BUILDING STREETS NETWORK FOR THE CITY OF DURA WORKING UNDER GIS NETWORK ANALYST EXTENSION

BY

FADI AMRO **FADI DWEIK**

WESAM AMRO

CIVIL & ARCHITECTURAL ENGINEERING DEPARTMENT

COLLEGE OF ENGINEERING AND TECHNOLOGY

PALESTINE POLYTECHNIC UNIVERSITY

HEBRON- WEST BANK

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DECEMBER- 2006

بسم ا الرحمن الرحيم

Palestine Polytechnic University

College of Engineering & Technology

Civil & Architecture Engineering Department

Graduation Project

BUILDING STREETS NETWORK FOR THE CITY OF DURA WORKING UNDER GIS NETWORK ANALYST EXTENSION

Project Team

FADI AMRO   FADI DWEIK   WESAM AMRO

Project Supervisor

ENG.MAHER OWAIWI

HEBRON-PALESTINE

DECEMBER 2006

Certification

Palestine Polytechnic University

HEBRON-PALESTINE

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In accordance with the recommendation of project supervisor and acceptance of all examining committee members, this project has been submitted to the Department of Civil and Architectural Engineering in the college of Engineering and Technology in partial fulfillment of requirements of the department for degree of Bachelor of Surveying and Geomatics Engineering.

Signature of Project Supervisor **Signature of Department Chairman**

Name………………………. **Name**…………………………

DECEMBER 2006

بسم ا الرحمن الرحيم

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FADI AMRO FADI DWEIK WESAM AMRO

A project report submitted in partial fulfillment of requirements for the degree of Bachelor of Engineering in Survey and Geomatics Engineering Department.

SUPERVISED BY

ENG.MAHER OWAIWI

HEBRON-PALESTINE

DECEMBER 2006

الإهداء

Dedication

عندما يعيش الإنسان في وسط الظلام والمعاناة وتنسكب الدموع غزيرة في دنيا الآلام ويقف الجسد بكل ما يحمل من مصاعب شامخا, وينجز عملا ما ليكون بإذن ا في القمة يهديه ويقدمه إلى أعز وأحب من لديه في الوجود

إلى المعلم الأول الهادي البشير عليه الصلاة والسلام

إلى نبض روحي المتألقة بالعطاء .... والدي الحبيب

إلى تلك الشمعة التي تحترق لتضئ لنا الطريق ....أمي الغالية

إلى من فني في سبيلها الجسد والمال ....فلسطيننا الحبيبة

إلى الذي ضحى و أنكر الذات في سبيل ا

إلى من هم اعزمنا جميعا إلى ثوار الأرض أينما وجدوا

إلى القابعين خلف قضبان الحديد ينتظرون يوم الحرية

إلى من أصبحت المستشفيات بيوتهم الثانية

شعبنا الصابر المحتسب

إلى هؤلاء جميعا نهدي عملنا هذا

ونسأل ا أن يجعله في ميزان حسناتنا يوم القيامة

فريق العمل:

1. فادي عمرو

2. فادي ألدويك

3. وسام عمرو

شكر وتقدير

نتوجه بالشكر والتقدير العميق إلى جامعة بوليتكنك فلسطين التي احتضنت مسيرتنا التعليمية وإلى جميع معلمينا ومعلماتنا في المراحل المدرسية المختلفة.

ونتوجه بالشكر العميق إلى مشرفنا الأستاذ ماهر العويوي ,على ما قدمه لنا من نصح و إرشاد ومساعدة قيمة خلال إنجاز هذا البحث كما نشكر جميع الأساتذة في دائرة الهندسة المدنية والمعمارية.

كما نتوجه بالشكر إلى بلدية دورا على مساهمتها الطيبة في توفير الخرائط اللازمة للمشروع و إلى جميع من ساعدنا ووقف إلى جانبنا لإنجاز هذا المشروع .

Abstract

BUILDING STREETS NETWORK FOR THE CITY OF DURA WORKING UNDER GIS NETWORK ANALYST EXTENSION

BY

FADI AMRO FADI DWEIK WESAM AMRO

Palestine Polytechnic University 2006

Supervisor By:

ENG.MAHER OWAIWI

Dura city is one of the largest community in Hebron District, which is subject to fast development in its streets network. To date the city lacks an appropriate digital streets Network database.

This project covers various aspects of building an appropriate computerized streets network database for Dura city. The resultant database will work under ArcGIS 9 Network Analyst extension. The work covers all required editing for converting the streets to ARCGIS syntax. Field measurement was carried out and several visits to police department, hospitals, clinics, and schools have been conducted.

This project enables the users to determine the shortest and fastest path between different locations in Dura city. The project will benefit in the dispatch of emergency and will help in planning strategies within city of Dura such as school, and fir place locations.

ملخص

بناء شبكة طرق لمدينة دورا باستخدام نظام المعلومات الجغرافية

إعداد

فادي عمرو فادي الدويك وسام عمرو

إشراف:

المهندس ماهر العويوي

مدينة دورا هي إحدى المدن الفلسطينية والتي تقع جنوب الضفة الغربية وهي كغيرها من المدن الفلسطينية تفتقر إلى وجود شبكة طرق صالحة الاستخدام في نظام تحليل الشبكات في برنامج نظم المعلومات الجغرافية

وقد اشتمل هذا المشروع على إعداد وتحضير شبكة طرق محوسبة لهذه المدينة على نظام GIS , حيث تم تسمية الشوارع وعمل نماذج للتقاطعات الرئيسية وعمل تعديلات وقياس السرعات التشغيلية بالإضافة إلى عمل تحديث لشبكة الطرق .

وسوف يصبح بالامكان استخدام هذه الشبكة داخل نظام GIS في تحديد اقصر وأسرع مسار من حيث الزمن والمسافة بالإضافة إلى تحديد المواقع للمنشآت المراد إقامتها مثل المدارس ومراكز الإسعاف الأولي والمطاعم ومحطات الوقود .

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CHAPTER ONE

1.1 Problem Definition

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1.4 Project Importance

1.5 Scope of Work

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1.7 Organization of the Project

1.8 Time Table

This chapter covers the general idea of the project, its importance, objectives, study area, scope of work, phases of the project work, and the problems that found during project work …..etc.

CHAPTER ONE

INTRODUCTION

1.1 Problem Definition

The recent fast development in Dura city, which affects the public sector economic activities, educational sector and human resources, impose a huge stress on the street network within the city and between the city and the surrounding cities and towns.

It is common known that, this increasing demand on Dura streets network make it very important to build a digital streets network model as part of integrated planning strategy for Dura city development plan. This will help in finding the shortest or fastest path from point to point in some critical condition or in some economic cases.

The recent development in information technology facilitate the management of different sectors of our life. The GIS system is one of these modern database technologies, which proved its ability and strength in many applications, including environment, transportation, municipal activities, and military actions .

The idea of this project came into mind as a result of brain storming with the Dura Municipality engineers; this will be an attempt to use GIS technology to find the shortest and fastest routes.

1.2 The Study Area

1.2.1 Location and Topography

Dura city is situated some 8 Km southwest of Hebron, the location map of Dura city is shown in fig (1.1).

The population within Dura municipal boundary has been determined by a census carried out by the Palestinian Bureau of Statistics on the night of 9 December (1997). The population is (46000) habitant. This population is expected to grow substantially up to the year (2028) planning horizon of this project (Arabteck Jardaneh, 1999).

The topography of the study area can be described as mountainous with steep slopes and few plan areas located east of the city. The city is about 900 meters above mean sea level (AMSL). The area of the city center is located between 820m and 870m AMSL. The built-up area of town spreads between the elevations of 760m to 890m AMSL.

The commercial center of the city is situated in the east central part of the area with dense housing on the adjacent hillsides. There is also extensive commercial development along the main streets leading from the city center to Hebron city.

1.2.2 Streets

The plan of the existing and proposed streets in the Dura city has been obtained from Dura Municipality. The main streets traverse the city from north to south in the same direction as the main drainage channels, as shown in fig (1.1).

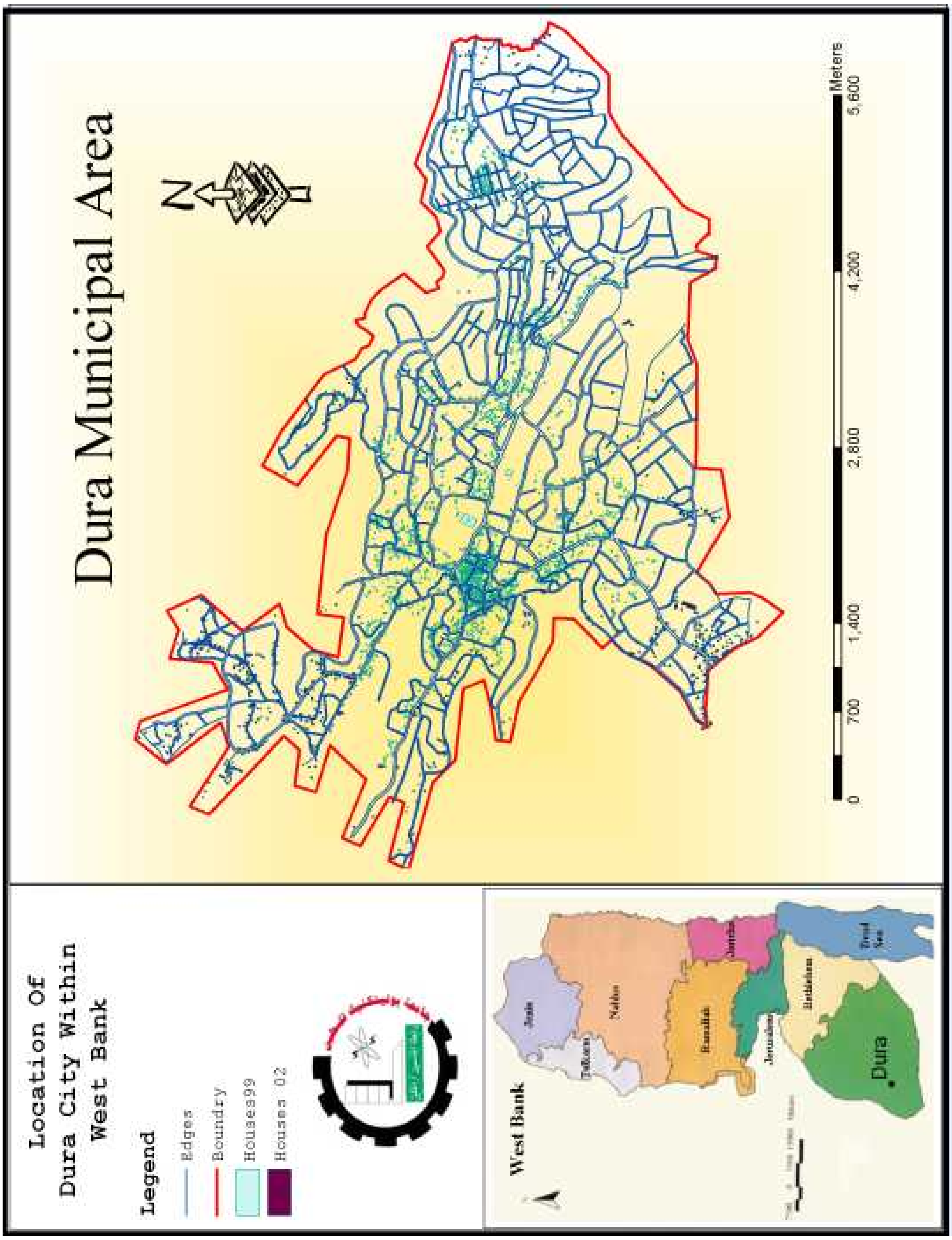


Figure (1.1): Location Map of Dura City

1.3 Objectives

1.3.1 Main Objective

The main objective is to build up a GIS Network Model for streets in Dura city.

Specific Objectives

1 Optimize route for police inspector in Dura city.
2. Public safety –route emergency response crews to incidents.
3. Calculate the drive time for first responder planning.
4. Determine the optimal route for point to point
5. To prepare network that can determine the best route between any two points and closest services
6. Calculate the accessibility for mass transit systems by using a complex network data set.
7. Route service calls for technicians including time window restrictions.
8. Determine the service area for the important facilities such as (schools , pharmacies, mosques,…...etc).

1.4 Project Importance

The Development of GIS systems applied in surveying and geometics science reaches our country very lately relative to the world around us. For that and for the following reasons, we decided to work on a combined system of GIS, streets, network, management, and geomatics applications.

1. Playing a small role in advancing this system in our community, municipalities, institutes and engineering offices.

2. Helping the Dura municipality by building a GIS streets network system as a good example for the sheets management in many modern applications.

1.5 Scope of Work

The main tasks in this project can be summarized in the following phases:

First phase

1) Data collection, this includes collection of information about the Dura streets network as a digital master plan. The data where obtained from the Engineering Department at Dura Municipality and by field survey to determine the speed, direction, and number of paths of each street segment.
2) Loading master data; this includes load the master plan data to the GIS.

Second Phase

Organizing the digital data in GIS environment by removing the lines or polygons which are useless and separate the information into layers (streets, buildings, boundaries')

Third Phase

Determining the center of each street, junction point for each segment and input the speed for each segment in the attribute table.

Fourth Phase

Using the Network Analysis and its application; including finding the best route for the time needed to reach any point from others.

1.6 Literature Study

According to project team knowledge and after reviewing and contacting different agencies in Palestine, there is only one project, which is related to our project entitled "Streets Network for Hebron City ", done by Musa'b Shain and Eyed Abu Isneineh as an under graduated project in the Department of Geomantic and Survey Engineering at PPU the project was done using Arc view 3.2 software.

1.7 Organization of the Project

Chapter One (Introduction)

This chapter covers general background, objectives, literature study and importance of this project.

Chapter Two (Geographic Information System)

This chapter covers the important of GIS and its applications.

Chapter Three (Geometric Network and Network Analyst in ArcGIS)

This chapter covers the use of Network Analyst Extension and its Application.

Chapter Four (Data Preparation)

This chapter covers all the field works, including field visits, and measurements. It also includes all the office operations and data preparation, like GIS operations, which includes data transfer, digitizing and creating of attributes tables.

Chapter Five (ArcGIS Network Analyst Applications)

This chapter covers the various applications on Dura Street Network database.

Chapter Six (Conclusions and Recommendations)

This chapter states the conclusions and recommendations of this project.

1.8 Time Table

Table (1.1) Project Schedule for Course (1)

Stages	**Week Number**	**Time Frame In Week**														
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Choosing The Project	**2**															
Problem Definition	**3**															
Literature Review	**2**															
Collecting data from Dura Municipality	**3**															
Field Survey	**4**															
Editing Data	**7**															

Table (1.2) Project Schedule for Course (2)

Stages	**Week Number**	**Time Frame In Week**														
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Coding The Streets and Filling the questionnaire	**2**															
Modeling Main Intersections	**3**															
Determining The Operating Speed	**3**															
Updating The Existing Network	**3**															
Writing And Editing The Report	**12**															

CHAPTER TWO

GEOGRAPHIC INFORMATION SYSTEM

This chapter covers the principles of Geographic Information System "GIS" history components and some of GIS applications.

CHAPTER TWO

GEOGRAPHIC INFORMATION SYSTEM

2.1 Introduction

Geographic Information System (GIS) is fundamental set of automated ideas and concepts rooted in over (2500) of exploration and geographic research. The early explorers shared this wonder as they searched for new lands, new people, and new resources.

As more of these lands were discovered, geographers began to use new tools to investigate the spatial distribution of people, plants, animals, and natural resources. They employed new methods of mapping and more efficient ways of examining the maps to that other had produced. Geographic exploration became more than going to new places and describing what explorers saw. Instead, it became a way of trying to decide why the patterns explorers saw existed and what impacts those patterns might have on the health and well-being of both the people and fragile environments in which they dwelled.

Today, with very few exceptions, much of the search has been explored by conventional means. The Machete and the pith helmet have been replaced by satellites and computers. Long, computerized maps and statistical Data-quantitative measures of unexplored terrain have supplanted hazardous journeys through deserts and tropical rainforests. They provide a different window into new worlds as well as old, much as the microscope and the telescope provided new eyes for the biologist and the astronomer.

We can now see deeper and farther than we could before, allowing us to map more of what is present on the landscape and to ask questions that could not have been imagined. Questions of where things were on the earth have been replaced by those that ask why are there and how that knowledge could be applied to predict future distributions and patterns. These predictions allow us to plan for the future, to design our natural and human world for the mutual benefit of both. We are still explorers. But our mission has been an even greater significance than our predecessors' have the ideas and tools you are about to learn are the supplies you will need to be effective in your travels through uncharted before we begin our introduction to the tools of the new explorer, a note of caution is necessary.

Exploration of geographic data, like exploration of unknown regions of the earth, is exciting. It is also filled with much potential danger, with quicksand and rockslides, dangerous and great risks. The greatest risks arise from lack of knowledge of what these hazards might be and how to avoid them. Good planning is essential to success of any journey and having the right tools is necessary first step. And like the explorers of old, having access to the tools is not enough. Nor is it enough to know how to use the tools.

2.2 History of GIS

The Canadian government built the first GIS, during the 1960s to analyze data collected by the Canada Land Inventory. Other governments and university laboratories soon built similar systems. However, GIS systems were not widely used until the late 1970s, when technological improvements and lower costs made computers widely available. GIS sales boomed during the 1980s, as governments and businesses found more uses for the systems. A number of companies began producing new GIS software to program computer systems to increase their functions. By the early 1990s, about 100,000 GIS systems were in operation, And with more developments, many versions and many packages related to GIS appears to be applied in cartography field, such as ArcView 2.3, ArcView 2.3a, ArcView 8, and other powerful packages different in tools and menus but have the same principals like ArcInfo, Geomedia, or ArcGIS, ArcTools…etc .

2.3 Definition of GIS

A Geographical Information System (GIS) is a computer package capable of handling spatial data in the form of digital maps and information about places. An individual using a GIS can ask questions of the data related to a map, search for patterns and distributions and investigate the links between different sets of data. A GIS can carry out complex calculations and data mapping quickly and efficiently and even create - new data.

GIS is best defined by the type of questions it can answer:

- Location - What is at a given location?
- Condition - Where does something occur?
- Trends - What has changed since …?
- Patterns - What spatial patterns exist?
- Modeling - What if …?

Many computer programs or drafting packages can handle simple geographic or spatial data, but this doesn't make them a GIS. A true GIS links spatial data with geographic information about a particular feature on a map. In short, a GIS doesn't hold maps or pictures - it holds a database. The database concept is central to a GIS and is the main difference between a GIS and other computer mapping packages.

GIS packages vary considerably from those which are capable of displaying data on a map according to a query on a database, to more complex GIS applications which have more advanced relational database and mapping facilities. Such GIS systems are often employed by utility companies and planning departments and are capable of for example determining the suitability of sites for development, evaluating environmental impacts or identifying the best location for a new facility as well as many other uses.

2.4 Components of GIS

A working GIS integrates five key components: hardware, software, data, people and methods, fig (2.1).

Figure (2.1): GIS Main Components

Hardware:

Hardware is the computer on which a GIS operates. Today, GIS software runs on a wide range of hardware types, from centralized computer servers to desktop computers used in stand-alone or networked configurations.

Software:

GIS software provides the functions and tools needed to store, analyze, and display geographic information. Key software components are:

1. Tools for the input and manipulation of geographic information.
2. A database management system (DBMS).
3. Tools that support geographic query, analysis, and visualization.

Data:

Possibly the most important component of a GIS is the data. Geographic data and related tabular data can be collected in-house or purchased from a commercial data provider. A GIS will integrate spatial data with other data resources and can even use a DBMS, used by most organizations to organize and maintain their data, to manage spatial data.

People:

GIS technology is of limited value without the people who manage the system and develop plans for applying it to real-world problems, GIS users range from technical specialists who design and maintain the system to those who use it to help them perform their everyday work.

Methods:

A successful GIS operates according to a well-designed plan and business rules, which are the models and operating practices unique to each organization.

2.5 GIS Applications

Many GIS databases consist of sets of information called layers. Each layer represents a particular type of geographic data. For example, one layer may include information on the streets in an area. Another layer may contain information on the soil in that area, while another records elevation.

The GIS can combine these layers into one image, showing how the streets, soil, and elevation relate to one another. A GIS database can include as many as (100) layers.

Engineers might use this image to determine whether a particular part of a street is more likely to crumble.

The applications of a GIS are vast and continue to grow. By using a GIS, scientists can research changes in the environment; engineers can design road systems; electrical companies can manage their complex networks of power lines; governments can track the uses of land; and fire and police departments can plan emergency routes. Many private businesses have begun to use a GIS to plan and improve their services.

CHAPTER THREE

GEOMETRIC NETWORK AND NETWORK ANALYST IN ArcGIS SOFTWARE

3.1 What is a Network?

3.2 What can you do with Networks in ArcGIS?

3.3 Geometric Network?

3.4 Network Analyst

This chapter describes and explores the different components of the Geometric Network and Network Analyst Extension.

CHAPTER THREE

GEOMETRIC NETWORK AND NETWORK ANALYST IN ArcGIS

The economic foundation of the modern world is its infrastructure; the collection of streets, pipelines, and wires that enable the movement of energy, commodities, and information. This infrastructure can be modeled as networks. ArcGIS provides a complete model for capturing, storing, and analyzing networks.

3.1 What is a Network?

Networks consist of two fundamental components: edges and junctions, Edges connect to each other at junctions; the flow from edges in the network is transferred to other edges through junctions.

3. 2 What can you do with Networks in ArcGIS?

ArcGIS provides a rich set of tools that allow you to perform many common network analysis tasks on your networks. Some of the common types of analyses that you can perform on your network using Arc Map are:

1. Trouble call analysis: determines the likely cause of a problem based on the location of customers with service problems.
2. Isolation traces: determines which switches have to be opened in order to cut power to a part of the network.
3. Contaminant tracing: determines whether a particular site is a possible cause of contamination.

3. 3 Geometric Network?

Feature classes can participate together in a network. the features have geometry and can be mapped, such a network is called a geometric network. A geometric network, besides containing the connectivity information between edges and junctions, also defines rules of behavior, such as what classes of edges can connect to a particular class of junction or at what class of junction two classes of edges must connect.

3.3.1 Creating a Geometric Network

To create a geometric network, you use a wizard to specify which feature classes will participate in the network. Once the network is created, it is maintained throughout the life cycle of the database. ArcGIS maintains the connectivity information whenever you edit the participating feature classes, based on the connectivity rules and relationships that you define in the geodatabase.

3.3.2 Tools for Analyzing and Building Networks

ArcGIS includes a variety of tools for analyzing networks and a rich set of objects for building custom networks with complex behavior.

3.3.3 Connecting and Disconnecting Network Features

In some cases, you may wish to disconnect a feature from the network. Disconnecting a feature does not delete it from the database; it removes the topological associations it has to other features in the network. Similarly, connecting a feature to the network creates topological relationships between the feature and its neighboring features.

3.3.4 Enabling and Disabling Features

Any feature in a geometric network can be enabled or disabled. By default, all features in a geometric network are enabled when you create the network. Disabling features lets you treat features as if they were disconnected from the network without actually removing the topological connections that they have to other features in the network.

3.3.5 Utility Network Analyst Toolbar

In order to use ArcMap to analyze your networks, you must load the Utility Network Analyst toolbar. This toolbar contains most of the tools needed to perform the analysis tasks, fig (3.1).

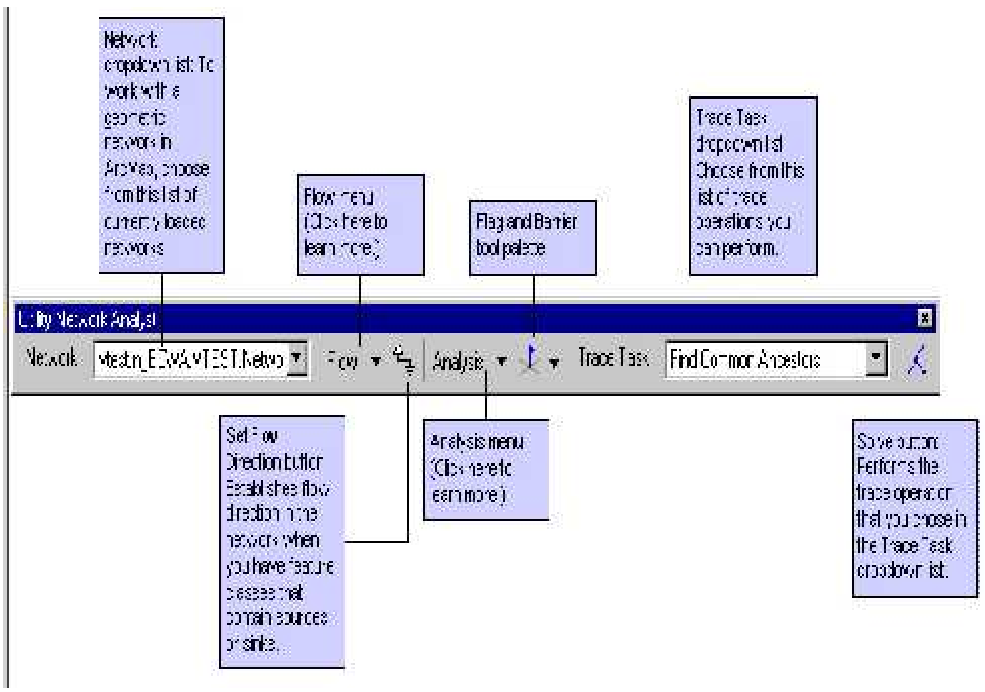


Figure (3.1): Utility Network Analyst Tool Bar

3.4 Network Analyst

3.4.1Types of networks

A network is a system of interconnected elements, such as lines connecting points. Examples of networks include highways connecting to cities, streets interconnected to each other at street intersections, and sewer and water lines that connect to houses.

Connectivity is inherently important in order to travel over the network. Network elements, such as edges (lines) and junctions (points), must be interconnected to allow navigation over the network. Additionally, these elements have properties that control navigation on the network.

In GIS, networks are widely used for two kinds of modeling—transportation and utility network modeling.

3.4.2 Transportation network

Transportation networks are undirected networks. This means that although an edge on a network may have a direction assigned to it, the agent (the person or resource being transported) is free to decide the direction, speed, and destination of traversal. For example, a person in a car traveling on a street can choose which street to turn onto, when to stop, and which direction to drive. Restrictions imposed on a network, such as one-way streets or "no U-turn allowed", are guidelines for the agent to follow. This is in stark contrast to the utility network.

In ArcGIS, transportation networks are modeled using network datasets.

3.4.3 Utility network

A utility network is directed. This means the agent (for example, water, sewage, or electricity) flows along the network based upon certain rules built into the network. The path that the water will take is predetermined. It can be changed, but not by the agent. The engineer controlling the network can change the rules of the network by opening some valves and closing others to change the direction of the network.

3.4.4 Network Analyst toolbar

The Network Analyst toolbar provides you the commands for creating new analysis layers, tools for working with those analysis layers, and tools to work with and build network datasets.

- The Network Analyst dropdown menu provides you with commands for creating new analysis layers for route, service area, closest facility, or origin-destination cost matrices.

- You can open or close the Network Analyst Window with the Network Analyst Window button, and show directions with the Directions button.
- You can create new network locations for use in network analysis with the Create Network Location tool.
- You can select or move network locations using the Select/Move Network Location tool.
- You can compute the analysis using the Solve command.
- You can choose the network dataset you want to work with, as well as the command to build the network dataset, and there is a tool that allows you to browse through the sources along a network dataset.

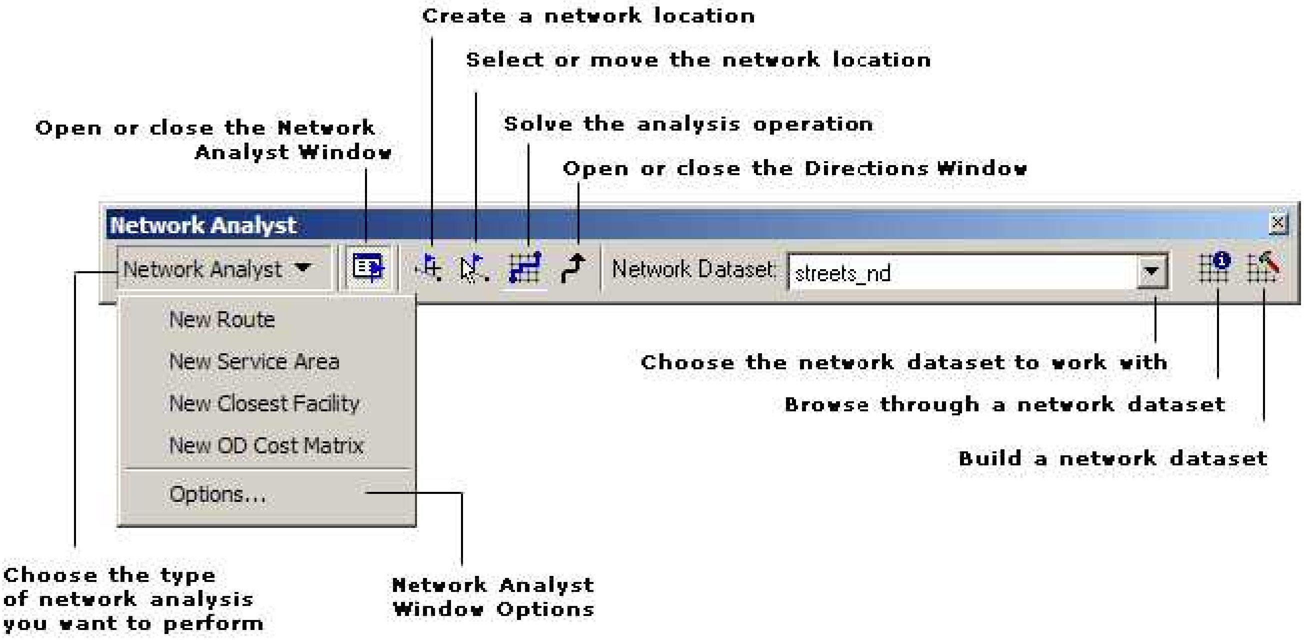


Figure (3.2): Network Analyst tool bar

3.4.5 Network Analyst Tools toolbox

Network Analyst uses the standard ArcGIS geoprocessing interface. Any tool from the Network Analyst Tools toolbox can be used in a model. Additionally, these tools are available in the geoprocessing scripting environments, such as Python, JavaScript, and VBScript. You can run these tools and models from Arc Toolbox. Alternatively, you can access these tools from the command line window.

The following tables list the tools available in the Network Analyst toolbox and provide a brief description of each.

Analysis toolset Tool	**Description**
Add Field To Analysis Layer	Adds a field to a network analysis layer.
Add Locations	Adds network locations to a network analysis layer.
Calculate Location Fields	Calculates network location fields for a point feature class.
Directions	Generates direction information for a network analysis layer with routes. The direction information is written to a file in either XML or text format.
Make Closest Facility Layer	Creates a closest facility network analysis layer and sets its navigation properties.
Make OD Cost Matrix Layer	Finds the shortest paths for origin–destination pairs and records the impedance and other accumulated attributes.
Make Route Layer	Creates a route network analysis layer and sets its navigation properties.
Make Service Area Layer	Creates a service area network analysis layer and sets its navigation properties.
Solve	Performs the analysis appropriate to the network analysis layer on which it is executed.

Table(3.1): Analysis toolset Tool and its Description

Network Dataset toolset Tool	**Description**
Build Network	Reconstructs the network connectivity and attribute information.

Table(3.2): Network Dataset toolset Tool and its Description

Turn Feature Class toolset Tool	**Description**
Create Turn Feature Class	Creates a new turn feature class.
Increase Maximum Edges	Increases the maximum number of edges in a turn feature class.
Populate Alternate ID Fields	Creates and populates additional fields on the turn feature class or classes in a network dataset that reference the edges by alternate IDs.
Turn Table To Turn Feature Class	Converts an ArcView GIS turn table or Arc Info Workstation coverage turn table to an ArcGIS turn feature class.
Update by Alternate ID Fields	Updates all the edge references in each turn feature class in a network dataset using an alternate ID field.
Update by Geometry	Updates all the edge references in the turn table using the geometry of the feature.

Table(3.3): Turn Feature Class toolset Tool and its Description

3.4.6 Network Analyst Window

The Network Analyst Window is designed to help users quickly and easily manage their network analysis layers and the network analysis classes (containing network locations and results). This is a dockable window in ArcGIS.

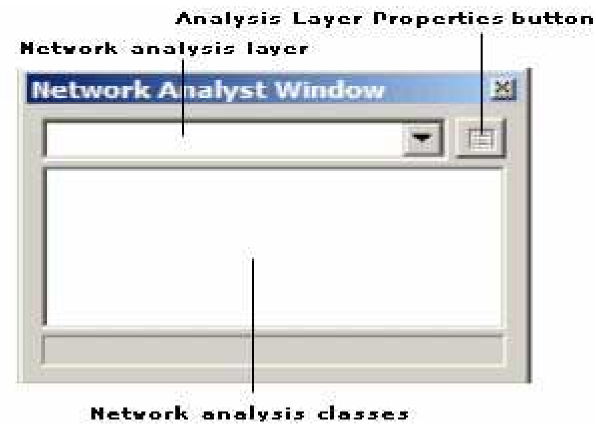


Figure (3.3): Network Analyst window

When a network analysis problem is selected, the network analysis layer is added to the Network Analyst Window. The Analysis Layer Properties button is enabled, and the network analysis classes relevant to the analysis are loaded.

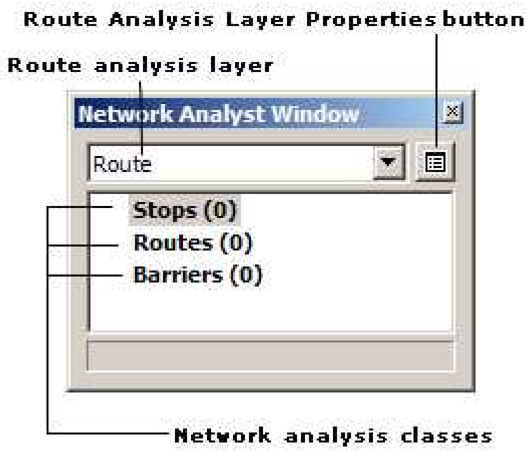


Figure (3.4): Network Analyst window for Route analysis layer

3.4.7 Network elements

Network datasets are made of network elements. Network elements are generated from the sources used to create the network dataset. The geometry of the source features is used to establish connectivity. In addition, network elements have attributes that control navigation over the network.

There are three kinds of network elements: edges, junctions, and turns. Edges are elements that connect to other elements (junctions) and are the links over which resources flow. Junctions connect edges and facilitate navigation from one edge to another. Turn elements record information about movement between two or more edges.

Edges and junctions form the basic structure of any network. Connectivity in a network deals with connecting edges and junctions to each other. Turns are optional elements that store information about a particular turning movement; for instance, a left turn is restricted from one particular edge to another.

3.4.8 Network sources

There are three types of network sources that participate in the creation of a network dataset: edge feature sources, junction feature sources, and turn feature sources. Line feature classes participate as edge feature sources. Point feature classes participate as junction feature sources. Turn feature classes participate as turn feature sources in a network. A turn feature source explicitly models a subset of possible transitions between edge elements during navigation.

Each feature class that participates in a network as a source generates elements based on its assigned role. For example, a line feature class is used as a source for edge elements, and a point feature class is used to generate junction elements. Turn elements are created from a turn feature class. The generated junction, edge, and turn elements form the underlying graph, which is the network.

Geometric network feature classes cannot participate as network dataset sources because they are actively linked to a geometric network. Feature classes that participate as a source in a network dataset can participate in a topology.

Consider the example of a simple transportation network and the sources that participate in its creation. This network has a streets feature class that can act as an edge source, a street intersections feature class acting as a junction source, additional line feature classes that act as edges (rail lines, bus routes), and point feature classes that act as junctions (rail stations and bus stations).

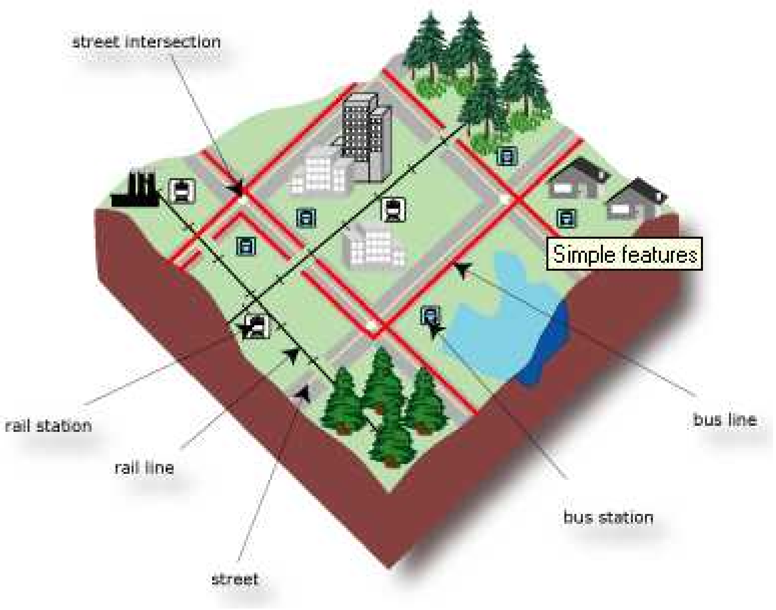


Figure (3.5): Streets Intersections

All feature classes that reside in the feature dataset, which contains the network dataset, can participate as network sources. Only two sources can participate in a shapefile network dataset—a line shapefile and a shapefile turn feature class.

3.4.9 Types of evaluators used by a network

Each attribute defined in the network must have values for each source participating in the network. An evaluator assigns values for the attribute of each source. In ArcView GIS and ARC/INFO, values for attributes were assigned from a field in the shapefile or coverage. In ArcGIS, the field evaluator assigns values to a network attribute from a field for each network source. In addition, there are other types of evaluators that can be used, for instance, constants, field expressions, or VBScript.

The four types of evaluators are described below.

Field evaluator—The most common way to assign values for a network attribute is by identifying a single field that will be used to evaluate the network attribute when the network dataset is built.

For example, a field evaluator may be used in cases where the value describes a measurement, such as meters.

Field expression evaluator—The field evaluator can be modified to take a field expression as the value instead of a single field. In this case, you'll build an expression on the Field Evaluator dialog box. For example, if the units of the network attribute are in meters but the units of source data are in feet, you can create an expression to translate the feet into meters when the network dataset is built.

Constant evaluators—Attributes can be assigned a constant value. The value can be numeric (0, 1, 2) for cost, descriptor, and hierarchy attributes, or a Boolean expression (Traversable or Restricted) for a restriction attribute.

VBScript evaluator—Attributes can be assigned from the result of the execution of VBScript. This provides a way to model complex attributes. Unlike other evaluators, the VBScript evaluator does not assign values when a network is built. Instead, it assigns values when a particular network analysis requires the use of that attribute. If the values of an attribute change constantly, the use of a

VBScript evaluator can ensure the use of updated attributes for network analysis.

Every junction source requires one evaluator. Every edge source requires two—one for each direction of the edge.

A default evaluator can be assigned for edges, junctions, and turns. If an explicit evaluator is not specified for a particular source, the values for that source are assigned by the default evaluator.

To assign an evaluator to a single source, you will:

1. Select the source for which the evaluator must be assigned.
2. Choose an evaluator type, such as Field, Constant, or VBScript.
3. Select a field from which the values can be assigned for the network attribute.

If the values are derived from a field, the field will be selected from a dropdown menu. If the values are to be calculated based on a field expression, set evaluator type as Field and press F12 on your keyboard to bring up the Field Evaluators dialog box. Alternatively, you can right-click the source on the Evaluators dialog box and choose Properties from the Value menu to open the Field Evaluators dialog box.

3.4.10 Cost

Certain attributes are used to measure and model impedances, such as travel time (transit time on a street) or demand (the volume of garbage picked up on a street). These attributes are apportioned able along an edge; that is, they are divided proportionately along the length of an edge. For example, if travel time is modeled as a cost attribute, then traversing half an edge will take half the time as traversing the whole edge. This means that if the travel time to traverse the edge is 3 minutes, it takes 1.5 minutes to traverse half the edge. If you are looking for a 1.5-minute route along this edge, the route feature will be created from the first half of the edge feature.

Network analysis often involves the minimization of a cost (also known as impedance) during the calculation of a path (also known as finding the best route). Common examples include finding the fastest route (minimizing travel time) or the shortest route (minimizing distance). Travel time (drive time, pedestrian time) and distance (meters) are also cost attributes of the network dataset.

3.4.11 Descriptors

Descriptors are attributes that describe characteristics of the network or its elements. Unlike costs, descriptors are not apportioned. This means that the value does not depend on the length of the edge element. For example, the number of lanes is an example of a descriptor on a street network. Speed limit of streets is another descriptor attribute for a street network. Although it is not a cost attribute and cannot be used as impedance, it can be used in conjunction with distance to create a cost attribute (for example, drive time) that can be used as impedance.

3.4.12 Restrictions

Restrictions can be identified for particular elements, such that during an analysis, restricted elements cannot be traversed. For example, one-way streets can be modeled with a restriction attribute, so they can only be traversed from one end to another and not in the reverse direction. In all cases, a restriction attribute is defined using a Boolean data type.

In another example, certain sources where pedestrians are not allowed could be restricted using the attribute No Pedestrians. In this case, the restriction can be used as a parameter during best route analysis to ensure the pedestrian does not use streets that are restricted.

3.4.13 Evaluator examples

3.4.13.1 Assigning values to cost attributes

For the network attribute Drive time, the evaluator for the streets network source is a field type. The field FT_Minutes contains values for the network attribute in the from–to direction for the streets source. Similarly, values for the to–from direction of the streets source are assigned from the field TF_Minutes.
In this example, the other edge sources in this network are transit edges and do not have a drive time. Hence, they can be assigned a constant value of -1.

Source	Direction	Element	Type	Value
Metro_Lines	From-To	Edge	Constant	-1
Metro_Lines	To-From	Edge	Constant	-1
Streets	From-To	Edge	Field	FT_Minutes
Streets	To-From	Edge	Field	TF_Minutes
Transfer_Stations	From-To	Edge	Constant	-1
Transfer_Stations	To-From	Edge	Constant	-1
Transfer_Street_Station	From-To	Edge	Constant	-1
Transfer_Street_Station	To-From	Edge	Constant	-1
Metro_Entrances		Junction		
Metro_Stations		Junction		
ParisNet_Junctions		Junction		

Table(3.4): Assigning cost attribute

3.4.13.2 Assigning values to restrictions

Restriction attributes have a Boolean data type. Since a source element can be either restricted or traversable, it can be assigned a constant (restricted or traversable).

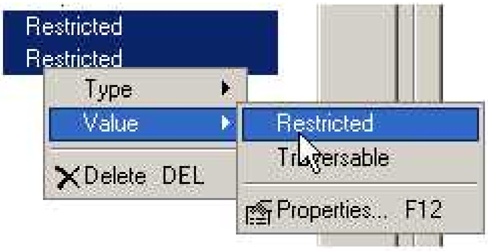


Figure (3.6): The traversable window

Alternatively, restriction attributes can be assigned from a field in the source feature class. For example, you can use a field expression evaluator to generate Boolean results—if the expression is true, the element is restricted; if not, it is traversable. When a network dataset is created, Network Analyst searches through all sources for commonly used fields, such as One way. If it finds a One way field in any source, it creates a One way network attribute, and assigns values for the relevant source based on the field expression shown below.

3.4.13.3 Assigning hierarchies

Hierarchy in a network dataset can be assigned typically via a field evaluator. If the Streets feature class has a road class attribute (Hierarchy) with values 1, 2, and 3—possibly representing interstates, major roads, and minor roads—the hierarchy attribute can be set using the field evaluator.

Source	Direction	Element	Type	Value
Metrolines	From-To	Edge		
Metrolines	To-From	Edge		
Streets	From-To	Edge	Field	Hierarchy
Streets	To-From	Edge	Field	Hierarchy

Table(3.5): Assigning hierarchies

3.4.14 Turns in the network dataset

Turns can be made at any junction where edges connect. There are n^2 possible turns at every network junction, where n is the number of edges connected at that junction. Even at a junction with a single edge, it is possible to make one U-turn.

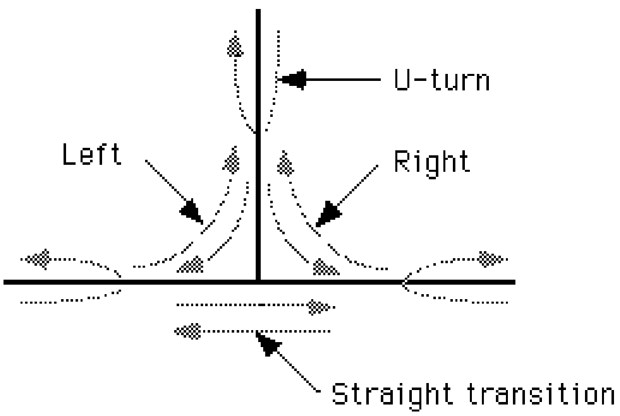


Figure (3.7): Directions of the U-turn

Turn features are stored in a turn feature class. You can create turn data in either a geodatabase feature class or a shapefile. To edit turn features, the turn feature class must participate in a network dataset.

* **Create features representing U-turns**

To create a new U-turn feature, you will click at three locations along the line feature representing the edge where the U-turn occurs.

1. Click somewhere along the length of the line feature.
2. Click at the end of the line feature where the U-turn occurs.
3. Double-click along the length of the same line feature to finish the sketch.

   The field values specific to the turn feature should be filled in automatically.

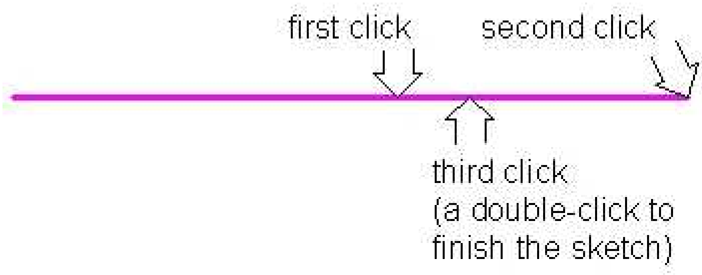


Figure (3.8): Creating features representing U-turn

3.4.15 Setting directions

The minimum requirements for a network dataset to support directions are:

- a length attribute with length units
- at least one edge source
- at least one text field on the edge source

The directions generated when a route is computed are customizable at the network dataset level. This means that the street names used for reporting directions, shields, and boundary information are stored with the network dataset schema. These settings can be modified by the users to customize the directions.

3.4.15.1 Directions attributes

The units used to report directions can be modified on the General tab.
The Display Length Units are the units used to report the length. For example, if miles were chosen, all directions generated for this network dataset would be reported in miles. ArcGIS Network Analyst supports the following five length units: feet, kilometers, meters, miles, and yards.

The Length Attribute is used to calculate the length of each segment of the route for which the directions are reported. Any cost attribute can be selected as the length attribute. ArcGIS automatically searches through the network attributes and tries to assign the relevant cost attribute.
The Time Attribute is used to calculate the time taken to traverse each segment during the reporting of directions.

3.4.15.2 Street name fields

Street name fields can be set up for each edge source in the network. These are the names that are used to report directions. For instance, the name of the street (First Ave) is obtained from this field to report directions, such as, "Turn left onto First Ave." The Name column displays a dropdown list of text fields for the source, from which a street name field can be chosen.
Some feature classes have directional modifiers (N or S) and street types (Ave, St, or Dr) in separate fields. In such cases, the entire street name resides in the three different fields.
Some feature classes have alternate names of streets listed in different fields. These can be set up by increasing the Number of Alternate Names and setting up the Name field along with the optional Prefix and Suffix fields (as described above).

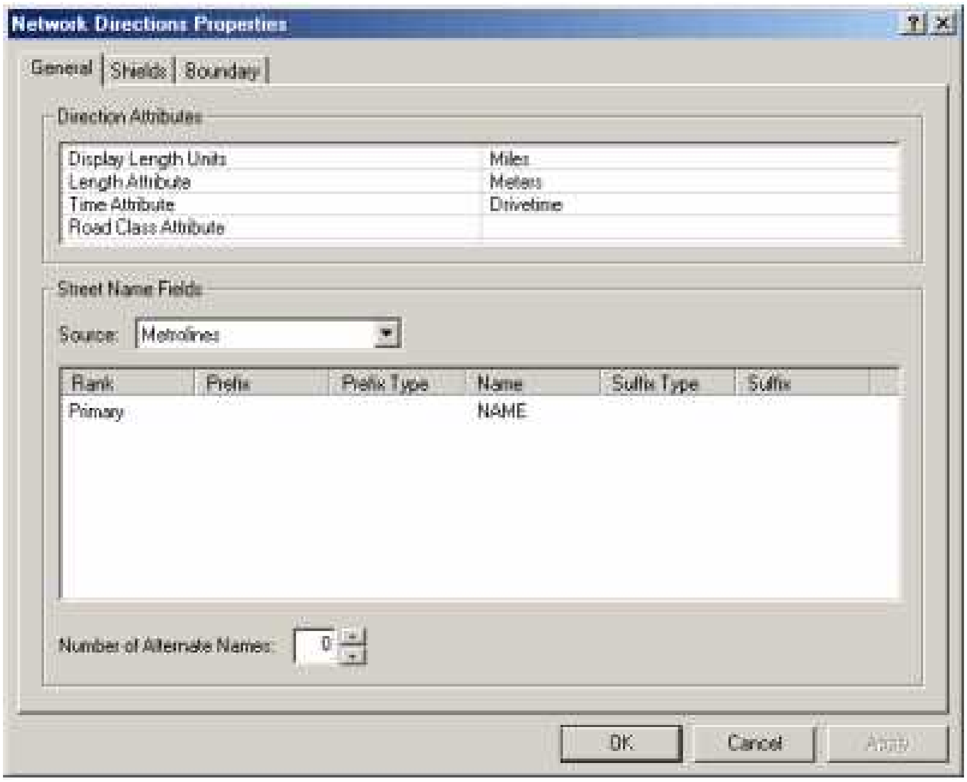


Figure (3.9): Network Direction properties

3.4.15.3 Shields

Shields are signs that display highway numbers. Some edge sources have shield information (for example, I-15, CA-72, or OH-10) that can be used to report directions. For instance, if you have a freeways source that has interstates and state highways, the road shield descriptions can be specified for this source. For example, the Santa Ana Freeway has a shield description of I-5. Both the street name field (which contains Santa Ana Freeway) and the road description field (I-5) can be used to report directions.

Some sources have road shield descriptions in one field (I-10 or CA-63). In such a case, choose Single Field and choose the field containing road shield descriptions.

A source can also have shield descriptions in two fields—one is the shield type (containing values such as, I, CA or TN) and the other is the number (5 or 43). Together, they give the complete road shield description.
Optionally, the shield type (I, CA, or TN) can be associated with shield descriptions (Interstate, California, or Tennessee). This would result in directions, such as "Take Interstate 10 for 155 miles".

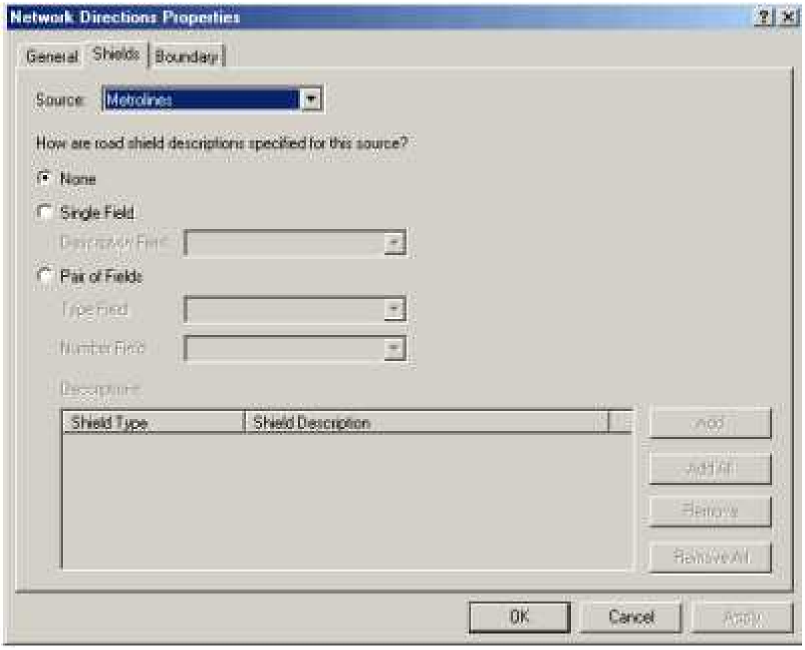


Figure (3.10): Sources of the Network Direction properties

3.4.15.4 Boundary

Some edge sources have a boundary field that denotes what region they are in. For instance, a highway source may have a State field that denotes in what state the segment of highway is. This is useful in generating directions, such as "Entering California".
You can choose any text field in the Boundary Field column. While generating directions, any change in the value of the boundary field is reported. This means if

you start in Nevada and continue south on I-15, when you reach California, the Boundary Field will show the value "Entering California".

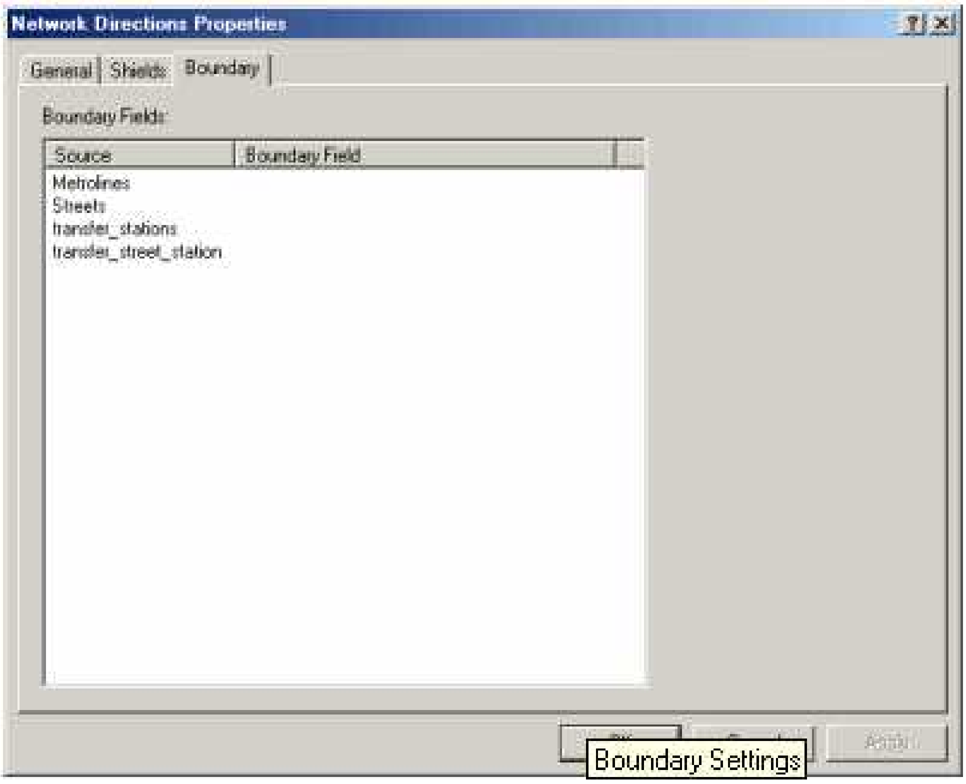


Figure (3.11): Network Direction properties for boundaries

3.4.16 Designing the network dataset

To model transportation networks, a network dataset must be thoughtfully designed. You can achieve this by following the four-step process discussed below.

Step 1: Select the source workspace

A network dataset can be created within a geodatabase or shapefile workspace, or it can reside in an SDC dataset. A shapefile network dataset supports one edge source, while a geodatabase network supports multiple edge and junction sources. An SDC dataset is a highly compressed countrywide street network that can be used for network analysis.

- If you want to model multimodal networks, create your network dataset in a geodatabase workspace. If you have multiple sources that connect to each other using sophisticated connectivity rules, the network dataset should be created in a geodatabase workspace.
- If you have a single edge source in shapefile format that you want to use for quick and simple network analysis, create a shapefile network dataset.
- If you have purchased data from a GIS data vendor in SDC format, you can directly use SDC data for network analysis.

Step 2: Identify the sources and the role they will play in the network

- A shapefile network dataset is composed of an edge source and an optional turn source. Geodatabase feature classes that are present in the same feature dataset as the network can participate as sources in the network. It is, therefore, important to identify which of those will participate as network sources.
- If the network dataset supports turns, the turn feature class or classes that will be used need to be identified. If your turns are stored as ARC/INFO or ArcView GIS turn tables, you can migrate your turn data to turn feature classes.

Step 3: Model connectivity

Connectivity can be established for a network dataset using the ArcGIS Connectivity model in conjunction with the elevation field model.

- It is important to study the network and determine how the different elements will connect to each other.

- You should design your connectivity concept before creating a network dataset.
- A multimodal network requires multiple connectivity groups and the presence of transfer junctions in each connectivity group.
- The elevation field model can be used to enhance the connectivity of the network, if there is elevation field data available.
- For each edge and junction source, determine the connectivity policy.
- Address special scenarios, such as bridges and tunnels.

Step 4: Define attributes and determine their values

- Identify the impedances to be used during network analysis and determine their values from network sources.
- Determine the restrictions that will be used to control navigation over the network.
- Establish hierarchy (if required) for the edge elements in the network.

3.4.17 Creating a new turn feature

Turn features are stored in a turn feature class. You can create turn data in either a geodatabase feature class or a shapefile. To edit turn features, the turn feature class must participate in a network dataset.

*** Create features representing U-turns**

To create a new U-turn feature, you will click at three locations along the line feature representing the edge where the U-turn occurs.

4. Click somewhere along the length of the line feature.
5. Click at the end of the line feature where the U-turn occurs.
6. Double-click along the length of the same line feature to finish the sketch.

The field values specific to the turn feature should be filled in automatically.

CHAPTER FOUR

DATA PREPARATION

4.1 Overview

4.2 Dura Municipality Streets Data.

4.3 Dura Network Attributes Tables

4.5 Creating a network dataset for Dura Streets Network in ArcGIS software

This chapter covers all the field works, including field visits, and measurements. It also includes all the office operations and data preparation, like GIS operations, which includes data transfer, digitizing and creating of attributes tables.

CHAPTER FOUR

DATA PREPARATION

4.1 Overview

The nature of network analysis project in general contains field work followed by observations, analysis and assessment process "office work".

This project include, several operation's that were made officially starting with obtaining street data from Dura Municipality, drawing of street centerline, determination of street flow direction, speeds on street, street junctions, creating network table's attribute in GIS environment, raw field observation's entrance to the computer, cad drawing, assessments ……est.'s.

4.2 Dura Municipality Streets Data

An AutoCAD drawing file containing the street edges of Dura city were obtained from Engineering Department of Dura Municipality, fig (4.1).

The obtained AutoCAD streets edges were cleaned in ArcGIS environment using Geometric network tools, in which the separate lines of the same street edges were connected and any extra lines were removed.

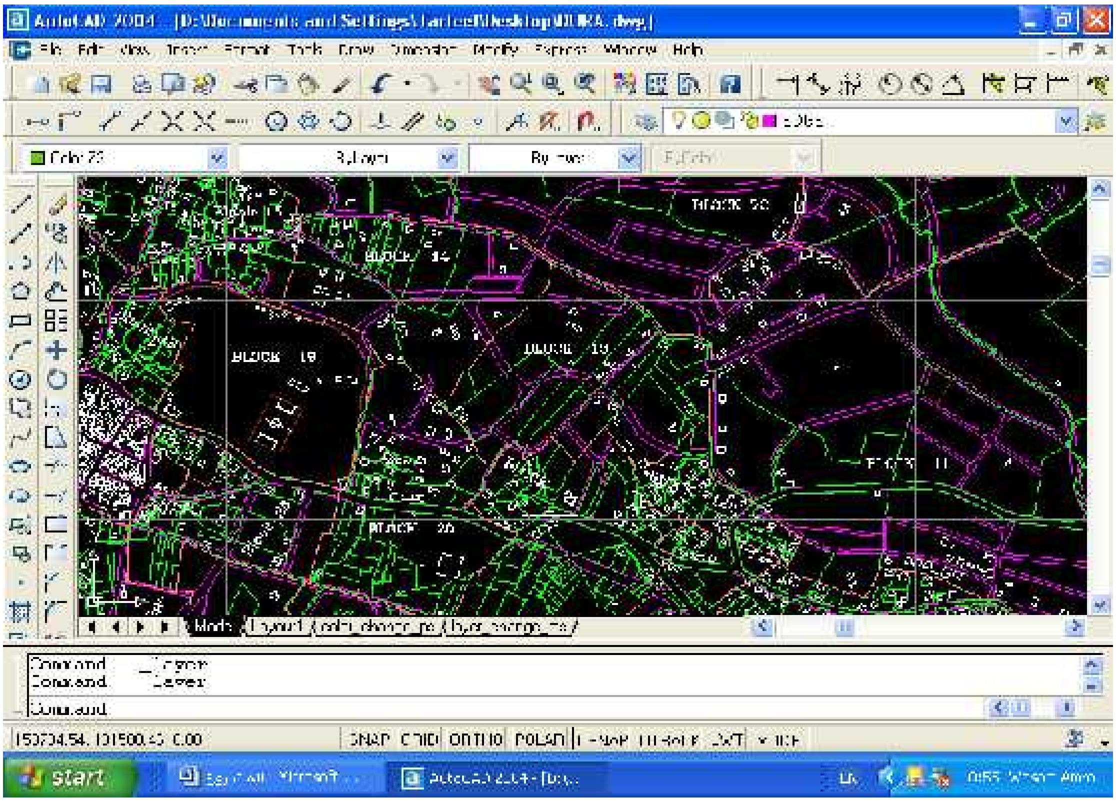


Figure (4.1): AutoCAD file of Dura Master Plan

4.2.1 Streets Centerlines

Centerline definition: A line representing the physical center of a street way between street shoulders, often coinciding with the center painted line dividing bi-directional travel lanes, represents both directions of travel. Limited access interstates, highways, and boulevards divided by concrete barriers or grassy median strips are modeled by two centerlines, one for each direction of travel.

4.2.2 Streets Centerlines Importance

Streets centerlines are a framework layer because they can support address matching ("geo-coding"), transportation modeling, street way management, vehicle routing, and cartography.

Streets centerlines also frequently define boundaries for emergence dispatch service areas, political boundaries, parcels, and zoning, so they are a foundation layer in the geometric construction of other layers.

4.2.3 Drawing Streets Centerlines for Dura City

Street centerline was created at the mid distance between the street two edges using the drawing tools in AutoCAD environment.

Creating Centerlines in AutoCAD Environment

This paragraph describes how to create a centerline of a street has two edges using AutoCAD 2004 software, fig (4.2):

1. Choosing Measure Tool from the tooling bar.
2. Activate the measure distance.
3. Measure the distance between the two edges.
4. Make the offset by the half distance between the two edges.

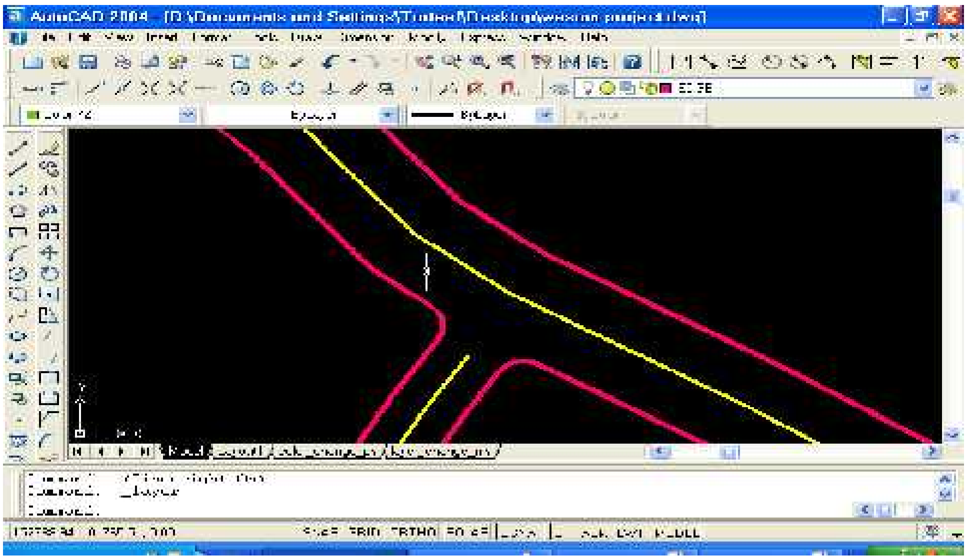
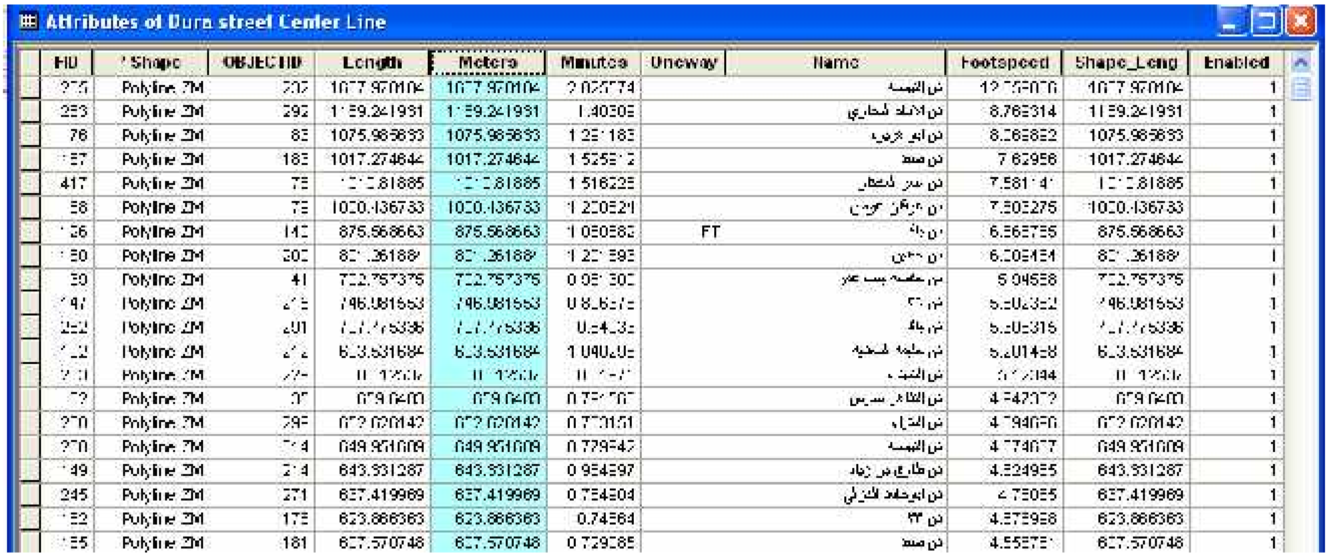


Figure (4.2): Creating Street Center Line

4.3 Dura Network Attribute Table

Network attributes are properties of the network elements that control traversability over the network. Examples of attributes include the time to travel a given length of street, which streets are restricted for which vehicles, the speeds along a given street, and which streets are one-way, Fig(4.3).



Attributes of Dura street Center Line

FID	Shape	OBJECTID	Length	Meters	Minutes	Oneway	Name	Footspeed	Shape_Leng	Enabled
275	Polyline ZM	202	1077.970104	1077.970104	2.025774		[illegible]	[illegible]	1077.970104	1
253	Polyline ZM	292	1159.241991	1159.241991	1.40303		[illegible]	8.763314	1159.241991	1
76	Polyline ZM	83	1075.985693	1075.985693	1.251183		[illegible]	8.263822	1075.985693	1
157	Polyline ZM	183	1017.274644	1017.274644	1.525912		[illegible]	7.62956	1017.274644	1
417	Polyline ZM	75	1010.81885	1010.81885	1.516225		[illegible]	7.581141	1010.81885	1
58	Polyline ZM	73	1020.436733	1020.436733	1.220524		[illegible]	7.303275	1020.436733	1
126	Polyline ZM	140	875.568663	875.568663	1.050582	FT	[illegible]	6.363735	875.568663	1
150	Polyline ZM	200	821.26188	821.26188	1.221393		[illegible]	6.203434	821.26188	1
30	Polyline ZM	41	722.757375	722.757375	0.951300		[illegible]	5.04538	722.757375	1
147	Polyline ZM	[illegible]	746.081553	746.081553	[illegible]		[illegible]	[illegible]	746.081553	1
252	Polyline ZM	201	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	1
[illegible]	Polyline ZM	[illegible]	653.531684	653.531684	1.040205		[illegible]	5.201458	653.531684	1
[illegible]	Polyline ZM	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	1
[illegible]	Polyline ZM	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	1
270	Polyline ZM	[illegible]	[illegible]	[illegible]	0.770151		[illegible]	[illegible]	[illegible]	1
270	Polyline ZM	[illegible]	649.951009	649.951009	[illegible]		[illegible]	[illegible]	649.951009	1
149	Polyline ZM	[illegible]	643.931287	643.931287	0.954397		[illegible]	4.324955	643.931287	1
245	Polyline ZM	271	637.419969	637.419969	0.754304		[illegible]	[illegible]	637.419969	1
152	Polyline ZM	173	623.886363	623.886363	0.74364		[illegible]	4.373958	623.886363	1
155	Polyline ZM	181	627.570748	627.570748	0.729285		[illegible]	[illegible]	627.570748	1

Figure (4.3): Examples of attribute Table .

Network attributes have four basic properties: name, usage type, units, and data type. Additionally, they have a set of assignments defining the values for the elements.

- The usage type specifies how the attribute will be used during analysis, which is identified as a cost, descriptor, restriction, or hierarchy.
- Units of a cost attribute are either distance or time units (for example, centimeters, meters, miles, minutes, and seconds). Descriptors, hierarchies, and restrictions have unknown units.
- Data types can be either Boolean, integer, float, or double. Cost attributes cannot be a Boolean data type.

Restrictions are always Boolean, whereas a hierarchy is always an integer.

Network attributes are created either in the New Network Dataset wizard (when defining a new network) or on the Network Dataset Properties dialog box on the Attributes tab. To create network attributes, first define the name of the attribute, its usage, units, and data type. Next, assign evaluators for each source that will provide the values for the network attribute when the network dataset is built. This is done by selecting the attribute and clicking Evaluators.

4.3.1 Cost For Dura Facility

1. Speed on Streets

The speed of travel of each street within Dura Municipality area were obtained from Dura police center and some information were obtained by distribution of a questionnaire to driving school's and drivers within Dura Municipality area.

The following Table summarizes the speed on a sample of street within Dura Municipality.

Summary of speed on a sample of street within Dura Municipality

No.	Street Name	Speed (Km/h)
1	شارع عمر بن الخطاب	30
2	شارع القدس	50
3	شارع فلسطين	30
4	شارع المدارس	50

Table (4.1) Summary of speed on a sample of street within Dura Municipality

2. Length of Street Segments

The length of the street segments is calculated directly by the ArcGIS software

3. Time Needed for Ambulance to Drive to the Accident Area

Information obtained from the ambulance drivers indicate that the ideal time needed to reach the accident area is 8.30 min

4. Time Needed for Fire cars to reach the accident area

The ideal time needed to drive from Dura Municipality fire station to the accident area is 6 min, as stated by the fire stations employees.

5. The Pharmacy Service Area

100 m is the radius of the pharmacy service area indicated by the Palestinians Pharmacy Association.

6. Schools Service Area

From the international standards and from a (Samer Eissa) graduated project, the ideal service area for schools is found to be 500m.

7. Mosques Service Area

The time for Mosques service area is consider to be 10 min . This time is the time between (AL-AZAN) and the start of the praying.

4.3.2 Add Cost and Restricted Field to Dura Network Attribute Table

To work in network analysis it is important to give each part of the center line its cost (speed) and restrictions (direction) and this need adding field on the attributes table, fig (4.4).

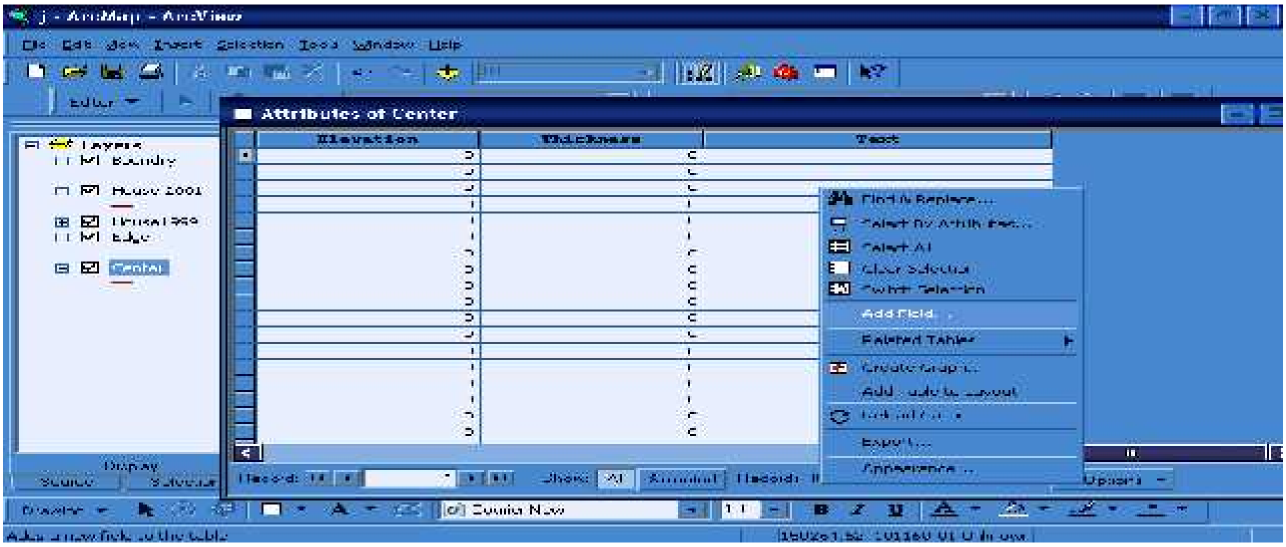


Figure (4.4) : Adding Fields to Attribute Table

The following table summarize the added field, and their properties

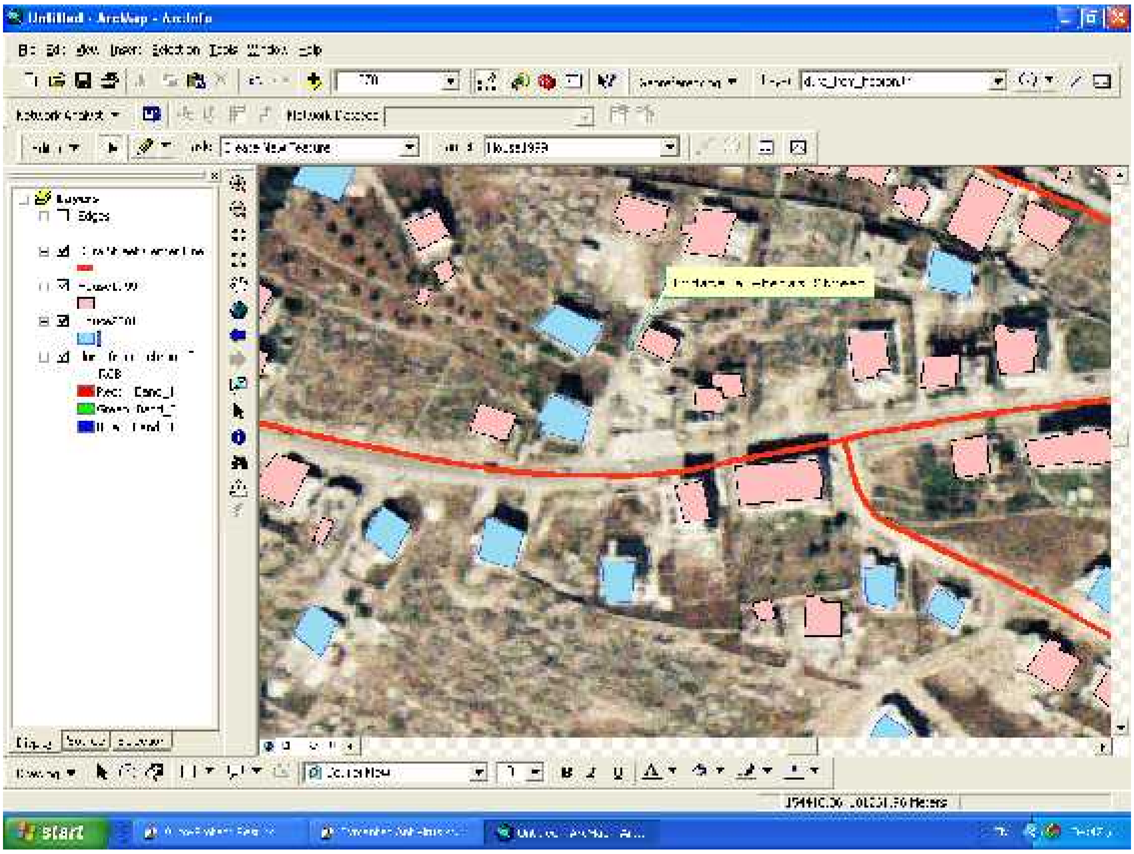
Field	**Format**	**Type**
Meters	Double	Cost
One-way	Text	Restriction
Minutes	Double	Cost
Footspeed	Double	Cost

Table (4.2): Summery of the added field and their properties

4.4 Updating the Dura streets network

Updating the master plan is one of the most important things in many countries. Every country has its philosophy and strategy. We used in this project a recent image for the Dura city to update the streets.

This work is done by ArcGIS package, One of the main roads were added to the network and a hundred of segments were added too.



Figure(4.5): Update of Dura city Street network

4.5 Creating a network dataset for Dura Streets Network in ArcGIS software

1. Right-click the Dura Street Center line.shp, and choose New Network Data set. This shapefile contains street data for Dura city.

2. The name of the network dataset is set to Dura Street Center Line_ND by default, fig(4.6).

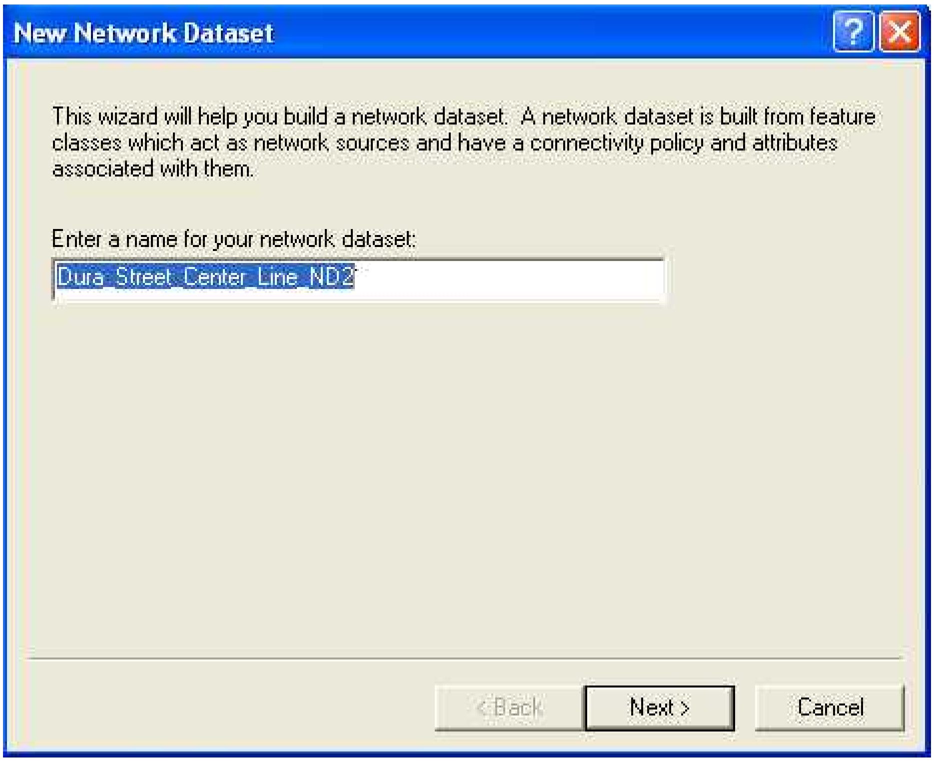


Figure (4.6): Creating Dura Streets Network step 2

Network Connectivity defines how features that participate in a network connect to each other. The default connectivity for a network dataset places all sources in one connectivity group and assigns all edge sources endpoint connectivity. In a shapefile based network there is only one edge source, hence there is no need for multiple connectivity groups. Also, we wish to model streets with end point connectivity.

3. You will accept the default connectivity, (fig 4.7).

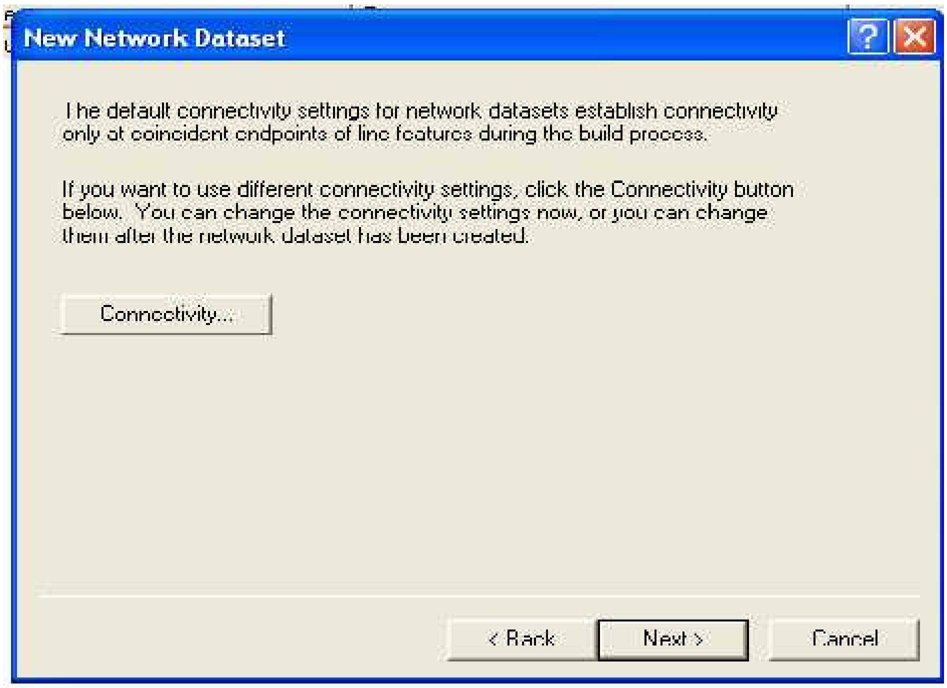


Figure (4.7): Defining Connectivity for Dura Streets Network

Earlier versions of ArcView GIS and ARC/INFO support optional elevation fields to establish connectivity. Each feature in a shape file or coverage would be assigned two Z-elevation values, one for each endpoint. If the endpoints of line features have the same Z-elevation value, connectivity is established. If the values are different, they do not connect.

The elevation field contains logical elevation values for establishing connectivity only and does not provide height information for the feature. ArcGIS Network Analyst can use this data to modify the connectivity settings established in the previous step. ArcGIS Network Analyst automatically searches and maps the relevant fields.

4. Accept the default elevation fields settings. If ArcGIS Network Analyst finds elevation fields data in your shapefile, fig (4.8).

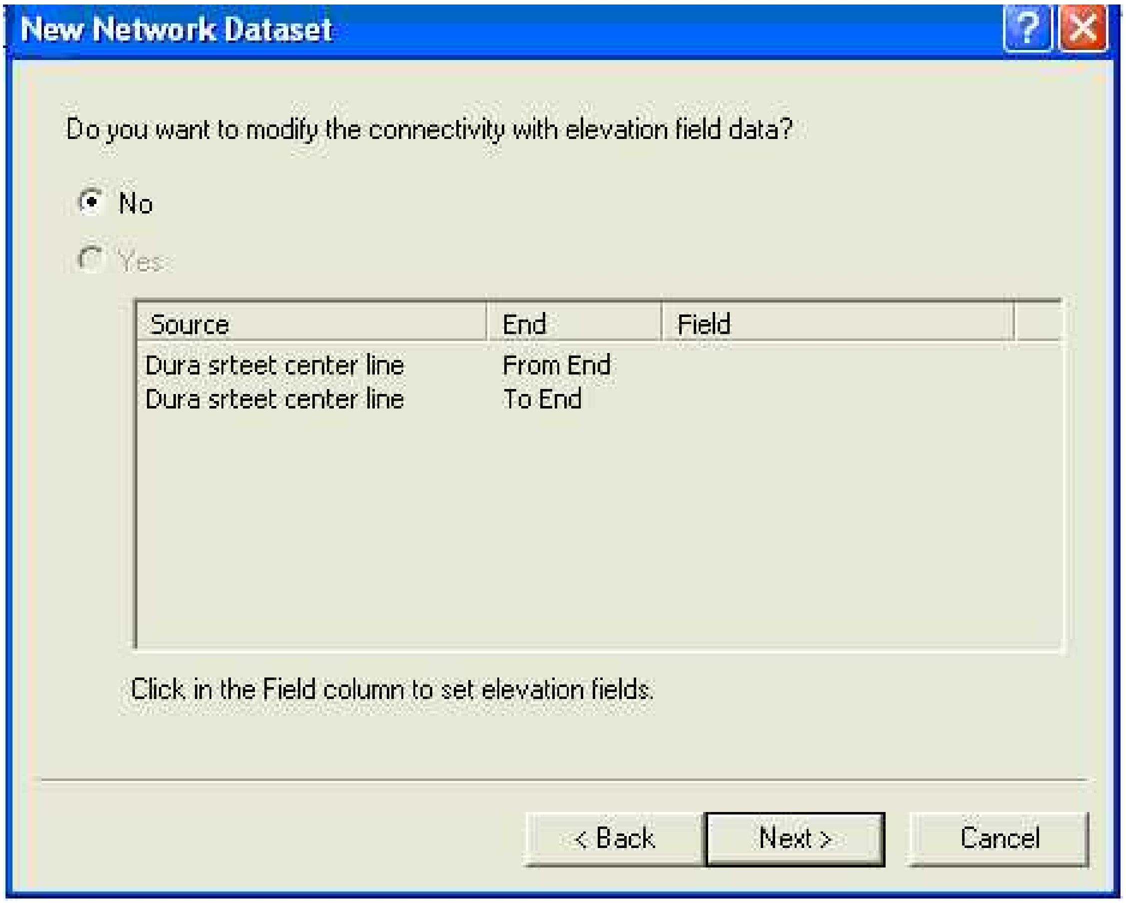


Figure (4.8): Dura Streets Network modify the Connectivity Without Elevation Data

ArcGIS Network Analyst supports turns in a shapefile based network. Turn information (such as turning restrictions and delays) enhance the quality of network analysis. Earlier versions of ARC/INFO and ArcView GIS used turn tables. These turn tables can be converted into turn features and used in the network dataset.

The advantage of Global Turns is that you do not need to create individual turn features for rules that apply to every turn in the network.

5. Click Yes to model turns in the network.

6. Click Next to continue.

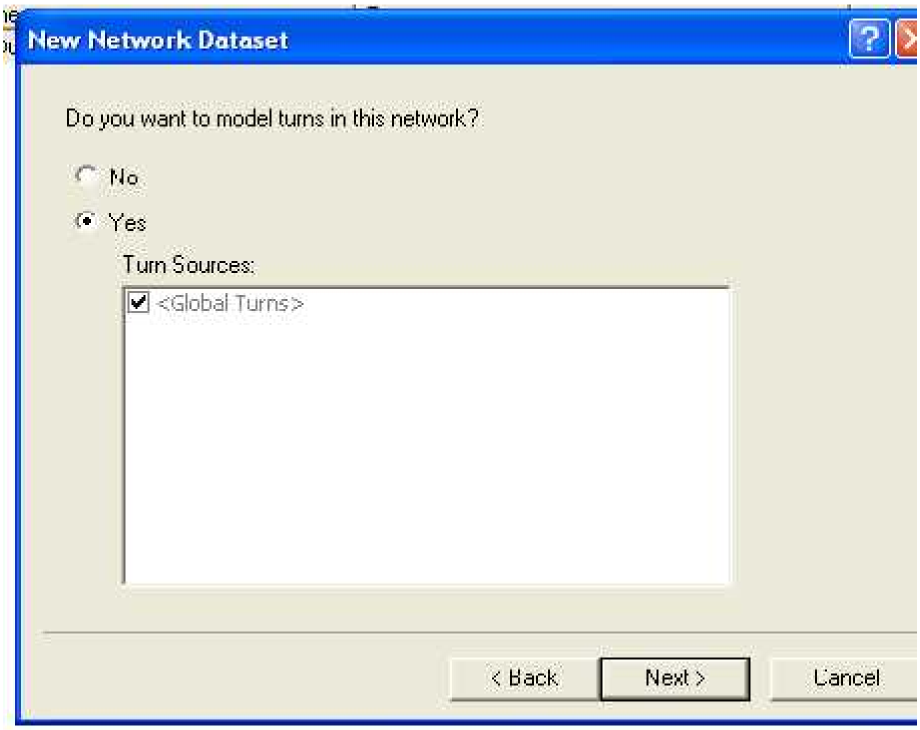


Figure (4.9): Turns modifying in Dura Streets Network

Network attributes are properties of the network that are used to control navigation. Common examples are costs that function as impedances over the network. Restrictions like one-way traversal are also examples of network attributes. The ArcGIS Network Analyst analyzes the source shapefile and looks for common fields like Meters, Minutes, and One-way.

Once it finds these fields, it automatically creates the corresponding network attributes and assigns the respective fields to them. (This can be viewed by clicking the Evaluators button.)

7. Since the attributes are automatically defined and assigned values, click Next to continue.

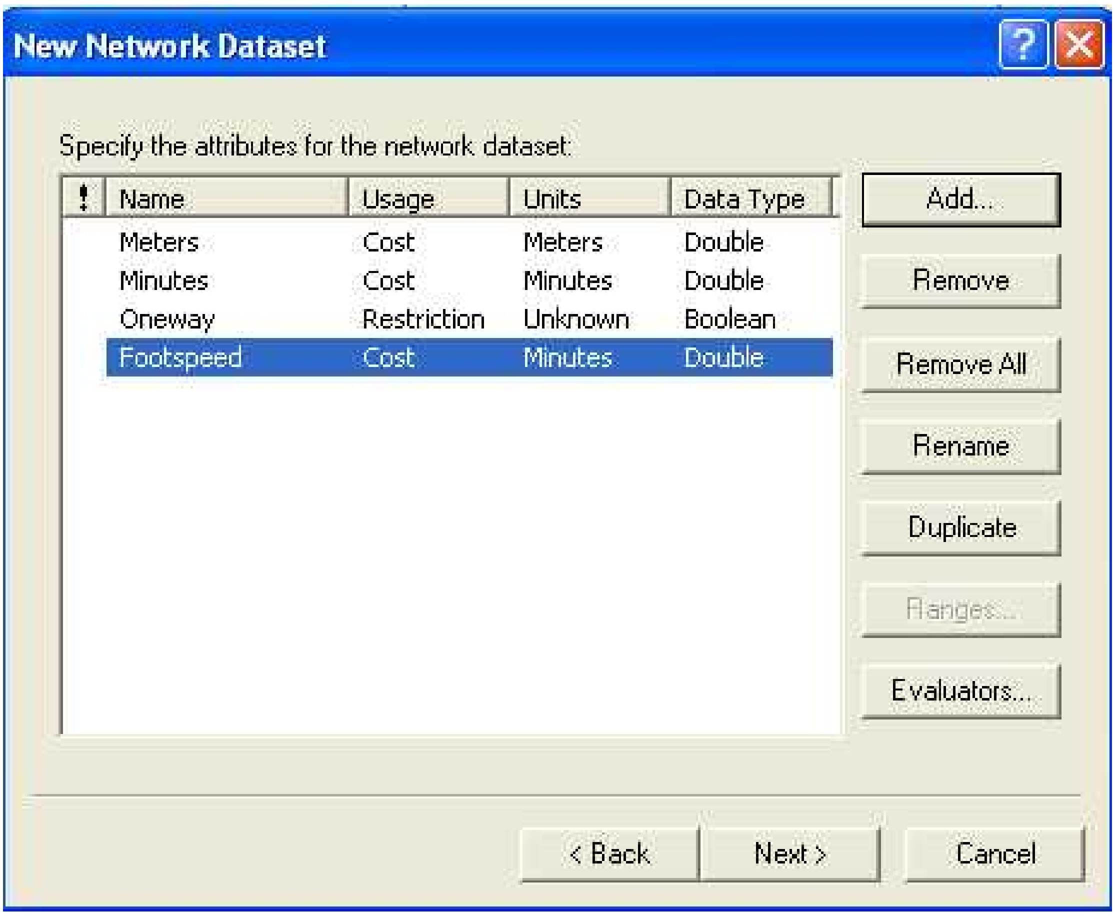


Figure (4.10): Specifying Cost and Restriction fields for Dura Streets Network

To use driving directions in a network analysis, they should be set-in the network dataset.

8. Select yes to establish driving directions settings for this network dataset .The Network Analyst automatically finds and maps the field in the streets source that will be used to report street names .Additionally Length and Time fields are automatically mapped as well.

9. Click Next to continue.

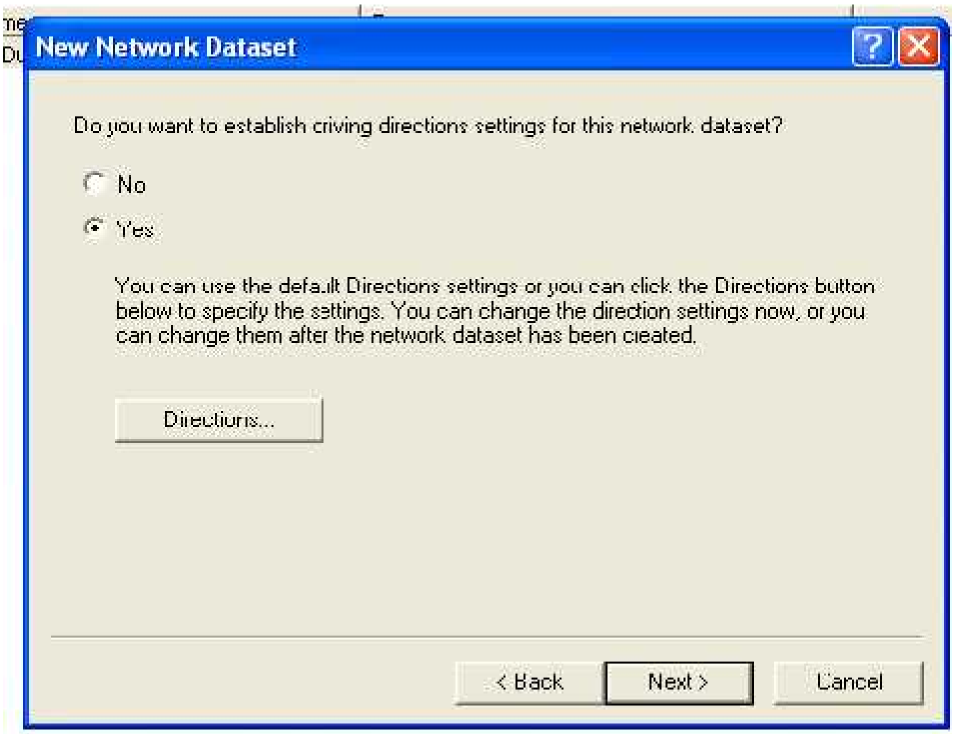


Figure (4.11): Establish Driving Directions Settings of Dura Streets Network

10. A summary of all the settings that have been chosen is displayed in the following window for your review.

Click Finish to create the new shapefile based network dataset.

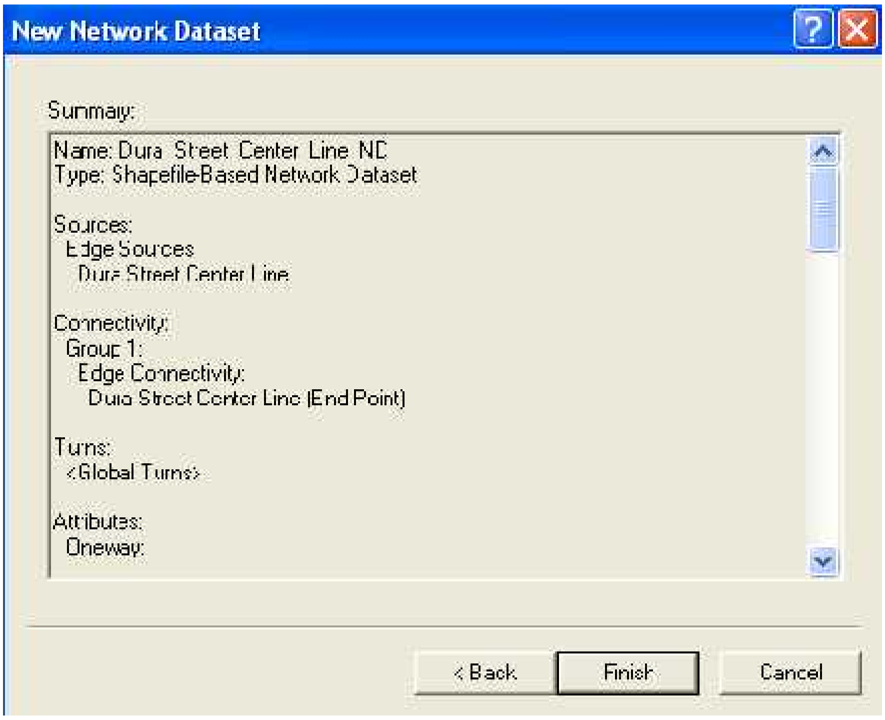


Figure (4.12): Summary of Dura Streets Network Settings

Once created, the system prompts for the network to be built.

11. Click yes to build the network.

The network dataset has been built when the progress bar disappears.
The shapefile based network, Dura Streets Center line _ND, is added to ArcCatalog along with the system junctions shapefile Dura Streets Center line _ND_Junctions.

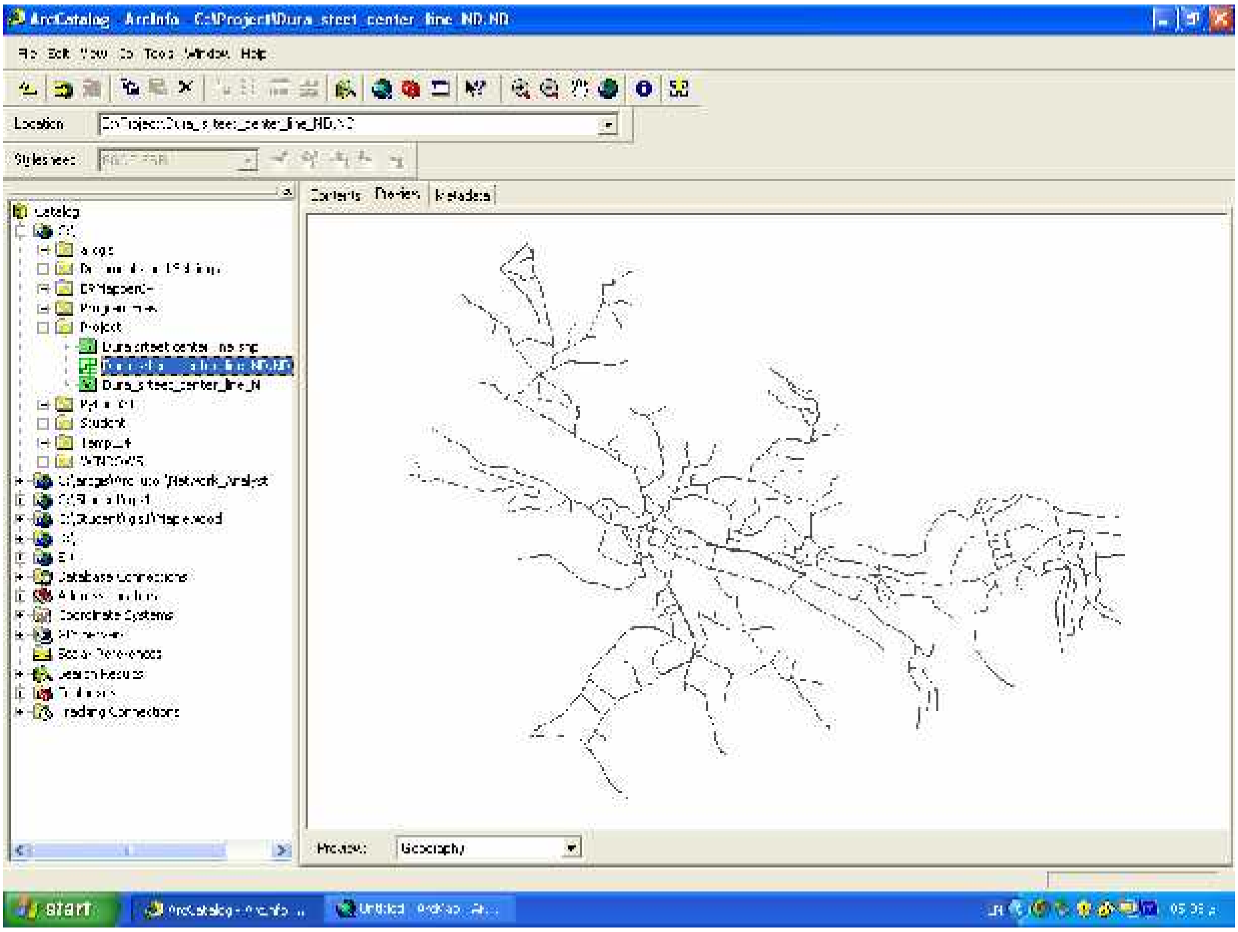


Figure (4.13): Dura Streets Network Dataset

CHAPTER FIVE

ArcGIS NETWORK ANALYST APPLICATIONS

5.1 Finding the best route using a network dataset .

5.2 Finding the closest Facility.

5.3 Calculating service area .

This chapter covers the various applications on Dura street network database.

CHAPTER FIVE

ArcGIS NETWORK ANALYST APPLICATIONS

5.1 Finding the best route using a network dataset.

5.1.1 Preparing your display

On the Network Analyst toolbar, click the Network Analyst dropdown menu and click New Route.

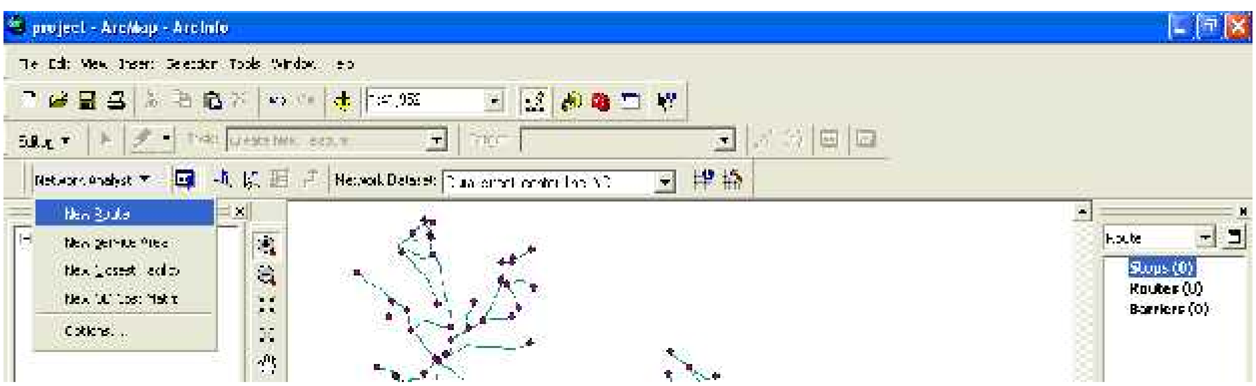


Figure (5.1): Creating Route Model

The Network Analyst Window now contains empty lists of Stops, Routes and Barriers categories.

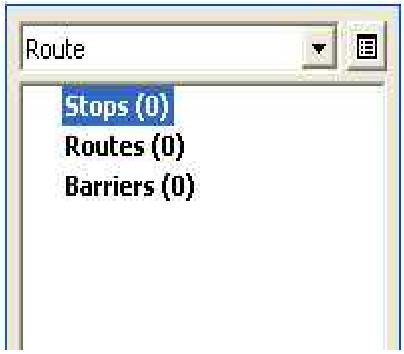


Figure (5.2): Empty Stops, Routes, and Barriers

Additionally, the table of contents contains a new Route analysis layer.

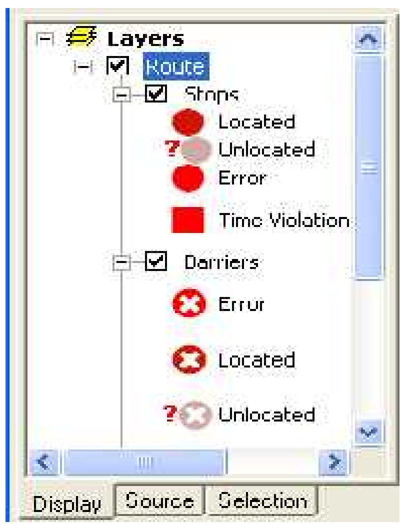


Figure (5.3): Dura Streets Network Table of Content

5.1.2 Adding stop at Ambulance and Accident Locations

you will add the stops between Ambulance and Accident Locations .

1. Click Stops(0) on the Network Analyst Window.

2. On the Network Analyst Toolbar, click the Create Network Location tool .

3. Click on the Ambulance location on the street network in the map to define a new stop location.

The program then calculates the nearest network location and symbolizes the stop with the located symbol. The stop will remains elected until another stop is placed or until it is unselected.

Figure (5.4): Identify the Ambulance location as stops

The located stop also displays the number 1. The number represents the order in which the stops will be visited by the calculated route. You will also notice that the Stops category on the Network Analyst Window now lists 1 stop.

Figure (5.5): Assigning the Ambulance location as Graphic Pick 1

4. Add a second stop on the map representing the accident location. The new stops is numbered. The order of stops can be changed on the Network Analyst Window. The first stop is treated as the origin and the last, as the destination.

Figure (5.6): Order of Stops, Graphic Pick 1 is the origin, Graphic Pick 2 is the destination

Figure (5.7): The Location of Ambulance and Accident Locations

If a stop is not located on the network, it will appear with an unlocated symbol.
An unlocated stop can be located on the network by moving it, closer to any edge that belongs to the network. On the Network Analyst Toolbar, click Select/Move Network Location tool .Using the Select/Move Network Location tool , click and drag the unlocated stop closer to an edge on the network

5.1.3 Setting up the parameters for the analysis

you will specify that your route will be calculated based on time (minutes), that U-turns are allowed everywhere, and that one-way restrictions must be followed.

1. Click the Analysis Layer Properties button next to Route layer on the Network Analyst Window to bring up the Layer Properties dialog for Route .
2. In the Layer Properties dialog, click the Analysis Settings tab. Make sure the impedance selected is Minutes (Minutes).

4. Do not reorder stops. (Leave the box unchecked). This preserves the order of stops as decided by you, when you created the stops.

5. Choose Everywhere from the Allow U-turns dropdown box.

6. Choose True Shape from the Output Shape Type dropdown box.

7. Check the box labeled Ignore Invalid Locations. This will let you find the best route using located stops. Stops that were not located on the network will be ignored.

8. Check One way in the Restrictions list.

9. Click the Directions tab.

10. Make sure the Distance Units are set to Meters, the Display Time box's checked and the time attribute is set to Minutes.

11. Click OK.

5.1.4 Run the process to compute the best route between the Ambulance and the Accident location

1. Click the Solve button  on the Network Analyst toolbar. The route polyline appears in the map and in the Route category of the Network Analyst Window.

Figure (5.8): Route Polyline between the Ambulance and the Accident location

2. Right-click the new route called ‘Graphic Pick 1 - Graphic Pick 3’and click Directions Window to display driving directions.

Figure (5.9): Calling the driving direction window

4. The Directions Window can also be displayed with turn-by-turn maps that can be shown by clicking on the Map link.

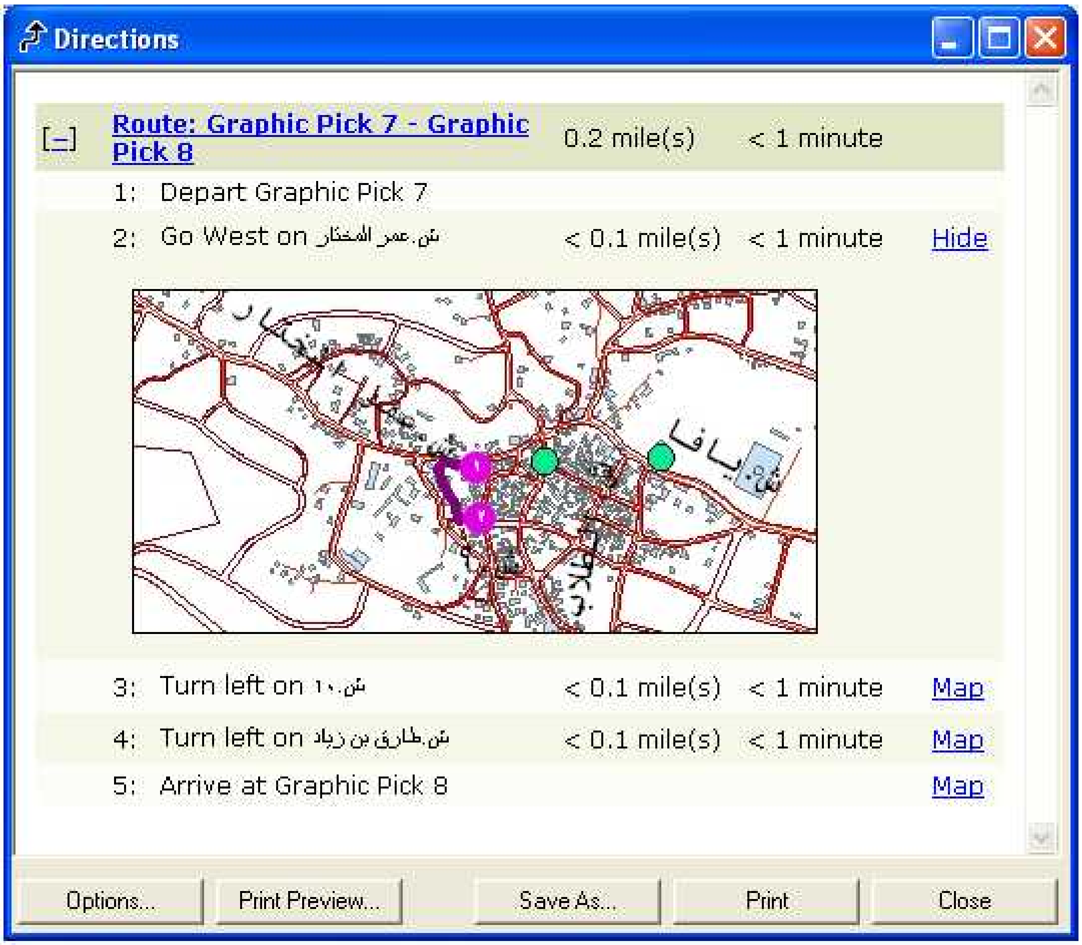


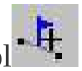
Figure (5.10): Directions window of Ambulance route

5. Close the Directions Window.

5.1.5 Adding a barrier on Dura Streets Network

In this section, you will add a barrier on the route that represents a roadblock and will find an alternate route to the destination avoiding the roadblock.

1. On the Network Analyst Window, click Barrier (0).

2. On the Network Analyst Toolbar, click the Create Network Location tool  .

3. click anywhere on the route, to place barrier.

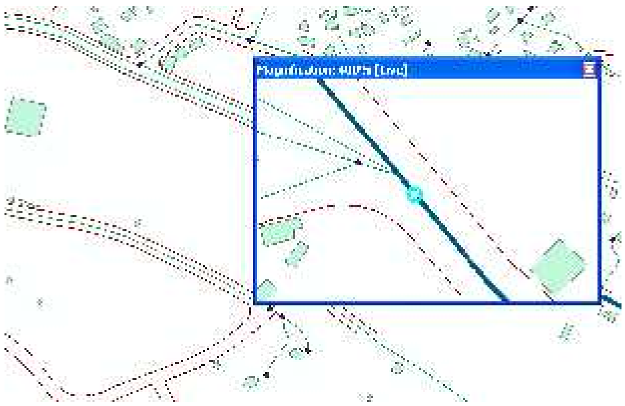


Figure (5.11): Adding barrier to Dura Streets Network

4. Click the Solve button  on the Network Analyst toolbar. A new alternative route is computed, avoiding the barrier, fig(5.12).

Figure (5.12): New Alternative route between the Ambulance and the accident location, avoiding the barrier

5. Close the Magnifier Window.

5.1.6 Applications of Finding the best route using a network dataset in Dura City

1. In garbage collection :finding the best rout that the Garbage car must run to pick up The Garbage from containers .

This done by instate the containers locations on the master plane as a Shapefile thin choose the containers which should be picking up thin solve the network to find the best rout .

3. In incidents

a. Ambulance arrival : finding the best rout for ambulance to arrive from its station to any incident location.

b. Fir engine arrival : finding the best rout for fire engine to arrive to the blaze to house it .

c. Police car arrival : finding the best rout for police car to arrive from police center to any accident location .

This application done by instate the locations of (ambulance station, fire station, police center) on the master plane as shapefile , when any incident happen the Employ(in any facility) instate the location on the network then solve to find the best route and print the map and direction table for the drivers.

3. Best route for arriving from any location in the city to any facility to implement that we instate all important locations and facilities by adding them to the network as shape file (schools, mosque, clinic, post office, public office, university, pharmacies) as following :

a. arriving from any point to clinic this done by define the location that the user in and define the clinic location then solve to find the best rout see or print the direction window which including the map for the best rout .
b. arriving to the connection point leading to Hebron hospitals by define the connection point between Dura and Hebron network .
c. finding the best rout to arrive from any point to the university .
d. finding the best rout to arrive from any point to any mosque in dura.
e. finding the best rout to arrive from any point to the Historical places.
f. finding the best rout for educational overseers cars to complete their round to the schools and other offices.
g. finding the best rout for tax overseers cars to complete their round to the stores .
h. finding the best rout for goods retailer to reach all stores from warehouses
i. finding the best rout to arrive from any point to the Public office .
j. finding the best rout for the taxi to get the any point in the city that call for taxi .
k. finding the best rout for gas retailer to reach all clientage by instate their location and solve for the best rout and print the direction table and best rout map.
l. finding the alternative rout when a barrier made on the best rout.

5.2 Finding the closest Facility .

5.2.1 Creating the Closest Facility analysis layer

On the Network Analyst toolbar, click the Network Analyst dropdown menu and click New Closest Facility, fig(5.13)

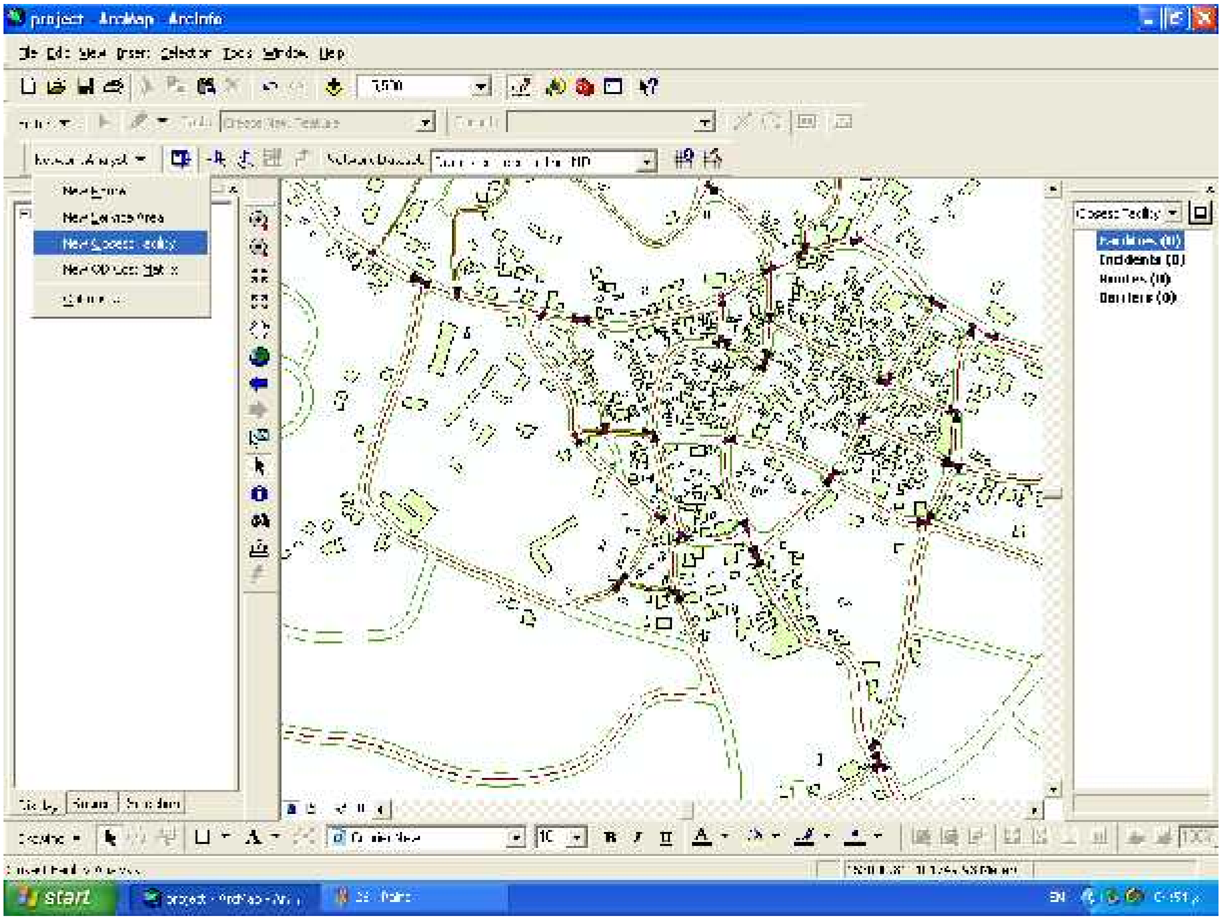


Figure (5.13):Create New closest facility

The Network Analyst Window now contains an empty list of Facilities, Incidents, Routes, and Barriers categories fig(5.14).

Figure (5.14): Network Analyst window of closest facility

Additionally, the Table of Contents contains a new Closest Facility analysis (group) layer fig(5.15) .

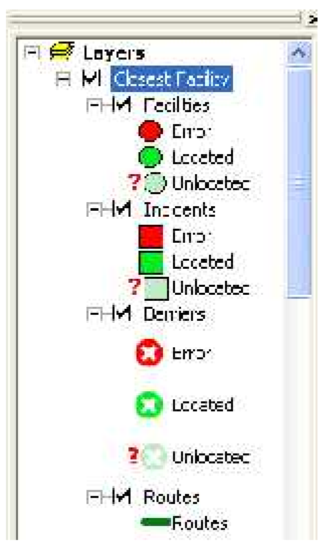


Figure (5.15):Table of content with closest facility layers

*** Adding facilities**

you will add facilities from a point file for which a layer file has been created.

1. Right-click Facilities (0) in the Network Analyst window and click Load Locations, fig(5.16)

2. Select Fire_ Station from the Load From dropdown list, fig(5.17)

Figure (5.16) Load facility location

3. Click OK.

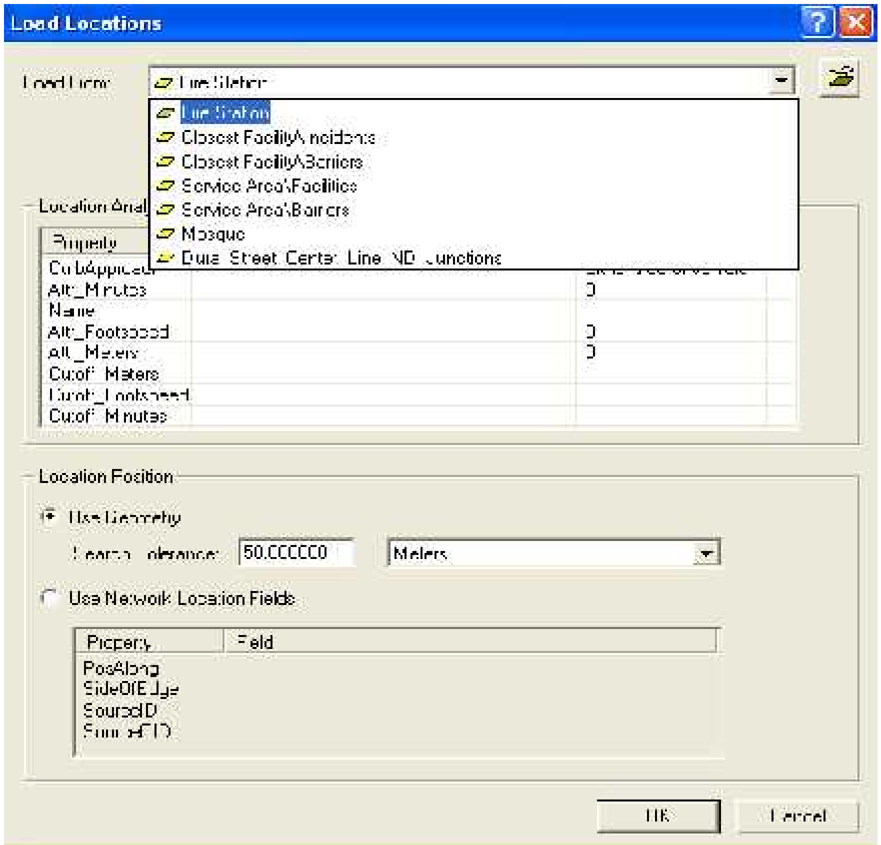


Figure (5.17): Loading Fire stations as closest facility

*** Adding an incident**

1. Click Incidents(0) on the Network Analyst Window to select it as the feature layer to which you will add the street address as a network location, fig(5.18).

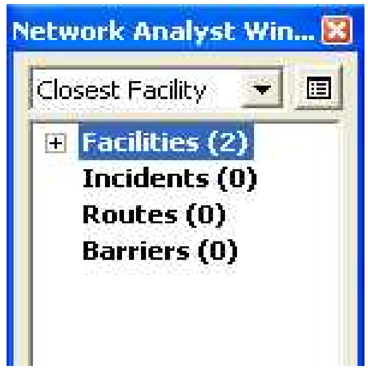


Figure (5.18): Incident elements of closest facility

2. Select any location in the city as incident.

*** Setting up the parameters for the analysis**

1. Click the Analyst Layer Properties Button next to Closest Facility on the Network Analyst Window to bring up the Layer Properties dialog, fig(5.19).

2. In the Layer Properties dialog, click the Analysis Settings tab.

3. Click the Impedance dropdown arrow and click Minutes (Minutes).

4. Set the Default Cutoff value to 2. ArcGIS will search for fire stations that are within three minutes of the fire. Any fire station outside of two minutes drive time will be ignored.

5. Increase the Facilities to Find from 1 to 3. ArcGIS will attempt to search for three fire stations from the fire site, within the two minute cutoff. If there are only two fire stations within the two minute cutoff, then the third fire station will not be found.

6. Under Travel From, select Facility (fire station) to Incident (fire).

7. Select Everywhere from the Allow U-Turns dropdown box.

8. Select True Shape from the Output Shape Type dropdown box.

9. Check the box labeled Ignore Invalid Locations. This will let you find the best route using located stops. Stops that were not located on the network will be ignored.

10. Check One way in the Restrictions list.

11. Click OK to save the settings.

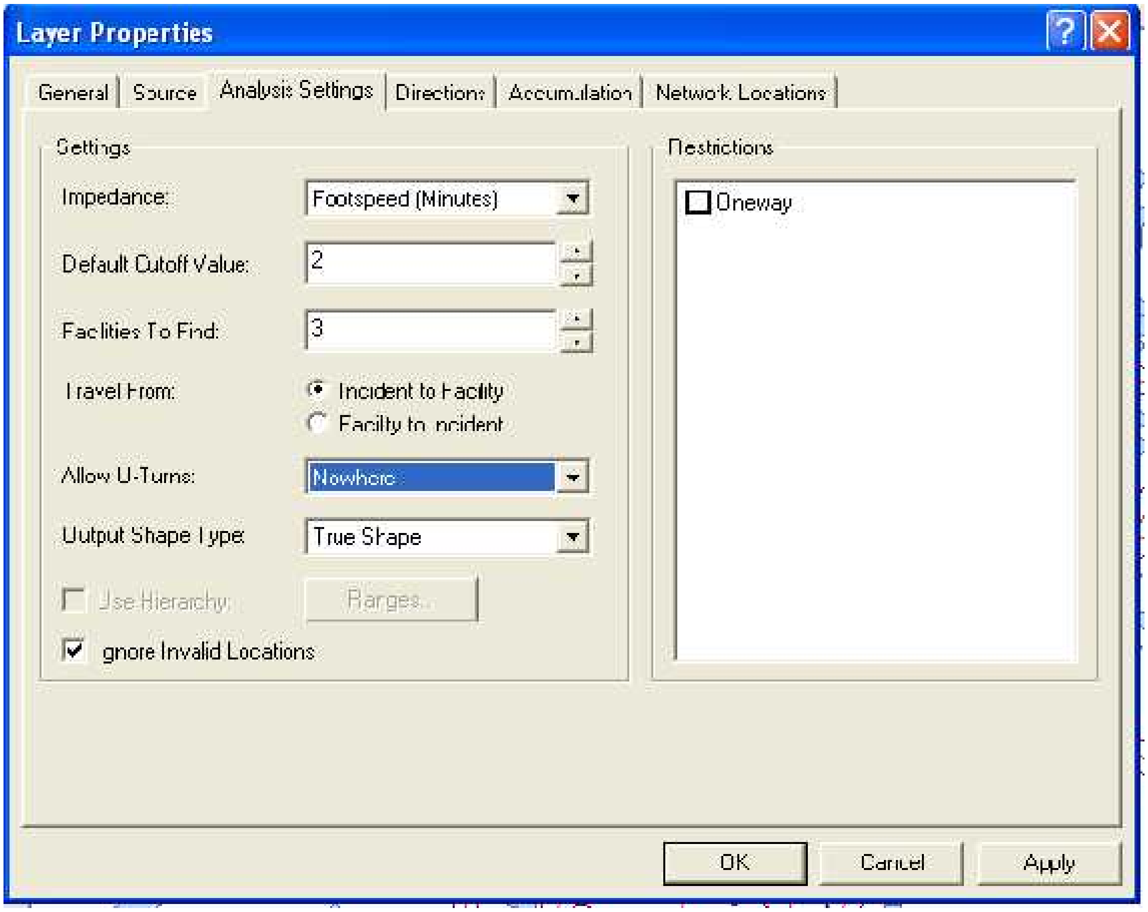


Figure (5.19): Setting the parameters of the closest facility layer

5.2.2 Run the process to identify the closest facility

1. Click the Solve button  on the Network Analyst toolbar. The routes appear in the Map and in the Route Category on the Network Analyst Window, fig(5.20).

Figure(5.20):The route between the fire station and the incident

2. Click the Directions Window button  in the Network Analyst Toolbar to generate directions for routes from each fire station, fig(5.21).

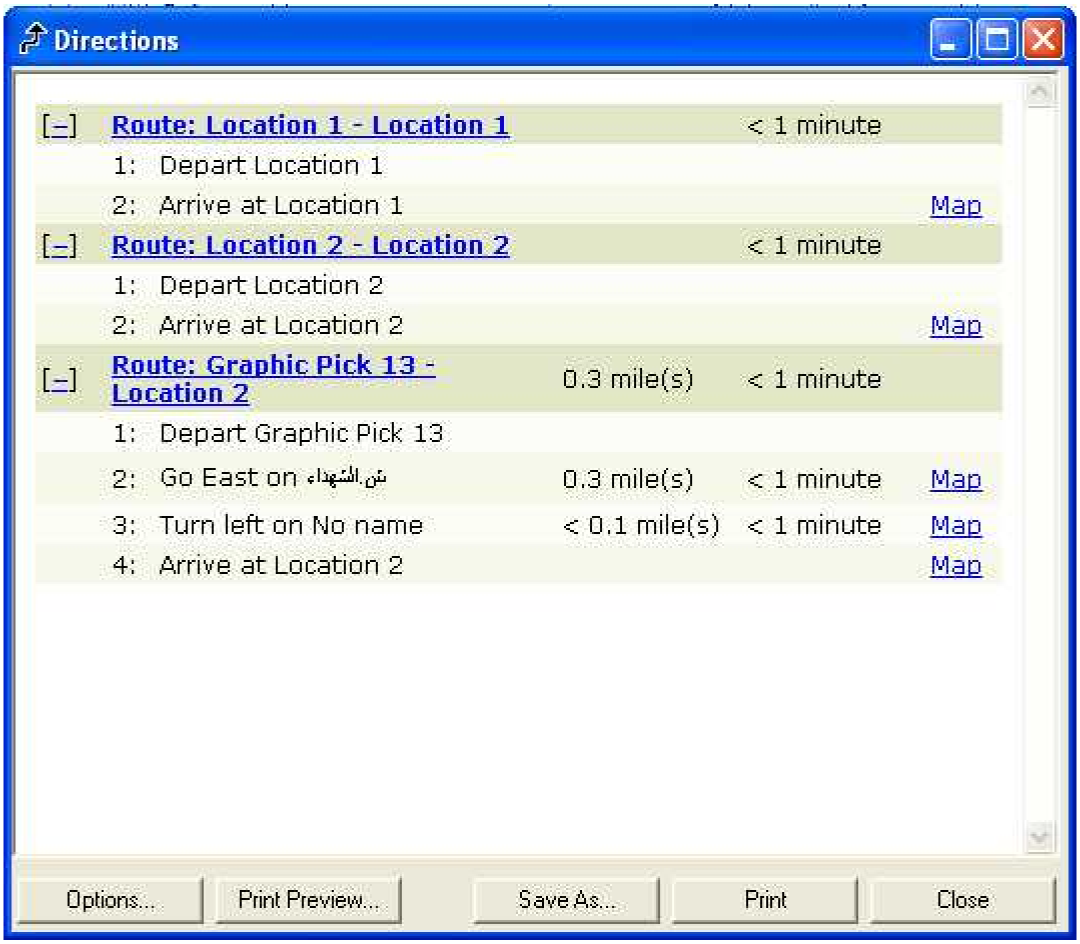


Figure (5.21**)**: Direction window between the first station and the target street

5.2.3 Applications of Finding the closest facilities using a network dataset In Dura City

1. calculate the closest fire station to the location of the incident.

2. calculate the closest pharmacies that we can to reach from any location in a defined time .

3. calculate the closest stores that we can to reach from any location in a defined time .

4. calculate the closest police office that we can to reach from any location of accident in a defined time .

5. calculate the closest clinics that we canto reach from any location of accident in a defined time .

5.3 Calculating Service Area

5.3.1 Creating the Service Area analysis layer

On the Network Analyst toolbar, click the Network Analyst dropdown menu and click New Service Area, fig(5.22).

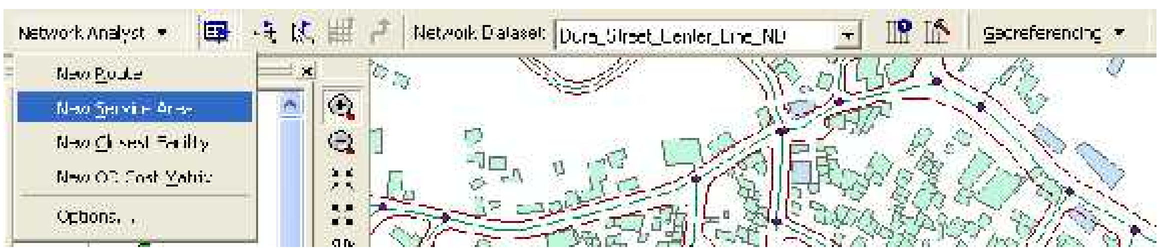


Figure (5.22): Creating new service area

The Network Analyst Window now contains an empty list of Facilities, Barriers, Lines, and Polygons categories, fig(5.23).

Figure (5.23): Network Analyst window of service area

Additionally, the table of contents contains a new Service Area analysis layer, fig(5.24).

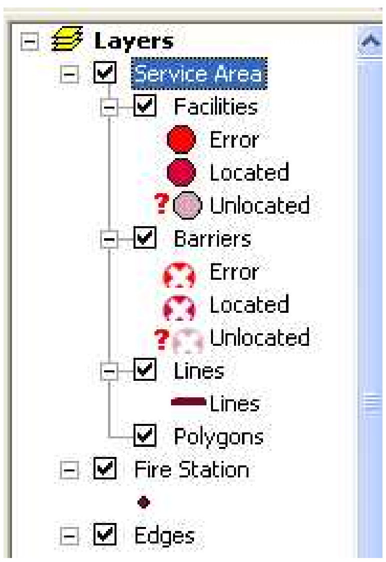


Figure (5.24): Table of the content with service area layer

*** Adding facilities**

you will add (Schools, pharmacies, Houses,…..) as facilities for which the service area polygons will be generated, fig(5.25).

Figure (5.25): Loading facilities for service area generated polygons

1. Right-click Facilities (0) on the Network Analyst Window and select Load Locations. Select Schools in the Load From dropdown list and click OK, fig(5.26).

2. The facilities are visible on the map

Figure (5.26): Schools as facilities to service area

*** Setting up the parameters for the analysis**

you will specify that your service area will be calculated based on Drive time (minutes). Three service area polygons will be calculated for each facility, one at 1 minutes, one at 2 minutes, and another at 3 minutes. You will specify that the direction of travel will be from the facility, not towards the facility, that no U-turns are allowed, and that one way restrictions must be followed, fig(5.27).

1. In the Network Analyst Window, click the Analysis Layer Properties Button  to bring up the Layer Properties dialog box
2. Click the Analysis Settings tab
3. Click the Impedance dropdown list and select Drive time (Minutes).
4. Type “1 2 3”in the Default polygon breaks text box. (Enter this as 1 2 3, the three numbers are separated by a space, without the quotes.)
5. Under Direction, click Away from facility.
6. Click Nowhere from the Allow U-turns dropdown list.
7. Check One way in the Restrictions list to honor one way restrictions.
8. Check the Ignore Invalid Locations checkbox.

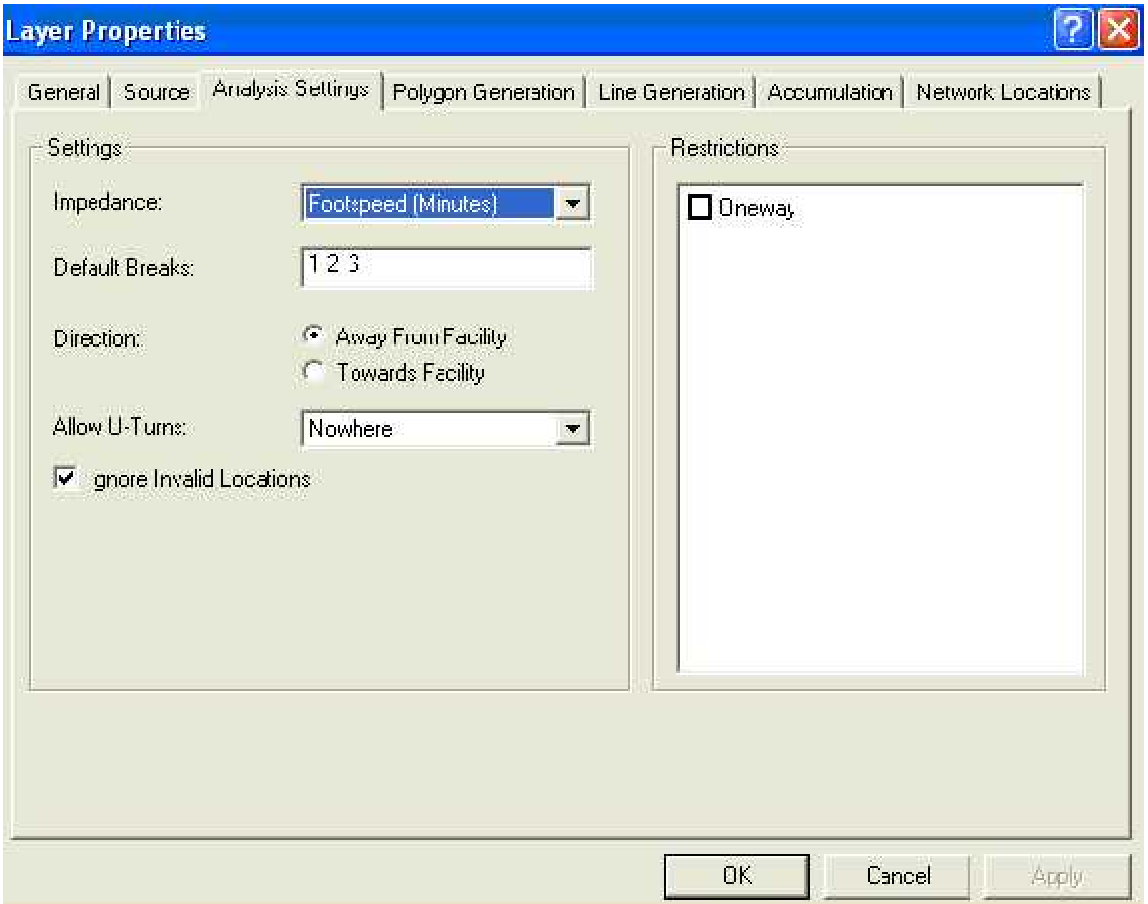


Figure (5.27): Setting parameters for service area

9. Click the Polygon Generation tab.

10. Make sure that Generate Polygons is checked.

11. Click Generalized for Polygon Type. This results in faster analysis. Detailed polygons are much more accurate, but need more time to be generated.

12. Click Separate polygons per facility under Multiple Facilities Options. This results in individual polygons per facility that may or may not overlap, Fig(5.28).

13. Click Rings for the Overlap type. This excludes areas of smaller breaks from the polygons of a bigger break.

14. Click Apply to save the settings.

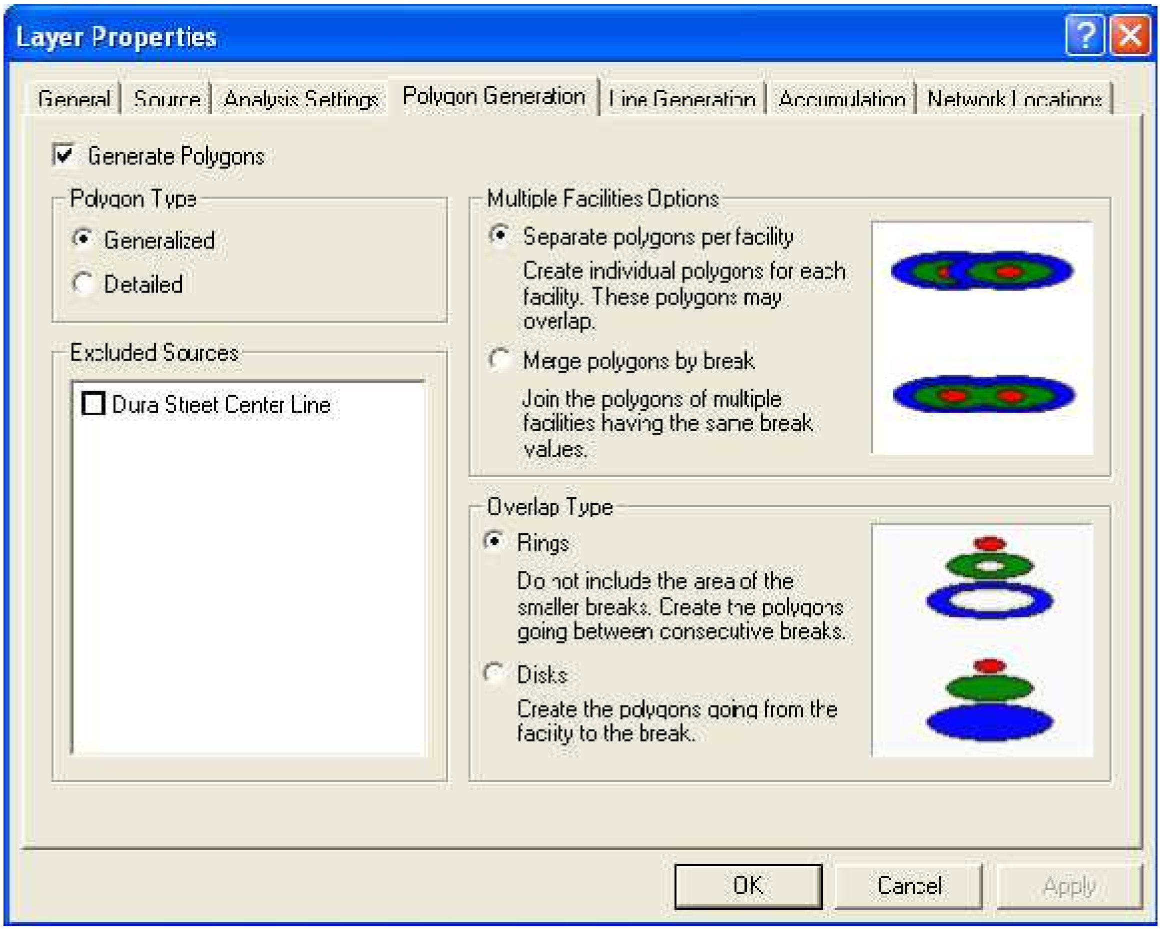


Figure (5.28): Setting parameters for service area polygons

17. Click OK to save your settings.

* **Run the process to compute the Service Area**

Click the Solve button on the Network Analyst toolbar. The service area polygons appear on the map and on the Network Analyst Window. There is a transparency set by default for the Polygons layer. This shows the underlying layers and gives an idea of the area under the polygons with respect to the street network, fig(5.29).

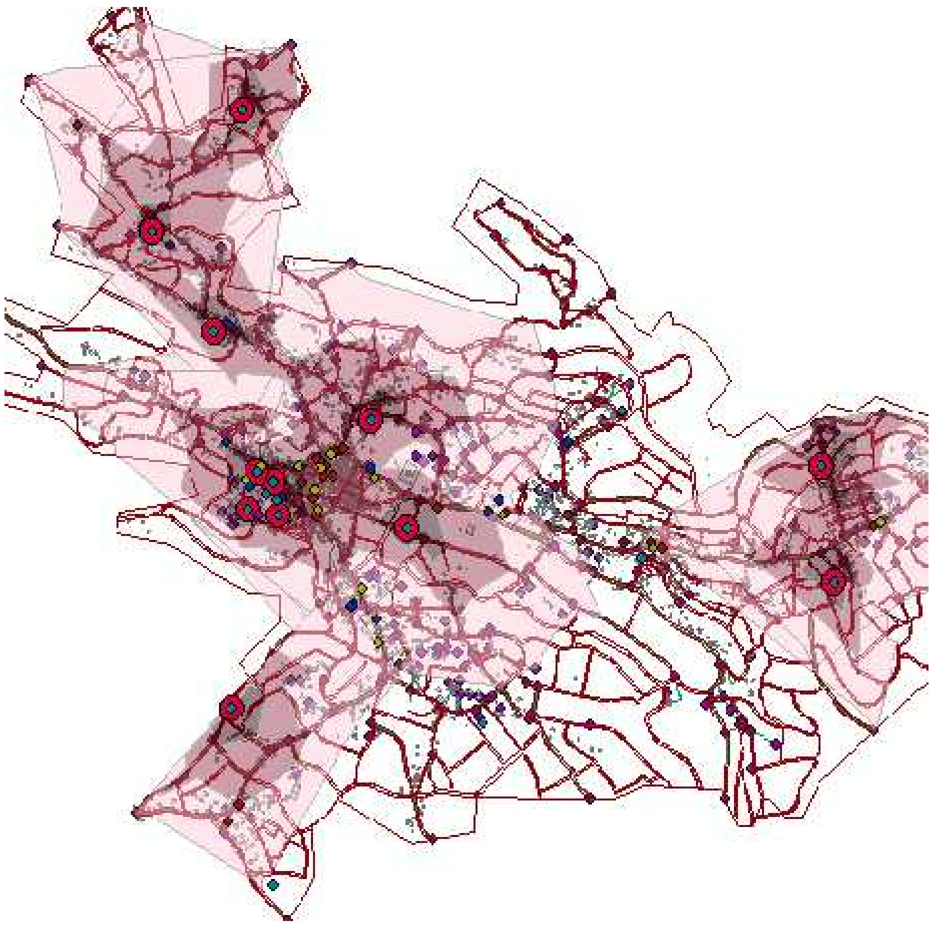


Figure (5.29): Service area based on 1,2 and 3 min drive time

*** Identifying Houses that do not lie within any polygon**

1. In the table of contents select and move the Houses feature layer to the top to improve visibility, fig(5.30).

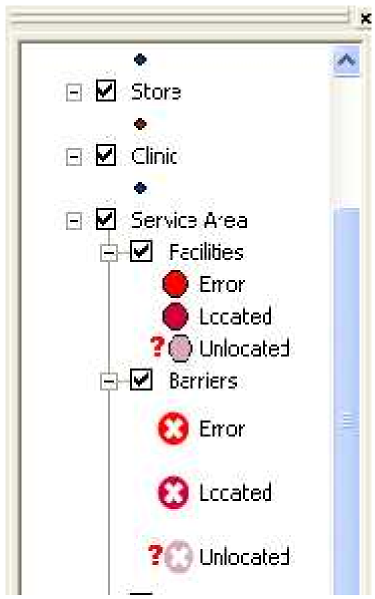


Figure (5.30):Service area layers

2. Choose Select by Location from the Selection menu, fig(5.31).

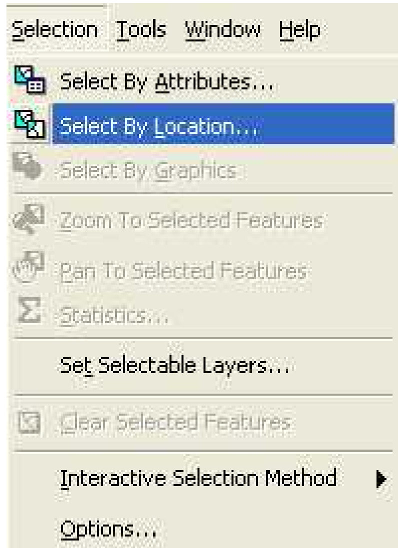


Figure (5.31): Selecting by location

3. Create the selection query in the Select by Location to select features from Houses that are completely within Polygons, fig(5.32).

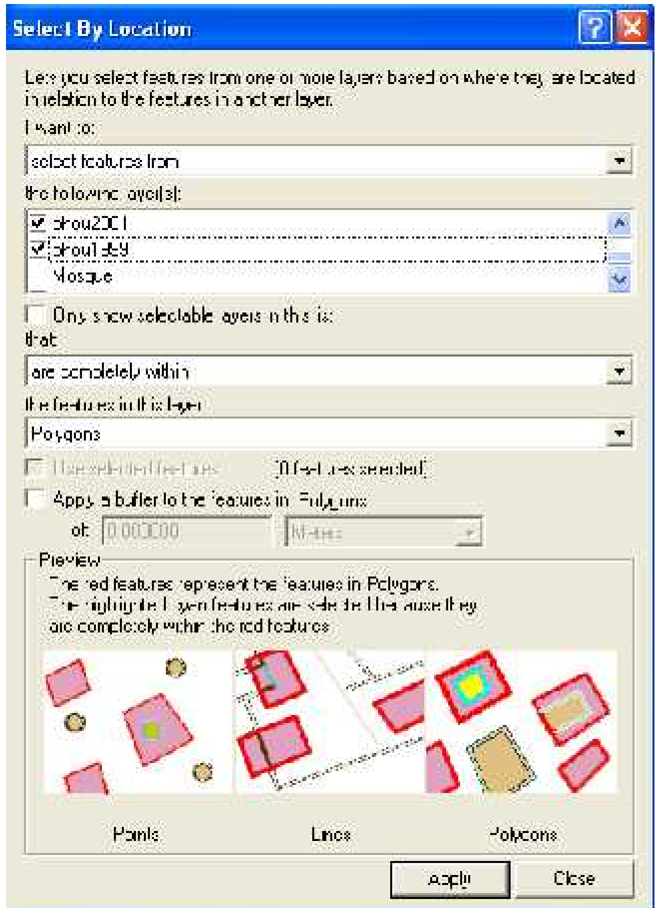


Figure (5.32): Select Houses that are completely within the service area

4. Click Apply. This will select all Houses that lie within service area polygons.

5. Click Close. You want to select Houses that are not within the service area polygons, which is the inverse of the current selection. To get the selection of houses that are not within the service area polygons, you can switch the selection.

6. Right-click houses in the Table of Contents, point to Selection and choose Switch Selection, fig(5.33).

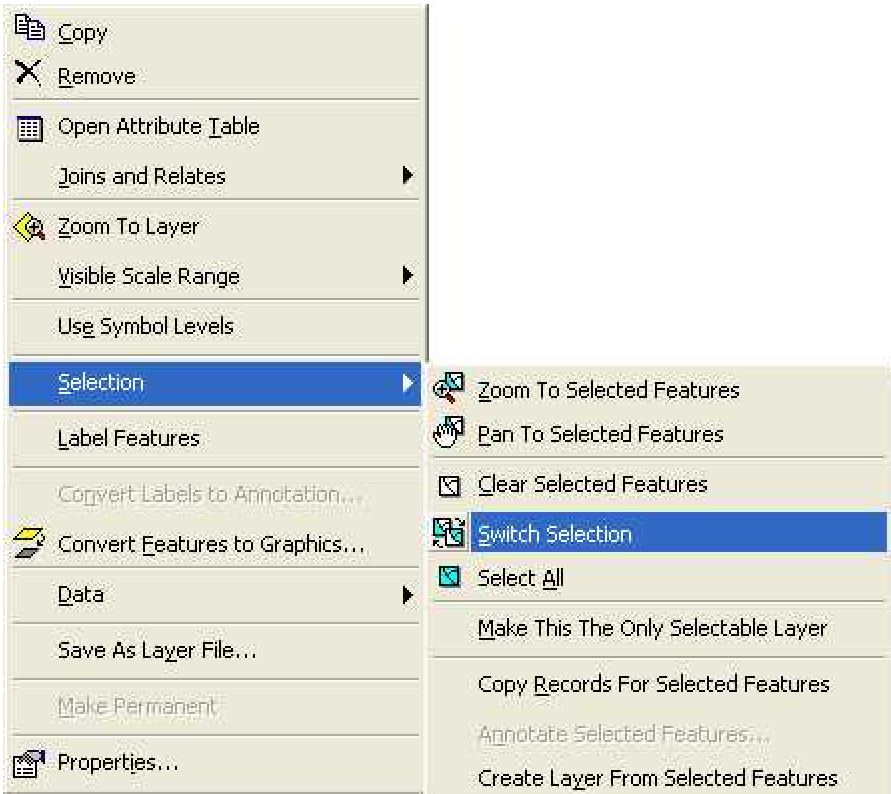


Figure (5.33): Switch selection to select the houses that are outside the service area

7. The selection now shows the distribution of Houses not contained in any service area polygon. You use this selection to identify the area to which you will relocate a Schools. This area appears to be in the center of the map, fig(5.34).

Figure (5.34): The Houses outside the service area polygons

8. Right-click Houses in the Table of Contents, point to Selection and choose Clear Selected Features.

* **Relocating the least accessible Schools**.

Use the Select\Move Network Location Tool  to move one of the Schools to the unserved area to check the new service area, fig(5.35).

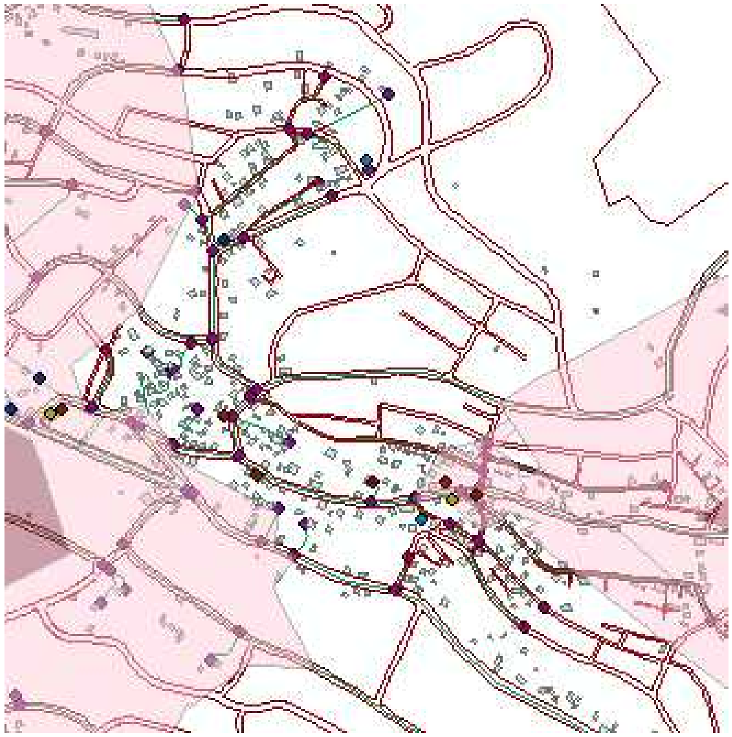


Figure (5.35): Before Moving the school

5.3.2 Run the process to compute the Service Area

Click the Solve button  on the Network Analyst toolbar. The service area polygons appear on the map and on the Network Analyst Window, fig(5.36).

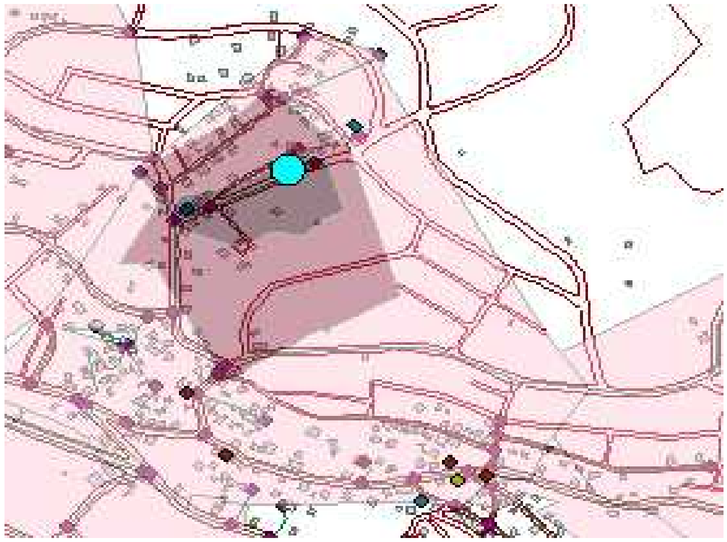


Figure (5.36): After Moving the school

* **Identifying the service area polygon that each House lies within**

1. In the table of contents, right-click houses feature layer, point to Joins and Relates and select Join..., fig(5.37).

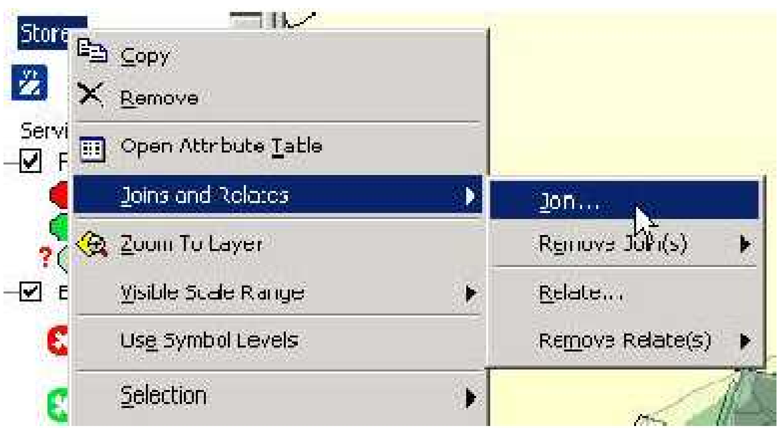
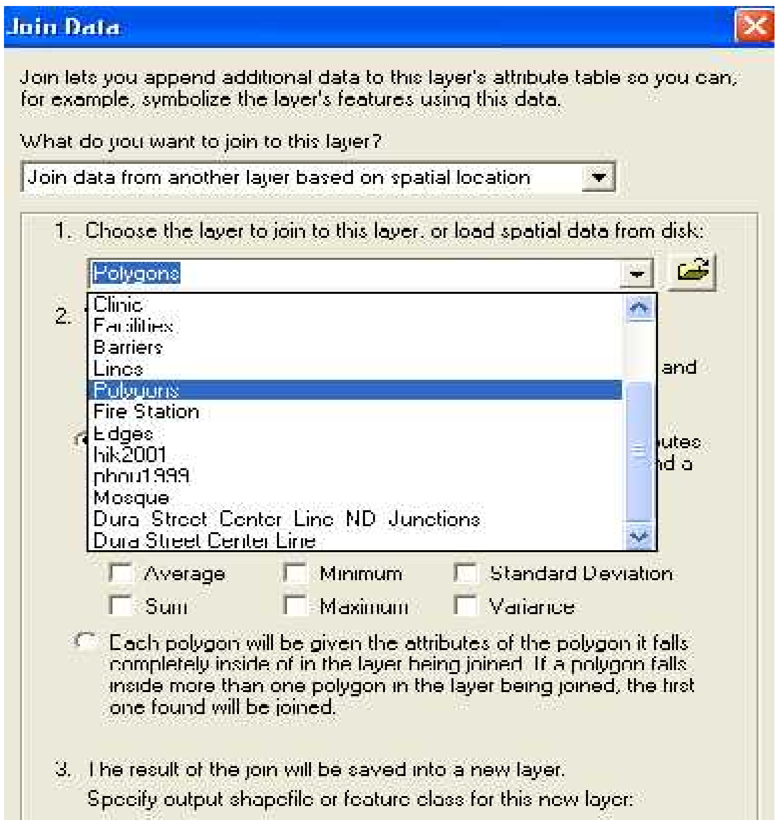


Figure (5.37):Load the join data panel

2. Choose Join data from another layer based on spatial location, fig(5.38
3. Select Polygons as the layer to join to this layer.
4. Select the first radio button labeled "it falls inside" to add the attributes of polygon to all points that fall inside the polygon.
5. Specify the output shape file to save the result of the join as Houses with Poly.shp.



Figure(5.38): Join data parameters

6. Click OK to perform the join.

7. Right-click the newly added Houses with Poly feature layer and select Open Attribute Table. Each row displays the name of the store and polygon it falls under. You can use this table to generate other useful categories such as the number of stores within 0-3 minute service area of schools, fig (5.39).

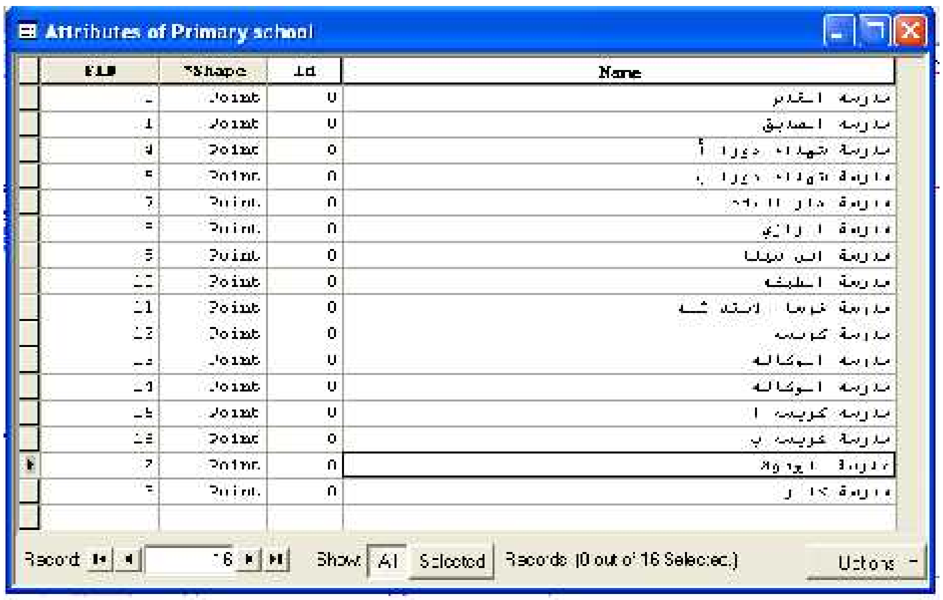


Figure (5.39): Attribute table of Houses with service area information

5.3.3 Applications of Calculating service area

1. Calculating Service area for Dura mosques, the service area for mosques of Dura was calculated base on the walking speed of a man, which assumed to be 8 km/h.
2. Public phones.
3. Primary schools.
4. Pharmacies.
5. Warehouses.
6. Clinics

This done by instate the location of each facility and defined the time for service area that needs a service and move one of facilities to a location which it serve the un served area

CHAPTER FIVE

ArcGIS NETWORK ANALYST APPLICATIONS

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ArcGIS NETWORK ANALYST APPLICATIONS

5.1 Finding the best route using a network dataset.

5.1.1 Preparing your display

On the Network Analyst toolbar, click the Network Analyst dropdown menu and click New Route.

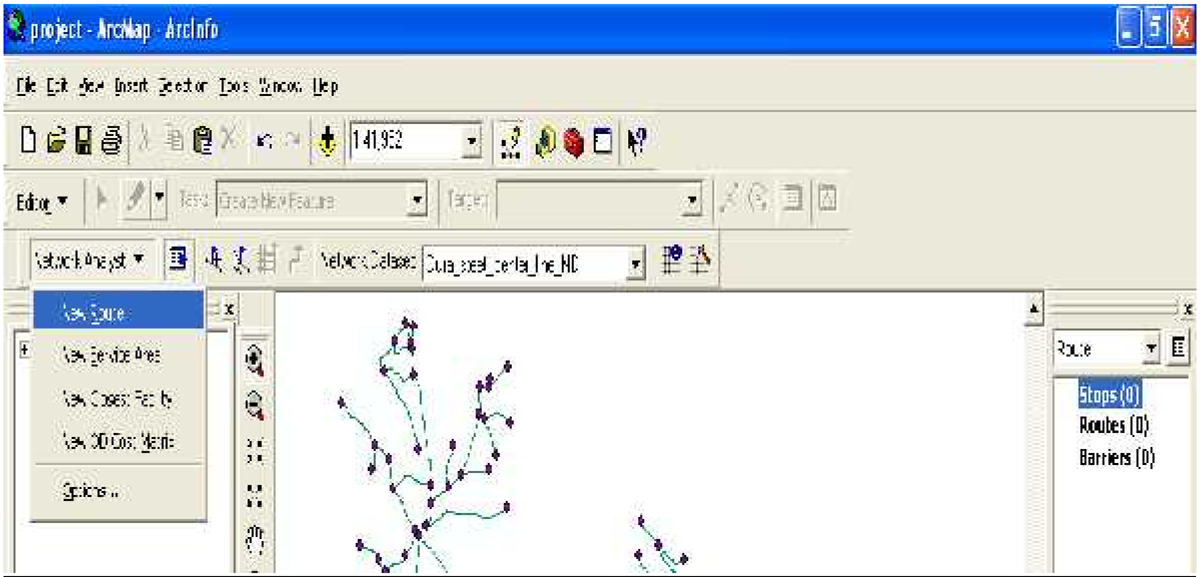


Figure (5.1): Creating Route Model

The Network Analyst Window now contains empty lists of Stops, Routes and Barriers categories.

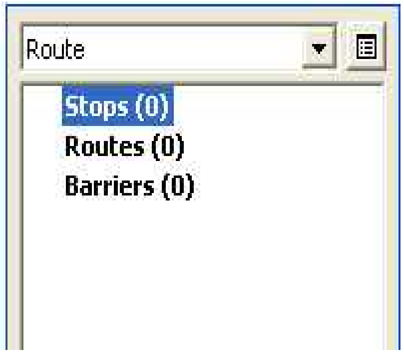


Figure (5.2): Empty Stops, Routes, and Barriers

Additionally, the table of contents contains a new Route analysis layer.

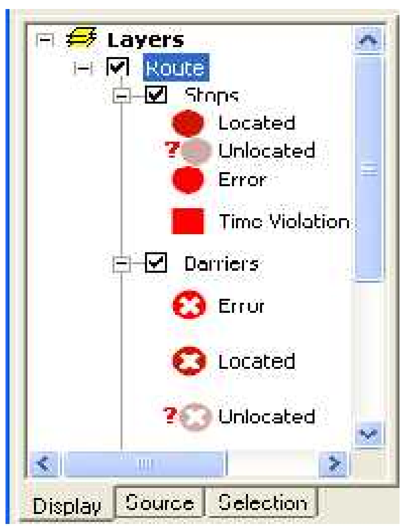


Figure (5.3): Dura Streets Network Table of Content

5.1.2 Adding stop at Ambulance and Accident Locations

you will add the stops between Ambulance and Accident Locations .

1. Click Stops(0) on the Network Analyst Window.

2. On the Network Analyst Toolbar, click the Create Network Location tool .

3. Click on the Ambulance location on the street network in the map to define a new stop location.

The program then calculates the nearest network location and symbolizes the stop with the located symbol. The stop will remains elected until another stop is placed or until it is unselected.

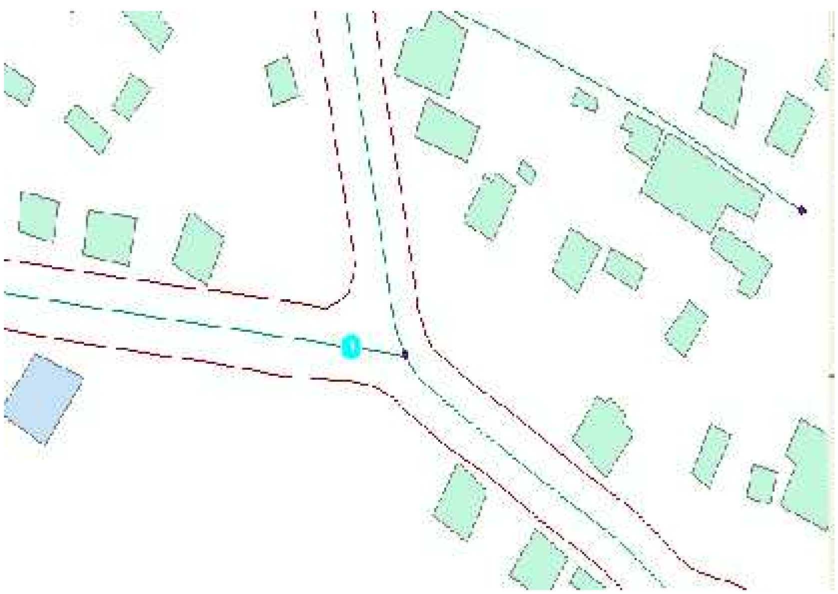


Figure (5.4): Identify the Ambulance location as stops

The located stop also displays the number 1. The number represents the order in which the stops will be visited by the calculated route. You will also notice that the Stops category on the Network Analyst Window now lists 1 stop.

Figure (5.5): Assigning the Ambulance location as Graphic Pick 1

4. Add a second stop on the map representing the accident location. The new stops is numbered. The order of stops can be changed on the Network Analyst Window. The first stop is treated as the origin and the last, as the destination.

Figure (5.6): Order of Stops, Graphic Pick 1 is the origin, Graphic Pick 2 is the destination

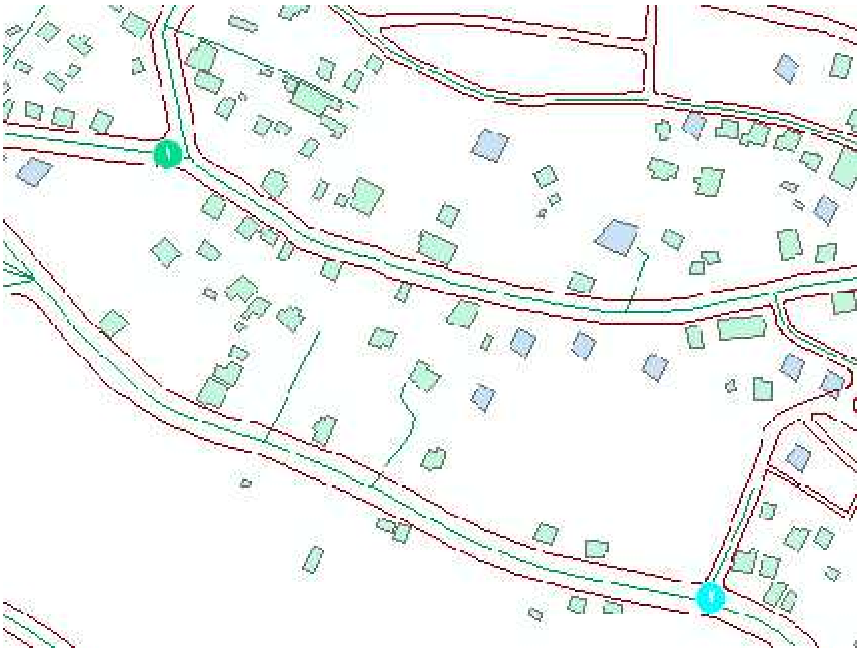


Figure (5.7): The Location of Ambulance and Accident Locations

If a stop is not located on the network, it will appear with an unlocated symbol. An unlocated stop can be located on the network by moving it, closer to any edge that belongs to the network. On the Network Analyst Toolbar, click Select/Move Network Location tool  .Using the Select/Move Network Location tool  , click and drag the unlocated stop closer to an edge on the network

5.1.3 Setting up the parameters for the analysis

you will specify that your route will be calculated based on time (minutes), that U-turns are allowed everywhere, and that one-way restrictions must be followed.

1. Click the Analysis Layer Properties button next to Route layer on the Network Analyst Window to bring up the Layer Properties dialog for Route .

2. In the Layer Properties dialog, click the Analysis Settings tab. Make sure the impedance selected is Minutes (Minutes).

4. Do not reorder stops. (Leave the box unchecked). This preserves the order of stops as decided by you, when you created the stops.

5. Choose Everywhere from the Allow U-turns dropdown box.

6. Choose True Shape from the Output Shape Type dropdown box.

7. Check the box labeled Ignore Invalid Locations. This will let you find the best route using located stops. Stops that were not located on the network will be ignored.

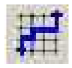
8. Check One way in the Restrictions list.

9. Click the Directions tab.

10. Make sure the Distance Units are set to Meters, the Display Time box’s checked and the time attribute is set to Minutes.

11. Click OK.

5.1.4 Run the process to compute the best route between the Ambulance and the Accident location

1. Click the Solve button  on the Network Analyst toolbar. The route polyline appears in the map and in the Route category of the Network Analyst Window.

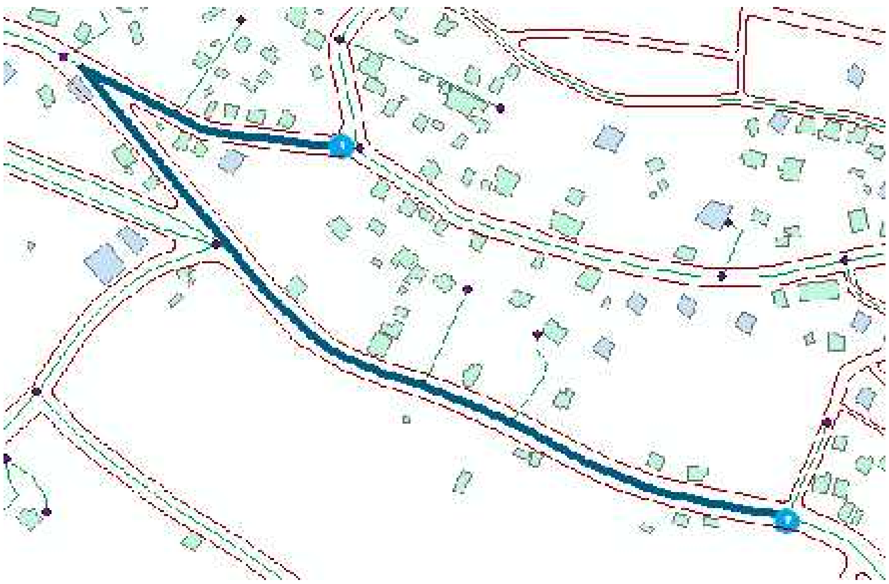


Figure (5.8): Route Polyline between the Ambulance and the Accident location

2. Right-click the new route called 'Graphic Pick 1 - Graphic Pick 3'and click Directions Window to display driving directions.

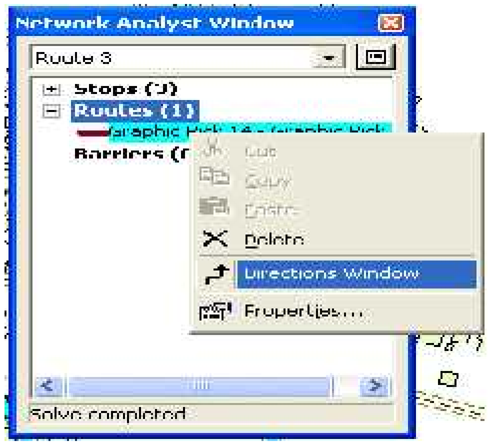


Figure (5.9): Calling the driving direction window

4. The Directions Window can also be displayed with turn-by-turn maps that can be shown by clicking on the Map link.

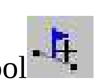
Figure (5.10): Directions window of Ambulance route

5. Close the Directions Window.

5.1.5 Adding a barrier on Dura Streets Network

In this section, you will add a barrier on the route that represents a roadblock and will find an alternate route to the destination avoiding the roadblock.

1. On the Network Analyst Window, click Barrier (0).

5. On the Network Analyst Toolbar, click the Create Network Location tool  .

6. click anywhere on the route, to place barrier.

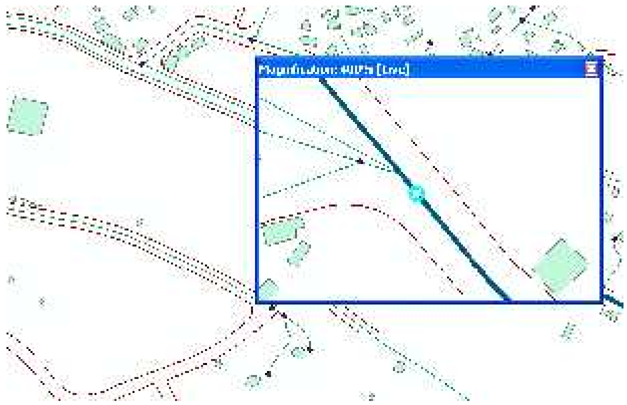


Figure (5.11): Adding barrier to Dura Streets Network

7. Click the Solve button  on the Network Analyst toolbar. A new alternative route is computed, avoiding the barrier.

Figure (5.12): New Alternative route between the Ambulance and the accident location, avoiding the barrier

8. Close the Magnifier Window.

5.2 Finding the closest fire stations.

5.2.1 Creating the Closest Facility analysis layer

On the Network Analyst toolbar, click the Network Analyst dropdown menu and click New Closest Facility, Fig(5.13)

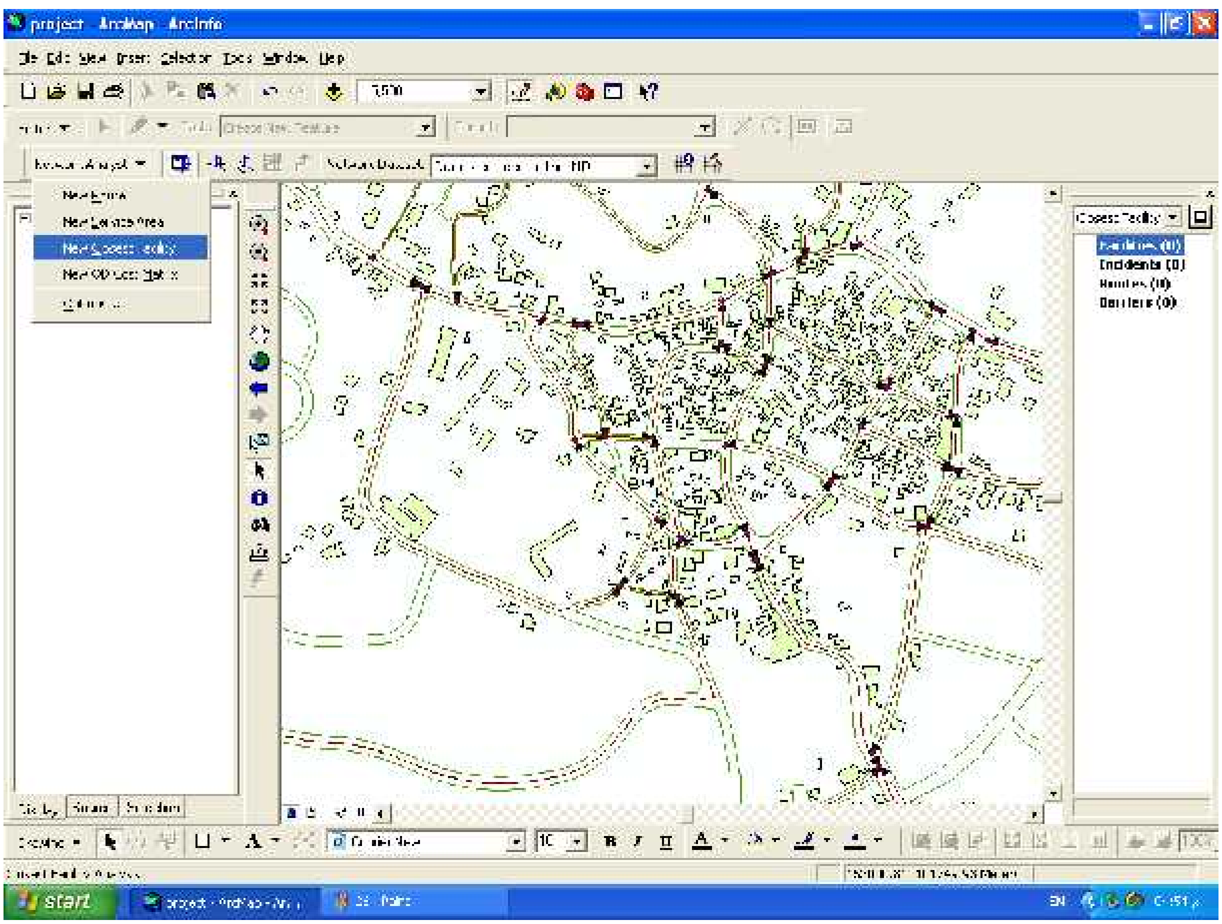


Figure (5.13):Create New closest facility

The Network Analyst Window now contains an empty list of Facilities, Incidents, Routes, and Barriers categories Fig(5.14).

Figure (5.14): Network Analyst window of closest facility

Additionally, the Table of Contents contains a new Closest Facility analysis (group) layer Fig(5.15) .

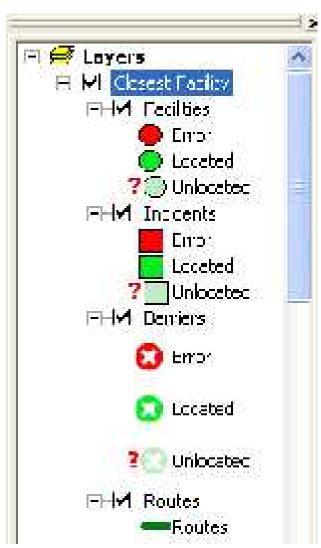


Figure (5.15):Table of content with closest facility layers

* Adding facilities

you will add facilities from a point file for which a layer file has been created.

1. Right-click Facilities (0) in the Network Analyst window and click Load Locations, Fig(5.16)

2. Select Fire_ Station from the Load From dropdown list, Fig(5.17)

Figure (5.16) Load facility location

3. Click OK.

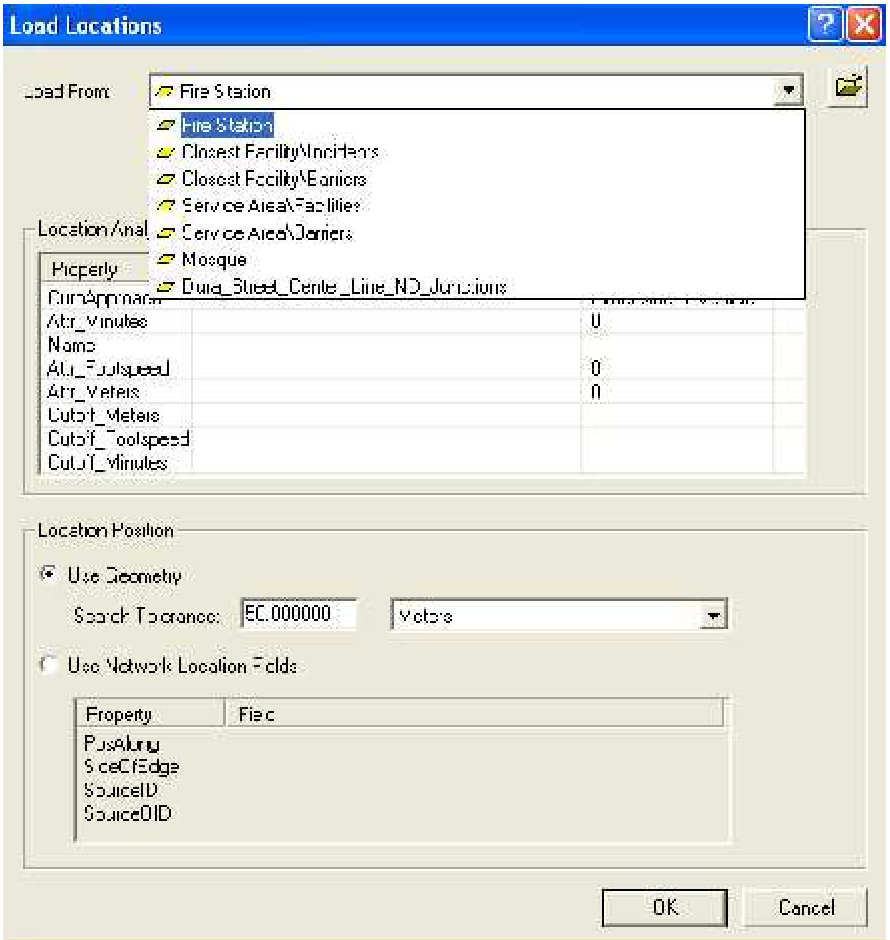


Figure (5.17): Loading Fire stations as closest facility

* Adding an incident

you will find a street address (OMAR_BIN_ALKHATAB) and add it as an incident for Closest Facility Analysis.

1. Click Incidents(0) on the Network Analyst Window to select it as the feature layer to which you will add the street address as a network location, Fig(5.18).

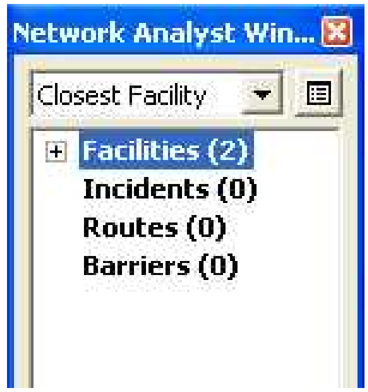


Figure (5.18): Incident elements of closest facility

2. Select Find from the Edit menu to bring up the Find Dialog, Fig(5.19).

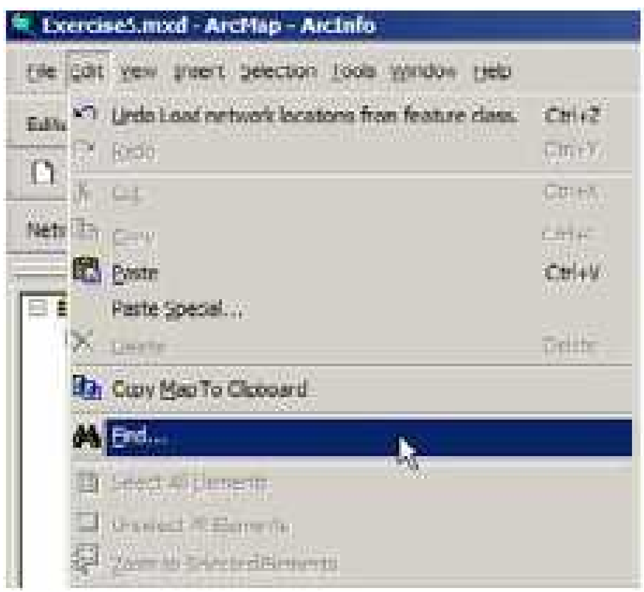


Figure (5.19): Use Find to search for incident elements

3. In the Addresses tab, Select (Dura Streets) from the Choose and address locator dropdown list, Fig(5.20).

Figure (5.20):

4. Enter "OMAR_BIN_ALKHATAB" in the text box labeled Street or Intersection, Fig(5.21)

Figure (5.21):

5. Click Find. One location is found with that street address and is listed as a row in the table in the Find Dialog, Fig(5.22)

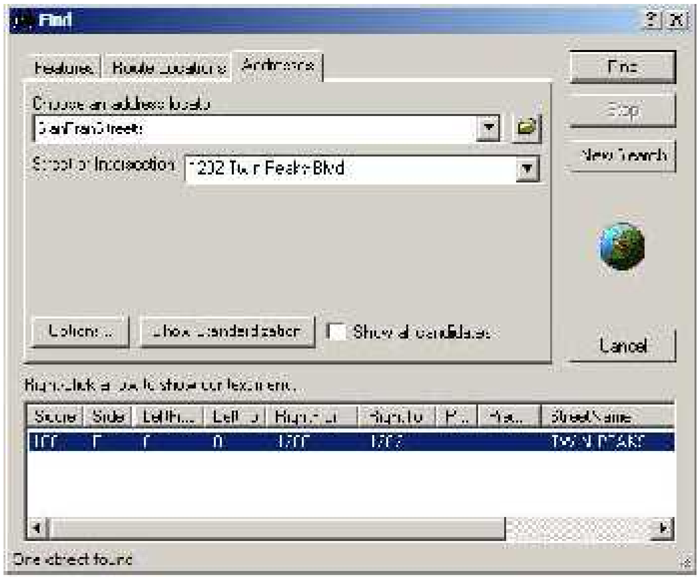


Figure (5.22):

6. Right-click the row and click “Add as Network Location”. This adds the located address as an incident on the Network Analyst Window and on the map, the new incident is added to the Network window,

7. Close the Find Dialog.

* Setting up the parameters for the analysis

1. Click the Analyst Layer Properties Button next to Closest Facility on the Network Analyst Window to bring up the Layer Properties dialog.

2. In the Layer Properties dialog, click the Analysis Settings tab.

3. Click the Impedance dropdown arrow and click Minutes (Minutes).

4. Set the Default Cutoff value to 3. ArcGIS will search for fire stations that are within three minutes of the fire. Any fire station outside of three minutes drive time will be ignored.

5. Increase the Facilities to Find from 1 to 4. ArcGIS will attempt to search for four fire stations from the fire site, within the three minute cutoff. If there are only three fire stations within the three minute cutoff, then the fourth fire station will not be found.

6. Under Travel From, select Facility (fire station) to Incident (fire).

7. Select Everywhere from the Allow U-Turns dropdown box.

8. Select True Shape from the Output Shape Type dropdown box.

9. Check the box labeled Ignore Invalid Locations. This will let you find the best route using located stops. Stops that were not located on the network will be ignored.

10. Check One way in the Restrictions list.

11. Click OK to save the settings.

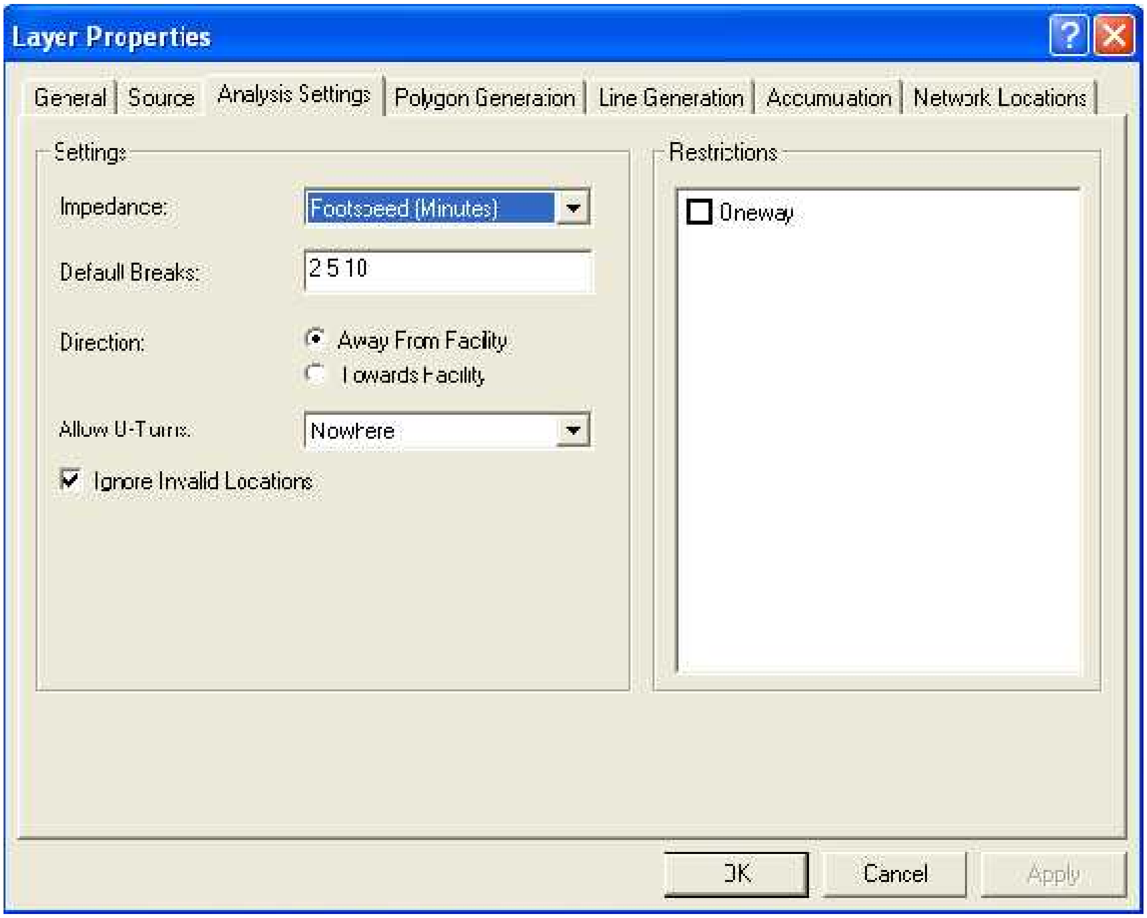


Figure (5.23): Setting the parameters of the closest facility layer

5.2.2 Run the process to identify the closest facility

1. Click the Solve button  on the Network Analyst toolbar. The routes appear in the Map and in the Route Category on the Network Analyst Window.

2. Click the Directions Window button  in the Network Analyst Toolbar to generate directions for routes from each fire station, Fig(5.24).

Figure (5.24): Direction window between the first station and the street we need

5.3 Calculating service area

5.3.1 Creating the Service Area analysis layer

On the Network Analyst toolbar, click the Network Analyst dropdown menu and click New Service Area, Fig(5.25).

Figure (5.25): Creating new service area

The Network Analyst Window now contains an empty list of Facilities, Barriers, Lines, and Polygons categories, Fig(5.26).

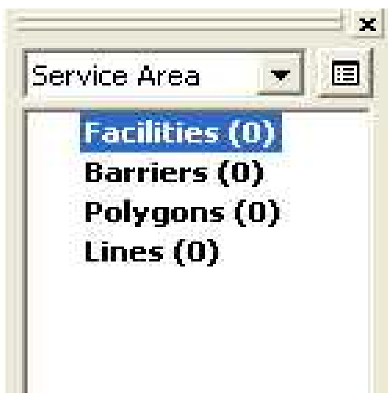


Figure (5.26): Network Analyst window of service area

Additionally, the table of contents contains a new Service Area analysis layer, Fig(5.27).

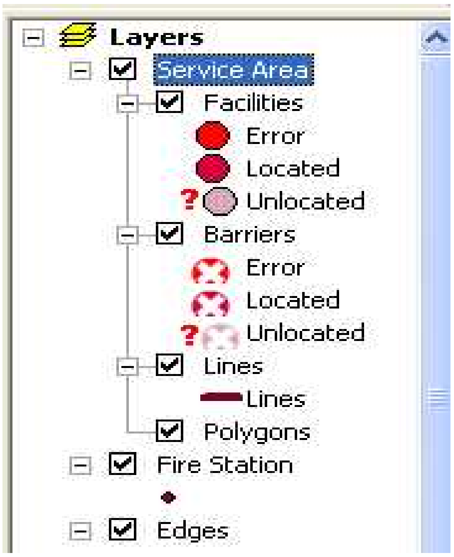


Figure (5.27): Table of the content with service area layer

* Adding facilities

you will add (Schools, pharmacies, Houses,…..) as facilities for which the service area polygons will be generated, Fig(5.28).

Figure (5.28): Loading facilities for service area generated polygons

1. Right-click Facilities (0) on the Network Analyst Window and select Load Locations. Select Schools in the Load From dropdown list and click OK, Fig(5.29).

2. The facilities are visible on the map

Figure (5.29): Schools as facilities to service area

*** Setting up the parameters for the analysis**

you will specify that your service area will be calculated based on Drive time (minutes). Three service area polygons will be calculated for each facility, one at 3 minutes, one at 5 minutes, and another at 10 minutes. You will specify that the direction of travel will be from the facility, not towards the facility, that no U-turns are allowed, and that one way restrictions must be followed.

1. In the Network Analyst Window, click the Analysis Layer Properties Button  to bring up the Layer Properties dialog box

2. Click the Analysis Settings tab.

3. Click the Impedance dropdown list and select Drive time (Minutes).

4. Type “2 5 10” in the Default polygon breaks text box. (Enter this as 2 5 10, the three numbers are separated by a space, without the quotes.)

5. Under Direction, click Away from facility.

6. Click Nowhere from the Allow U-turns dropdown list.

7. Check One way in the Restrictions list to honor one way restrictions.

8. Check the Ignore Invalid Locations checkbox.

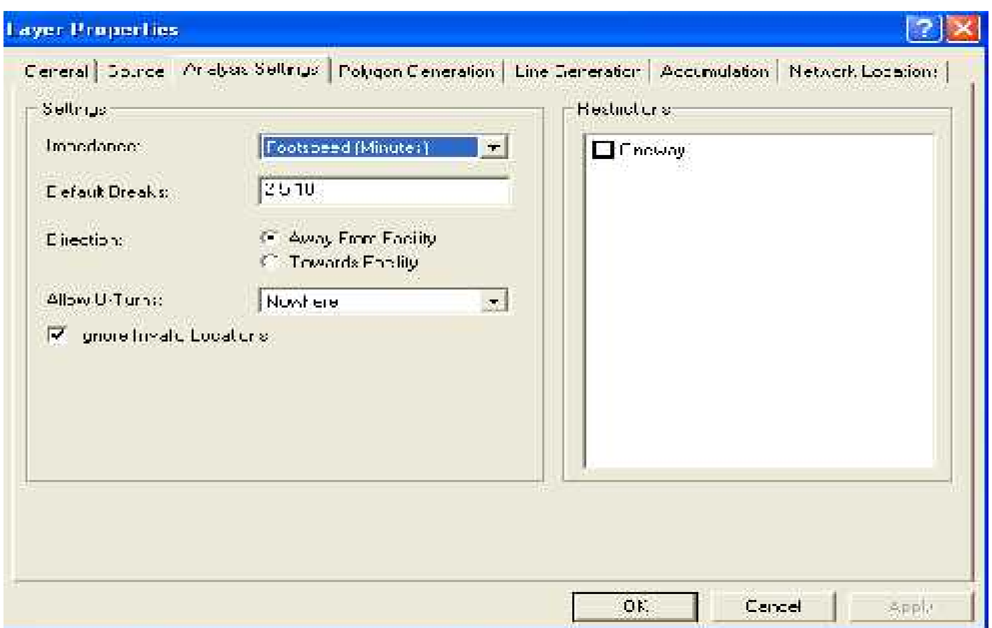


Figure (5.30): Setting parameters for service area

9. Click the Polygon Generation tab.

10. Make sure that Generate Polygons is checked.

11. Click Generalized for Polygon Type. This results in faster analysis. Detailed polygons are much more accurate, but need more time to be generated.

12. Click Separate polygons per facility under Multiple Facilities Options. This results in individual polygons per facility that may or may not overlap, Fig(5.31).

13. Click Rings for the Overlap type. This excludes areas of smaller breaks from the polygons of a bigger break.

14. Click Apply to save the settings.

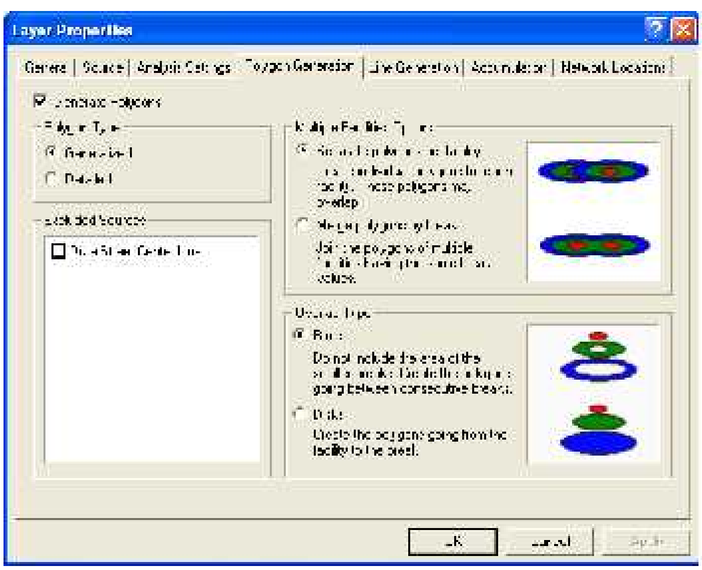


Figure (5.31): Setting parameters for service area polygons

17. Click OK to save your settings.

* **Run the process to compute the Service Area**

Click the Solve button on the Network Analyst toolbar. The service area polygons appear on the map and on the Network Analyst Window. There is a transparency set by default for the Polygons layer. This shows the underlying layers and gives an idea of the area under the polygons with respect to the street network.

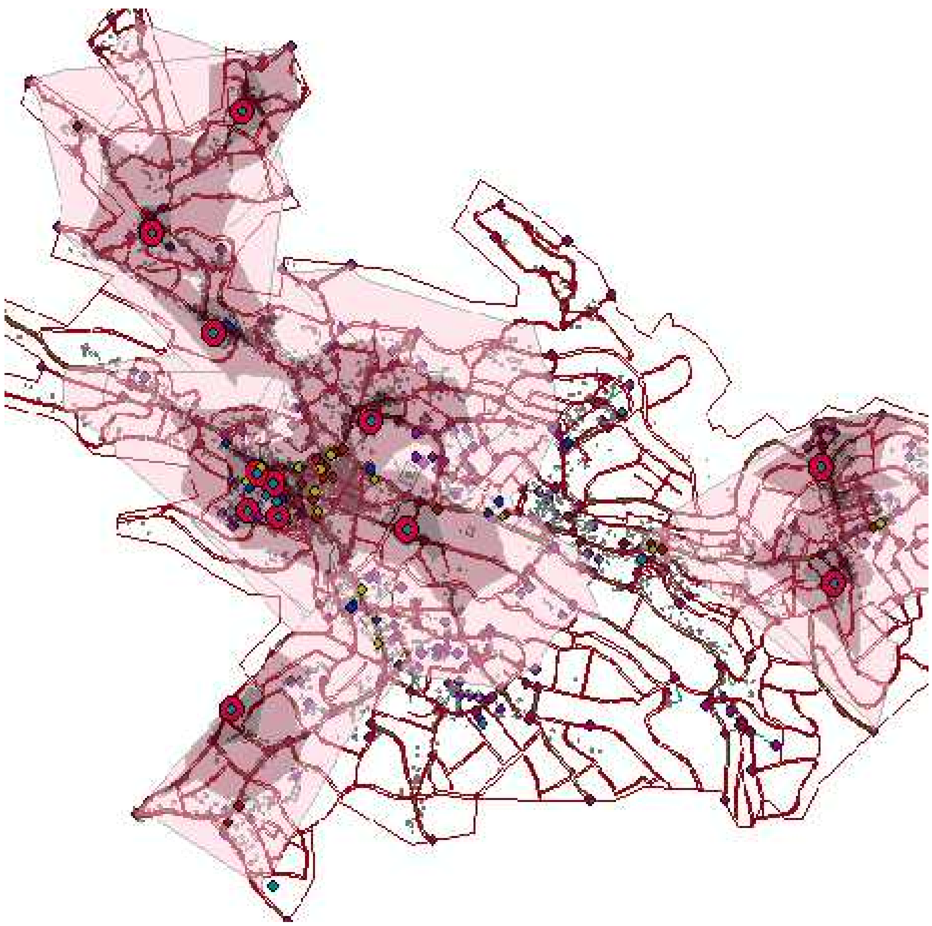


Figure (5.32): Service area based on 2,5 and 10 min drive time

* Identifying **Houses** that do not lie within any polygon

1. In the table of contents select and move the Houses feature layer to the top to improve visibility.

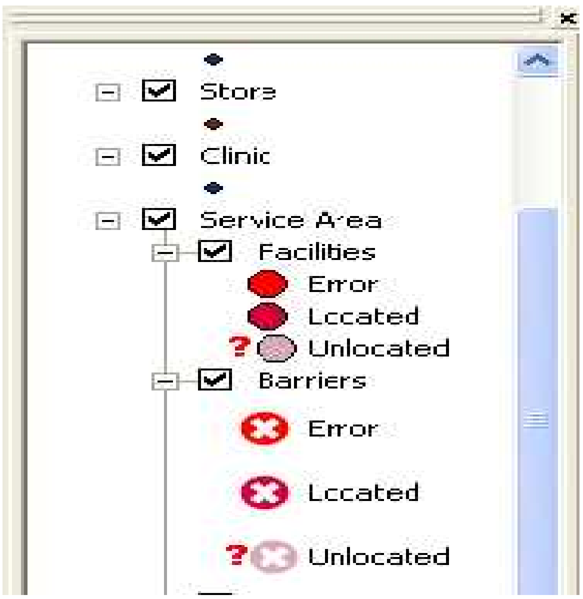


Figure (5.33):

2. Choose Select by Location from the Selection menu.

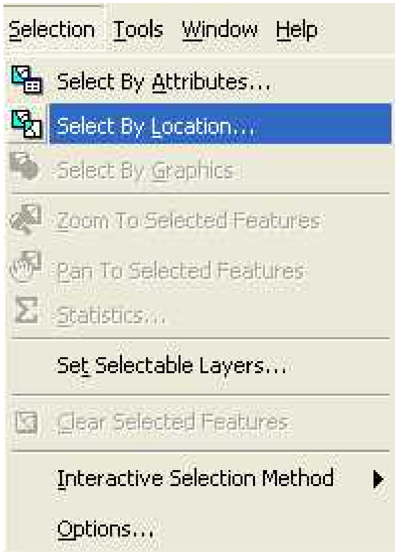


Figure (5.34): Selecting by location

3. Create the selection query in the Select by Location to select features from Houses that are completely within Polygons, Fig(5.35).

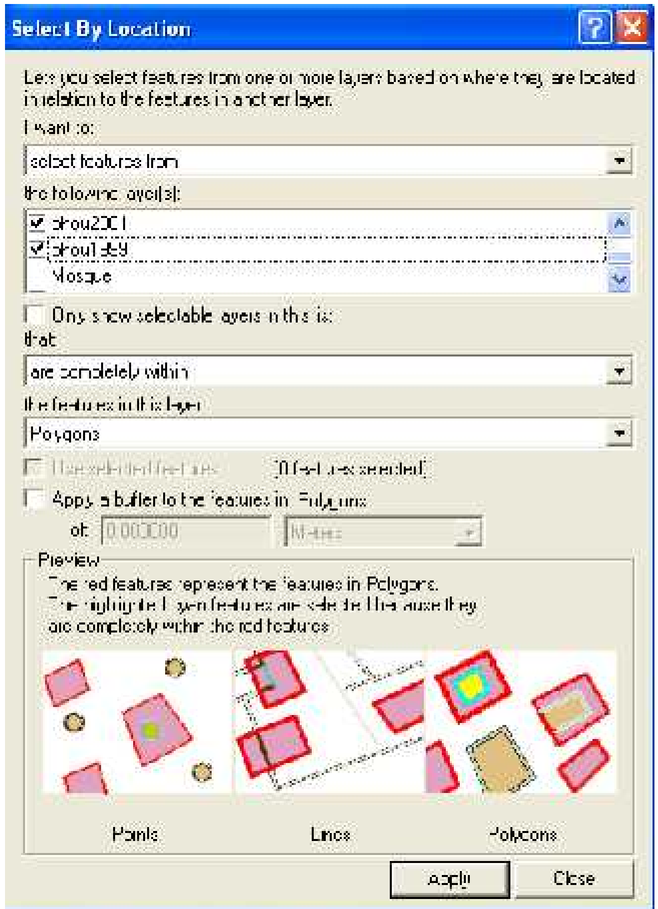


Figure (5.35): Select Houses that are completely within the service area

4. Click Apply. This will select all Houses that lie within service area polygons.

5. Click Close. You want to select Houses that are not within the service area polygons, which is the inverse of the current selection. To get the selection of houses that are not within the service area polygons, you can switch the selection.

6. Right-click houses in the Table of Contents, point to Selection and choose Switch Selection, Fig(5.36).

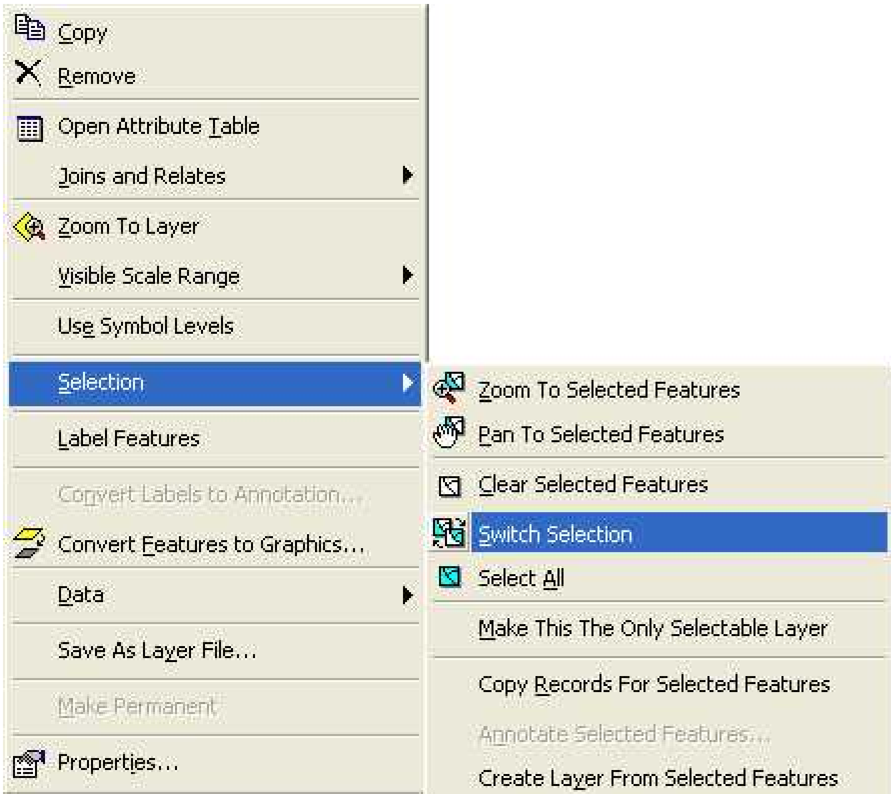


Figure (5.36): Switch selection to select the houses that are outside the service area

7. The selection now shows the distribution of Houses not contained in any service area polygon. You use this selection to identify the area to which you will relocate a Schools. This area appears to be in the center of the map, Fig(5.37).

Figure (5.37): The Houses outside the service area polygons

8. Right-click Houses in the Table of Contents, point to Selection and choose Clear Selected Features.

* **Relocating the least accessible Schools**.

Use the Select\Move Network Location Tool  to move one of the Schools to the unserved area to check the new service area, Fig(5.38).

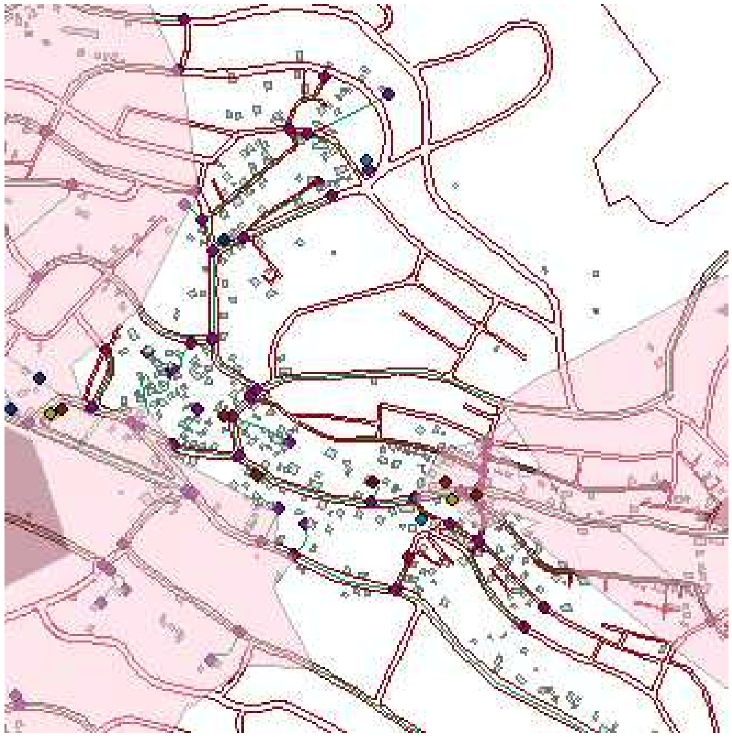


Figure (5.38): Before

5.3.2 Run the process to compute the Service Area

Click the Solve button  on the Network Analyst toolbar. The service area polygons appear on the map and on the Network Analyst Window, Fig(5.39).

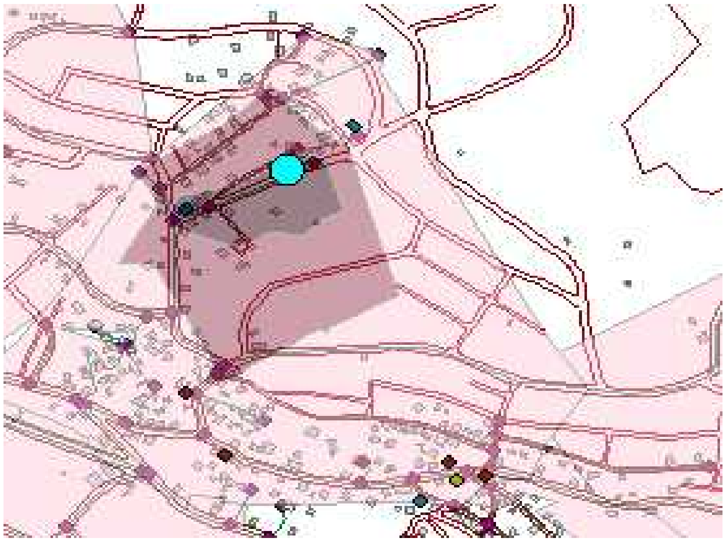


Figure (5.39): After

* **Identifying the service area polygon that each House lies within**

1. In the table of contents, right-click houses feature layer, point to Joins and Relates and select Join...

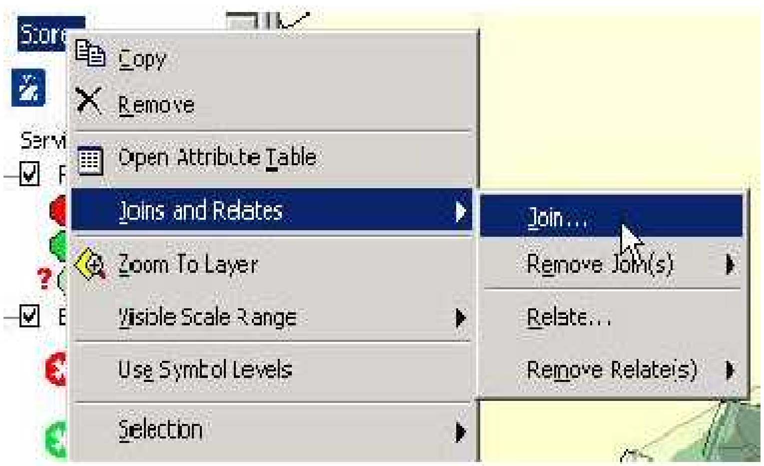


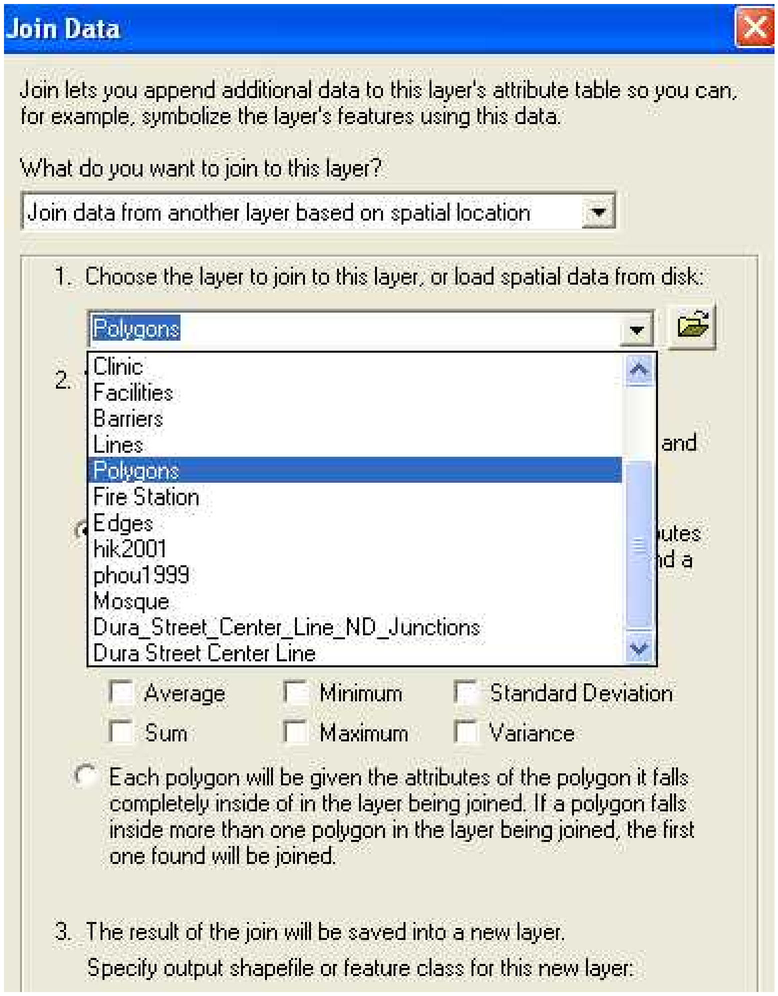
Figure (5.40):

2. Choose Join data from another layer based on spatial location

3. Select Polygons as the layer to join to this layer.

4. Select the first radio button labeled "it falls inside" to add the attributes of polygon to all points that fall inside the polygon.

5. Specify the output shape file to save the result of the join as Houses with Poly.shp.



Figure(5.41): Join data parameters

6. Click OK to perform the join.

7. Right-click the newly added Houses with Poly feature layer and select Open Attribute Table. Each row displays the name of the store and polygon it falls under. You can use this table to generate other useful categories such as the number of stores within 0-3 minute service area of schools, Fig (5.42).

Attributes of StoreswithPoly

FID	Shape	OBJECTID_1	OBJECTID	POI	NOM	ObjectID_2	FacilityID	Name	FromBreak	ToBreak
0	Point	2	6	CENTRE COMM	AU PRINTEMPS HAUSSMANN	11	2	Warehouse #2 : 5 - 10	5	10
1	Point	3	7	CENTRE COMM	GALERIES LAFAYETTE HAUSSMANN	11	2	Warehouse #2 : 5 - 10	5	10
2	Point	4	8	CENTRE COMM	ARCADES DU LIDO	11	2	Warehouse #2 : 5 - 10	5	10
3	Point	5	9	CENTRE COMM	GALERIE DU CLARIDGE	11	2	Warehouse #2 : 5 - 10	5	10
4	Point	6	10	CENTRE COMM	ELYSEE 26	11	2	Warehouse #2 : 5 - 10	5	10
5	Point	7	11	CENTRE COMM	GALERIE DES TROIS QUARTIERS	11	2	Warehouse #2 : 5 - 10	5	10
6	Point	9	14	CENTRE COMM	ESPACE EXPANSION FORUM DES HALLES	11	2	Warehouse #2 : 5 - 10	5	10
7	Point	12	17	CENTRE COMM	BAZAR DE L'HOTEL-DE-VILLE	11	2	Warehouse #2 : 5 - 10	5	10
8	Point	18	23	CENTRE COMM	MAINE-MONTPARNASSE	11	2	Warehouse #2 : 5 - 10	5	10
9	Point	19	24	CENTRE COMM	GAITE	11	2	Warehouse #2 : 5 - 10	5	10
10	Point	13	18	CENTRE COMM	GALERIE COMMERCIALE PASSY PLAZA	28	5	Warehouse #5 : 5 - 10	5	10
11	Point	8	13	CENTRE COMM	GALERIE SAINT DIDIER	29	6	Warehouse #6 : 5 - 10	5	10
12	Point	20	25	CENTRE COMM	ITALIE 2	24	4	Warehouse #4 : 5 - 10	5	10
13	Point	21	26	CENTRE COMM	CENTRE COMMERCIAL MASSENA 13	24	4	Warehouse #4 : 5 - 10	5	10
14	Point	11	16	CENTRE COMM	SAMARITAINE	27	2	Warehouse #2 : 3 - 5	3	5
15	Point	14	19	CENTRE COMM	LE MARCHE SAINT GERMAIN	27	2	Warehouse #2 : 3 - 5	3	5
16	Point	15	20	CENTRE COMM	LE BON MARCHE	27	2	Warehouse #2 : 3 - 5	3	5
17	Point	1	5	CENTRE COMM	LES BOUTIQUES DU PALAIS DES CONGRES	25	6	Warehouse #6 : 3 - 5	3	5
18	Point	17	22	CENTRE COMM	S.C.I. BEAUGRENELLE	31	5	Warehouse #5 : 0 - 3	0	3
19	Point	16	21	CENTRE COMM	PRINTEMPS NATION	33	3	Warehouse #3 : 0 - 3	0	3
20	Point	10	15	CENTRE COMM	GALERIE CARROUSEL DU LOUVRE	38	2	Warehouse #2 : 0 - 3	0	3

Record: 0 Show: All Selected Records (0 out of 21 Selected.) Options

Figure (5.42): Attribute table of Houses with service area information

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

6.2 Recommendations

This chapter includes all results and recommendations of this graduated project

6.1 Conclusions

1. This is the first trail to built a suitable streets network, for the Dura city, which works under ArcGIS network analyst extension. The prepared network will help the vehicle drivers, ambulance vehicle, police, planners and ministry of education and many others.

2. Geometric Network shows a great efficiency as a network editing tool.

3. This project built a computerized spatial database, which will help local government, education sector, and emergency cases.

4. GPS technology can be applied with pocket pc to ultimate the using of this spatial network moving vehicles such as police cars, ambulance, private and public cars.

5. We Updated the Dura streets network up to the year 2005.

6.2 Recommendations

1. Applying this new technology in daily uses of police officers, local government, and in the ministry of planning..

2. Modify the street addresses of Dura Streets to match the universal standards

Chapter Six

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1. Applying this new technology daily uses of police officers, local government, and in the ministry of planning..

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6.3 Reference

1. Police Department

2. Fire Station Department

3. Dura municipality Engineering Department

4. Educational Department

5. Palestinian Pharmacy Association

6. Gradated project for Samer Eissa (Building a Network for Schools in Hebron District).

7. الهلال الحمر الفلسطيني

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APPENDIX-A
COMPUTER PROGRAMS USED IN THE PROJECT

A-1 ArcView 3.2a

It is a Geographic Information System “GIS” computer package that produced by the Environmental System Research “ESRI” a leading company in GIS Industry. It is one version of many series versions of GIS packages by ESRI.

A-2 Arc GIS desktop- Arc View

is full-featured GIS software for visualizing, analyzing, creating, and managing data with a geographic component. Most data has a component that can be tied to a place: an address, postal code, global positioning system location, census block, city, region, country, or other location. ArcView allows you to visualize, explore, and analyze this data, revealing patterns, relationships, and trends that are not readily apparent in databases, spreadsheets, or statistical packages.

A-3 ArcMap

ArcMap is a comprehensive map-authoring application for ArcGIS Desktop (ArcInfo, ArcEditor, and ArcView). It is the central application for all map-based tasks including cartography, map analysis, and editing.

ArcMap offers two types of map views:

Geographic data view—an environment where geographic layers are symbolized, analyzed, and compiled into GIS datasets. A table of contents interface organizes and controls the drawing properties of the GIS data layers in the data frame. The data view is a window into any GIS dataset for a given area.

Page layout view—an environment where map pages contain geographic data views as well as other map elements such as scale bars, legends, north arrows, and reference maps. The page layout view is used to compose maps on pages for printing and publishing.

A-4 ArcGIS

Is an integrated collection of GIS software products for building a complete GIS .ArcGIS enables users to deploy GIS functionality wherever it is needed—in desktops, servers, or custom applications; over the Web; or in the field.

A-5 ArcInfo

is the most complete GIS available. It includes all the functionality of ArcView and ArcEditor and adds advanced spatial analysis, data manipulation, and high-end cartography tools. Professional GIS users use ArcInfo for all aspects of data building, modeling, analysis, and map display.

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is a powerful GIS desktop system for editing and managing geographic data. ArcEditor is a member of the ArcGIS family of GIS products and includes all the functionality of ArcView and adds a comprehensive set of tools to create, edit, and ensure the quality of your data.

ArcEditor supports single-user editing as well as a collaborative process between many editors. An extensive set of tools is included for simple data cleanup and input as well as for sophisticated design and versioning.

A-7 ArcGIS Network Analyst Extension

Is a powerful extension that provides network-based spatial analysis including routing, travel directions, closest facility, and service area analysis. ArcGIS Network Analyst enables users to dynamically model realistic network conditions, including turn restrictions, speed limits, height restrictions, and traffic conditions, at different times of the day.

A-8 ArcCatalog

ArcCatalog is a shared ArcGIS application that allows you to organize and access all GIS information such as maps, globes, datasets, models, metadata, and services. It includes tools to

- Browse and find geographic information
- Record, view, and manage metadata
- Define, export, and import geodatabase schemas and designs
- Search and browse GIS data on local networks and the Web
- Administer an ArcGIS Server

Users employ ArcCatalog to organize, find, and use GIS data as well as document data holdings using standards-based metadata. A GIS database administrator uses ArcCatalog to define and build geodatabases. A GIS server administrator uses ArcCatalog to administer the GIS server framework.

A-9 AutoCAD 2004

This is Cartographic Aided drawing program is a drawing program used for drawing any thing, like: land representation, Parcels, buildings, and other application like machine drawing in 3D model …..Etc.
It is same as AutoCAD 14, 2000, and 2002, a new version of CAD and the more powerful one to make powerful drawing.

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APPENDIX-B
SOME OF DEFINITION'S

B-1 Attribute

1. Non spatial information about a geographic feature in a GIS usually stored in a table and linked to the feature by a unique identifier. For example, attributes of a river might include its name, length, and sediment load at a gauging station.
2. In raster datasets, information associated with each unique value of a raster cell.
3. Information that specifies how features are displayed and labeled on a map; for example, the graphic attributes of a river might include line thickness, line length, color, and font for labeling.

B-2 Attribute table

1. A database or tabular file containing information about a set of geographic features, usually arranged so that each row represents a feature and each column represents one feature attribute. In raster datasets, each row of an attribute table corresponds to a certain zone of cells having the same value. In a GIS, attribute tables are often joined or related to spatial data layers, and the attribute values they contain can be used to find, query, and symbolize features or raster cells.

B-3 Azimuthal projection

1. A map projection that transforms points from a spheroid or sphere onto a tangent or secant plane. The azimuthal projection is also known as a planar or zenithal projection.

B-4 Shapefile

1. A vector data storage format for storing the location, shape, and attributes of geographic features. A shapefile is stored in a set of related files and contains one feature class.

B-5 Simple edge feature

1. In a geodatabase, a line feature that corresponds to a single network element in the logical network.

B-6 Barrier

1. In network analysis, an entity that prevents flow from traversing a network edge or junction.
2. A line feature used to keep certain points from being used in the calculation of new values when a raster is interpolated. The line can represent a cliff, ridge, or some other interruption in the landscape. Only the sample points on the same side of the barrier as the current processing cell will be considered.
3. For geometric networks in ArcMap, a temporary graphic that is placed on the network, past which a trace cannot continue.
4. For geometric network datasets in ArcMap, a network location in a network analysis layer that restricts the traversability of a network element (edge or junction) in the network dataset.

B-7 Theme

1. In ArcView, a set of related geographic features such as streets, parcels, or rivers, along with their attributes. All features in a theme share the same coordinate system, are located within a common geographic extent, and have the same attributes. Themes are similar to layers in ArcGIS 8.x and 9.0.

B-8 Layer

1. The visual representation of a geographic dataset in any digital map environment. Conceptually, a layer is a slice or stratum of the geographic reality in a particular area, and is more or less equivalent to a legend item on a paper map. On a road map, for example, roads, national parks, political boundaries, and rivers might be considered different layers.
2. In ArcGIS, a reference to a data source, such as a shapefile, coverage, geodatabase feature class, or raster, that defines how

the data should be symbolized on a map. Layers can also define additional properties, such as which features from the data source are included. Layers can be stored in map documents (.mxd) or saved individually as layer files (.lyr). Layers are conceptually similar to themes in ArcView 3.x.

B-9 Feature layer

1. A layer that references a set of feature data. Feature data represents geographic entities as points, lines, and polygons.

B-10 CAD layer

1. A layer that references a set of CAD data. CAD data is vector data of a mixed feature type. CAD layers may be of two types: CAD drawing dataset layers, in which one map layer represents the entire CAD file, and CAD feature layers, in which data is organized by geometry type.
2. A component of a CAD drawing file. CAD layers are the digital equivalent of acetates in overlay drafting, and are powerful tools for organizing a drawing into logical categories. CAD layers and levels may be managed with ArcGIS. In MicroStation, layers are also referred to as levels.

B-11 Centerline

1. A line digitized along the center of a linear geographic feature, such as a street or a river that at a large enough scale would be represented by a polygon.

B-12 Connectivity

1. The way in which features in GIS data are attached to one another functionally or spatially.
2. In a geodatabase, the state of association between edges and junctions in a network system for network data models. Connectivity helps define and control flow, tracing, and path finding in a network.
3. In a coverage, topological identification of connected arcs by recording the from-node and to-node for each arc. Arcs that share a common node are connected.

B-13 Connectivity group

1. In network datasets, a logical grouping of point features, line features, or both, that controls how network elements is connected. Connectivity groups are defined when a network dataset is built. A network dataset may have multiple connectivity groups.

B-14 Geodatabase

1. A collection of geographic datasets for use by ArcGIS. There are various types of geographic datasets, including feature classes, attribute tables, raster datasets, network datasets, topologies, and many others.

B-15 Edge

1. A line between two points that forms a boundary. In a geometric shape, an edge forms the boundary between two faces. In an image, edges separate areas of different tones or colors. In topology, an edge defines lines or polygon boundaries.

B-16 Export

1. To move data from one computer system to another, and often, in the process, from one file format to another.

B-17 Extension

1. In ArcGIS, an optional software module that adds specialized tools and functionality to ArcGIS Desktop. ArcGIS Network Analyst, ArcGIS StreetMap, and ArcGIS Business Analyst are examples of ArcGIS extensions.

B-18 Feature

A representation of a real-world object on a map

B-19 Point feature

1. A map feature that has neither length nor area at a given scale, such as a city on a world map or a building on a city map.

2. In ArcGIS software, a digital map feature that represents a place or thing that has neither length nor area at a given scale.

B-20 Polygon feature

1. A map feature that bounds an area at a given scale, such as a country on a world map or a district on a city map.
2. In ArcGIS software, a digital map feature that represents a place or thing that has area at a given scale. A polygon feature may have one or more parts. For example, a building footprint is typically a polygon feature with one part. If the building has a detached unit, it might be represented as a multipart feature with discontinuous parts. If the detached unit is in an interior courtyard, the building might be represented as a multipart feature with nested parts. A multipart polygon feature is associated with a single record in an attribute table.

B-21 Polyline feature

1. In ArcGIS software, a digital map feature that represents a place or thing that has length but not area at a given scale. A polyline feature may have one or more parts. For example, a stream is typically a polyline feature with one part. If the stream goes underground and later reemerges, it might be represented as a multipart polyline feature with discontinuous parts. If the stream diverges around an island and then rejoins itself, it might be represented as a multipart polyline feature with branching parts. A multipart polyline feature is associated with a single record in an attribute table.

B-22 Line feature

1. A map feature that has length but not area at a given scale, such as a river on a world map or a street on a city map.

B-23 Geometric network

1. Edge and junction features that represent a linear network, such as a utility or hydrologic system, in which the connectivity of features is based on their geometric coincidence. A geometric network does not contain information about the connectivity of features; this information is stored within a logical network. Geometric networks are typically used to model directed flow systems.

B-24 Geometric element

1. One of the most basic parts or components of a geometric figure: that is, a surface, shape, point, line, angle, or solid

B-25 junction

1. For network data models in a geodatabase, a point at which two or more edges meet.
2. In a coverage, a node joining two or more arcs.

B-26 Junction connectivity policy

1. In network datasets, a connectivity policy that defines how a junction may connect to an edge. There are two junction connectivity policies: honor and override.

B-27 Layout

1. The arrangement of elements on a map, possibly including a title, legend, north arrow, scale bar, and geographic data.
2. In ArcGIS, a presentation document incorporating maps, charts, tables, text, and images.
3. In ArcView 3.x, one of the five types of documents that can be contained within a project file. A layout is used to prepare hard copy maps. It can be composed of views, tables, charts, imported graphics, and graphic primitives and can also contain cartographic elements such as scale bars and north arrows.

B-28 Network attribute

1. A type of attribute associated with a network element in a network dataset. Network attributes are used to help control flow through a network (similar to a weight in a geometric network). All network elements in a network dataset have the same set of

attributes. There are four types of network attributes: cost, descriptor, hierarchy, and restriction.

B-29 Cost

1. A function of time, distance, or any other factor that incurs difficulty or an outlay of resources.
2. In ArcGIS Network Analyst, an attribute of a network element used to model impedance and demand in network datasets. Cost is an attribute that is accumulated during traversal of a network.

B-30 Hierarchy

1. A type of network attribute for a network element in a network dataset. Hierarchy can be used during network analysis to assign priority to a network element. For example, in a transportation network dataset, a "road class" hierarchy can be assigned to edges to favor major roads instead of local streets.

B-31 Restriction

1. A Boolean network element attribute used for limiting traversal through a network dataset. "One way street," "no trucks allowed," and "buses only" are examples of restrictions

B-32 Descriptor

1. A type of attribute for network elements that cannot be apportioned. The value of a descriptor stays the same through the length of an edge element in a network dataset. Descriptors describe characteristics of the element; for example, the number of lanes for a particular road in a road network.

B-33 Route

1. Any line feature, such as a street, highway, river, or pipe that has a unique identifier.
2. A path through a network.

B-34 Route analysis

1. In ArcGIS Network Analyst, a type of network analysis that determines the best route from one network location to one or

more other locations. It can also calculate the quickest or shortest route depending on the impedance chosen. The order of the stops may be determined by the user. For example, if the impedance is time, then the best route is the quickest route.

B-35 Stop

1. In ArcGIS Network Analyst, a network location used to determine a route in route analysis. Users can specify multiple stops, of which two must be used to represent an origin and a destination. Stops in between (known as intermediary stops) are visited en route from the first to the last stop.

B-36 Street network

1. A system of interconnecting lines and points that represent a system of roads for a given area. A street network provides the foundation for network analysis; for example, finding the best route or creating service areas.

B-37 Tool

1. A command that requires interaction with the GUI before an action is performed. For example, a zoom tool requires a user to use the mouse to click on or draw a box over a digital map before the tool will cause the map to be redrawn at a larger scale.
2. A geoprocessing command in ArcGIS that performs such specific tasks as clip, split, erase, or buffer.

B-38 Toolbar

1. A graphical user interface (GUI) with buttons that allow users to execute software commands

B-39 WGS84

1. Acronym for *World Geodetic System 1984*. The most widely used geocentric datum and geographic coordinate system today, designed by the U.S. Department of Defense to replace WGS72. GPS measurements are based on WGS84.

40 B-field

A column in a table that stores the values for a single attribute.

APPENDIX-C
SOME OF FIGURES AND TABELS

بسم ا الرحمن الرحيم

جامعة بوليتكنك فلسطين

Palestine Polytechnic University

استبيان عن تقدير السرعة على الطرق في مدينة دورا

1-وقت الإزدحام المروري (11-2) مساء

***السؤال الأول:**

معدل سرعة السيارة في الأماكن التي يوجد بها ازدحام مثل (....................................).

1. 20km /hr
2. 25km/hr
3. 30km/hr
4. 35km/hr
5. غير ذلك (حدد)
6. لا أعرف .

السؤال الثاني:

معدل سرعة السيارة في الشوارع الرئيسية مثل (...).

1. 40km/hr
2. 45km/hr
3. 50km/hr
4. 55km/hr
5. غير ذلك (حدد)
6. لا أعرف .

***السؤال الثالث:**

معدل سرعة السيارة في الشوارع غير النافذة .

1. 30km/hr
2. 35km/hr
3. 40km/hr
4. 45km/hr
5. غير ذلك (حدد)
6. لا أعرف .

بسم ا   الرحمن الرحيم

جامعة بوليتكنك فلسطين

Palestine Polytechnic University

استبيان عن تقدير السرعة على الطرق في مدينة دورا

2. وقت الإزدحام المروري (9-7.30) صباحا

***السؤال الأول:**

معدل سرعة السيارة في الأماكن التي يوجد بها ازدحام مثل (....................................).

1. 20km /hr
2. 25km/hr
3. 30km/hr
4. 35km/hr
5. غير ذلك (حدد)
6. لا أعرف .

السؤال الثاني:

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1. 40km/hr
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4. 55km/hr
5. غير ذلك (حدد)
6. لا أعرف .

***السؤال الثالث:**

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1. 30km/hr
2. 35km/hr
3. 40km/hr
4. 45km/hr
5. غير ذلك (حدد)
6. لا أعرف .

بسم ا الرحمن الرحيم
جامعة بوليتكنك فلسطين
Palestine Polytechnic University

استبيان عن تقدير سرعة سيارة الإسعاف على الطرق في مدينة دورا

2.عند عدم وجود إختناقات مرورية (حوادث سير)

*السؤال الأول:
معدل سرعة السيارة في الأماكن التي يوجد بها ازدحام مثل (....................................).

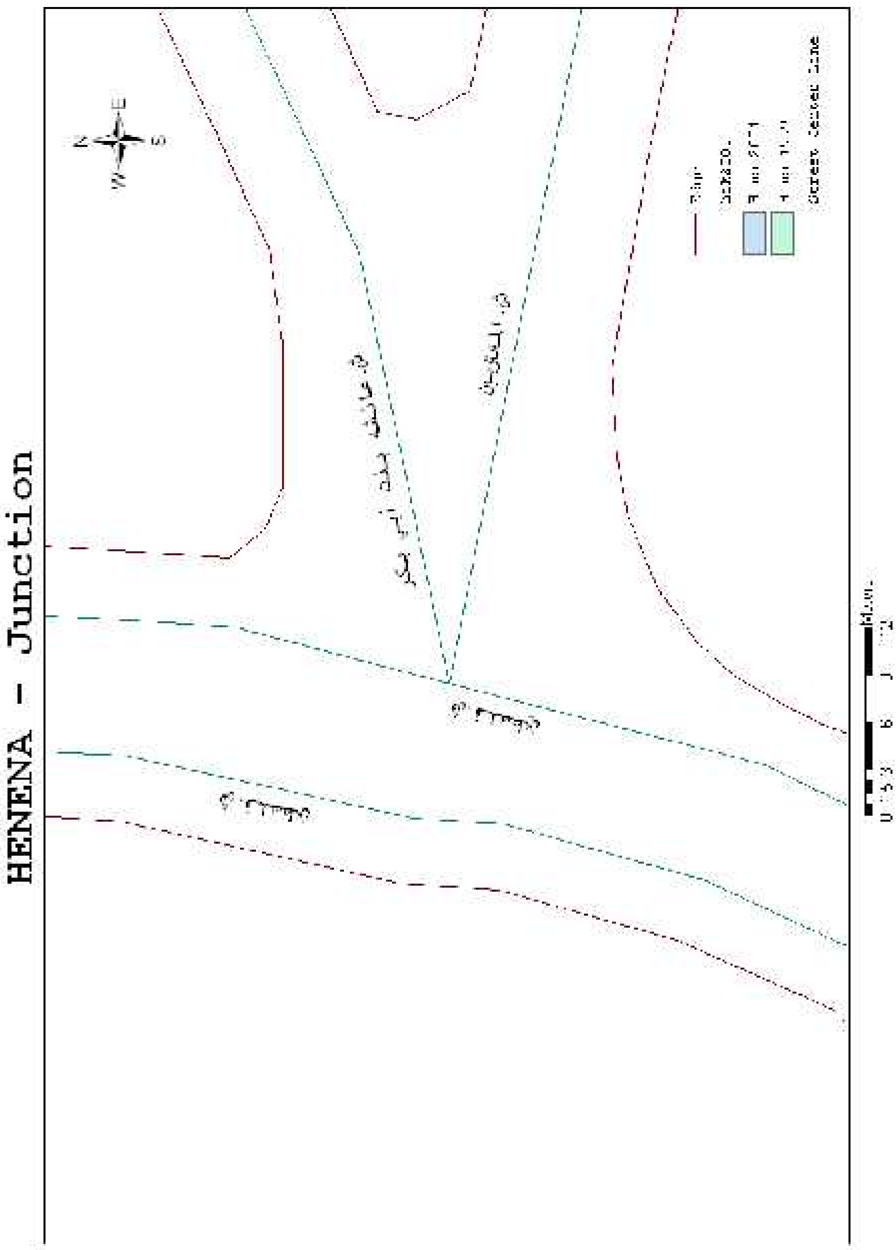
1.20km /hr   2. 25km/hr
3.30km/hr   4. 35km/hr
5.غير ذلك (حدد)   6. لا أعرف .

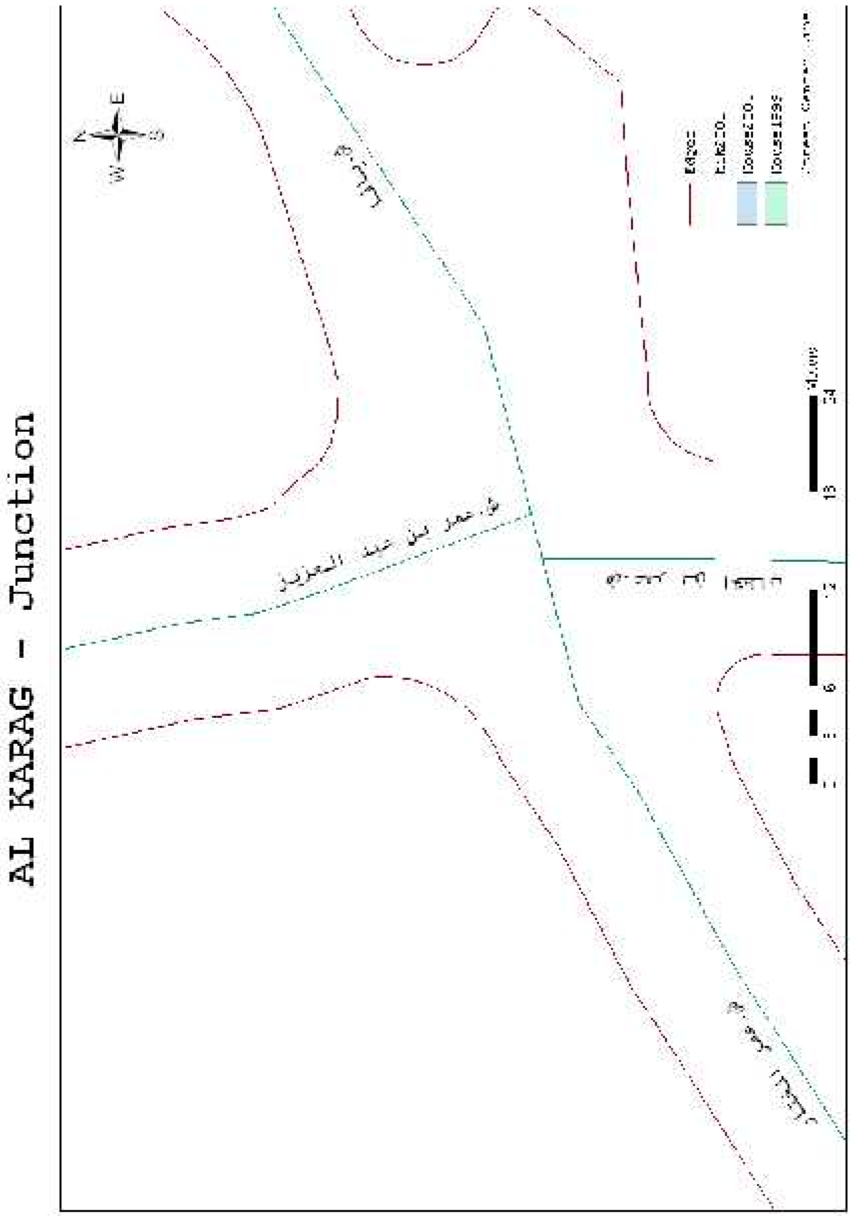
السؤال الثاني:
معدل سرعة السيارة في الشوارع الرئيسية مثل (..).

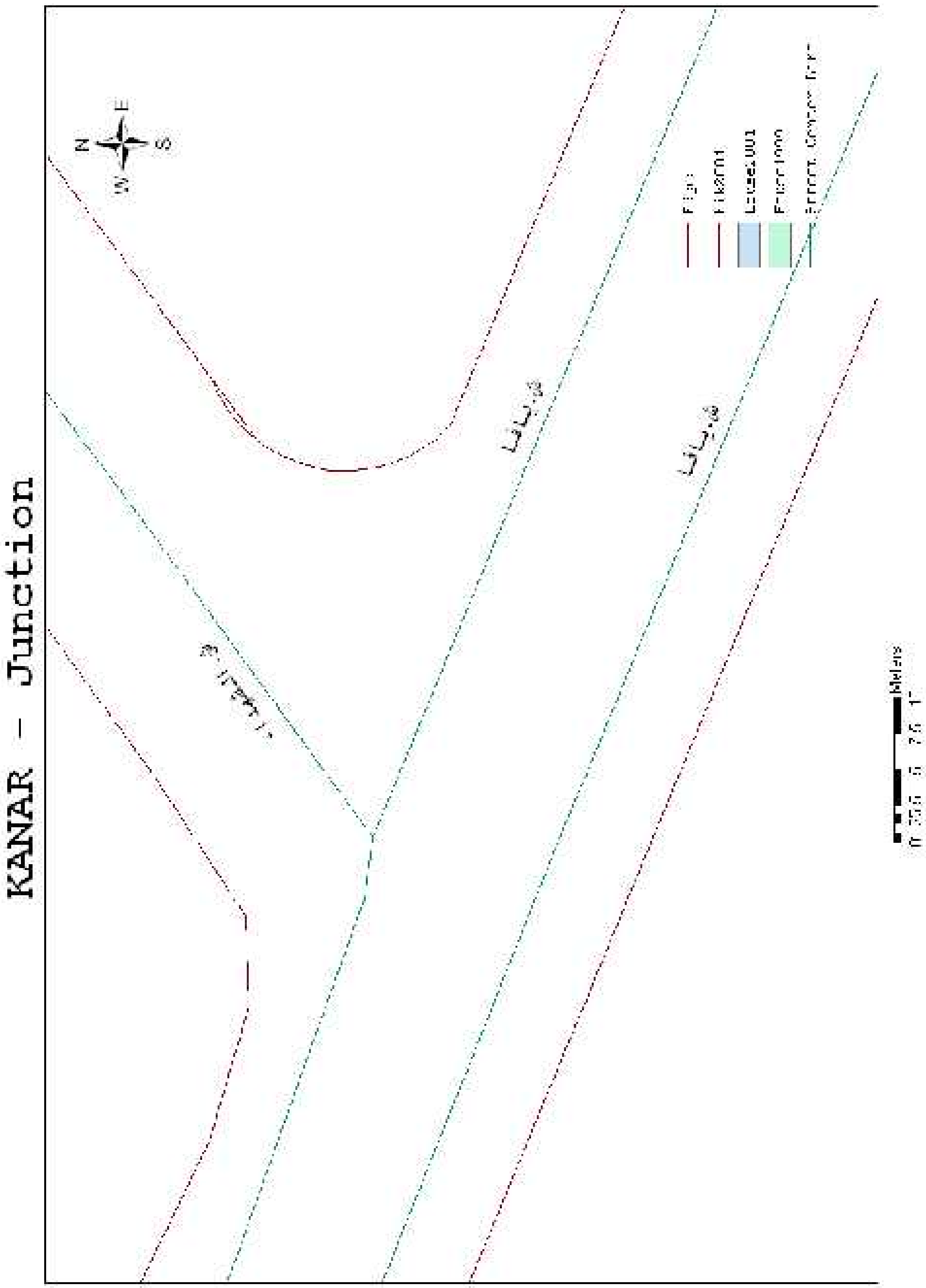
1.40km/hr   2. 45km/hr
3.50km/hr   4. 55km/hr
5. غير ذلك (حدد)   6. لا أعرف .

*السؤال الثالث:
معدل سرعة السيارة في الشوارع غير النافذة .

1.30km/hr   2. 35km/hr
3.40km/hr   4. 45km/hr
5. غير ذلك (حدد)   6. لا أعرف .


HENENA - Junction


AL KARAG - Junction


KANAR - Junction
N
E
S
W
Meters

APPENDIX-A
COMPUTER PROGRAMS USED IN THE PROJECT

A-1 ArcView 3.2a

It is a Geographic Information System “GIS” computer package that produced by the Environmental System Research “ESRI” a leading company in GIS Industry. It is one version of many series versions of GIS packages by ESRI.

A-2 Arc GIS desktop- Arc View

is full-featured GIS software for visualizing, analyzing, creating, and managing data with a geographic component. Most data has a component that can be tied to a place: an address, postal code, global positioning system location, census block, city, region, country, or other location. ArcView allows you to visualize, explore, and analyze this data, revealing patterns, relationships, and trends that are not readily apparent in databases, spreadsheets, or statistical packages.

A-3 ArcMap

ArcMap is a comprehensive map-authoring application for ArcGIS Desktop (ArcInfo, ArcEditor, and ArcView). It is the central application for all map-based tasks including cartography, map analysis, and editing.

ArcMap offers two types of map views:

Geographic data view—an environment where geographic layers are symbolized, analyzed, and compiled into GIS datasets. A table of contents interface organizes and controls the drawing properties of the GIS data layers in the data frame. The data view is a window into any GIS dataset for a given area.

Page layout view—an environment where map pages contain geographic data views as well as other map elements such as scale bars, legends, north arrows, and reference maps. The page layout view is used to compose maps on pages for printing and publishing.

A-4 ArcGIS

Is an integrated collection of GIS software products for building a complete GIS .ArcGIS enables users to deploy GIS functionality wherever it is needed—in desktops, servers, or custom applications; over the Web; or in the field.

A-5 ArcInfo

is the most complete GIS available. It includes all the functionality of ArcView and ArcEditor and adds advanced spatial analysis, data manipulation, and high-end cartography tools. Professional GIS users use ArcInfo for all aspects of data building, modeling, analysis, and map display.

A-6 ArcEditor

is a powerful GIS desktop system for editing and managing geographic data. ArcEditor is a member of the ArcGIS family of GIS products and includes all the functionality of ArcView and adds a comprehensive set of tools to create, edit, and ensure the quality of your data.

ArcEditor supports single-user editing as well as a collaborative process between many editors. An extensive set of tools is included for simple data cleanup and input as well as for sophisticated design and versioning.

A-7 ArcGIS Network Analyst Extension

Is a powerful extension that provides network-based spatial analysis including routing, travel directions, closest facility, and service area analysis. ArcGIS Network Analyst enables users to dynamically model realistic network conditions, including turn restrictions, speed limits, height restrictions, and traffic conditions, at different times of the day.

A-8 ArcCatalog

ArcCatalog is a shared ArcGIS application that allows you to organize and access all GIS information such as maps, globes, datasets, models, metadata, and services. It includes tools to

- Browse and find geographic information
- Record, view, and manage metadata
- Define, export, and import geodatabase schemas and designs
- Search and browse GIS data on local networks and the Web
- Administer an ArcGIS Server

Users employ ArcCatalog to organize, find, and use GIS data as well as document data holdings using standards-based metadata. A GIS database administrator uses ArcCatalog to define and build geodatabases. A GIS server administrator uses ArcCatalog to administer the GIS server framework.

A-9 AutoCAD 2004

This is Cartographic Aided drawing program is a drawing program used for drawing any thing, like: land representation, Parcels, buildings, and other application like machine drawing in 3D model …..Etc.
It is same as AutoCAD 14, 2000, and 2002, a new version of CAD and the more powerful one to make powerful drawing.

APPENDIX-B
SOME OF DEFINITION'S

B-1 Attribute

1. Nonspatial information about a geographic feature in a GIS usually stored in a table and linked to the feature by a unique identifier. For example, attributes of a river might include its name, length, and sediment load at a gauging station.
2. In raster datasets, information associated with each unique value of a raster cell.
3. Information that specifies how features are displayed and labeled on a map; for example, the graphic attributes of a river might include line thickness, line length, color, and font for labeling.

B-2 Attribute table

1. A database or tabular file containing information about a set of geographic features, usually arranged so that each row represents a feature and each column represents one feature attribute. In raster datasets, each row of an attribute table corresponds to a certain zone of cells having the same value. In a GIS, attribute tables are often joined or related to spatial data layers, and the attribute values they contain can be used to find, query, and symbolize features or raster cells.

B-3 Azimuthal projection

1. A map projection that transforms points from a spheroid or sphere onto a tangent or secant plane. The azimuthal projection is also known as a planar or zenithal projection.

B-4 Shapefile

1. A vector data storage format for storing the location, shape, and attributes of geographic features. A shapefile is stored in a set of related files and contains one feature class.

B-5 Simple edge feature

1. In a geodatabase, a line feature that corresponds to a single network element in the logical network.

B-6 Barrier

1. In network analysis, an entity that prevents flow from traversing a network edge or junction.
2. A line feature used to keep certain points from being used in the calculation of new values when a raster is interpolated. The line can represent a cliff, ridge, or some other interruption in the landscape. Only the sample points on the same side of the barrier as the current processing cell will be considered.
3. For geometric networks in ArcMap, a temporary graphic that is placed on the network, past which a trace cannot continue.
4. For geometric network datasets in ArcMap, a network location in a network analysis layer that restricts the traversability of a network element (edge or junction) in the network dataset.

B-7 Theme

1. In ArcView, a set of related geographic features such as streets, parcels, or rivers, along with their attributes. All features in a theme share the same coordinate system, are located within a common geographic extent, and have the same attributes. Themes are similar to layers in ArcGIS 8.x and 9.0.

B-8 Layer

1. The visual representation of a geographic dataset in any digital map environment. Conceptually, a layer is a slice or stratum of the geographic reality in a particular area, and is more or less

equivalent to a legend item on a paper map. On a road map, for example, roads, national parks, political boundaries, and rivers might be considered different layers.

2. In ArcGIS, a reference to a data source, such as a shapefile, coverage, geodatabase feature class, or raster, that defines how the data should be symbolized on a map. Layers can also define additional properties, such as which features from the data source are included. Layers can be stored in map documents (.mxd) or saved individually as layer files (.lyr). Layers are conceptually similar to themes in ArcView 3.x.

B-9 Feature layer

1. A layer that references a set of feature data. Feature data represents geographic entities as points, lines, and polygons.

B-10 CAD layer

1. A layer that references a set of CAD data. CAD data is vector data of a mixed feature type. CAD layers may be of two types: CAD drawing dataset layers, in which one map layer represents the entire CAD file, and CAD feature layers, in which data is organized by geometry type.
2. A component of a CAD drawing file. CAD layers are the digital equivalent of acetates in overlay drafting, and are powerful tools for organizing a drawing into logical categories. CAD layers and levels may be managed with ArcGIS. In MicroStation, layers are also referred to as levels.

B-11 Centerline

1. A line digitized along the center of a linear geographic feature, such as a street or a river that at a large enough scale would be represented by a polygon.

B-12 Connectivity

1. The way in which features in GIS data are attached to one another functionally or spatially.

2. In a geodatabase, the state of association between edges and junctions in a network system for network data models. Connectivity helps define and control flow, tracing, and path finding in a network.
3. In a coverage, topological identification of connected arcs by recording the from-node and to-node for each arc. Arcs that share a common node are connected.

B-13 Connectivity group

1. In network datasets, a logical grouping of point features, line features, or both, that controls how network elements is connected. Connectivity groups are defined when a network dataset is built. A network dataset may have multiple connectivity groups.

B-14 Geodatabase

1. A collection of geographic datasets for use by ArcGIS. There are various types of geographic datasets, including feature classes, attribute tables, raster datasets, network datasets, topologies, and many others.

B-15 Edge

1. A line between two points that forms a boundary. In a geometric shape, an edge forms the boundary between two faces. In an image, edges separate areas of different tones or colors. In topology, an edge defines lines or polygon boundaries.

B-16 Export

1. To move data from one computer system to another, and often, in the process, from one file format to another.

B-17 Extension

1. In ArcGIS, an optional software module that adds specialized tools and functionality to ArcGIS Desktop. ArcGIS Network Analyst,

ArcGIS StreetMap, and ArcGIS Business Analyst are examples of ArcGIS extensions.

B-18 Feature

A representation of a real-world object on a map

B-19 Point feature

1. A map feature that has neither length nor area at a given scale, such as a city on a world map or a building on a city map.
2. In ArcGIS software, a digital map feature that represents a place or thing that has neither length nor area at a given scale.

B-20 Polygon feature

1. A map feature that bounds an area at a given scale, such as a country on a world map or a district on a city map.
2. In ArcGIS software, a digital map feature that represents a place or thing that has area at a given scale. A polygon feature may have one or more parts. For example, a building footprint is typically a polygon feature with one part. If the building has a detached unit, it might be represented as a multipart feature with discontinuous parts. If the detached unit is in an interior courtyard, the building might be represented as a multipart feature with nested parts. A multipart polygon feature is associated with a single record in an attribute table.

B-21 Polyline feature

1. In ArcGIS software, a digital map feature that represents a place or thing that has length but not area at a given scale. A polyline feature may have one or more parts. For example, a stream is typically a polyline feature with one part. If the stream goes underground and later reemerges, it might be represented as a multipart polyline feature with discontinuous parts. If the stream diverges around an

island and then rejoins itself, it might be represented as a multipart polyline feature with branching parts. A multipart polyline feature is associated with a single record in an attribute table.

B-22 Line feature

1. A map feature that has length but not area at a given scale, such as a river on a world map or a street on a city map.

B-23 Geometric network

1. Edge and junction features that represent a linear network, such as a utility or hydrologic system, in which the connectivity of features is based on their geometric coincidence. A geometric network does not contain information about the connectivity of features; this information is stored within a logical network. Geometric networks are typically used to model directed flow systems.

B-24 Geometric element

1. One of the most basic parts or components of a geometric figure: that is, a surface, shape, point, line, angle, or solid

B-25 junction

1. For network data models in a geodatabase, a point at which two or more edges meet.
2. In a coverage, a node joining two or more arcs.

B-26 Junction connectivity policy

1. In network datasets, a connectivity policy that defines how a junction may connect to an edge. There are two junction connectivity policies: honor and override.

B-27 Layout

1. The arrangement of elements on a map, possibly including a title, legend, north arrow, scale bar, and geographic data.

2. In ArcGIS, a presentation document incorporating maps, charts, tables, text, and images.
3. In ArcView 3.x, one of the five types of documents that can be contained within a project file. A layout is used to prepare hard copy maps. It can be composed of views, tables, charts, imported graphics, and graphic primitives and can also contain cartographic elements such as scale bars and north arrows.

B-28 Network attribute

1. A type of attribute associated with a network element in a network dataset. Network attributes are used to help control flow through a network (similar to a weight in a geometric network). All network elements in a network dataset have the same set of attributes. There are four types of network attributes: cost, descriptor, hierarchy, and restriction.

B-29 Cost

1. A function of time, distance, or any other factor that incurs difficulty or an outlay of resources.
2. In ArcGIS Network Analyst, an attribute of a network element used to model impedance and demand in network datasets. Cost is an attribute that is accumulated during traversal of a network.

B-30 Hierarchy

1. A type of network attribute for a network element in a network dataset. Hierarchy can be used during network analysis to assign priority to a network element. For example, in a transportation network dataset, a "road class" hierarchy can be assigned to edges to favor major roads instead of local streets.

B-31 Restriction

1. A Boolean network element attribute used for limiting traversal through a network dataset. "One way street," "no trucks allowed," and "buses only" are examples of restrictions

B-32 Descriptor

1. A type of attribute for network elements that cannot be apportioned. The value of a descriptor stays the same through the length of an edge element in a network dataset. Descriptors describe characteristics of the element; for example, the number of lanes for a particular road in a road network.

B-33 Route

1. Any line feature, such as a street, highway, river, or pipe that has a unique identifier.
2. A path through a network.

B-34 Route analysis

1. In ArcGIS Network Analyst, a type of network analysis that determines the best route from one network location to one or more other locations. It can also calculate the quickest or shortest route depending on the impedance chosen. The order of the stops may be determined by the user. For example, if the impedance is time, then the best route is the quickest route.

B-35 Stop

1. In ArcGIS Network Analyst, a network location used to determine a route in route analysis. Users can specify multiple stops, of which two must be used to represent an origin and a destination. Stops in between (known as intermediary stops) are visited en route from the first to the last stop.

B-36 Street network

1. A system of interconnecting lines and points that represent a system of roads for a given area. A street network provides the foundation for network analysis; for example, finding the best route or creating service areas.

B-37 Tool

1. A command that requires interaction with the GUI before an action is performed. For example, a zoom tool requires a user to use the mouse to click on or draw a box over a digital map before the tool will cause the map to be redrawn at a larger scale.
2. A geoprocessing command in ArcGIS that performs such specific tasks as clip, split, erase, or buffer.

B-38 Toolbar

1. A graphical user interface (GUI) with buttons that allow users to execute software commands

B-39 WGS84

1. Acronym for *World Geodetic System 1984*. The most widely used geocentric datum and geographic coordinate system today, designed by the U.S. Department of Defense to replace WGS72. GPS measurements are based on WGS84.

40 B-field

A column in a table that stores the values for a single attribute.

APPENDIX-C
SOME OF FIGURES AND TABELS

بسم الله الرحمن الرحيم

جامعة بوليتكنك فلسطين

Palestine Polytechnic University

استبيان عن تقدير السرعة على الطرق في مدينة دورا

1-وقت الإزدحام المروري (2-11) مساء

*السؤال الأول:

معدل سرعة السيارة في الأماكن التي يوجد بها ازدحام مثل (.....................................).

1. 20km /hr
2. 25km/hr
3. 30km/hr
4. 35km/hr
5. غير ذلك (حدد)
6. لا أعرف .

السؤال الثاني:

معدل سرعة السيارة في الشوارع الرئيسية مثل (..).

1. 40km/hr
2. 45km/hr
3. 50km/hr
4. 55km/hr
5. غير ذلك (حدد)
6. لا أعرف .

*السؤال الثالث:

معدل سرعة السيارة في الشوارع غير النافذة .

1. 30km/hr
2. 35km/hr

3.40km/hr   4.45km/hr

6. لا أعرف .   5. غير ذلك (حدد)

بسم الله الرحمن الرحيم

جامعة بوليتكنك فلسطين

Palestine Polytechnic University

استبيان عن تقدير السرعة على الطرق في مدينة دورا

2. وقت الإزدحام المروري (7.30-9) صباحا

*السؤال الأول:

معدل سرعة السيارة في الأماكن التي يوجد بها ازدحام مثل (.....................................).

1.20km /hr   2. 25km/hr

3.30km/hr   4. 35km/hr

6. لا أعرف .   5.غير ذلك (حدد)

السؤال الثاني:

معدل سرعة السيارة في الشوارع الرئيسية مثل (...).

1.40km/hr   2. 45km/hr

3.50km/hr   4. 55km/hr

6. لا أعرف .   5. غير ذلك (حدد)

*السؤال الثالث:

معدل سرعة السيارة في الشوارع غير النافذة .

1.30km/hr   2. 35km/hr

3.40km/hr   4. 45km/hr

6. لا أعرف .   5. غير ذلك (حدد)

بسم الله الرحمن الرحيم

جامعة بوليتكنك فلسطين

Palestine Polytechnic University

استبيان عن تقدير سرعة سيارة الإسعاف على الطرق في مدينة دورا

2.عند عدم وجود إختناقات مرورية (حوادث سير)

*السؤال الأول:

معدل سرعة السيارة في الأماكن التي يوجد بها ازدحام مثل (.....................................).

1.20km /hr 2. 25km/hr

3.30km/hr 4. 35km/hr

5.غير ذلك (حدد) 6. لا أعرف .

السؤال الثاني:

معدل سرعة السيارة في الشوارع الرئيسية مثل (...).

1.40km/hr 2. 45km/hr

3.50km/hr 4. 55km/hr

5. غير ذلك (حدد) 6. لا أعرف .

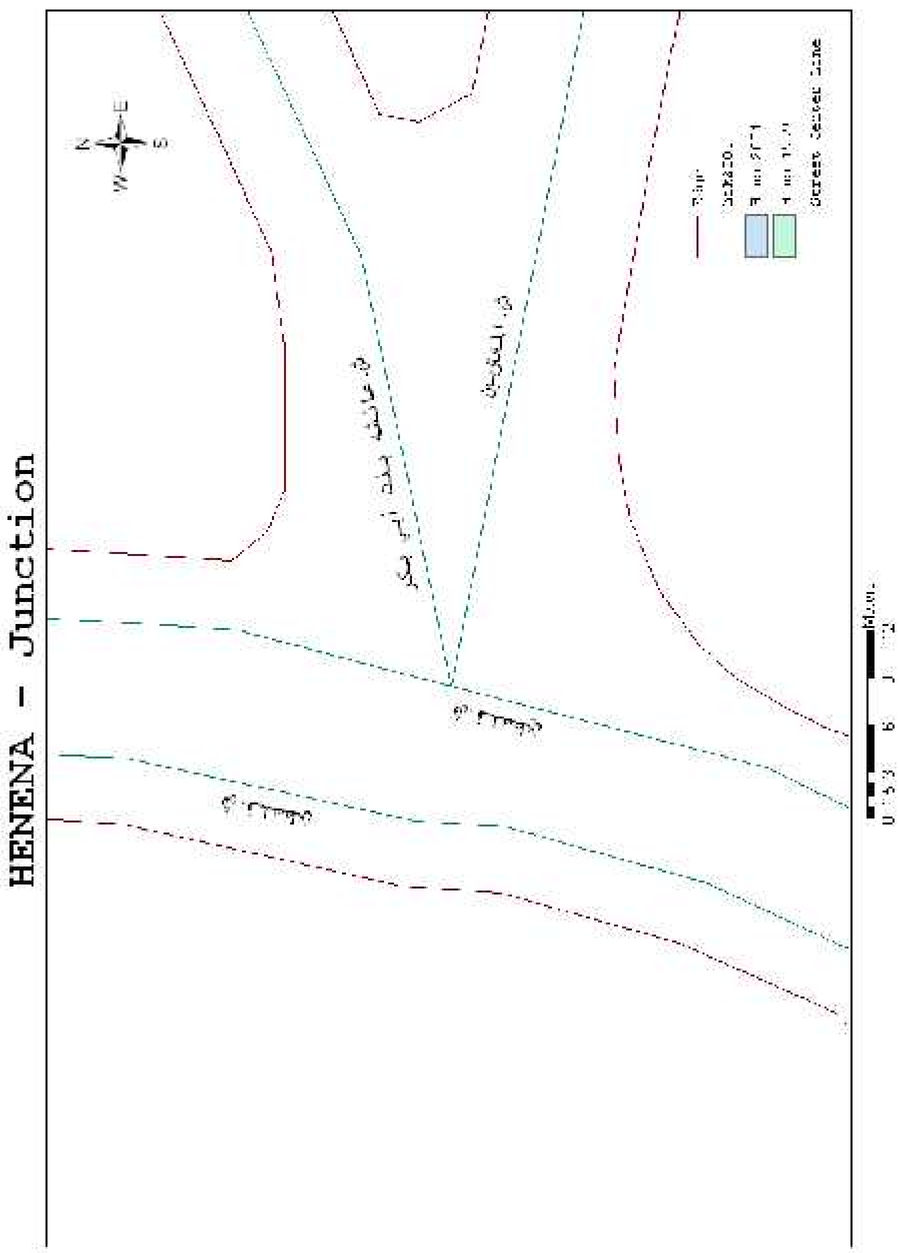
*السؤال الثالث:

معدل سرعة السيارة في الشوارع غير النافذة .

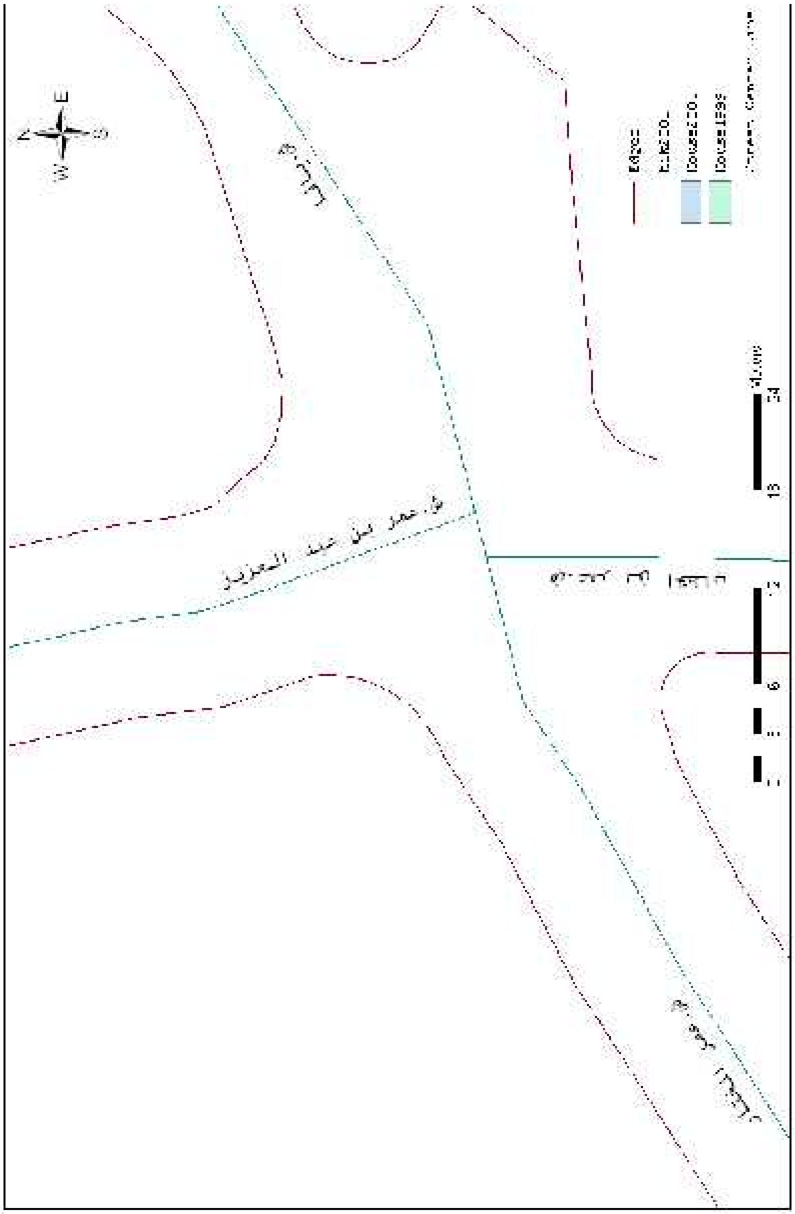
1. 30km/hr 2. 35km/hr

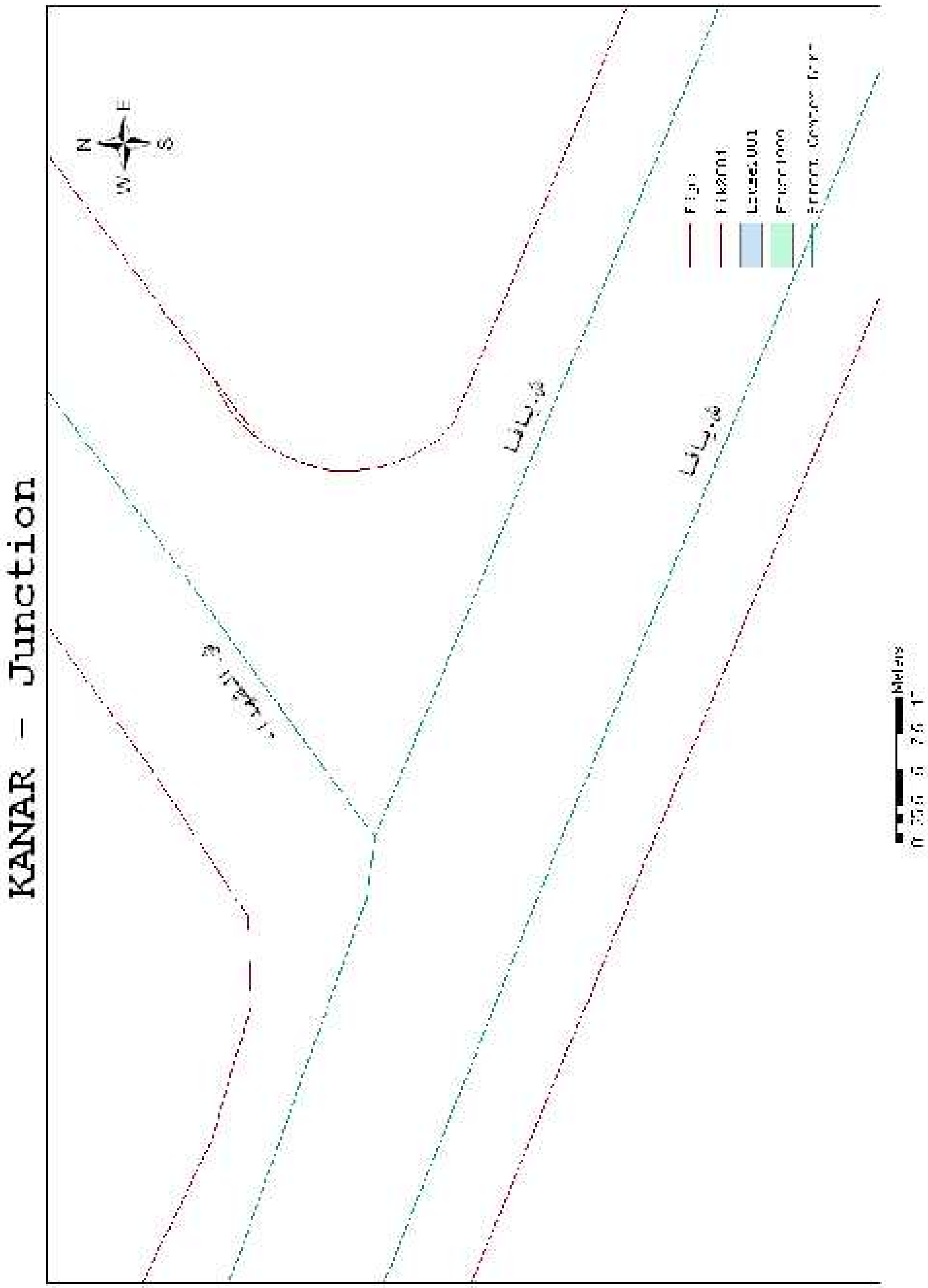
3. 40km/hr 4. 45km/hr

5. غير ذلك (حدد) 6. لا أعرف .


HENENA - Junction
Street Center Line

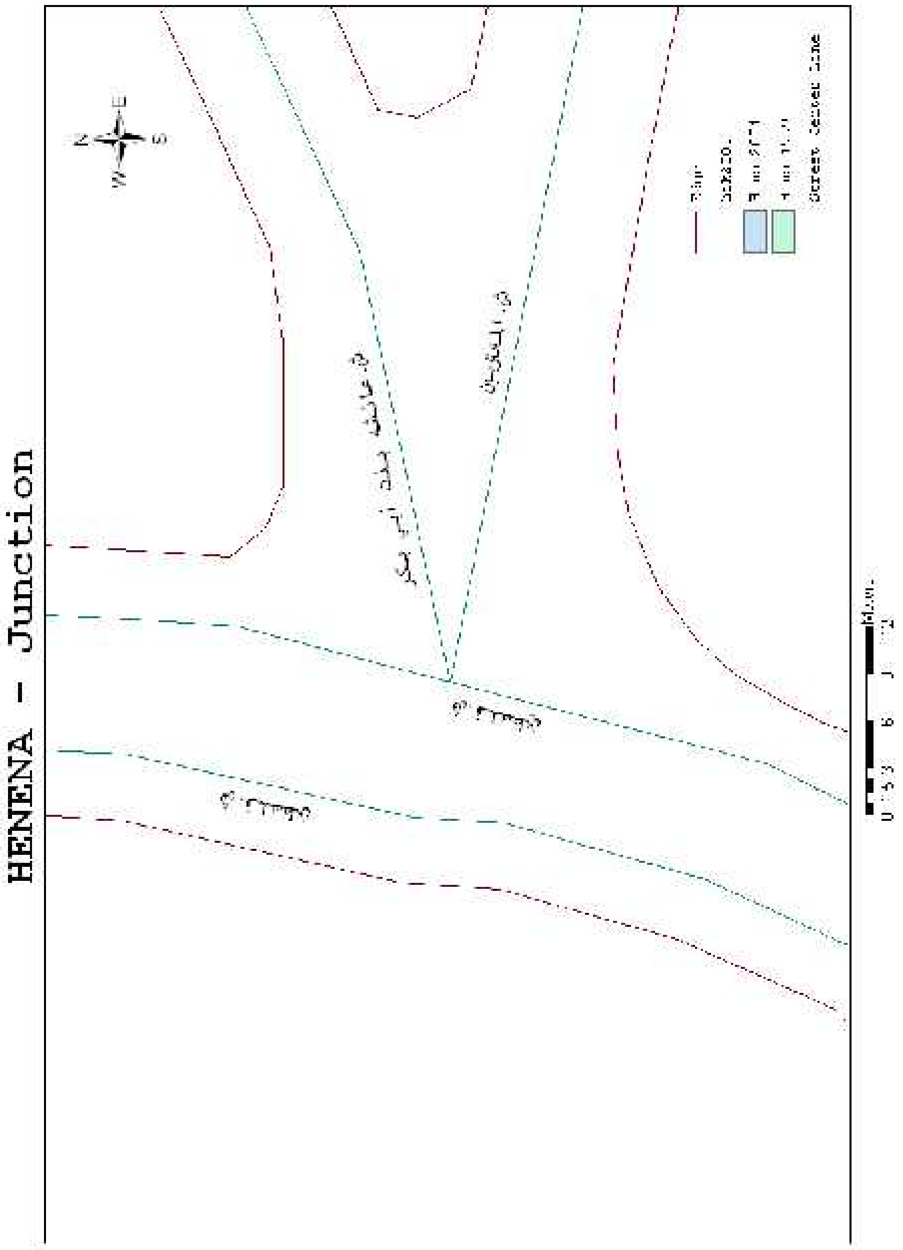
AL KARAG - Junction



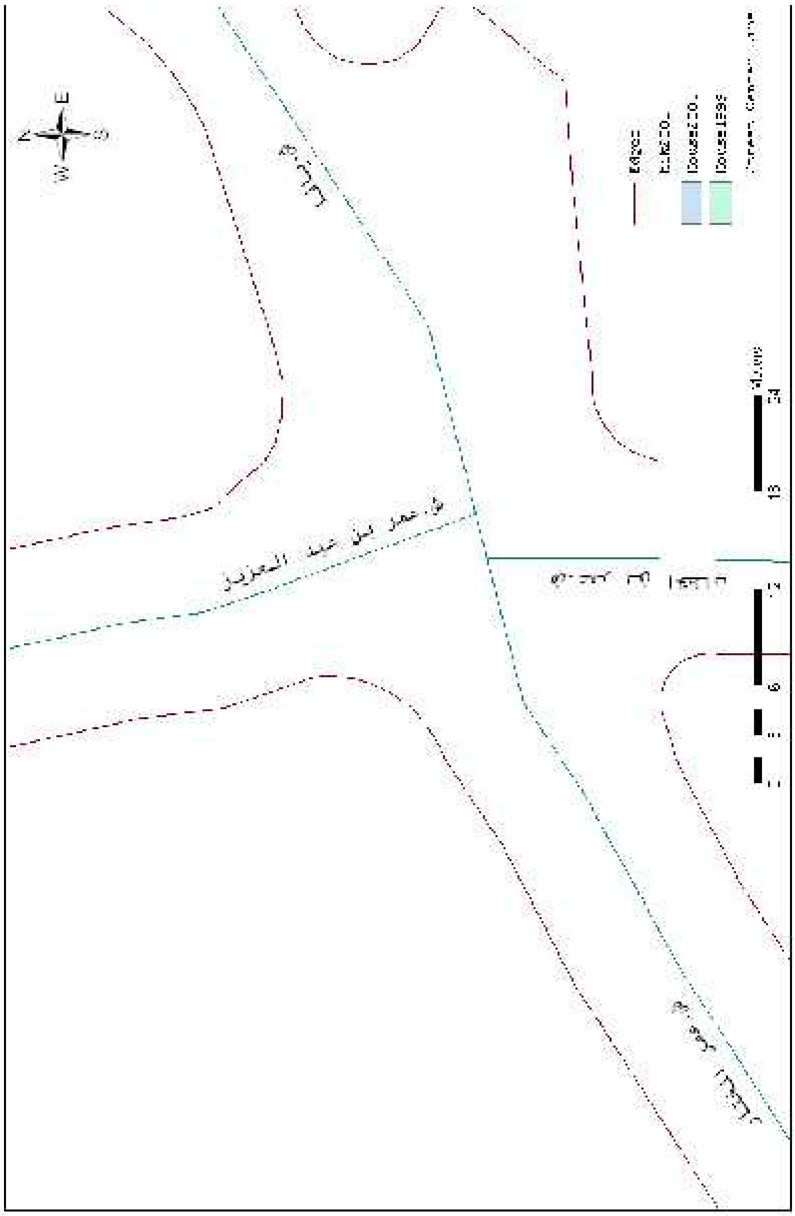

KANAR - Junction
Meters

APPENDIX-C

SOME OF FIGURES AND TABELS



AL KARAG - Junction



KANAR - Junction