.	97	0.023	0.067	0.095	0.059	0.054	0.052	0.050	0.054	0.065	0.083	0.065	0.066	0.065	0.051	0.049	0.042	0.026	0.014	0.010	0.042
	98	0.041	0.076	0.064	0.056	0.063	0.065	0.065	0.066	0.065	0.060	0.072	0.076	0.065	0.054	0.042	0.025	0.017	0.010	0.006	0.042
AVERAGE PERCENTAGE		3.21%	7.14%	7.92%	5.73%	5.83%	5.87%	5.78%	6.00%	6.51%	7.13%	6.82%	7.08%	6.53%	5.27%	4.54%	3.34%	2.19%	1.22%	0.80%	98.88%
ADJUSTED PERCENTAGE		3.24%	7.22%	8.01%	5.80%	5.89%	5.93%	5.84%	6.07%	6.58%	7.21%	6.89%	7.16%	6.60%	5.33%	4.59%	3.38%	2.21%	1.24%	0.81%	100.00%

(Number of riders, trips, headway times and income of both methods)

	Bus 5	OPERATING HOURS																			
	TIME	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
METHOD 1	ADJUSTED TOTAL N0. OF RIDERS	11398																			
	NO. OF RIDERS IN EACH HOURS	370	823	913	661	672	676	666	692	750	822	786	816	752	607	523	385	252	141	92	11,398
	ADJUSTED TOTAL N0. OF TRIPS	114																			
	N0. OF TRIPS IN EACH HOUR	4	8	9	7	7	7	7	7	8	8	8	8	8	6	5	4	3	1	1	114
	HEADWAY TIME	3	1	1	2	2	2	2	2	1	1	1	1	1	2	2	3	4	8	12	53
	NO. OF BUSES	3	7	7	6	6	6	6	6	7	7	7	7	7	5	4	3	2	1	1	98
	MODIFIED HEADWAY TIME	9	10	9	10	10	10	10	10	10	10	10	10	10	9	9	9	9	8	12	183
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	117	260	288	209	212	214	210	219	237	260	248	258	238	192	165	122	80	45	29	3602
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	189	422	467	338	344	346	341	354	384	421	402	418	385	311	268	197	129	72	47	5839
METHOD 2	ADJUSTED TOTAL N0. OF RIDERS	22993																			
	NO. OF RIDERS IN EACH HOURS	746	1661	1841	1333	1355	1364	1343	1395	1514	1658	1585	1646	1518	1225	1055	776	508	285	186	22993
	ADJUSTED TOTAL N0. OF TRIPS	230																			
	N0. OF TRIPS IN EACH HOUR	7	17	18	13	14	14	13	14	15	17	16	16	15	12	11	8	5	3	2	230
	HEADWAY TIME	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	4	6	26
	NO. OF BUSES	6	15	16	12	12	12	12	13	14	15	14	14	14	11	9	7	4	2	1	203
	MODIFIED HEADWAY TIME	9	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	9	8	6	182
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	236	525	582	421	428	431	424	441	478	524	501	520	480	387	333	245	161	90	59	7267
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	382	851	943	683	694	699	688	715	775	849	812	843	777	627	541	398	260	146	95	11778

11- Bus 6

(Excluded hours)

Bus 6		EXCLUDED HOURS				
TIME		0.00	1.00	2.00	3.00	4.00
SITE NO.	40	155	72	41	32	70
	49	109	54	27	31	48
	86	125	63	39	32	47
TOTAL		389	189	107	95	165
SITE NO.	40	0.009	0.004	0.002	0.002	0.004
	49	0.007	0.004	0.002	0.002	0.003
	86	0.006	0.003	0.002	0.002	0.002
AVERAGE PERCENTAGE		0.008	0.004	0.002	0.002	0.003
ADJUSTED PERCENTAGE		1.87%				

(Total Daily Traffic for operating hours)

Bus 6		OPERATING HOURS																		
TIME		5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
SITE NO.	40	299	1048	1558	690	851	803	1029	1067	1429	1215	771	872	919	845	838	860	720	497	323	17004
	49	98	532	761	585	841	713	918	819	903	692	806	1032	1118	1055	1011	955	773	493	280	14654
	86	167	1184	1868	1189	1317	1229	1350	1272	1609	1459	890	1144	1155	1112	977	791	845	441	261	20566
TOTAL		564	2764	4187	2464	3009	2745	3297	3158	3941	3366	2467	3048	3192	3012	2826	2606	2338	1431	864	52224
SITE NO.	40	0.018	0.062	0.092	0.041	0.050	0.047	0.061	0.063	0.084	0.071	0.045	0.051	0.054	0.050	0.049	0.051	0.042	0.029	0.019	0.0417
	49	0.007	0.036	0.052	0.040	0.057	0.049	0.063	0.056	0.062	0.047	0.055	0.070	0.076	0.072	0.069	0.065	0.053	0.034	0.019	0.0417
	86	0.008	0.058	0.091	0.058	0.064	0.060	0.066	0.062	0.078	0.071	0.043	0.056	0.056	0.054	0.048	0.038	0.041	0.021	0.013	0.0417
AVERAGE PERCENTAGE		0.011	0.052	0.078	0.046	0.057	0.052	0.063	0.060	0.075	0.063	0.048	0.059	0.062	0.059	0.055	0.051	0.045	0.028	0.017	98.167 %
ADJUSTED PERCENTAGE		1.10%	5.28%	7.96%	4.70%	5.82%	5.28%	6.41%	6.13%	7.60%	6.44%	4.88%	6.02%	6.33%	5.97%	5.63%	5.24%	4.62%	2.86%	1.72%	100%

(Number of riders, trips, headway times and income of both methods)

	Bus 6	OPERATING HOURS																		
	TIME	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
METHOD 1	ADJUSTED TOTAL N0. OF RIDERS	16970																			
	NO. OF RIDERS IN EACH HOURS	187	896	1351	797	988	897	1088	1040	1290	1093	828	1022	1075	1013	955	889	785	486	293	16970
	ADJUSTED TOTAL N0. OF TRIPS	170																			
	N0. OF TRIPS IN EACH HOUR	2	9	14	8	10	9	11	10	13	11	8	10	11	10	10	9	8	5	3	170
	HEADWAY TIME	12	2	2	3	2	2	2	2	2	2	3	2	2	2	2	2	3	4	7	59
	NO. OF BUSES	1	4	6	3	4	4	5	5	6	5	3	4	5	4	4	4	3	2	1	73
	MODIFIED HEADWAY TIME	12	10	10	8	9	10	10	10	10	10	8	9	10	9	9	10	8	9	7	177
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	59	283	427	252	312	283	344	329	408	345	262	323	340	320	302	281	248	154	92	5363
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	96	459	692	408	506	459	557	533	661	560	424	523	550	519	489	455	402	249	150	8692
METHOD 2	ADJUSTED TOTAL N0. OF RIDERS	22821																			
	NO. OF RIDERS IN EACH HOURS	251	1205	1816	1072	1329	1206	1463	1399	1735	1469	1113	1374	1445	1362	1285	1195	1055	653	394	22821
	ADJUSTED TOTAL N0. OF TRIPS	228																			
	N0. OF TRIPS IN EACH HOUR	3	12	18	11	13	12	15	14	17	15	11	14	14	14	13	12	11	7	4	228
	HEADWAY TIME	9	2	1	2	2	2	1	2	1	1	2	2	2	2	2	2	2	3	6	44
	NO. OF BUSES	1	5	8	5	6	5	7	6	8	7	5	6	6	6	6	5	5	3	1	101
	MODIFIED HEADWAY TIME	9	9	10	10	10	9	10	9	10	10	10	10	9	10	10	9	10	10	6	180
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	79	381	574	339	420	381	462	442	548	464	352	434	457	430	406	378	334	206	124	7212
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	129	617	930	549	681	618	749	716	889	753	570	704	740	698	658	612	541	335	202	11690

12- Bus 7

(Excluded hours)

Bus 7		EXCLUDED HOURS				
TIME		0.00	1.00	2.00	3.00	4.00
SITE NO.	59	188	98	63	34	46
	66	255	194	69	65	104
TOTAL		443	292	132	99	150
SITE NO.	59	0.013	0.007	0.004	0.002	0.003
	66	0.014	0.010	0.004	0.004	0.006
AVERAGE PERCENTAGE		1.36%	0.87%	0.41%	0.30%	0.44%
ADJUSTED PERCENTAGE		3.50%				

(Total Daily Traffic for operating hours)

Bus 7		OPERATING HOURS																		
TIME		5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
SITE NO.	59	169	787	754	443	481	519	611	854	1160	799	781	897	935	922	915	865	765	595	423	14104
	66	290	861	1070	802	981	761	865	911	1001	824	905	1126	1277	1142	1265	1251	1102	852	530	18503
TOTAL		459	1648	1824	1245	1462	1280	1476	1765	2161	1623	1686	2023	2212	2064	2180	2116	1867	1447	953	32607
SITE NO.	59	0.012	0.056	0.053	0.031	0.034	0.037	0.043	0.061	0.082	0.057	0.055	0.064	0.066	0.065	0.065	0.061	0.054	0.042	0.030	0.042
	66	0.016	0.047	0.058	0.043	0.053	0.041	0.047	0.049	0.054	0.045	0.049	0.061	0.069	0.062	0.068	0.068	0.060	0.046	0.029	0.042
AVERAGE PERCENTAGE		1.38%	5.12%	5.56%	3.74%	4.36%	3.90%	4.50%	5.49%	6.82%	5.06%	5.21%	6.22%	6.77%	6.35%	6.66%	6.45%	5.69%	4.41%	2.93%	96.62%
ADJUSTED PERCENTAGE		1.43%	5.30%	5.76%	3.87%	4.51%	4.03%	4.66%	5.68%	7.06%	5.24%	5.40%	6.44%	7.00%	6.58%	6.89%	6.67%	5.89%	4.57%	3.03%	100.00%

(Number of riders, trips, headway times and income of both methods)

	Bus 7	OPERATING HOURS																			
	TIME	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.	23.00	TOTAL
METHOD 1	ADJUSTED TOTAL N0. OF RIDERS	13907																			
	NO. OF RIDERS IN EACH HOURS	199	736	801	538	627	561	648	790	981	728	750	896	974	915	959	928	819	635	422	13907
	ADJUSTED TOTAL N0. OF TRIPS	139																			
	N0. OF TRIPS IN EACH HOUR	2	7	8	5	6	6	6	8	10	7	8	9	10	9	10	9	8	6	4	139
	HEADWAY TIME	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19
	NO. OF BUSES	3	11	13	8	10	9	10	11	15	11	12	14	15	15	15	15	13	10	7	217
	MODIFIED HEADWAY TIME	9	9	10	9	10	10	10	9	10	10	10	10	10	10	10	10	10	10	10	187
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	63	233	253	170	198	177	205	250	310	230	237	283	308	289	303	293	259	201	133	4395
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	102	377	410	276	321	287	332	405	503	373	384	459	499	468	491	475	419	325	216	7124
METHOD 2	ADJUSTED TOTAL N0. OF RIDERS	22443																			
	NO. OF RIDERS IN EACH HOURS	321	1188	1292	868	1012	905	1046	1275	1583	1175	1211	1445	1571	1476	1547	1497	1322	1025	681	22443
	ADJUSTED TOTAL N0. OF TRIPS	224																			
	N0. OF TRIPS IN EACH HOUR	3	12	13	9	10	9	10	13	16	12	12	14	16	15	15	15	13	10	7	224
	HEADWAY TIME	2	1	0	1	1	1	1	0	0	1	1	0	0	0	0	0	0	1	1	12
	NO. OF BUSES	5	15	15	12	14	13	14	16	16	16	16	16	16	16	16	16	17	15	11	275
	MODIFIED HEADWAY TIME	10	8	7	9	9	9	8	8	6	9	8	7	6	7	7	7	8	9	10	152
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	102	376	408	274	320	286	331	403	500	371	383	457	497	466	489	473	418	324	215	7093
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	165	609	662	445	518	464	536	653	811	602	620	740	805	756	793	767	677	525	349	11496

13- Bus 8

(Excluded hours)

Bus 8		EXCLUDED HOURS				
TIME		0.00	1.00	2.00	3.00	4.00
SITE NO.	3	139	72	43	35	103
	4	83	52	31	48	67
	41	158	91	57	45	50
TOTAL		380	215	131	128	220
SITE NO.	3	0.014	0.007	0.004	0.003	0.010
	4	0.007	0.004	0.002	0.004	0.005
	41	0.013	0.008	0.005	0.004	0.004
AVERAGE PERCENTAGE		1.11%	0.62%	0.38%	0.37%	0.65%
ADJUSTED PERCENTAGE		3.23%				

(Total Daily Traffic for operating hours)

Bus 8		OPERATING HOURS																		
TIME		5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
SITE NO.	3	197	949	797	476	443	482	676	750	781	786	612	491	471	417	386	374	329	262	180	10251
	4	383	1223	659	517	689	729	695	789	1041	1037	1038	650	545	524	394	368	339	296	295	12492
	41	177	848	728	493	459	496	622	653	954	1061	983	810	734	593	499	450	451	391	277	12080
TOTAL		757	3020	2184	1486	1591	1707	1993	2192	2776	2884	2633	1951	1750	1534	1279	1192	1119	949	752	34823
SITE NO.	3	0.019	0.093	0.078	0.046	0.043	0.047	0.066	0.073	0.076	0.077	0.060	0.048	0.046	0.041	0.038	0.036	0.032	0.026	0.018	0.042
	4	0.031	0.098	0.053	0.041	0.055	0.058	0.056	0.063	0.083	0.083	0.083	0.052	0.044	0.042	0.032	0.029	0.027	0.024	0.024	0.042
	41	0.015	0.070	0.060	0.041	0.038	0.041	0.051	0.054	0.079	0.088	0.081	0.067	0.061	0.049	0.041	0.037	0.037	0.032	0.023	0.042
AVERAGE PERCENTAGE		2.15%	8.69%	6.36%	4.29%	4.55%	4.88%	5.77%	6.35%	7.95%	8.25%	7.47%	5.57%	5.01%	4.39%	3.68%	3.44%	3.22%	2.72%	2.14%	96.87%
ADJUSTED PERCENTAGE		2.22%	8.97%	6.56%	4.43%	4.69%	5.04%	5.96%	6.55%	8.21%	8.52%	7.71%	5.75%	5.17%	4.53%	3.80%	3.55%	3.32%	2.81%	2.21%	100.00%

(Number of riders, trips, headway times and income of both methods)

	Bus 8	OPERATING HOURS																			
	TIME	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	TOTAL
METHOD 1	ADJUSTED TOTAL N0. OF RIDERS	15339																			
	NO. OF RIDERS IN EACH HOURS	341	1,376	1,007	679	720	773	914	1,005	1,259	1,306	1,183	881	794	695	583	545	510	431	338	15,339
	ADJUSTED TOTAL N0. OF TRIPS	153																			
	N0. OF TRIPS IN EACH HOUR	3	14	10	7	7	8	9	10	13	13	12	9	8	7	6	5	5	4	3	153
	HEADWAY TIME	7	2	2	3	3	3	2	2	2	2	2	3	3	3	4	4	4	5	7	62
	NO. OF BUSES	1	6	4	3	3	3	4	4	5	5	5	4	3	3	2	2	2	2	1	62
	MODIFIED HEADWAY TIME	7	10	9	10	9	9	10	9	9	9	9	10	8	10	8	8	9	10	7	168
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	108	435	318	215	227	244	289	318	398	413	374	279	251	220	184	172	161	136	107	4848
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	174	705	516	348	369	396	468	515	645	669	606	451	406	356	299	279	261	221	173	7857
METHOD 2	ADJUSTED TOTAL N0. OF RIDERS	14689																			
	NO. OF RIDERS IN EACH HOURS	326	1318	964	650	689	740	875	962	1206	1251	1133	844	760	666	559	522	488	413	324	14689
	ADJUSTED TOTAL N0. OF TRIPS	147																			
	N0. OF TRIPS IN EACH HOUR	3	13	10	7	7	7	9	10	12	13	11	8	8	7	6	5	5	4	3	147
	HEADWAY TIME	7	2	2	3	3	3	3	2	2	2	2	3	3	3	4	4	5	5	7	65
	NO. OF BUSES	1	6	4	3	3	3	4	4	5	5	5	3	3	3	2	2	2	1	1	60
	MODIFIED HEADWAY TIME	7	10	9	10	10	9	10	9	9	9	10	8	9	10	8	9	9	5	7	168
	INCOME IF TICKET PRICE 750 FILS FOR 2 HOURS	103	416	305	205	218	234	276	304	381	395	358	267	240	210	177	165	154	130	102	4642
	INCOME IF TICKET PRICE 500 FILS FOR 2 HOURS	167	675	494	333	353	379	448	493	618	641	580	432	389	341	286	267	250	211	166	7524

الملخص

نظام النقل الجماعي أو ما يعرف بالنقل الجماهيري هو أسلوب أساسي من انظمة النقل حيث يمكنه استيعاب جمهور غفير من الناس خلال اقصر وقت ممكن، لاسيما خلال ساعات الذروة. نظام النقل الجماعي أصبح القضية الأكثر إلحاحا في دول الخليج مع ارتفاع معدل نمو البشر والسيارات والركاب وانخفاض وسائل النقل العامة مقارنة بالبلدان المتقدمة. ونتيجة لذلك، أدى ارتفاع كثافة المركبات على شبكات الطرق العامة الى زيادة الإزدحام، وتطوير انظمة النقل الجماعي يعد أمرا مهما من النواحي الاقتصادية والاجتماعية والبيئية وذلك من أجل التوسيع من شبكة الطرق.

ونظرا للنمو المتزايد في عدد السكان والارتفاع المستمر في عدد المركبات، بالاضافة الى محدودية المساحات المخصصه للنقل وارتفاع الطلب على التنقل، وعدم وجود نظام نقل عام مناسب، علاوة على ضعف النظام الحالي للنقل وارتفاع غير مقبول في الوقت المستغرق في التنقل، والازدحام الشديد للمركبات والذي ينعكس سلبا على البيئة، فإن نظام النقل الجماعي أمر لا بد منه في مملكة البحرين. وقد تم في هذه الدراسة تخطيط وإدارة إحتياجات الأنواع مختلفة من انظمة النقل الجماعي بما فيها الحافلات والترام والمترو والسكك الحديدية الخفيفة مع توسعاتها المستقبلية.

كما تقدم هذه الدراسة مقترحاً ماكروسكوبي (Macroscopic) لتصميم شبكة نقل متكاملة مع وسائل نقل أخرى، استنادا إلى المعلومات الكلية المتاحة، وتعتمد على اتجاه السيارات، عدد السكان، استهلاك الوقود وتطور مشاريع الإسكان. إضافة إلى ذلك، فإن عملية الادارة للمستخدم مبنية على المستوى الجزئي للمعلومات أو ما يعرف بالميكروسكوبي (Microscopic). وتشتمل على الخلفية التاريخية والمعلومات اليومية ونظام اوقات التشغيل للحركة المرورية ومعدل الأجرة.

تم توزيع استبيانات وتحليلها باستخدام برنامج SPSS للإجابة على العديد من التساؤلات ذات الصلة بالمستخدم كمعدل الأجرة، وصلاحية التذكرة، وساعات التشغيل وإمكانية استخدام النظام. كما تم إجراء العديد من المقابلات اللازمة لجمع البيانات مع ممثلين من بعض الوزارات التي لها صلة بالموضوع. وقد تم تطوير نظام التخطيط وتقدير مستخدمي الشبكة بشكل مفصل في هذه الدراسة، حيث تم تصميم نظام متكامل باستخدام برنامج الميكروسوفت اكسل. وقد صممت الدراسة ليتسنى نقلها بسهولة إلى أي بلد وتقتصر الدراسة على نظام النقل الجماعي المحدود وندرة البيانات المتاحة باستثناء مجموع بيانات حركة المرور اليومية.

ونتيجة لذلك، تم تطوير شبكة تتكون من مسارين للمترو، وثلاثة طرق للترام وثمانية خطوط للحافلات السريعة. ويقدر إجمالي عدد المستفيدين من الشبكة المقترحة نحو 900 الف راكب، كما يقدر المدخول اليومي للنظام بنحو 300 الف دينار بحريني.

ولعل من الأهمية أن نذكر بمكان ضرورة الاهتمام في الإعلان والتسويق السليم لجذب الناس على استخدام النظام. وعلاوة على ذلك، ينبغي إجراء دراسات إضافية لتحديد أفضل نموذج للنظام من حيث كون التصميم المطلوب من فوق الأرض أو تحت الأرض.

جامعة البحرين

كلية الهندسة

قسم الهندسة الميكانيكية

نظام مواصلات جماهيرية للبحرين: وفق تخطيط ماكروسكوبي وإدارة ميكروسكوبية

أطروحة مقدمة كجزء من متطلبات الحصول على درجة الماجستير في الإدارة الهندسية

إعداد

دلال يوسف الكوهجي

20029565

إشراف

الأستاذ الدكتور هاشم محمد نور المدني
أستاذ النقل والمواصلات قسم الهندسة المدنية

جامعة البحرين

مملكة البحرين